City and County of Honolulu

Department of Transportation Services

Rapid Transit Division (RTD)

CORE SYSTEMS DESIGN-BUILD-OPERATE-MAINTAIN CONTRACT

TECHNICAL PROVISIONS

TP-6 DIVISION 27

COMMUNICATIONS

CONFORMED SET

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Prepared for:
Honolulu High-Capacity Transit Corridor Project

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TECHNICAL PROVISIONS

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DIVISION 03 – CONCRETE

SECTION 27 13 01

FIBER OPTIC CABLING NETWORK SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section includes the specifications for the design, furnish, installation and testing of a complete Fiber Optic Cabling Network System which will provide effective communication for all the Honolulu High-Capacity Transit Corridor Project (HHCTCP) properties, Maintenance and Storage Facility (MSF), ancillary buildings and yard, train stations, platforms, parking lots, and vehicles. The Fiber Optic Cabling Network system will be based on existing proven technology and the use of available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

B. Section Includes:

1. Fiber Optic Cabling Network
2. Fiber Optic Cabling Network Backbone Cable
3. Fiber Optic Drop Cable
4. Transfer Trip Fiber Optic Point-To-Point Network
5. Emergency Trip Fiber Optic Pairs
6. Fiber Optic Distribution Panels
7. Fiber Optic Connectors and Jumper Cables
8. Fiber Optic Cable: Expansion and Sparing
9. Fiber Optic Installation, Spicing, and Testing
10. Optical Splices
11. Testing

C. Related Sections:

1. Section 27 20 01 – Communications Transmission System
2. Section 27 30 01 – Telephone Systems
3. Section 27 60 00 – SCADA System
4. Section 27 70 00 – Wireless Communications
5. Section 27 80 00 – Passenger Information System
6. Section 27 90 00 – Operations Control Center Ancillary Equipment
7. Section 27 90 01 – CCTV System

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. Note: The governing version of the listed documents shall be the latest as adopted and administered or approved or recommend by the City.

B. Code of Federal Regulations (CFR):

1. 7 CFR 1755.900 — Corning Cabling Systems Generic Specification for Loose Tube Optical Fiber Cables for Outdoor Applications
2. 7 CFR 1755.900(p)(2)(ii) — Measurement of Fiber Point Defects Using an OTDR

C. Electronic Industries Association (EIA) / Telecommunications Industry Association (TIA):

1. TIA/EIA-472 — Generic Specification of Fiber Optic Cables
2. ANSI/TIA/EIA 568-B.3 — Commercial Building Telecommunications Cabling Standard
3. TIA/EIA-598-B — Optical Fiber Cable Color Coding
4. ANSI/TIA/EIA FOCIS 604-2A — Fiber Optic Connector Intermatability Standard

D. Insulated Cable Engineers Association (ICEA):

1. ANSI/ICEA S-87-640 — Standard for Outside Plant Communications Cable
2. ANSI/ICEA S-83-596 — Standard for Fiber Optic Premises Distribution Cable
3. IEEE 802.3af — Power over Ethernet (PoE)

E. International Telecommunication Union (ITU):

1. ITU-T G.652.D — Characteristics of a Single-mode Optical Fibre and Cable

F. National Electrical Manufacturers Association (NEMA):

1. IEC 60529 — Ingress Protection (IP) 66

G. National Fire Protection Association (NFPA):

1. NFPA 70 — Article 770, Optical Fiber Cables and Raceways

H. Telcordia (formerly Bellcore):

1. TR-TSY-000020 — Generic Requirement for Optical Fiber and Optical Cables.
2. GR-20-CORE — Generic Requirements for Optical Fiber and Optical Fiber

3. GR-63-CORE — Earthquake Environment (Zone 4) and Office Vibration Environment.

4. GR-409-CORE — Generic Requirements for Premises Fiber Optic Cable

5. GR-326-CORE — Single-mode Optical Connectors and Jumper Assemblies

I. EIA/TIA, REA/RUS PE-90 and GR-20 industry standards.

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Fiber Optic System Product Data: Submit fiber optic cabling system data, including but not limited to, specification sheets, shop drawings, Manufacturer's Product Data Sheets, and related data.

C. Fiber Optic Cabling Installation Drawings: Submit detailed installation documents indicating splicing details, distribution panel layouts, shop drawings, and related details.

D. Shop Drawings: Indicate actual device placements, number and type of cables between devices, fiber optic bend radius and mounting details, destination and termination point ID numbers, cable route ID numbers, slack and cable storage points, and site and building floor plans showing conduit size and routing.

E. Point-to-point WD Wiring Diagrams: Indicate terminal-to-terminal connection between system components, type of connections, and other information necessary to make final terminations.

F. Fiber Optic Cable Submittal for Content: All fiber optic cable submittals shall include the following information from the Manufacturer:

1. Current Catalog Cut Sheet

2. Manufacturer's installation instructions

3. Manufacturer's Production Cable Configuration Drawing(s)

4. Manufacturer's confirmation letter listing the Optical Fiber Manufacturer (glass), which shall be utilized for the manufacture of said OSP Cable/s

5. Letter of certification warranting compliance with Telcordia GR-20-CORE

6. The Manufacturer's REA Listing Letter that demonstrates a minimum of 2 years continuous listing

7. Letter of certification warranting compliance with TIA/EIA-472, Generic Specification of Fiber Optic Cables

G. Fiber Optic Cable Schedule:

1. Shall provide but not be limited to the following:
   a. Number of cables
   b. Number of terminations
   c. Conduit Type or ID number

d. Source cable ID
e. Terminating cable ID
f. Cable routing path or segment ID

2. Total cable distance:
   a. Cable routing allowance
   b. Excess cable allowance (slack)
   c. Actual cable distance between all termination points

3. Copies of the Fiber Optic Cable Schedule submittal shall also be submitted to the Communications Transmission System (CTS) contractor for use in computing optical link budgets for that system.

H. Fiber Optic Cable Loss Budget:

1. Perform and furnish fiber optic link budget calculations based at 1310 nanometers (nm) and 1550 nm wavelength factory tested loss for the cable.

2. State all engineering metrics and assumptions used in computing the optical loss budgets.

3. Measurements and calculation shall be provided but not be limited to the following
   a. Fiber optic cable loss per foot
   b. Routing Distance of fiber optic cable
   c. Connector and splice loss assumptions
   d. Total expected loss due to distance
   e. Loss to other factors such as dispersion and other optical cable impairments
   f. Total System Losses
   g. Planned Optical System Loss Margin

4. Results of above shall be provided to the CTS subcontractor for use in determining the CTS optical link budget and for any simulations that depend on these parameters.

I. Final Test Report using Optical Time Domain Reflectometer (OTDR):

1. Submit the results of testing the installed fiber optic plant by using an OTDR.

2. Submission shall consist of the following:
   a. Main Technical Report consisting of an explanation of all events shown on the traces, an interpretation of each event and an explanation of how they correlate with equipment, splices, connectors, and patch panels in the test path.
   b. The starting and end points of the Fiber Under Test (FUT) shall be clearly identified in the Final Test Report.
   c. Technician signoff sheet attesting to the time, date, and identity of the person doing the testing as well as the equipment used, serial number, and date attesting to the last calibration of the instrument.
   d. A pass/fail summary of all tests including a record of measured values vs. required values.
   e. An Appendix to the main report with the original copies of the OTDR traces for bi-directional tests of all optical stands in the system along with event numbers

for each trace and with the FUT starting and end points clearly marked on the trace.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture, test and installation of the communication cable shall conform to the requirements of the General Conditions of this Contract and all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. General Quality Requirements:

1. The cable manufacturer shall be TL 9000 registered.

2. The cable shall be provided and installed in continuous lengths. Splicing and/or cutting of the fiber cable is strictly forbidden except where called for explicitly in the RFP Plans or pre-approved by the City.

3. All fibers in the fiber optic cable shall be spliced and/or terminated as indicated on the plans, using fusion splices as specified, or as approved by the City.

4. All optical glass cores shall be of the same manufacturer.

C. Certified Fiber Optic Technicians:

1. Tasks requiring the opening of the fiber optic cable jacket, installation of fiber optic connectors, fusion splicing, or the testing of any fiber optic cable, drop cable, or patch cords shall require Contractor provision of Fiber Optic Technicians that have been pre-approved by the City.

2. Technicians must provide evidence of at least two of the following:
   a. Technicians shall have attended and successfully completed at least one 4-day "Installation of Fiber Optic Products School." This school shall be conducted by a major manufacturer of fiber optic products or a City approved independent generic 4-day school that encompasses all aspects of outside plant fiber optic technician certification.
   b. Technicians shall show evidence of Electronic Technical Association (ETA) Fiber Optic Installer Certification.
   c. Technicians shall show evidence of current BICSI certification for fiber optic installation and testing.

3. Experience: Technicians shall demonstrate a minimum of 2 years continuous work experience. Work experience shall include fusion splicing, termination, and testing (OTDR and Optical Loss Test Set based).

4. Qualifications: Prior to work on the fiber optic cable plant, submit for approval to the City, work resumes of all Fiber Optic Technicians proposed to work on this project. Said resumes shall demonstrate the project history of each Technician. Approved technicians shall carry on their person evidence of their approved status (City's Letter of Acceptance).

5. Fiber Optic Technician Interns or Apprentices:
   a. The Contractor may utilize Fiber Optic Technician Interns or Apprentices. Interns or apprentices must be pre-approved by the City.

b. The Intern Technicians must be capable of providing evidence of the following:

1) Intern Technicians shall have attended and successfully completed at least one four-day "Installation of Fiber Optic Products School". This school shall be conducted by a major manufacturer of fiber optic products or a City approved independent generic four day school that encompasses all aspects of outside plant fiber optic technician certification.

2) Intern Technicians shall demonstrate a minimum of 2 years work experience. Work experience shall include fusion splicing, termination, and testing (OTDR and Optical Loss Test Set based testing).

6. Fiber optic technician interns or apprentices shall not be allowed to perform work on this project without the direct supervision and presence of a certified technician.

PART 2 – PRODUCTS

2.01 FIBER OPTIC CABLING NETWORK

A. The FOCN will be comprised of the following elements:

1. Fiber Optic Backbone Network consisting of two separate 48-strand single-mode fiber cables in separate duct banks of the elevated guideway alternately routed to each Passenger Station Fiber Optic Node (i.e. Node) in the alignment to the Maintenance and Storage Facility (MSF) Operations Control Center (OCC) and to the Remote Operations and Control Center (ROCC) as required in the build out.

2. Fiber Optic Drop Cable Network consisting of a single 24-strand single-mode optic cable in an enclosed underground conduit from Blue Light Stations (BLS), Wireless Nodes (e.g., a wayside location where wireless data can transmitted and received by the fiber optic network at the node), Train Control Houses, Garages and Parking Areas, Traction Power Substations (TPSS) and Gap Breaker Stations (GBS).

3. Transfer Trip Interconnect Network (TTIN) consisting of a single 24-strand single-mode fiber optic cable in an enclosed underground conduit connecting each GBS and TPSS in a "daisy-chain" multi-drop configuration.

4. Fiber Optic Distribution Panels (FDP) located at the termination points of the backbone and at the drop access points of the FOCN. These will include:

   a. Cable management trays (CMTs)
   b. Fiber optic cable storage and slack enclosures
   c. Bulkheads
   d. Strain-relief and bend radius protection devices
   e. Fusion-type splices and pigtails and connectors for both active and dark fiber strands.
   f. Fiber optic jumper cables between FDP bulkheads and fiber optical electrical switching devices.

B. Fiber optic grounding at one end of the fiber optic cable, routing, and other miscellaneous fastening, installation, and protective hardware (including eye protection) necessary to provide a high-quality state-of-the-art FOCN. Work in this Section will include (at a minimum) the following:

1. Furnish, install and test Fiber Optic Backbone Cable in elevated guideway consisting of two 48-strand single-mode fiber optic cables, installed in separate conduit boxes on the guideway.

2. Furnish, install, and test Fiber Optic Drop Cable Network consisting of a single 24-strand single-mode optic cable in enclosed underground conduit from BLS, Wireless Nodes, Train Control Houses, Garages and Parking Areas, TPSS and GBS, and MSF as specified.

3. Furnish, install, splice, and test FDPs at Passenger Station optical Nodes, OCC, TPSS, GBS, Parking Garages and Park and Ride, Train Control Houses, and BLS.

4. Furnish, install, and test fiber optic jumper cables.

5. Furnish, install, and test fiber optic cable slack enclosures, enclosures, and bend radius protection equipment.

6. Furnish, install, and test fiber terminations for spare and dark fiber strands.

C. The Work involves:

1. Site surveys

2. System and component design

3. Design review and approval

4. Manufacture and delivery of material and equipment

5. Installation and construction

6. Optimization, acceptance testing, and commissioning

7. Spares, documentation, training, and warranty

8. Maintenance

2.02 FIBER OPTIC CABLING NETWORK BACKBONE CABLE

A. Engineer, furnish, install, and test a complete FOCN to interconnect the following facilities:

1. Passenger Stations

2. OCC and ROCC

3. TPSS and GBS

4. Train Control House

5. Wireless Trackside Nodes

6. Maintenance Storage Facility Yard and Shop areas, Maintenance of Equipment (MOE), and Train Wash Buildings

7. BLS

NOTE: Fiber Optic cabling to BLS shall be considered part of the Passenger Station FOCN.

B. The FOCN shall consist of the following elements:

1. Fiber optic conduits and duct banks
2. Fiber optic cable
3. FDPs
4. CMTs and jumper cables
5. Slack storage enclosures, cable protection hardware, and other fiber cable plant accessories

C. The FOCN backbone cable shall consist of the following elements:

1. Two 48-strand single-mode full-metal jacket, armored or rodent protected , low smoke low-flame FO backbone cables placed in different locations within a cable raceway of the elevated vehicle guideway as laid out in RFP Plans.
2. Fiber distribution and termination panels (FDP) for network and access side terminations including CMTs, pigtail connectors, splice trays, cable storage, and connectorized bulkheads.
3. Fiber optic jumper cables, patch panels, risers, and cable slack enclosures.

D. Fusion splices at network and access FDPs to ensure end-to-end connectivity as specified in the FOCN backbone cable:

1. Shall be an armored, full metal jacket, or otherwise rodent-proof all-dielectric loose buffer tube type fiber optical cable.
2. All controls and communications cables that are vital shall be protected from rodents i.e. rat, mongoose, and other creatures that gnaw/eat cables. (i.e. fiber optic backbone cables, TT/ETS cables, and Supervisory Control and Data Acquisition (SCADA) control cables and other vital systems cables).
3. Shall be 48-strand single-mode type suitable for operation at optical wavelengths of both 1310 nm and 1550 nm.
4. Optical fibers shall be placed inside buffer tubes without adhering to the inside of the buffer tube.
5. Shall be either a Totally Dry or Dry Block type design (i.e. no gel outside the buffer tubes).
6. Shall be rated for both indoor and outdoor applications.
7. Shall exhibit low-water-peak attenuation.
8. Each buffer tube of the FOCN shall not have more than 12 fiber count.
9. Shall have a strength member made up of Kevlar™ yarn.
10. The nominal outer diameter of the cable shall not exceed 0.75 inch.

11. The fibers shall be colored with ultraviolet (UV) curable inks:
    a. Buffer tubes containing fibers shall be color coded with distinct and recognizable colors in accordance with TIA/EIA-598-B, "Optical Fiber Cable Color Coding."
    b. For cables containing more than 12 buffer tubes, standard colors shall be used for tubes 1 through 12 and stripes shall be used to denote tubes 13 through 24. The color sequence applies to tubes containing fibers only, and shall begin with the first tube. If fillers are required, they shall be placed in the inner layer of the cable. The tube color sequence shall start from the inside layer and progress outward.
    c. In buffer tubes containing multiple fibers, the colors shall be stable across the specified storage and operating temperature range and not subject to fading or smearing onto each other or into the gel filling material. Colors shall not cause fibers to stick together.

12. The buffer tubes shall be resistant to external forces and shall meet the buffer tube cold bend and shrink back requirements of 7 CFR 1755.900.

13. Each buffer tube shall be filled with a non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel. The gel shall be free from dirt and foreign matter. The gel shall be readily removable with conventional nontoxic solvents.
    a. The central member shall consist of a dielectric, glass reinforced plastic (GRP) rod (optional steel central member). The purpose of the central member is to provide tensile strength and prevent buckling.
    b. The central member shall be overcoated with a thermoplastic when required to achieve dimensional sizing to accommodate buffer tubes/fillers.
    c. The dielectric yarns shall be helically stranded evenly around the cable core.

14. Cables shall contain one ripcord under the sheath for easy sheath removal. Armored cables shall contain two ripcords under the steel armor for easy armor removal. Additionally, armored cables that have an inner sheath will also contain one ripcord under the inner sheath.

15. Cable jackets shall be marked with the manufacturer’s name, month, and year of manufacture; sequential meter or foot markings; a telecommunication handset symbol as required by Section 350G of the National Electrical Safety Code® (NESC®); fiber count; and fiber type.
    a. The actual length of the cable shall be within -0/+1 percent of the length markings.
    b. The print color shall be white, with the exception that cable jackets containing one or more coextruded white stripes, which shall be printed in light blue.
    c. The height of the marking shall be approximately 2.5 mm.
    d. The jacket or sheath shall be free of holes, splits, and blisters. The cable jacket shall contain no metal elements and shall be of a consistent thickness.

E. Fiber splices made shall be of the fusion-type. Mechanical splices of any type are expressly prohibited by this Contract.

F. Typical Fiber Optic Backbone Cable: Single-mode fibers within the Fiber Optic Backbone Cable cables shall have the following characteristics:

1. Fiber Manufacturers: Corning SMF-28e or SMF E9 ITU-T G.652D) or engineer approved equal
2. Color-coded fibers and buffer tubes in accordance with the requirements of TIA/EIA-598 shall be provided
3. Shall support a minimum of 10 Gigabit Ethernet operation
4. Operational wavelength: 1310 nm and 1550 nm
5. Fiber coating diameter: 250 microns
6. Fiber cladding diameter: 125 microns
7. Core diameter: 8.3 microns (nominal)
8. Zero dispersion wavelength: 1310nm, plus or minus 010 nm
9. Maximum dispersion range: 3.2 ps/nm-km (range 1285 to 1330 nm -19 ps/nm-km (range 1530 to 1565 nm)
10. Core/cladding concentricity: less than or equal to 1 micron
11. Refractive Index: 0.37 percent
12. Cut-off wavelength: Maximum 1350 nm
13. Max Optical Attenuation: 0.5 dB/km at 1310, 0.5 dB/km at 1550
14. Minimum Bend Radius: Short Term: 10 inches, Long Term: 5 inches

G. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the FOCN Systems.

2.03 FIBER OPTIC DROP CABLE

A. General: Fiber Optic Drop Cable shall be supplied inside conduit to provide connectivity to the following locations:

1. TPSS and GBS dual-homed to Passenger Station main FDPs. This means a separate Fiber Optic Drop Cable will be connected from redundant ports of the Edge Switch at TPSS/GBS to fiber optic nodes at two adjacent Passenger Stations to provide a backup path in case of the failure of one drop cable.
2. Point-to-point between TPSS and GBS.
3. Train Control Houses to TPSS.
4. Point-to-point between Train Control Houses.
5. Wireless Trackside Nodes to nearest Passenger Stations main FDPs.
6. Parking Lots and Garages to nearest Passenger Stations main FDPs.
7. BLS to Passenger Station main FDPs.

8. Passenger Station interconnections among passenger station communication devices.

B. Fiber Optic Drop Cable:

1. Shall be non-armored single-jacket all-dielectric loose buffer tube type fiber optical cable
2. Shall be 24-strand single-mode type suitable for operation at optical wavelengths of both 1310 nm and 1550 nm
3. Shall be rated for both indoor/outdoor applications
4. Shall have single mode maximum attenuation of better than 0.5 dB at both 1310 nm and 1550 nm wavelength
5. Shall exhibit low water-peak attenuation
6. Shall be either Totally Dry or Dry Block type design (i.e. no gel outside the buffer tubes)
7. Shall comply with EIA/TIA, REA/RUS PE-90, and GR-20 industry standards
8. Shall be provided in spools of at least 26,000 feet
9. Shall be gel-free dry type

C. Fiber Manufacturers: Shall be Corning SMF-28e or OFS Fortex or engineer approved equal

D. Typical Fiber Optic Drop Cable shall have the following characteristics:

1. Color-coded fibers and buffer tubes in accordance with the requirements of TIA/EIA-598 shall be provided
2. Drop cable shall support a minimum of 1 Gigabit Ethernet operation
3. Operational wavelength: 1310 nm and 1550 nm
4. Fiber coating diameter: 250 microns
5. Fiber cladding diameter: 125 microns
6. Core diameter: 8.3 microns (nominal)
7. Zero dispersion wavelength: 1310 nm, plus or minus 010 nm
8. Maximum dispersion range: 3.2 ps/nm-km (range 1285 to 1330 nm -19 ps/nm-km (range 1530 to 1565 nm)
9. Core/cladding concentricity: less than or equal to 1 micron
10. Refractive Index: 0.37 percent
11. Cut-off wavelength: Maximum 1350 nm
12. Max Allowed Optical Attenuation: 0.5 dB/km at 1310 nm, 0.5 dB/km at 1550 nm
13. Minimum Bend Radius: Short Term: 10 inches, Long Term: 5 inches

2.04 TRANSFER TRIP FIBER OPTIC POINT-TO-POINT NETWORK

A. Refer to directive drawings DD028: Fiber Optic Cabling Network & Dual Logical Rings 1 of 2 and DD029: Fiber Optic Cabling Network & Dual Logical Rings 2 of 2.

B. The TTIN shall be comprised of two 24-strand single-mode fiber optic cables, which interconnect all TPSS and GBS and carries transfer trip messages to the breakers at these substation locations.

1. These cables shall be terminated by optical fusion splicing to a Fiber Distribution Panel (FDP) at each TPSS or GPS for use by the internal Transfer Trip system.

2. These cables shall not route to nor be connected to any network switching equipment.

C. Routing of the transfer trip fiber optic cable shall be by means of a 5-inch communications duct bank that shall contain four 1-inch innerducts, two of which shall accommodate the two 24-strand fiber optic cables dedicated to Transfer Trip operation and the other two shall be for TPSS SCADA.

1. TTIN fiber optic cables shall travel via the elevated guideway main cable raceway without intervening splice points. They shall not connect to Passenger Station Optical Nodes, but shall be run directly to the next nearest TPSS or GBS location along the alignment.

2. The TTIN shall not connect to the OCC or to any ROCC, but shall remain a self-contained dedicated fiber transmission path between all TPSS and GBS on the alignment.

D. General: Fiber optic Drop Cable shall be supplied inside conduit to provide connectivity between the following locations:

1. All TPSS and GBS (on a single multi-drop).

2. Train Control Houses to OCC (on a single multi-drop separate from multi-drop specified in Article 2.03D.1 herein).

3. Note: These separately daisy-chain multi-drop cables shall not be provisioned from the same fiber optic cable, but shall be separate cables to ensure spatial path diversity.

E. Fiber Optic Multi-Drop Cable:

1. Shall be a non-armored single-jacket, all-dielectric loose buffer tube type fiber optical cable

2. Shall be 12-strand single-mode type suitable for operation at optical wavelengths of both 1310 nm and 1550 nm

3. Shall be rated for both indoor/outdoor applications

4. Shall have single-mode maximum attenuation of better than 0.5 dB at both 1310 nm and 1550 nm wavelengths

5. Shall exhibit low-water-peak attenuation

6. Shall be either Totally Dry or Dry Block type design (i.e. no gel outside the buffer tubes)

7. Shall comply with EIA/TIA, REA/RUS PE-90 and GR-20 industry standards

8. Shall be provided in spools of at least 26,000 feet

F. Fiber Manufacturers: Shall be Corning SMF-28e or OFS Fortex or engineer approved equal

G. Typical Fiber Optic Drop Cable shall have the following characteristics:

1. Color-coded fibers and buffer tubes in accordance with the requirements of TIA/EIA-598 shall be provided

2. Drop cable shall support a minimum of 1 Gigabit Ethernet operation

3. Operational wavelength: 1310 nm and 1550 nm

4. Fiber coating diameter: 250 microns

5. Fiber cladding diameter: 125 microns

6. Core diameter: 8.3 microns (nominal)

7. Zero dispersion wavelength: 1310 nm, plus or minus 010 nm

8. Maximum dispersion range: 3.2 ps/nm-km (range 1285 to 1330 nm -19 ps/nm-km (range 1530 to 1565 nm)

9. Core/cladding concentricity: less than or equal to 1 micron

10. Refractive Index: 0.37 percent

11. Cut-off wavelength: Maximum 1350 nm

12. Max Allowed Optical Attenuation: 0.5 dB/km at 1310 nm, 0.5 dB/km at 1550 nm

13. Minimum Bend Radius: Short Term: 10 inches, Long Term: 5 inches

2.05 EMERGENCY TRIP FIBER OPTIC PAIRS

A. For purposes of sending the breaker trip activation signal from a TPSS located BLS the following shall apply:

1. Within the 24-strand single mode drop cable running between TPSS and Passenger Stations four strands of cable shall be set aside.

2. Two shall be dedicated for the primary transmission of messages associated with the TPSS Blue Light ETS and two shall be spares reserved for the same purpose.

3. These four strands shall constitute a direct point-to-point connection between TPSS/GBS and shall not be part of the shared switched fiber optic transmission system.

   a. No intermediate connection to any network switching equipment shall be required for these pairs.

4. Four strands shall be connected though by means of fusion splicing at each passenger station's FDP and shall route though the drop cable to the next TPSS/GBS facility where they will terminate at that facilities FDP.
    a. The path shall be a continuous one and avoid any extra spice or termination points.
5. The four fiber optic strands will be part of the 24-strand drop bundle but shall not be used for any other purposes except the transmission of ETS related messages.
6. Two strands shall be labeled "ETS Activation Pair-Working" and the other "ETS Activation Pair- Reserve" and be separated from the other fiber optic strands carrying SCADA and other data.

2.06 FIBER OPTIC DISTRIBUTION PANELS

A. General:

1. FDPs shall provide main termination points for the backbone and drop fiber optic cables.
2. Panels shall allow organized to allow arrangement and re-arrangement of fiber optic interconnection hardware, and allow all connectors to be in plain view at once and labeled for efficient fiber management.
3. FDPs shall be a dedicated, key-lockable enclosure or cabinet.
4. Shall be rack mountable in either 19-inch or 23-inch racks.
5. FDP Chassis shall be constructed of heavy gauge aluminum.
6. FDPs shall consist of a CMT, Splice Trays with splicing block to hold and protect the spliced cable, Bulkhead Plates for accommodating connectors, Slack Enclosures, Bend Radius protectors, and all necessary mounting brackets, cable attachment, and grounding hardware.
7. All FDPs shall employ pre-terminated pigtail connectors with no more than 0.3 dB (max) loss per pigtail connector and with an average connector loss of 0.20 dB or less.
8. All FDPs shall accommodate active, spare, and dark fiber as specified in this Article.
9. All patch panels for connection to nearby fiber optic electronic equipment shall be storable in the CMT.
10. The CMT shall be capable of supporting pigtails at least 118 inches (3 meters) long to facilitate fusion splicing.
11. CMTs shall be opened by means of a front loaded cover tray.
12. The FDP shall accommodate excess cable slack enclosures for future splicing.
13. FDP panels shall be designed with no protruding parts on either bottom or top in order to permit stacking.

B. Main Fiber Distribution Frames (M-FDP):

1. The Main Distribution Frames shall be located at the main fiber optic switching nodes located at Passenger Stations, the OCC and at any ROCC locations.

2. They shall accommodate two 48-strand single-mode fiber optic backbone cables as specified above with at least 50 percent expansion capacity.

3. Shall provide sliding radius limiters or equivalent structure to provide cable management for incoming and outgoing fibers routed in or from the main cable raceway.

4. ST key and bayonet lock connectors shall be employed on the bulkhead of the M-PDF and for fiber optic patch panel kits to achieve improved performance in high mechanical vibration environments.

5. Fiber optic cable shall be routable to the chassis of the M-FDP from either overhead or underneath as required. Best entry point through the chassis shall be determined based on site requirements.

6. M-FDPS shall provide Edge Protectors to protect fiber optic cables from sharp angles at bend points in the cable routing.

7. Extra rack space shall be allocated at each Passenger Station Train Communications and Control Room (TC&C) to accommodate a Fiber Optic Patch Panel that shall be available to the City of Honolulu Department of Information Technology (City IT Department) to terminate and splice up to 96 strand fiber optical cables, which shall be installed under the FOCN contract.

   a. The extra rack space for the PDFs shall be provided under the FOCN contract in consultation with the City IT Department’s space needs.

   b. Access to any FDPs for fiber termination shall be limited to City IT Department personnel or their authorized representatives.

   c. No City IT Department personnel or their authorized representatives shall be permitted to obtain access to RTD fiber terminating or switching equipment in the TC&C.

C. Local Fiber Distribution Panels (L-FDP):

1. Local distribution panels shall be used to terminate cables for the 12-strand single mode Fiber Optic Drop Cables coming from Train Control Houses, TPSS, GBS, BLS, Wireless Trackside Nodes and Stations LANs (SLANs).

2. L-FDP shall be employed in TPSS, GPS, and TC Houses to provide fiber optic termination points for the multi-drop cabling used between TPSS and GBS and between TC Houses.

3. L-FDPs shall be designed to accommodate at least 50 percent spare capacity for future expansion.

4. Shall have sliding radius limiters or equivalent structures to provide cable management for incoming and outgoing fibers.

5. All fiber optic patch panels for connection to optical electronics (e.g. Ethernet switches) the L-FDPs shall be storable in the CMT of the panel.

6. ST key and bayonet lock connectors shall be employed on the bulkhead of the L-PDF and for fiber optic patch panel kits to achieve improved performance in high mechanical vibration environments.

7. Fiber optic cable shall be routable to the chassis of the L-FDP from either overhead or underneath as required. Best entry point through the chassis shall be determined based upon site requirements.

2.07 FIBER OPTIC CONNECTORS AND JUMPER CABLES

A. Shall meet or exceed the following standard requirements:

1. Telcordia GR-326-CORE: “Single-mode Optical Connectors and Jumper Assemblies”

2. ANSI/TIA/EIA FOCIS 604-2A: “Fiber Optic Connector Intermatability Standard”

3. TIA/EIA 568-B.3: ANSI/TIA/EIA-568-B: Commercial Building Telecommunications Cabling Standard

B. Fiber optic connections to optical switches and other equipment shall be made using connectorized fiber optic pigtail fusion-spliced at the CMT to the bulkhead and by using fiber optic jumper panels to interconnect the bulkhead to the external communications equipment ports.

C. Connections shall be designed to accommodate single-mode fiber and provide 20 feet of slack to accommodate future splicing and reconfiguration of the optical electronic devices.

D. Bulkhead and jumper cable connectors shall be either key and bayonet lock ST type connectors or spring- loaded LC connectors suitable for use in Small Form Pluggable (SFP) and high mechanical vibration environments.

E. The FDP shall utilize factory installed, pre-fabricated connectors with pigtails to minimize loss.

F. Fiber Optic Loss:

1. Maximum Connector Loss at the patch panel interface shall be 0.3 dB or better; average connector loss shall be 0.25 dB or better per connector. Return loss shall be greater than 20 dB per connector.

2. Maximum Splice Loss at the patch panel shall be 0.3 dB per splice and average splice loss shall be 0.2 dB or better

3. Typical insertion repeatability, defined as the difference in insertion loss between one plugging and another, shall be 0.2 dB or less.

4. Fiber Optic Connectors shall be either an Angle-polished type or an Ultra-polished straight type to ensure minimum loss and maximum performance.

5. Mixed connector systems are not allowed. The mating of angle-polished connectors to non-angle polished connectors is expressly prohibited due to the potential for high insertion loss. Regardless of finishing type chosen, the choice shall be consistently used for all fiber optic connectors in the system.

6. Connectors shall comply with UL 94 V-0 boot with Fungus Growth Rating of '0' per ASTM-G21-70, and 02 index ≥ 28 percent per ASTM (formerly known as American Society for Testing and Materials) D-2863-87.

G. Jumper cables shall be provided with a strain relief boot to connector type body.

2.08 FIBER OPTIC CABLE: EXPANSION AND SPARING

A. Fiber optic cables shall have the following strands for expansion and sparing (per cable):

Application	Initial Allocation	Spares	Dark Fiber (future use)
Fiber Optic Backbone	4	4	40
Fiber Optic Drop Cable	4	6	14
Fiber Optic Point-to-Point	2	2	20

B. Spare and Dark Fiber strands shall be terminated as follows:

1. Spare cable shall be field terminated using pre-fabricated (or factory manufactured) connector-type pigtail assemblies fusion-spliced to the incoming cable and the connectors mounted on the bulkhead for easy access.

2. Fifty percent of the dark fiber shall be field terminated as above and mounted on the bulkhead for easy access. The remaining 50 percent of the strands allocated for dark fiber shall be unconnectorized, bundled, and kept in splice trays for future use.

2.09 FIBER OPTIC INSTALLATION, SPICING, AND TESTING

A. Fiber Optic Cable: Pre-Installation, Storage, and Protection:

1. All storage and protection of pre-installed optical fiber shall conform to recommendations contained in the manufacturer's Reel Handling Manual or equivalent document.

2. Fiber shall be installed from reels large enough to ensure that no mid-span splice points or splice cases are required station to station along the entire length of the guideway.

3. The completed cable shall be packaged for shipment on non-returnable wooden reels. Required cable lengths and delivered cable lengths shall be stated in the purchase order.

4. Cable reels shall be carefully handled to avoid injury to persons or cable. Movement of reels on loading skids or sloping grades shall be controlled by use of a snub line or wedge. Reels shall always be blocked after positioning.

5. Top and bottom ends of the cable shall be available for on-spool testing.

6. These tests shall include each fiber strand being tested to comply with its rated maximum attenuation.

7. Tests with an OTDR shall determine if cracks or breaks in the fiber optic core have occurred during the shipping, handing, and storage of the reel.

8. Reels shall be stripped of all nails in outside edges of reel heads before pulling of cable, and shall be conveniently located for feeding cable into the conduit without excessive bending or possible injury to cable by abrasion on sides of pull boxes where pull boxes are required.

9. Reels shall be jacked to clear ground level by at least 6 inches before pulling cable.

10. Both ends of the cable shall be sealed to prevent the ingress of moisture.

B. Identification:

1. Each reel shall have a weather resistant reel tag attached identifying the reel and cable. The reel tag shall include the following information:
    a. Cable Number Gross Weight
    b. Shipped Cable Length in Meters Job Order Number
    c. Product Number Customer Order Number
    d. Date Cable was tested
    e. Country of Origin (e.g. USA)

C. Fiber Optic Cable: Installation:

1. The preferred method for Fiber Optic Cable installed shall be by the air jetting method. Regardless of method used the average pre-terminated total optical loss shall be equal to or less than 0.11 dB/1000 ft. in 1310 nm window and 0.08 dB/1000 ft in the 1550 nm window.

2. Cable pulling operations shall be performed so that a short-term bend radius of the cable shall not be exceeded in the unreeling and pulling operations.

3. For purpose of this Contract, the short-term bend radius shall be defined as the minimum radius a fiber optical cable can be bent around while under the tension of installation.
    a. The short-term bend (min) radius for the main 48-strand FO backbone cable shall be computed by the following formula: BR (short-term) = 15 x OD where OD is the outer diameter of the fiber optic cable to be installed.

4. Fiber optic cable installation techniques shall be such that the optical and mechanical characteristics of the cables are not degraded during installation.

5. Calculations shall be made to estimate pulling tensions for cable pulls, which require the use of pulling apparatus. These tensions shall be calculated in both directions to determine which will result in less stress on the cable.
    a. The direction requiring lower tension shall be used where possible. Indicate how each installation will be completed within the limitations and recommendations of the manufacturer and herein.
    b. All installation calculations shall be submitted to the City prior to the start of cable installation, as part of the applicable Cable Installation Plan. Tension calculations need not be provided for short sections of cable, which will be installed by hand pulling.

6. Apparatus to be used in air jetting cable shall be in good working order and shall be demonstrated to the City for two-way communication between the pulling and feed end of each pull shall be established before and maintained during the installation.

7. Cable shall not be allowed to chafe on the ground, in manholes or handhole edges, or sharp surfaces during pulling. Flexible pulling tubes shall be provided to guide and protect the cable, where necessary.

8. On all connectors the ceramic ferrule shall be cleaned before each connection to help prevent scratches and extend the connector life.

9. The submitted equipment shall utilize the most current technology available as determined by the City.

10. Adequate notification (24 hours) of the City/City Inspector will be notified for the first cable pull activities.

11. Conduit rollers and lip rollers with no burrs and the proper radius so as not to jeopardize the minimum bending.

12. Clean up trash daily. Prepare the job site for fiber installation/splice so that it is clean and safe and ready to install/splice the fiber optic cable.

D. Testing:

1. Final installation fiber optic testing shall be my means of a documented properly calibrated OTDR operated by a certified experienced technician.

2. Submit for pre-approval by the City all fiber optic fusion splicing, termination, and testing equipment and tools prior to the commencement of fiber work requiring a Fiber Optic Technician.

3. Supply to the City Standard Operating Procedures (SOPs) for the installation, splicing, termination, and testing of optical fiber.
   a. SOPs shall adhere to the requirements contained in herein.

4. Damaged cable shall be retested with the OTDR, and the results should be sent back to the City for approval.

5. All fiber optic cable installed shall be documented in a Master FOCN Cable Schedule as specified in Article 1.03 herein.

2.10 OPTICAL SPLICES

A. Optical Splicing General Requirements:

1. All optical fibers shall be spliced or terminated by the Contractor as shown in the Splicing diagrams in the plans. Splices shall be allowed only in locations as shown within the plans or as directed by the City.

2. All splices shall use the fusion technique.
   a. Fusion splicing equipment shall be provided by the Contractor and shall be cleaned, calibrated, and specifically adjusted to the fiber and environmental conditions at the start of each shift.

b. Splice enclosures, organizers and incidentals, and cable end preparation tools and procedures, shall be compatible with the cable type being delivered and approved by the City.

3. Fusion splicing equipment for the fiber optic cable shall be approved by the City.

B. Splice Protection:

1. Each spliced fiber shall be packaged in a heat shrinkable splice protection sleeve with strength member.

2. All fiber terminations shall be enclosed on cable splice trays and fiber strand exposure shall be minimized and protective hardware or covers shall always be used.

3. The use of Room Temperature Vulcanizing (RTV) silicone is strictly prohibited.

C. Spice Loss:

1. Splice loss shall not exceed 0.04 dB for any individual fusion splice.

2. All splice losses shall be recorded in tabular form and submitted to the City for approval.

3. For the fiber optic cable system, the per splice loss shall not exceed 0.03 dB on average.

D. Splice Testing:

1. Splices that are made between two cables shall be tested using an OTDR.

2. A full bi-directional test (using bi-directional averaging) shall be performed on all spliced circuits and unused fibers using the OTDR.

3. These splices shall be tested at both 1310 nm and 1550 nm and printouts and electronic files of the splice tests shall be provided.

4. A full engineering report shall be issued that details how the tests were performed including identification of the technician(s) involved in the measurements explanation of the OTDR traces, explanations of any anomalies, and a list of steps and timetables to correct those anomalies.

E. Splicing Safety: Fiber optic cable shall be labeled with the "Must wear eye protection" or its Occupational Safety and Health Administration equivalent.

2.11 TESTING

A. Factory Testing:

1. Submit results of factory testing for each spool of fiber optical cable shipped and delivered under this Contract.

2. Tests shall include measurements made at 1310 and 1550 manometer windows.

3. Tests shall be made on each separate strand of fiber in both directions.

B. On-Spool Testing:

1. All cabled optical fibers greater than 1,000 meters in length shall be 100 percent attenuation tested. The attenuation of each fiber shall be provided with each cable reel.

2. OTDR measurements to characterize any breaks, fractures or reflection loss. Total optical attenuation (all causes) shall not exceed 0.12 dB loss per 1,000 feet per spool.

C. Installed System Testing:

1. Tests to characterize actual fiber optic loss in dB per 1,000 feet shall be performed at both 1310 and 1550 nm wavelengths using an OTDR under provisions in Article 1.03 herein.

2. Supply evident of the calibration of the OTDR along with date, method of testing and third party certification of the results.

PART 3 – EXECUTION

3.01 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Maintain and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and testing phases of the Work, maintenance and support shall be available from the Contractor, on site, within one hour, 24 hours per day, 7 days a week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support shall be available from the Contractor, on site, as a minimum, within 1 working day of notification of the need for such maintenance and support.

D. The Contractor's cost of providing such support shall be included in his price to design and build the system.

3.02 TRAINING

A. A minimum of four members of staff must receive sufficient training on the operation and configuration of the system to enable these operators to train others. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

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SECTION 27 20 01

COMMUNICATIONS TRANSMISSION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section includes the specifications for the design, furnish, installation, testing and commissioning of a complete Communications Transmission System (CTS) that will provide effective communication for all the Honolulu High-Capacity Transit Corridor Project (HHCTCP) properties, Maintenance and Storage Facility (MSF), ancillary buildings, train stations, parking lots, traction power substations, vehicles and blue lights stations. The Communications Transmission System will be based on existing proven technology and the use of available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

B. Section Includes:

1. Communications Transmission System
2. 10 Gigabit Switched Optical Node
3. Network Edge and Aggregation Switches
4. Fiber Optic Modems
5. Wireless Appliances for Yard and Shop Workforce
6. Network Management System
7. System Software
8. Communications Transmission System Expansion Requirements

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 60 00 – SCADA Communications System
3. Section 27 30 01 – Telephone Systems
4. Section 27 70 00 – Wireless Communications
5. Section 27 80 00 – Passenger Information System
6. Section 27 90 00 – Operations Control Center Ancillary Equipment
7. Section 27 90 01 – CCTV System

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. Note: The governing version of the listed documents shall be the latest as adopted and administered or approved by the City. In the event that any reference or standard cited herein is superseded by another reference or standard, the latest version in effect on the date of the Request for Proposals shall be used.

B. Electronic Industries Association (EIA) / Telecommunications Industry Association (TIA):

1. EIA/TIA 232 — Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange
2. EIA/TIA 422 — Electrical Characteristics of Balanced Voltage Digital Interface Circuits
3. EIA 485 — Standard for Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multi-Point Systems
4. EIA-310-D — Cabinets, Racks, Panels, and Associated Equipment
5. TIA/EIA/IS-968-A — North American Terminal Equipment Certification Standard

C. Electromagnetic Compatibility (EMC):

1. EMC Emission – EN55022 Class A
2. EMC Immunity – EN50082-1

D. Federal Communications Commission (FCC):

1. FCC Title 47 CFR Part 15 Subpart B Class B

E. Institute of Electrical and Electronics Engineers (IEEE):

1. 802.1D 2004 — Rapid Spanning Tree Algorithm
2. 802.1p — Traffic Priority and Dynamic Multicast Filtering in LANs
3. IEEE 802.1ag — Service Layer OAM (Connectivity Fault Management)
4. 802.3ah — OAM Ethernet Fiber Access with Network Interface Devices
5. 802.1Q — VLAN standard
6. 802.3 — Ethernet LAN
7. 802.3u — Network Maintenance
8. 802.3z — Gigabit Ethernet over Optical Fiber 1000BaseSx, 1000Base-Tx

9. 802.3ab — Gigabit Ethernet Over Twisted Pair Cabling 1000Base-T
10. 802.3ae-2002 — 10 Gigabit Ethernet Standard
11. IEEE 1613 — Standard Environmental and Testing Requirements for Communications Networking Devices in Electric Power Substations
12. IEEE.1588 — Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems

F. International Electrotechnical Institute (IEC):

1. IEC 61000 — Electromagnetic Compatibility (EMC)
2. IEC 60529 — Ingress Protection (IP) 66

G. Internet Engineering Task Force (IETF) Requests For Comments (RFC):

1. RFC 3209 — “RSVP-TE: Extensions to RSVP for LSP Tunnels”
2. RFC 3473 — “Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Extensions”
3. RFC 3564 — “Requirement for the Support of Differentiated Services Traffic Engineering”
4. RFC 3630 — “Traffic Engineering (TE) Extensions to OSPF Version 2”
5. RFC 3785 — “Use of Interior Gateway Protocol (IGP) Metric as a second MPLS Traffic Engineering (TE) Metric”
6. RFC 3812 — “Multiprotocol Label Switching (MPLS) Traffic Engineering (TE) Management Information Base (MIB)”
7. RFC 4090 — “Fast Reroute Extensions to RSVP-TE for LSP Tunnels”
8. RFC 4201 — “Link Bundling in MPLS Traffic Engineering (TE)”
9. RFC 4206 — “Label Switched Paths (LSP) Hierarchy with Generalized Multi-Protocol Label Switching (GMPLS) Traffic Engineering (TE)”
10. RFC 4208 — “Generalized Multiprotocol Label Switching (GMPLS) User-Network Interface (UNI): Resource ReserVation Protocol-Traffic Engineering (RSVP-TE) Support for the Overlay Model”
11. RFC 4420 — “Encoding of Attributes for Multiprotocol Label Switching (MPLS) Label Switched Path (LSP) Establishment Using Resource ReserVation Protocol-Traffic Engineering (RSVP-TE)”
12. RFC 4872 — “RSVP-TE Extensions in Support of End-to-End Generalized Multi-Protocol Label Switching (GMPLS) Recovery”

13. RFC 4874 "Exclude Routes – Extension to Resource ReserVation Protocol-Traffic Engineering (RSVP-TE)"

14. RFC 4875 "Extensions to Resource Reservation Protocol – Traffic Engineering (RSVP-TE) for Point-to-Multipoint TE Label Switched Paths (LSPs)"

15. RFC 4974 "Generalized MPLS (GMPLS) RSVP-TE Signaling Extensions in Support of Calls"

H. Metro Ethernet Forum (MEF):

1. MEF-9 Metro Ethernet Forum Product Certification

2. MEF-14 Metro Ethernet Network Architecture

I. National Electrical Manufacturers Association (NEMA):

1. IEC 60529 Ingress Protection (IP) 66

J. SFF Committee: # SFF-8053: Standard for Gigabit Optical Interfaces

K. Simple Network Management Protocol (SNMP):

1. SNMPv1 and v2 Network Management Protocols

2. SNMPv3 Authentication & Encryption for Security

L. Telecordia (Bellcore):

1. NEBS (Network Equipment Building System) Level 3

2. GR-1089-CORE Electromagnetic Compatibility and Electrical Safety

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Manufacturer's Manuals for each communication subsystem, defining equipment operation, contain schematic diagrams of all circuitry, and define maintenance and alignment procedures for each item of equipment provided.

C. System descriptive information including product data sheets and manufacturer's installation instructions and manuals: In accordance with the City requirements and all applicable standards.

D. Test Reports: Provide certified test reports for all factory and field testing conducted.

E. Shop Drawings that shall include but not be limited to the following:

1. Rackface elevation drawings for all rack-mounted equipment showing mechanical details, mounting, indicators, interconnecting cables, interconnection devices, arrangement plans, and assembly drawing with complete keyed parts lists

2. Number and type of interfaces between devices

3. Equipment mounting details and power requirements

4. Equipment MAC layer addresses and location for service mapping

5. Site and building floor plans showing placement of network switches and ancillary devices

6. Point-to-point wiring diagrams indicating terminal-to-terminal connection between system components, type of connections, and other information necessary to make and document final terminations

F. Optical Link Budget:

1. Perform an optical link budget for all optical fiber paths in the network using the transmitter and receiver characteristics of each optical switch and submit the results along with all engineering assumptions and methodology used to develop the Optical Link Budget.

2. Calculations shall be made at wavelengths of both 1550 and 1310 nanometers (nm) using optical transceiver parameters specified by the manufacturer of choice for this equipment.

3. All system link budgets shall be computed using results of post-installation tests by the FOCN contractor, which shall provide actual fiber, connector, splice, and pigtail losses for each strand and segment under test.

4. Data required for Optical Link Budget shall include but not be limited to the following:
   a. Fiber attenuation at 1550 and 3110 nm wavelengths (supplied by FOCN contractor)
   b. Optical transmitter power output and minimum optical power receiver threshold using 3 dB for de-rating the optical receiver to account for optimal operation above equipment rated thresholds
   c. Connector-related loss (supplied by FOCN contractor)
   d. Fusion Splice Loss (supplied by FOCN contractor)
   e. Fiber optic patch panel or jumper loss (supplied by FOCN contractor)
   f. Additional dispersion-related loss for fiber optic cabling as included by manufacturer

5. Optical loss budgets shall also be performed on all protection and failover paths according to the current stage of network build-out. Optical Loss Margin in units of dB shall be determined, and reported.
   a. Total Optical System Loss shall be engineered to leave at least a 3 dB margin above the maximum allowable path loss for the optical transceivers as specified by the manufacturer of choice for this equipment.

G. Network Failover Testing:

1. Test network section to pass 802.1q tagging or other suitable Quality of Service (QoS) and Trafficking Engineering (TE) protocols and demonstrate <50 millisecond failover times.

2. Testing shall all failover scenarios detailed in Article 1.11 herein.

3. Document results of testing in a “Final Network Failover Test Report”.

4. Develop and submit an Action Plan that details procedures to be used when test results do not agree with predicted signal levels. The Action Plan shall include list of the steps to be taken to achieve compliance.

5. City representatives shall be notified before each test and be permitted to inspect and witness the any of the tests or surveys conducted under the Test Plan.

H. Record of Tests and Inspections:

1. Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria.

2. Include results of tests, inspections, and retests.

I. Network Migration Plan:

1. Describe future product rollout windows and how they will be implemented during the life of the Contract.

2. Vendor shall describe planned product technology upgrades will be administered and documented ensure minimum disruptions to revenue service without the need to perform intrusive core backplane or other system upgrades to accommodate upgraded cards.

3. Shall provide for City software ownership in the event a company is no longer able to execute provisions of the Contract.

4. Shall provide necessary hardware upgrades to accommodate any new software releases during the life of the Contract.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, configure, test, install and commission the CTS to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. The Contractor must employ factory-trained service personnel with a minimum of 5 years experience in the installation, provisioning and test of optical and high-speed switched data communications equipment.

C. The CTS integrator shall be responsible for the deployment and commissioning of all Edge and Main Optical Node switch communications as well as all Passenger Station Optical Node communications to and from the main Operations Control Center (OCC), the Maintenance Operation Center, or the Remote Operations Control Center (ROCC), whichever is in operation for that particular phase of system deployment.

D. Shall retain on staff a communications systems integrator who shall be either (i) an original equipment manufacturer of the switching products with at least 5 years of experience integrating voice, video, and critical infrastructure data in the metro rail environment; or (ii) a communications systems integrator who holds a certification from the original equipment manufacturer for the design, implementation, commissioning, and operations that network technology.

1.06 NETWORK BACKBONE RING

A. The backbone shall consist of nodes interconnected by optical fibers equipped to operate as two physically separated fiber optic rings as shown on the RFP Plans. A dual two-fiber optical cable ring structure shall be required for redundancy and protection purposes. See Section 27 13 01 – Fiber Optic Cabling Network System.

B. A Network Ring shall be defined as a two physically independent, properly terminated and self-healing fiber optic networks along with all node switches associated electronics required to deliver 10 Gbps optical data frames to each segment of the network.

1. Each ring shall be capable of operating at 10 Gbps non-blocking data rates (OC-192), for a total two-ring capacity of 20 Gbps.

2. Each network ring shall occupy a separate physical location in the cable raceway of the elevated guideway.

3. Each segment of the network (e.g. between individual optical nodes) shall have full access to the entire 10 Gbps bandwidth of the ring.

C. Each optical node transceiver will be capable of transmitting and receiving 10 Gbps data rates bi-directionally in full-duplex mode.

D. The configuration shall be such that every other passenger station shall be connected to the ring so that the failure of any one Network Optical Node Switch shall not isolate any part of the network except the affected node.

E. The core backbone Network Topology of the CTS shall be two physically separated fiber optic cables each of which shall compromise a self-healing ring.

1. Each alternate station along the alignment will connect to different physical cable so that in the event of a complete break in one cable, a Station Node shall receive the full 10 Gbps data capacity by means of the another cable coming from the alternate station.

2. Refer to RFP Plans: “Fiber Optic Cabling Network and Dual Logical Rings”.

3. Refer to RFP Plans: “Communications Transport System (CTS) Block Diagram”.

1.07 NETWORK OPTICAL NODE

A. Network Optics Node (i.e. Node) shall be defined as the presence of a full duplex (i.e. separate transmit and receive fiber paths), bi-directional, non-blocking 10 Gigabit switch which shall be provisioned to accept and deliver network traffic to designated network access points in the system.

1. These access points shall include Traction Power and Gap Breaker Substations, Train Control Houses, Wireless access nodes, servers, databases, and any other train communications system devices.

B. Network Optical Nodes shall be located at the following instillations:

1. At Passenger Stations at Train Control and Communication (TC&C) rooms

2. At the OCC located in the Operations and Service (ONS) Building

3. At remote Site locations for the ROCC

C. The Network Optical Node shall consist of a chassis, redundant power supplies, universal slots for interface cards), a control and management module, and optical transceivers for the optical links.

1. The universal slots shall allow a mix of interfaces to be installed, whereby the choice of a slot can be arbitrary (slot independent) for all the nodes in the ring.

D. Node-to-node communications shall be by 10 Gigabit Carrier Grade Ethernet standard protocols or any other suitable open-standard protocols over a single-mode multi-strand FOCN.

E. The CTS interface between the Station LAN (SLAN) and the backbone FOCN shall be in the TC&C room located at the Passenger Station.

F. The CTS interface between the OCC LAN and the backbone FOCN shall be in the Operations Control Room TC&C room located at the ONS.

G. The node shall be of a modular design allowing the installation of additional modules and/or replacement of modules without affecting service on the network.

1. Each node shall consist of a chassis, redundant power supplies, universal slots for interface cards), a control and management module, and optical transceivers for the optical links.

2. Each node shall be equipped with circuitry for regenerating the optical signal, providing interfaces to the connected appliances and for monitoring and control of the node.

H. Details of the underlying physical layer of the fiber optic ring that comprise the data backbone of the CTS shall be detailed in Section 27 13 01 – Fiber Optic Cabling Network

I. Each passenger station shall be provisioned as an optical Network Node as defined herein.

1. Each alternating station along the guideway shall be connected to separate fiber optic cables, Cable A and Cable B, to balance the traffic and provide failover capability.

2. Nodes shall be remotely provisionable and able to be monitored from the OCC and from any designated ROCC.

3. Each optical fiber shall be provisioned to accept one-half the maximum data traffic or shall be provisioned as a protection ring able to take the maximum allowable data load (10 Gbps) in the event of a failure of the active (working) ring.

J. Each Traction Power Substation (TPSS) and Gap Breaker Station shall be connected to both rings (dual homing) through fiber optic drops to alternate passenger station Optical Nodes to provide maximum reliability.

K. The network shall allow setting up point-to-point links between systems as well as multipoint and multi-drop connections among systems using separate and secure VLAN tags provisioned at the network access ingress points.

1. Multipoint connections, or bus connections, shall allow any device to communicate with any other device so connected.

2. VLAN tags shall be provisioned at data ingress points along the CTS by managed Ethernet Edge Switches capable of supporting 802.1q and other relevant protocols detailed in Article 1.03 herein.

1.08 NETWORK SELF-LEARNING CAPABILITY

A. Network shall be designed to be built out in sections as required. Sections B-C shall include optical switching nodes at East Kapolei Station, UH West Oahu Station, Hoopili Station, West Loch Station, Waipahu Transit Center Station, Maintenance and Storage Facility, Leeward Community College Station, and Pearl Highlands Station.

B. The equipment and Network Element Manager shall be self-learning, self-configuring and require minimum provisioning as each new station node is added.

1. The addition of future stations shall require no more than the interconnection of fiber optic cable at the appropriate locations.

2. Each Fiber Optic Switch Node shall be capable of being configured as the end node for any segment of the dual ring.

1.09 NETWORK QUALITY OF SERVICE AND BANDWIDTH ALLOCATION

A. Hard QoS shall be defined as that level of service that provides a guaranteed minimum bandwidth of network capacity for each individual defined service (e.g. VoIP, CCTV, SCADA, and Passenger Information Systems) regardless of the traffic demands of the other services.

1. Hard QoS shall be provisioned and executed at the data ingress points of the CTS by Managed Ethernet Edge Switches.

B. The preferred protocol for assuring guaranteed bandwidth for each different class of service shall be Internet Engineering Task Force (IETF) "Differentiated Services-aware MPLS Traffic Engineering" (DiffServ-TE) as specified in RFC-3564. Protocols with equivalent performance meeting requirement specified herein shall also be considered.

1. The network shall either be Multi-Protocol Label Switching (MPSL) aware or utilize a similar suitable open-standard protocol for rapid and automatic reconfiguration in failover mode.

2. Each communications service shall have its own QoS level with a virtual private network with the main Metro Area Network (MAN).

3. System shall be deterministically provisioned so that communication link recovery will occur through known, available, and pre-provisioned paths (See Article 1.11 herein, for failover requirements).

4. The CTS shall be capable of implementing standard MPLS control plane protocols to distribute information among the network devices on available bandwidth on a per Class or per Service basis in each of the segments of the dual ring. Other solutions with equivalent performance meeting the requirements herein specified shall also be considered.

C. All video, voice, and data services shall be provisioned with two levels of service. A guaranteed Committed Information Rate (CIR) shall be provided and an Excess

Information Rate (EIR) shall be available when the network is not operating at maximum capacity.

1. The CIR shall be the guarantee minimum bit rate that shall be provided regardless of other traffic demands on the network.

2. CIRs shall provide a guaranteed QoS in terms of minimum guaranteed bit-rate, jitter, and allowable delay each separate data service on the network (e.g. voice, video, data).

3. Any traffic exceeding its CIR shall be limited at network access points to that rate during high demand so that each service shall always be guaranteed its own unique CIR independent of the demands by other services.

4. Each communications service shall be provided its own secure virtual channel within the CTS network. All data flows shall be secured and maintained within that service as having the same bandwidth, jitter, and delay parameters for proper bridging to maintain the guaranteed QoS for that service.

D. Bandwidth allocation shall be provisioned for each class of service to support that which the application (e.g. VoIP, CCTV, SCADA, and Passenger Information Systems) requires according to Table 27 20 01-1.

1. EIR rates shall be granted to data services only as network bandwidth becomes available and all other services have been granted their CIRs for any given network traffic load.

2. Network load shall be designed so that each service will always maintain its CIRs under all network traffic data loads.

Table 27 20 01-1

Service	Committed Information Rate	Unit
CCTV	3.0 Mbps	per camera
VoIP	64 Kbps	per voice circuit
SCADA	10 Kbps	per I/O device
Access Control/ Intrusion Detection	10 Kps	per network device
Alarms	10 Kbps	per network device
PA	64 Kbps	per station channel
VMS	10 Kbps	per sign
Train Control	64 Kbps	per train control port

E. The allocation of bandwidth for the CCTV cameras shall be dynamically assigned a higher bandwidth to ensure high resolution on the OCC Passenger Assist Consoles at the agent’s discretion.

1. As a minimum, the agents shall have the ability to increase the bandwidth for any video channel selected for display on the console monitor by a factor of two times.

F. The granularity of the minimum bandwidth allocation shall be such that low speed small bandwidth data signals (such as SCADA and Train Control) do not consume unnecessary bandwidth.

1. Low-bandwidth SCADA and Train Control signal shall be provisioned to meet data latency requirements of 500 milliseconds or better.

2. Bandwidth shall be selectable down to the 100 Kbps level or lower.

G. The allocation of the bandwidth to the virtual channels shall software configurable and be flexible to perform with a standard user-accessible GUI either at each individual node or centrally administered at the Network Element Manager located at the OCC.

1.10 SEGRATION OF SERVICE DATA FLOWS AND DEVICE ADDRESSING

A. To ensure the integrity of various data services using the shared CTS network the following shall be provided.

1. CTS shall provide a means to segregate and protect the integrity of different data services carrier over the fiber optic backbone.

2. Provide guaranteed “hard QoS” at ingress points to the network backbone.

3. This may be provisioned by the use of Access Control Lists for VLAN tags, MPLS labels, timeslots, or other means consistent with meeting the objects stated herein.

B. Individual network elements or device on the CTS shall be capable of being provisioned with a label, or network address unique to that element or device.

1. Purpose of such identification shall be that all network elements and device shall be able to be assigned name and a location for equipment inventory, for data routing, and for testing and alarm reporting.

1.11 NETWORK TRAFFIC ENGINEERING, FAILOVER, AND FAULT PROTECTION

A. Traffic Engineering (TE) shall be defined as the ability of the network to reliability provision, manage and respond to CTS data congestion, restore service if the fiber optic ring is damaged or cut and create failover paths through the CTS to obtain 50 milliseconds or better recovery time.

B. Each failover path shall be tested and verified separately in the “Final Network Failover Test Report” submitted to City

C. All network TE shall be provided using well-established, open protocols to provide opportunities for future network expansion using multi-vendor equipment sourcing.

D. Develop detailed system failover scenarios to account for each level of failure and describe what systems will remain unaffected.

1. Failure of one Optical Node shelf (Refer to RFP Plans, “Typical Fiber Optic Switch Node: Chassis Detail”)

2. Complete Optical Node Electrical Failure (all shelves at the same time)

3. Cut in main Optical back Cable feed from guideway to Station TC&C room (e.g., 4 strands of backbone cable going into Passenger Station Switching Node)

4. Complete cable cut in either one of the main fiber optic cables going though the elevated guideway

5. Complete cut in both FO cables at different points in elevated guideway

6. Complete cut of both FO cables at one point in the elevated guideway

7. Loss of one FO drop cable from TPSS to Passenger Station Node

8. Loss of both FO drop cables from TPSS to adjacent Passenger Station Node

9. Loss of one shelf of OCC Node Switch

10. Complete loss of Node Electronics (all shelves) at OCC Node

11. Loss of OCC main network provisioning platform

12. Loss of Passenger Station Ethernet LAN (SLAN failure) at any point in the station network

13. Failure of Train Control Ethernet Edge Switch

E. In the event of any optical node failures including but not limited to those detailed herein, pre-provisioned failover links shall be automatically be invoked by the CTS network hardware/firmware implemented at the Data Link Layer, to maintain the CIR for each subsystem on the network within the required 50 millisecond failover time or less.

1. Network protection shall be designed such that no Passenger Station Optical Node shall be isolated from the OCC due to a single failure of or break in one of the two main backbone fiber optic cables.

2. In the event of passenger station node failure, service to the next alternate passenger station node shall be by means of loopback from the failed node.

   a. Should a complete cable break occur on one of the guideway fiber optic cables, the system shall automatically perform a loop-back operation at each of the affect nodes, isolate the fault, and maintain communications for all user equipment that remains connected to the network by means of the second fiber optic cable.

   b. Upon a major failure at a node, the network shall automatically create and start up the new configuration without the node. Upon restoration of the failed node, the network switching algorithm shall support automatic alternate path operation with 50 milliseconds of the interruption.

   c. Upon restoration from complete power failure of an Optical Node, the Node shall recover its normal communications automatically without the need for City technical personnel intervention.

   d. All Optical Node power packs and fans shall be hot swappable without interruption to network service at that node.

   e. Faults that occur at two places in the FONC shall cause only that station located between those faults and the OCC to lose contact with the OCC. Communications to all other stations to the OCC shall be unaffected by such a failure.

3. To implement the necessary failover performance, each ring shall be capability of carrying full network traffic or in being operated as a protect ring while the other operates as the working ring.

F. Installation of network protection paths shall be provisioned for the currently deployed network with provision for additional network expansion of up to 100 percent.

1. In the case of additional build out of passenger station network nodes, the network shall be re-provisioned to meet the fault protection requirement specified herein for the additional nodes.

2. Any additional build out of nodes shall not cause the network to exceed the 50-millisecond failover times specified.

G. Recovery from indefinite power loss shall cause the CTS system software to completely reinitialize upon the restoration of power without user or maintenance personnel intervention.

H. No direct network access to the CTS from any other outside private LAN, MAN, or the public Internet shall be supported unless directed and approved by City.

1. All authorized internetworking with outside networks shall be protected by a physical firewall server and the latest network protection and security monitoring software.

1.12 NETWORK RELIABILITY

A. Mean Time Between Failure (MTBF) of Optical Components:

1. 10 Gigabit Ethernet Node Switch MTBF shall be 110,000 hours or longer.

2. One Gig Ethernet Access Modules MTBF shall be 110,000 hours or longer.

3. Optical Node chassis and fan tray MTBF shall be 1,600,000 hours or longer.

4. Ethernet Edge chassis and fan trays subsystems MTBF shall be 250,000 hours or longer.

5. All fan tray subsystem shall be replaceable without interruption in network node service or otherwise compromising CTS system performance.

6. Temperature hardened equipment not needing fans is preferable to fan equipped units operating in TPSS and Train Control Houses.

   a. Temperature hardened ranges shall be defined as continuous no failure operation at ambient temperature ranges of -40 degrees Fahrenheit to 145 degrees Fahrenheit without the uses of fans.

B. Reliability Analysis:

1. A Reliability Analysis shall be performed up to the point of interface with other subsystems or assemblies.

2. Develop reliability block diagrams that show each equipment element that is essential to the successful performance of each system/subsystem, including element interrelationships. Revise block diagrams to keep current with design iterations.

3. Develop a reliability model consisting of reliability block diagrams and probability of success equations. The model shall show the relationships required for system success. Revise the model to keep current with design iterations.

4. Accomplish reliability apportionment/prediction, including predicted mean time between failures (PMTBFs).

5. Conduct the predictions in accordance with established techniques, such as MIL-HDBK 217E, MIL-STD 756B, or properly documented and verifiable field failure data for identical or similar equipment.

6. Perform a detailed analysis of the ability of the systems provided to achieve the MTBF goals using the demonstration pass/fail criteria specified.
   a. Identify the highest failure rate components affecting the MTBF of each assembly or subsystem. Identify actions taken and specific features designed in by the Contractor to mitigate the effect of the failures.
   b. The analysis shall also recommend operational and maintenance related strategies that can reduce the impact of potential service failures, thereby enhancing the system's ability to maintain service.
   c. Document all assumptions made during the analysis.

1.13 NETWORK MANAGEMENT SYSTEM

A. NMS System shall be designed to permit simple configurations in accordance with a system that shall require minimal additions, moves, and changes once configured for final deployment.

   1. Configuration screens shall be self-explanatory, provide self-help features with reasonably detailed on screen explanations and proceed in a logical fashion.

   2. Shall be design to be used by personal with minimum training and no specialized network experience.

B. CTS shall be designed for robustness. Routing, LSP, or VLAN tagging problems in one data subsystem shall not affect data or service delivery for other data subsystems.

C. Cascading failures due to the mis-provisioning of routing or label switch paths for one service shall be prohibited from affecting the other services operating on the CTS system.

1.14 INTEGRATED NETWORK MANAGEMENT

A. Provision shall be made in the design to integrate control and coordinate all communications system network management capabilities on a single computing platform for the following subsystems:

   1. VoIP Telephony

   2. CCTV System

   3. Vehicle-to-Trackside Mobile Data

   4. SCADA including Traction Power and Train Control Data

   5. Passenger Information System

6. Access Control and Intrusion Detection
7. Yard Wi-Fi Wireless LAN
8. Fire Alarms and Intrusion and Access Control
9. Train Control and Signaling
10. Traction Power

B. Integrated Network Management shall consist of the following functionality:

1. Shall be able to take NMS information from all the communication system platforms and integrate, implement, and control Network Management services for the combined City communications infrastructure in a single unified database management and display platform.
2. Provision and establish failover paths for all services over the main fiber optic backbone cables.
3. Provision and establish priority for traffic types and Class of Service.
4. Provide element, network, and service management for both Layer 2 and Layer 3 networks.
5. Shall support multi-protocols including but not limited to SONET, IP, Ethernet, and MPLS.
6. Shall provide expansion of at least 50 percent in the number of subsystems managed
7. Provision and establish CIR levels that guarantee each service it own data bandwidth.
8. Provision and establish virtual secure and encrypted paths through the network for all services.
9. Provide network alarm monitoring, display, and logging capabilities for operations personnel at the OCC and ROCC locations.
10. Create master network display for OCC operations personnel showing:
    a. All Network Communication Nodes
    b. Fiber Optic Ring Paths active and standby
    c. Status and health of all communications subsystems
    d. Hardcopy printouts of all status messages and alarms with date, location, time stamping accurate to the nearest second
11. Provide ability to provision and scale the network for future growth, adding more devices and dynamically allocating bandwidth and QoS as required.
12. Allow external communications services such as Wireless LANs (WLAN), the mobile Voice Radio Communication System (VRCS) and future build outs of both private and public data systems to tie into the common Integrated NMS using open protocol interfaces such as SNMPv2 and SNMPv3 encryption.

C. Allow expansion of common Integrated Network Management capability to be ported to and operational from the City‘s future central Transit Center.

D. Vendor shall be responsible for coordination with all communications subsystem suppliers to assure integration of network management from a unified platform.

1. Network interconnection and transmission shall be application agnostic to allow an open source unified platform to be implemented without regard to the supplier of the particular communication\subsystem to be monitored.

2. Shall be based on open IP-based SNMPv2 NMS protocol suite.

3. Data encryption capability for network management information shall conform to the latest industry standards including but not limited to SNMPv3.

E. Equipment:

1. Preference shall be given for equipment vendors that support application agnostic network management and control platforms that integrate multiple communications subsystems into a unified command, control, and monitoring platform.

2. These platforms shall be fully fault-tolerant, redundant systems.

3. Shall be able to operate in a Windows NT, XP, VISTA operating system.

4. Shall support data archiving and real time fault and alarm reporting including but not limited to hardcopy prints to a high-quality laser printer.

5. Equipment shall support icon-based network element displays:
   a. Clicking on icon shall provide a presentation of but not limited to the following parameters:
      1) Network Address
      2) Physical Location
      3) Operational Status
      4) Service Group
      5) Bit rate and QoS Class

6. Equipment shall support display of network paths including failover modes as they are invoked by the network.

7. Shall support the ability to rapidly re-provision network connections, service classes, and priority of network data traffic.

1.15 NETWORK TIME SYNCHRONIZATION

A. Network shall be synchronized such that SCADA time stamps can be recorded and displayed with an accuracy of 100 milliseconds or better with respect to events occurring over the entire CTS network.

PART 2 – PRODUCTS

2.01 COMMUNICATIONS TRANSMISSION SYSTEM

A. The CTS consists of the following major elements:

1. Fiber Optic Cabling Network (FOCN)

2. Network Optical Node Switches
3. Network Data Aggregation Switches
4. Managed Ethernet Edge Switches
5. Media Gateways (as required)
6. Network Management System (NMS) Platform Hardware
7. Network Switching and Configuration System Software

B. Network Architecture: Open, industry-accepted and multi-sourced communications protocols will be implemented in the CTS design and operation to assure competitive, multi-vendor products and to maintain scalability and reduce future network expansion costs. Any network technology satisfying these and the other requirements set forth herein will be considered.

C. The Work involves:

1. Site surveys
2. System and component design
3. Design review and approval
4. Manufacture and delivery of material and equipment
5. Installation and construction
6. Optimization, acceptance testing, and commissioning
7. Spares, documentation, training, and warranty

2.02 10 GIGABIT SWITCHED OPTICAL NODE

A. CTS Nodes shall be located in the Communications Room at Passenger Stations and at the OCC and located in the shop building of the Maintenance and Storage facility. Each optical node shall operate as the access point to the main fiber optic backbone.

B. Each node shall employ a Carrier Grade Optical Node switch whose non-blocking data throughput shall be 10 Gbps. (OC-192).

C. The node shall consist of a chassis, redundant power supplies, and universal slots for interface cards, a control and management module, and optical transceivers for the optical links.

1. Control Cards shall be hot swappable and Gigabit Interface Converter (GBIC) capable as specified in SFF Committee in document # SFF-8053.
2. GBIC cards shall be employed to allow low cost swapping and upgrade of systems and support scalability to meet future data capacity needs.
3. Each node shall be equipped with circuitry for regenerating the optical signal, providing interfaces to the connected appliances and for monitoring and control of the node.

4. The node shall be of a 19- or 23-inch rack with a design allowing the installation of additional modules or shelves and/or replacement of modules and shelves.

D. Operating Ranges and Power Requirements:

1. Operating range shall be -45 to 145 degrees Fahrenheit with non-condensing humidity to 90 percent.

2. Shall operate on 24 VDC or provide the necessary external DC-DC converter to match a 24 DVC supply.

E. Onboard Alarms:

1. Warning: Green LED indicating a Warning alarm in the system

2. Minor: Yellow LED indicating whether there is a Minor level error in the system

3. Major: Orange LED indicating whether there is a Major level error in the system

4. Critical: Red LED indicating whether there is a Critical level error in the system

F. Optical Node Transceivers:

1. The optical transceivers shall interconnect the nodes using the optical infrastructure. The transceivers shall support single-mode fiber cables, operate in the 1310 nm or 1550 nm window with a minimum optical margin of 10 dBm per link.

2. Optical transceivers shall be available for operation at the SONET OC-192 rate of 10 Gbps.

3. The system shall provide a warning mechanism, prior to system failure, whenever necessary, (e.g. aging of transmitters).

4. Laser transmitters shall be secured with detection logic to reduce power whenever an open circuit occurs, for human safety precautions.

5. Optical laser safety shall meet or exceed FDA Radiation Performance Standard 21 CFR Subchapter J.

G. Power Supply Modules: Each node shall be equipped with redundant power supply modules to maximize system availability. Power supply modules shall each have an independent cabling system to connect with UPS power at the network node.

H. Backup Power: Backup power will be provide from rack mounted UPS unit at the passenger stations and from building UPS systems at the OCC and MSF.

1. Fiber Optic nodes shall tolerate an input voltage line variation of between 650 and 1000 volts.

I. Main switching nodes and edge switches shall all comply with Bellcore NEBS (Network Equipment Building System) Level 3 standard.

J. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the CTS.

2.03 NETWORK EDGE AND AGGREGATION SWITCHES

A. Connectivity to the 10 Gbps Node Switches shall be through Ethernet Edge switches, which shall provide access, managed switching and aggregation of network traffic from the Station LAN (SLAN) and from Train Control, TPSS, Gap Breaker Stations, and Wireless Trackside Nodes.

B. Ethernet Edge switches shall provide access using 10/100Base-TX and 100Base-FX interfaces.

C. At Train Control, Traction Power and Gap Breaker Stations and Wireless Trackside Nodes the local Ethernet Edge Switches shall convert any copper-based 10/100Base-T Ethernet signals into fiber based 100Base-TX signals using 10-kilometer optics for connection to the fiber optic drop cable back to the passenger station network node.

D. Edge Switches shall employ managed Ethernet protocols to tag packets create a secure VLAN and provide hard QoS, guaranteed CIRs to all devices using the Communications Transport Network as outlined in Article 1.08 herein.

E. VLAN tagging on edge switches shall be provisioned according to the following scenarios:

1. Port mapping: A physical access port shall be capable of being configured in conjunction with a single network VLAN. All packets arriving on the access port will be transmitted to the network using the same secure VLAN path.

2. VLAN Mapping: Each user VLAN shall be capable of being configured in conjunction with a network VLAN. Since different networks using the same VLAN may be connected to different access ports, the user VLAN is used in conjunction with a specific port number to define the connection.

3. IP Mapping: Each combination of source and destination IP addresses or IP masks is associated with a network VLAN. Each IP combination shall be capable of being configured in conjunction with a specific port number. In addition, it can be used in conjunction with a specific user VLAN tag or the specific piece of communications equipment connected to the port.

4. Other solutions with equivalent performance meeting requirements specified herein shall also be considered.

F. The node shall be of a 19- or 23-inch rack with a design allowing the installation of additional modules or shelves and/or replacement of modules and shelves.

G. Edge Switch Cards and Interfaces:

1. Edge switches shall provide interface to the passenger station optical network nodes using 1000Base-LX optical Gigabit Ethernet standard using a 1330 nm or 1550 nm laser.

2. Access modules in Edge Switches shall be redundant, hot swappable access modules with redundant power supplies and loopback capabilities for OA&M and serviceability.

3. Shall conform to the GBIC to network managers to configure each gigabit port on a port-by-port basis for either short-wave (SX), long-wave (LX), long-haul (LH), and copper physical interfaces (CX). SFP type interfaces are also acceptable.

4. The universal slots shall allow a mix of interfaces to be installed, whereby the choice of a slot can be arbitrary (slot independent) for all the nodes in the ring.

H. Operating Ranges and Power Requirements:

1. Operating range shall be -45 to 140 degrees Fahrenheit with non-condensing humidity to 90 percent.

2. Shall operate on 24 VDC or provide the necessary external DC-DC converter to match a 24 DVC supply.

3. Power requirements shall be 200-500 watts at 24 VDC. Current draw shall be less than 20 amps during normal operations.

4. Input Protection:
   a. Input Fuse (internal)
   b. Over voltage (transient of up to 310VAC and 1 minute shall cause no damage)
   c. Auto shut down when disengaged

5. Onboard Alarms:
   a. Warning: Green LED indicating a Warning alarm in the system
   b. Minor: Yellow LED indicating whether there is a Minor level error in the system
   c. Major: Orange LED indicating whether there is a Major level error in the system
   d. Critical: Red LED indicating whether there is a Critical level error in the system

I. Optical Node Transceivers:

1. The optical transceivers shall interface the network access devices at Traction and Gap Breaker Stations, Train Control, Wireless Nodes, Blue Light Stations, Garage, and Park and Ride Station with the main optical switching nodes.

2. The transceivers shall support single-mode fiber cables, operate in the 1310 nm or 1550 nm window with a minimum optical margin of 10 dBm per link.

3. The system shall provide a warning mechanism, prior to system failure, whenever necessary, (e.g. aging of transmitters).

4. Laser transmitters shall be secured with detection logic to reduce power whenever an open circuit occurs, for human safety precautions.

5. Optical laser safety shall meet or exceed FDA Radiation Performance Standard 21 CFR Subchapter J.

J. Supported Data Rates:

1. Output Capacity: 1000Base-Lx (1 GigEthernet) in full duplex mode

2. Import Ports: 10Base-T (Standard Ethernet), 10/100Base-Tx (Fast Ethernet), 100Base-Fx

3. Maximum Data Latency:
    a. Fast Ethernet access port: 8 us
    b. Gigabit Ethernet access port: 10 us
    c. Network port: 10 us

K. Hardware Defined Quality of Service:

1. CIR per Connection: 1 Mb/s to 1 Gbps in 1 Mb/s increments for each direction

2. EIR per Connection: 1 Mb/s to 1 Gbps in 1 Mb/s increments for each direction

L. Shall comply with Bellcore NEBS (Network Equipment Building System) Level 3 standard.

2.04 FIBER OPTIC MODEMS

A. In order to allow train control equipment to send data over a fiber optic drop cable, Fiber Optic Modems or Media Gateways shall be required.

1. The purpose of this equipment shall be to covert data to optical laser form suitable for transmission on a fiber optic cable.

2. This transmission shall be required if the Train Control equipment is not fiber-optic ready.

B. Modems shall function in the following way:

1. Covert any native copper based electrical signaling to a data transport form compatible with single-mode fiber optic cable.

2. Reconvert fiber optic-based data to a desired communications physical and data format.

3. Operate using 24 VDC or provide internal DC-to-DC conversion that permits operation at 24 VDC supply.

2.05 WIRELESS APPLIANCES FOR YARD AND SHOP WORKFORCE

A. As part of the MSF Yard and Shop workforce, mobile wireless appliances (laptops or other devices) shall be provided to interface with the Yard and Shop Wireless LAN (WLAN) data system.

B. Devices shall be IEEE 802.11g or 802.11n equipped Wi-Fi cards with antenna.

C. Shall support encryption and password protection consistent with the Yard and Shop wireless Access Points (APs).

D. Shall be prevented from interface with the Public WirelessInternet (e.g. Public 802.11 WiFi) and be firewall protected at the mobile application level against intrusion by other wireless systems.

E. Shall provide minimum 4 GB RAM and provide up to 150 Mbps wireless data speeds.

2.06 NETWORK MANAGEMENT SYSTEM

A. System shall be provided with a centralized Element Management System for network provisioning, maintenance, administration, and fault reporting.

B. The NMS shall allow and support open interfaces to third-party or non-proprietary NMS systems using standard protocols such as SNMP v1 and v2 and SNMP v3 encryption. The NMS System shall support non-proprietary API interfaces for open-network management protocols.

C. The Element Management System shall provide but not be limited to the following functionality:

1. Interface for configuration and monitoring of individual network elements such as optical node and edge switches and for network connectivity and fault monitoring.

2. Presentation to the operator an online status of the device with an internal topology hierarchy in a graphical interface that fully represents the device's physical configuration.

3. Provide capability that operators can both view and configure all attributes of the network element-secure Web-based Management.

D. Failure of the NMS system shall not result in failure of the core switching, routing, or failover capabilities of the CTS. Normal performance and data handling metrics shall continue to be met and the CTS shall continue to operate normally in the event of NMS software failure or in the event of NMS platform hardware failures.

E. NMS system shall be completely self-learning. In the event of a NMS database failure when all elements of the database have been lost, the NMS shall be able to rebuild the database by querying the existing elements while the network is in normal operation.

F. Network Management System Hardware:

1. All workstations dedicated to NMS functions and shall meet the standards and have the approval of the network switch vendor.

2. Shall provide a fully configurable platform for network operations, administration, provisioning, and fault management from a Central Control Facility.

3. Shall provide dedicated workstation for use as a GUI client.

4. CPU Intel Pentium® V processor or 1.7 GHz or Sun SPARC III, single 900 MHz CPU.

5. Minimum Memory requirement shall be 2 GB RAM.

6. Minimum Free Disk space shall be 120 GB.

7. Monitor shall be a 21-inch flat-panel monitor.

8. Video card shall be 256 MB video.

9. Networking shall be provided by 10/100Base-T Ethernet card.

10. System printers shall be laser printer units.

G. Network Management System Software:

1. Shall be provided by the system switch vendor or the network integration vendor depending on final communications design criteria and Contract requirements.

2. The primary functions of the software shall be to:
   a. Configure Label Switch Paths (LSPs) to provide for failover and fault recovery
   b. Set up VLANs for key communications systems
   c. Allocate hard QOS guarantees though the system
   d. Provision low jitter and low latency parameters for voice, video, and other real time network service
   e. Provide automatic notification and archiving of selected "alarm" events and levels
   f. Provide SNMP network services to view, configure, and troubleshoot the network in real time

3. In the event of a subcontractor for network software being unavailable to maintain and upgrade system software, all such software shall be retained and owned by the City.

4. OS shall be Microsoft® Windows® XP Professional (SP2 or later), Windows Vista Ultimate edition or Sun Solaris™ 8 or 9 base installation with recommended patches.

5. Shall be capable of Service Level Agreement (SLA) measurement and reporting capabilities to monitor and enforce all data, voice, and video system service levels.

6. The following network ports shall be available: HTTP TCP/Port 80, TFTP UDP/Port 69, SNMP UDP/ 162,161 if external SNMP management is being used and Port 23 for troubleshooting purposes.

7. Craft Port Network Management: Minimum field requirements: PC Windows based laptop with USB to DB-9 box.

8. Browser Netscape Navigator® 6.X+, or more recent version.

9. Java Runtime Environment Standard Edition V. 1.4.2_03 depending on network scale.

H. Administrator Workstation and Terminal Workstations:

1. The workstations shall be IBM or IBM compatible computers with suitable capacity for the designed purpose.

2. These workstations shall be shipped factory configured with all software pre-loaded and tested.

I. Database: There shall be a single database, of a suitably secure and reliable technology. It shall be possible to implement the database and all necessary client software on a single computer (subject to performance and capacity considerations).

J. System Interfaces:

1. CORBA/XML

2. Java™ API
3. SNMP V1, V2C, V3
4. Telnet/CLI
5. FTP/ TFTP
6. SYSLOG
7. Software
8. GUI software Java
9. Server software Java/C++

2.07 SYSTEM SOFTWARE

A. Design installation of all system software shall be conducted in such a way as to allow upgrades to be installed without disruption of revenue service operations.

B. All software shall be warranted and supported for 30 years.

C. Any upgrades shall be conducted in such a way that in the event of the failure of the new software, a back out to the earlier version will not unduly harm revenue operations.

D. In the event of any companies failure to provide for its obligations under this Contract due to bankruptcy or sale of the business, all existing system software residing on the CTS Network Management server will become the sole property of City.

2.08 COMMUNICATIONS TRANSMISSION SYSTEM EXPANSION REQUIREMENTS

A. To accommodate future expansion, the delivered CTS system shall be equipped with 10 percent spare I/O points for each type of interface card provided without the need to add additional hardware.

B. Spare Slots:

1. Each passenger station fiber optic node delivered shall be configured with at least two unused interface card slots for future expansion.

2. Expansion at the OCC and MSF shall be accommodated in the initial delivery by adding an additional fiber optic node chassis, if two spare slots are not available in each chassis.

C. Sufficient rack space shall be included at the OCC and other MSF sites for the addition of at least one multiplexer chassis and power supply capacity to support the addition as necessary.

1. The addition of future stations or optical switching hardware shall require no more than the interconnection of fiber optic cable at the appropriate locations. The equipment and Network Element Manager shall be self-learning and recognize new CTS equipment as it is added.

PART 3 – EXECUTION

3.01 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and testing phases of the Work, maintenance and support shall be available from the Contractor, on site, within one hour, and 24 hours per day, seven days a week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support shall be available from the Contractor, on site, as a minimum, within one working day of notification of the need for such maintenance and support.

D. The Contractor's cost of providing such support shall be included in his price to design and build the system.

3.02 SYSTEM QUALIFICATION TESTING

A. Vendor shall offer and execute implementation services for all network elements within agreed time schedules and in accordance with processes, relevant stipulations and mutually agreed upon standards.

   1. The service offering shall cover all scenarios, new sites, expansions of initially deployed sites and upgrades.

B. The service shall include but not be limited to the following activities:

   1. Site survey and installation

   2. Network planning

   3. Installation configuration and commissioning

   4. Integration testing including but not necessarily limited to the following:
      a. Failover Testing
      b. UPS/Power Testing
      c. Shelf and Card Reliability Tests
      d. Domain Testing
      e. QoS and Bandwidth Verification
      f. Redundancy Testing
      g. Dual-homed Network Testing

   5. Implementation of required corrective actions based on data results

C. Implementation shall include but not be limited to the following:

   1. Installation of equipment, including interconnections

   2. Inventory and checking of the delivered hardware

   3. Verification of the release level of the platform software

4. Integration/software installation and configuration

5. Configuration of the network connections and customization of the parameters

6. Preparation of the integration test report

7. Providing final conformance testing report with complete functionality

8. Assurance of site quality for the deployment by:
   a. Coordination of the site activities and ensuring subcontractor competence
   b. Quality checks, traceability/tracking, site scope validity checks

9. Fully operational installations testing according to the agreed schedule and quality criteria

10. High quality materials and managing the material handling

11. Site-specific documentation available online through the online project management tools

D. Contractor shall see to the usage of quality materials and workmanship in the site design:

1. Design and operation of the system shall conform to the referenced codes, regulations, and standards as applicable.

2. All equipment shall be attached to appropriate communications racks and floor assemblies and shall be held firmly in place.

3. For all equipment, fasteners and supports shall be adequate to support the required load.

4. Wire or cable terminated on terminal equipment that is moveable (such as terminal blocks mounted at switches) shall be routed to the terminal equipment such that, when the terminal equipment is rotated or moved, the wire or cable will not exceed allowable limits of bending.

5. Splices: Splices other than fusion splices shall not be permitted.

E. Green Requirements:

1. All suppliers shall be SO 14001 compliant.

2. Shall promote environmentally friendly packaging solutions to minimize waste and enable recycling.

3. Shall conduct removal of packaging materials from sites and ensures that the end-of-life treatment of obsolete network elements in an environmentally responsible manner which shall include removal of equipment and materials from the site for recycling and/or disposal.

3.03 TRAINING

A. A minimum of four members of staff must receive sufficient training on the operation and configuration of the CTS system to enable these operators to train others.

B. The training shall be conducted by the manufacturer's own training staff or by other certified training staff with a minimum of 5 years experience on the system they are providing training on.

C. Self-training materials shall be available for the software user interface.

3.04 GENERAL WARRANTY AND SYSTEM TEST REQUIREMENTS

A. All Equipment shall be warranted against defects in material and workmanship, under normal use, for 10 years from date of installation. In the event system is found by manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace any defective parts, provided the equipment is returned to manufacturer.

B. All software warranties shall include all patches, fixes, and upgrades to cover 30 years.

C. It is understood that in the event of the original software vendor(s) are unable to fulfill the obligations of the Contract that all installed software shall become the sole property of the City.

D. The Work shall involve but not be limited to the following activities:

1. Site surveys
2. System and component design
3. Design review and approval
4. Manufacture and delivery of material and equipment
5. Installation, construction, and provisioning
6. Optimization, acceptance testing, and commissioning
7. Spares, documentation, training, and warranty support
8. Follow up configuration to accommodate system expansion until the final testing and acceptance by City

E. Notification of CTS System Testing: The City reserves the right to be notified before any major CTS testing in sufficient time to have a representative present for the tests.

1. City shall have unrestricted access to all results of system tests.

END OF SECTION

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SECTION 27 30 01

TELEPHONE SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Description:

1. This Section includes the specifications for the design, furnish, installation, testing and commissioning of five distinct Telephone Systems that will provide effective communication for all the Honolulu High-Capacity Transit Corridor Project (HHCTCP) properties, Maintenance and Storage Facility (MSF), ancillary buildings, train stations, parking lots, traction power substations, vehicles and blue lights stations.

2. Locations where Work will be performed including the Maintenance and Storage Facility (MSF) Building:
   a. Operation Control Center (OCC) Communications and Equipment Room
   b. OCC Operations Room
   c. Standby OCC Center

B. Section Includes:

1. General
2. VoIP Gateway Interface Installation
3. Blue Light Station Emergency Telephones Installation
4. Station Emergency Telephones Installation
5. Passenger Information Telephones Installation
6. Train Emergency Telephones Installation
7. Administrative Telephones Installation
8. Station Manager Booth Admin Telephone Installation
9. Maintenance and Control Hardware/Software Installation
10. Telephone Cables to Station Manager Booths (Optional If Required)
11. Telephone Systems – As-Built Drawings
12. Maintenance during Installation, Testing, and Warranty
13. Hardware Maintenance after Warranty
14. Software Maintenance during Installation, Testing, and Warranty
15. Training

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications System
3. Section 27 60 00 – SCADA System
4. Section 27 70 00 – Wireless Communications
5. Section 27 80 00 – Passenger Information System
6. Section 27 90 00 – Operations Control Center & Ancillary Equipment
7. Section 27 90 01 – CCTV System
8. Section 27 90 03 – Maintenance Management Information System
9. Section 28 13 00 – Access Control
10. Section 28 36 00 – Seismic Detection

D. Related Requirements:

The following diagrams and drawings are included in the Contract Documents for reference in developing the Honolulu Rail Transit telephone systems:

1. Conceptual E-TEL Call Flow Block Diagram
2. Conceptual A-TEL Call Flow Block Diagram
3. Conceptual BLS E-TEL Call Flow Block Diagram
4. Conceptual P-TEL Call Flow Block Diagram
5. Conceptual T-TEL Call Flow Block Diagram
6. Drawing of recommended location of telephone units for each station and the MSF buildings
7. Recommended location of telephone units’ drawings in Rail Car

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. The governing version of the listed documents shall be the latest as adopted and administered by the City and County of Honolulu. Included in the References are standards and codes deemed pertinent to the final design of the system defined herein.

B. American National Standards Institute (ANSI):

1. ANSI T1.311 — DC Power Systems – Telecommunications Environment Protection
2. ANSI T1.315 — Telecommunications – Voltage Levels for DC Powered Equipment
3. ANSI T1.403 — Telecommunications – Carrier to Customer Installation – DS1 Metallic Interface

C. ASTM International (ASTM):

1. ASTM A312 — Seamless and Welded Austenitic Stainless Steel Pipe
2. ASTM A525 — Steel Sheet, Zinc Coated (Hot Galvanized) by the Hot Dip Process
3. ASTM A568 — Steel Sheet
4. ASTM B1 — Hard-Drawn Copper Wire
5. ASTM B2 — Medium-Hard-Drawn Copper Wire
6. ASTM B3 — Soft or Annealed Copper Wire
7. ASTM B8 — Concentric-Lay-Stranded Copper Conductor
8. ASTM D1373 — Medium-Voltage Rubber Insulating Tape
9. ASTM D3005 — Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

D. Electronic Industries Association (EIA):

1. EIA 152 — Minimum Standards for Land Mobile Communication, FM or PM Transmitters
2. EIA 195 — Electrical and Mechanical Characteristics for Terrestrial Relay System Antennas and Passive Reflectors
3. EIA 204 — Minimum Standards for Land Mobile Communications, FM or PM Receivers
4. EIA 220 — Minimum Standards for Land Mobile Communications Continuous Tone-Controlled Squelch Systems (CTCSS).
5. EIA 222 — Structural Standards for Steel Antenna Towers and Antenna Supporting Structures
6. EIA 232 — Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange
7. EIA 252 — Standard Microwave Transmission Systems
8. EIA 258 — Semi-Flexible Air Dielectric Coaxial Cables and Connectors, 50 Ohms

9. EIA 310 — Racks, Panels, and Associated Equipment

10. EIA 316 — Minimum Standards for Portable/Personal Radio Transmitters, Receivers, and Transmitters/Receiver Combination Land Mobile Communications FM or PM Equipment

11. EIA 329 — Minimum Standards for Land Mobile Communications Antennas

12. Part I — Base or Fixed Station Antennas

13. Part II — Vehicular Antennas

14. EIA 368 — Frequency Division Multiplex Equipment Standard for Nominal 4 KHz Channel Bandwidths

15. EIA 374 — Land Mobile Selective Signaling Standard

16. EIA 450 — Standard Form for Reporting Measurements of Land Mobile Base Station and Portable/Personal Radio Receivers in Compliance with FCC Part 15 Rules

17. EIA 485 — Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multi point Systems

18. EIA 603 — Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

E. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE 610.12 — Glossary of Software Engineering Terminology

2. IEEE 730.1 — Software Quality Assurance Plans

3. IEEE 982.2 — Guide for the Use of Standard Dictionary

4. IEEE 1012 — Software Verification and Validation Program

5. IEEE 1028 — Software Reviews and Audits

6. IEEE 1042 — Software Configuration Management

7. IEEE 1063 — Software User Documentation

8. C2 — National Electrical Safety Code (NEC)

9. C62.41 — Guide for Surge Voltage in Low Voltage AC

10. C95.1 — Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

F. Military Standards (MIL-STD):

1. MIL-HDBK 781 — Reliability Test Methods, Plans and Environments for Engineering Development, Qualification and Production

2. MIL-STD 756-(B) — Reliability Modeling and Prediction

3. MIL-STD 781-(D) — Reliability Design Qualification and Production Acceptance Tests: Exponential/ Distribution

4. MIL-STD 810-(G) — Department of Defense Test Method Standard – Environmental Engineering Considerations and Laboratory Tests

5. MIL-STD-882D — System Safety Program Requirements

6. MIL-STD-498 — Software Development and Documentation

G. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 — Enclosures for Electrical Equipment

H. National Fire Protection Association (NFPA):

1. ANSI/NFPA-70 — National Electrical Code

I. Occupational Safety and Health Administration (OSHA):

1. Safety and Health Regulations for Construction, Part 1926, Subpart F – Fire Protection and Prevention

J. Society of Automotive Engineers (SAE):

1. SAE J1708 — Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications

2. SAE J1587 — Joint SAE/TMC Electronic Data Interchange Between Microcomputer Systems in Heavy-Duty Vehicle Applications

K. Telcordia

L. Underwriter Laboratories Inc. (UL):

1. UL 44 — Rubber-Insulated Wire and Cable

2. UL 50 — Cabinets and Boxes

3. UL 62 — Flexible Cord and Fixture Wire

4. UL 94 — Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

5. UL 486A — Wire Connectors and Soldering Lugs for Use with Copper Conductors

6. UL 510 — Insulating Tape

7. UL 514A — Metallic Outlet Boxes

8. UL 514B — Fittings for Conduit and Outlet Boxes

9. UL 886 — Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations

10. UL 1581 Reference Standard for Electrical Wires, Cables, and Flexible Cords

11. UL 1778 Uninterruptible Power Supply Equipment

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Shop Drawings: Submit shop drawings for each telephone system, containing the following information:

1. Schematic flow diagram of system showing location of each telephone and accessories.

2. Label each control device with setting or adjustable range of control.

3. Wiring diagrams indicating all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

4. Logic diagrams showing sequence of events and their relationship.

5. Provide details of faces of control panels, including controls, instruments, and labeling.

6. Include sequence of operation.

C. Product Data: Submit manufacturer’s technical product data for each control device furnished with certificates of compliance, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

1. Samples: Submit sample of each type of furnished telephone.

2. Operation and Maintenance Data: Submit manufacturer’s operating and maintenance instructions for all items of equipment.

D. Definitive Design Review:

1. Block diagram drawings for each telephone system showing telephones and all major subsystem components including interfaces, locations, and manufacturer’s model numbers.

2. Complete and comprehensive operational description of all major system components for each telephone system.

3. Proposed station wiring and conduit distribution.

4. Certification: Manufacturers certification that all system components of each telephone system meet specified requirements.

E. Product Data: Manufacturer’s catalog cuts, material specifications, installation instructions, and other pertinent data for all furnished products for each telephone system.

F. Final Design:

1. Block diagram (signal flow chart) in block schematic form of each telephone system showing all telephones, cables, and interconnecting wiring with levels or signal voltages indicated throughout. Indicate all test points.

2. Rackface elevation drawings for all rack-mounted equipment showing mechanical details, mounting, indicators, interconnecting cables, interconnection devices, arrangement plans, and assembly drawing with complete keyed parts lists.

3. Panel layout drawings showing dimensioned panels, lettering, manufacturer's part numbers, and complete keyed assembly list.

4. Manufacturers' manuals for each telephone system, defining equipment operation, contain schematic diagrams of all circuitry, and define maintenance and alignment procedures for each item of equipment provided.

5. Schematic of conduit and wiring diagrams of each telephone system showing all interconnecting wiring including wire size, color, and all external connections.

G. Final Acceptance:

1. Operations and Maintenance Manual including as-built drawings and written documentation that accurately depict each telephone system in-service condition.

2. Circuit layout cards.

3. ATP as requested by the General Conditions requirements and must be approved by the City.

H. Manuals: In accordance with City requirements and applicable Standards.

I. Test Procedures and Reports: In accordance with this Section and applicable Standards.

J. Training: In accordance with City requirements.

K. Guidance to Contractor:

1. Reference drawings in Appendix A are provided to the Contractor as guidance only. Develop his design drawings from site surveys, system engineering, and final design reviews approved by the City.

2. The Contractor can propose alternative technologies and architectures in his technical proposal than outlined herein as long as benefits are clearly presented for City approval.

L. Safety and System RMA (Reliability, Maintainability, and Availability):

1. The new security panel design, consisting of Slave Remote Terminal Units (RTU) and Symmetric Multiprocessing (SMP), shall adhere to best practices of system safety, RMA as outlined in the Design Criteria Chapter 24 – System Assurance. Specifically:
   a. Eliminating critical and catastrophic hazards
   b. Providing high degree reliability
   c. Minimizing the downtime during maintenance and malfunctions

2. General RMA Requirements:
   a. Submit in the technical proposal a detailed study of RMA for the proposed SMP and the slave RTU. Spare parts, model types, quantities, and other applicable design parameters shall be taken into account in this study.
   b. Assume for the purposes of RMA calculations the following parameters for City-furnished equipment (if any): reliability of "1," availability of 100 percent, Mean Time To Repair (MTTR) of 2 hours, and Mean Time Before Failure (MTBF) of 25 years.
   c. At FDR, re-compute the RMA analysis based on final design. Real figures for MTTR and MTBF for City-furnished equipment shall be used where available.
   d. Identify critical and vital equipment and risk areas for proposed SMP and slave RTU, and submit a risk assessment report.
   e. Prior to commissioning a station, conduct a System Availability Test for 1 week that verifies overall system RMS parameters for that station.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, configure, test, install and commission all the telephone systems to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Conditions for quality assurance requirements and procedures.

C. Field Quality Control – Tests and Inspections:

1. Comply with manufacturers' written instructions.

2. Inspect interiors of enclosures, including the following:
   a. Integrity of mechanical and electrical connections
   b. Component type and labeling verification
   c. Ratings of installed components

3. Inspect components and accessories according to requirements in NETA Acceptance Testing Specifications.

4. Test manual and automatic operational features and system protective and alarm functions.

5. The telephone systems will be considered defective if it does not pass tests and inspections.

6. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

7. Prepare test and inspection reports.

PART 2 – PRODUCTS

2.01 TELEPHONE SYSTEMS

A. Furnish and install five complete functional turnkey telephone systems according to herein and all related Honolulu High-Capacity Transit Corridor Project (HHCTCP) Design Criteria Chapters and Specification Sections.

B. The Telephone Systems will be based on existing proven technology and the use of available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

C. The system will have all the features requested herein, unless waived by the City, and will operate at all stations and Rail Cars according to herein and to the complete satisfaction of the City.

D. Site inspections will be required by the Contractor to ensure a detailed understanding of the stations and the Work to be performed.

1. Detail telephone system design review
2. Delivery of components and equipment material
3. Installation of all five turnkey Telephone Systems
4. Optimization, acceptance, testing, and commissioning
5. System documentation, training, and warranty

E. The telephone systems to be provided are as follows:

1. Americans with Disability Act (ADA)-compliant Station Emergency Telephone (E-TEL) Systems
2. Administrative Telephone System (A-TEL)
3. Blue Light Stations (BLS) with integral E-TEL
4. Passenger Assistance Telephones (P-TEL)
5. Train Emergency Speakerphones (T-TEL)

F. Provide a centralized Alarm Monitoring and Control for each of the Telephone Systems.

G. Supply and install a complete functional turnkey system that will be ADA-compliant for the E-TEL, P-TEL, and T-TEL systems in accordance with the applicable ADA Guidelines.

H. System Design Criteria:

1. ADA regulations shall be followed with respect to the design of the telephone systems.
   a. Telephone services shall be designed to the current accepted industry standard for reliability and availability.
   b. The Core System Contractor shall be responsible for the system availability.

2. Utilize the SLAN/MAN to provide integrated OCC operator interface to all telephones via VoIP Gateways at all stations.

3. The Telephone systems shall consist of VoIP Interface(s)/GATEWAYS. The Gateways and/or Concentrators shall route calls to the OCC telephone workstation, if not answered writhing three rings and/or 30 seconds, calls shall be routed to the CCH E911/ PSAP Dispatch Telephone Center.

4. Unanswered calls from the station Telephones shall be routed to a designated telephone number and/or workstation. Stations from which call originates shall be presented on to the designated workstation.

5. Caller's detailed location shall be presented on the Station Manager Booth, OCC telephone console, and/or designated workstations.

6. E-TEL Phones:
   a. The E-TEL phones shall consist of outdoor-rated, vandal resistant, and ADA-compliant hands-free speakerphone communications device with stainless steel faceplate and metal buttons.
   b. E-TEL phones shall be installed in the stations and cars at suggested locations in accordance with the drawings, E-TEL phones in the cars are refereed to as T-TELs.
   c. The Emergency Phone shall have one red anodized aluminum tactile button labeled "EMERGENCY" and one red light emitting diode (LED) labeled "LIGHT ON INDICATES CALL RECEIVED." The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at the site or by an attendant. The unit shall be phone line powered; outside power source are not acceptable. The unit shall have a dedicated communication line.
   d. All calls originating from E-TEL phones from the stations and/or other facilities shall function as a standard telephone call (e.g. 2-way or full duplex communications) to the OCC and shall be transferable to the local E911 telephone system as required for incident management via an interface compatible with the local telephone company (HI Tel.).
   e. Provide 1 year maintenance Contract support as standard warranty at no additional cost to the City for all Contractor-provided system/sub-system components. Submit with the bid submittal a proposal for post warranty maintenance and service. It is understood and agreed that time is of the essence in respect to all corrective work to be undertaken pursuant to the warranty mentioned herein and thereafter for any maintenance Contract. Therefore, commence corrective work within 24 hours upon receipt of written notice from the City.
   f. All equipment shall be warranted against defects in material and workmanship, under normal use, for one year from date of installation. In the event the system is found by the manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace defective parts, provided the equipment is returned to manufacturer.
   g. The Work involves:
      1) Site surveys

2) System and component design
3) Design review and approval
4) Manufacture and delivery of material and equipment
5) Installation and construction
6) Optimization, acceptance testing, and commissioning
7) Spares, documentation, training, and warranty

7. A-TEL Phones:

a. The A-TEL phones shall consist of indoor/outdoor-rated, vandal resistant telephones handsets communications devices with stainless steel faceplate and metal buttons.

b. Shall consist of the following telephones:

1) Station manager’s booth telephone
2) MSF telephones
3) OCC telephones
4) Substation telephones
5) Train Communications and Control equipment room telephones

c. Shall provide for Private Automatic Branch Exchange (PABX)-like telephone communications to City personnel.

d. Shall provide 9-1-1 calling capabilities in accordance with a regular Public Switched Telephone Network PSTN telephone.

e. Personnel on the A-TEL system shall be able to place calls to all other personnel on the system (Intra-City calling) by using a simple extension number.

f. Personnel on the A-TEL system shall be able to place calls parties outside the City to other City agencies (Inter-agency) by using the regular PSTN telephone numbering plan.

g. The A-TEL system shall be capable of providing call blocking, call restriction, or toll-call blocking as necessary.

h. Voice-mail system shall be provided on all phones on the A-TEL system.

i. Shall be implemented via Voice Over IP (VoIP) protocols but provide all telephone features common to a standard Private Branch Exchange (PBX) telephone system including but not limited to:

1) Conference calling
2) Call transfer
3) PBX call hold
4) Follow me
5) Call forwarding
6) Speed dial
7) Calling ID
8) Account code
9) Voice messaging and voice broadcasting
10) PBX outgoing only
11) Message waiting indicator

j. Provide one-year maintenance Contract support as standard warranty at no additional cost to the City for all Contractor-provided system/sub-system components. Submit along with the bid submittal a proposal for post warranty maintenance and service. It is understood and agreed that time is of the essence in respect to all corrective work to be undertaken pursuant to the warranty mentioned herein and thereafter for any maintenance Contract. Therefore, commence corrective work within 24 hours upon receipt of written notice from the City.

k. All equipment shall be warranted against defects in material and workmanship, under normal use, for one year from date of installation. In the event the system is found by the manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace defective parts, provided the equipment is returned to manufacturer.

l. The Work involves:

1) Site surveys
2) System and component design
3) Design review and approval
4) Manufacture and delivery of material and equipment
5) Installation and construction
6) Optimization, acceptance, testing, and commissioning
7) Spares, documentation, training, and warranty

8. BLS/E-TEL Phones:

a. Each BLS shall be equipped with an E-TEL as defined herein connected to the telephone network via a dedicated drop cable.

b. Each BLS shall be equipped with a red button to initiate a third rail power shut down for the area of the BLS determined by Traction Power Design Criteria.

c. The power trip function shall be interlocked with the push-to-call button on the E-TEL.

d. Each BLS location shall be evaluated for utilization of solar power. Solar power and battery systems shall be sized to account for shading from adjacent structures.

e. Power for each BLS located at station platforms shall be powered from UPS (essential) power.

f. Blue Light Stations shall be configured in an enclosure with a latched door and labeled as “Emergency Power Trip.”

g. Closed circuit television camera view shall be activated when BLS cabinet door is opened.

h. Shall be compliant with NFPA 130 requirements.

i. The E-TEL phones shall consist of outdoor-rated, vandal resistant, and ADA-compliant hands-free speakerphone communications device with stainless steel faceplate and metal buttons.

j. The Emergency Phone shall have one red anodized aluminum tactile button labeled "EMERGENCY" and one red LED labeled "LIGHT ON INDICATES CALL RECEIVED." The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at the site or by an attendant. The unit shall be phone line powered, outside power source are not acceptable. The unit shall have a dedicated communication line.

k. Provide one-year maintenance Contract support as standard warranty at no additional cost to the City for all Contractor-provided system/sub-system components. Submit along with the bid submittal a proposal for post warranty maintenance and service. It is understood and agreed that time is of the essence in respect to all corrective work to be undertaken pursuant to the warranty mentioned herein and thereafter for any maintenance Contract. Commence corrective work within 24 hours upon receipt of written notice from the City.

l. All equipment shall be warranted against defects in material and workmanship, under normal use, for one year from date of installation. In the event the system is found by the manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace defective parts, provided the equipment is returned to manufacturer.

m. The Work involves:
   1) Site surveys
   2) System and component design
   3) Design review and approval
   4) Manufacture and delivery of material and equipment
   5) Installation and construction
   6) Optimization, acceptance, testing, and commissioning
   7) Spares, documentation, training, and warranty

9. P-TEL Phones:

a. P-TEL Phones shall be located at strategic location within stations and shall be an ADA compliant hands free speakerphone with a push-to-call button and connected to the telephone network via a compatible VoIP protocol dedicated drop cable.

b. The push-to-call button shall be labeled "PASSENGER INFORMATION".

c. Each P-TEL shall be labeled as “Assistance Telephone.”

d. Shall be constructed of high-grade stainless steel.

e. Shall be supervised via a polling technique or other method to verify daily that all emergency phones are functional.

f. Each P-TEL shall be a stanchion type colored yellow.

g. The P-TEL phones shall consist of outdoor-rated, vandal resistant and hands-free speakerphone communications device with stainless steel faceplate and metal buttons.

h. The P-TEL Phone shall have one red anodized aluminum tactile button labeled "PASSENGER INFORMATION" and one red LED labeled "LIGHT ON INDICATES CALL RECEIVED.” The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at the site or by an attendant. The unit shall be phone line powered, outside power source are not acceptable. The unit shall have a dedicated communication line.

i. Provide a maintenance Contract support as standard warranty at no additional cost to the City for all Contractor-provided system/sub-system components. Submit along with the bid submittal a proposal for post warranty maintenance and service. It is understood and agreed that time is of the essence in respect to all corrective work to be undertaken pursuant to the warranty mentioned herein and thereafter for any maintenance Contract. Therefore, commence corrective work within 24 hours upon receipt of written notice from the City.

j. All equipment shall be warranted against defects in material and workmanship, under normal use, for one year from date of installation. In the event the system is found by the manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace defective parts, provided the equipment is returned to manufacturer.

k. The Work involves:

1) Site surveys
2) System and component design
3) Design review and approval
4) Manufacture and delivery of material and equipment
5) Installation and construction
6) Optimization, acceptance, testing, and commissioning
7) Spares, documentation, training, and warranty

10. T-TEL Phones:

a. Train Emergency Speakerphones shall be full-duplex push-to-call hands free speakerphones (without handset) installed in the train cars with connectivity to the telephone system via a compatible VoIP protocol provided by a train-to-wayside wireless mobile data network.

b. All calls initiated shall be automatically routed directly to the OCC via a Private Line Automatic Ringdown (PLAR) capability.

c. The push-to-call button shall be labeled "EMERGENCY".

d. Shall be supervised via a polling technique or other method to verify daily that all emergency phones are functional.

e. Shall be labeled as “Emergency Telephone TPSS”.

f. Shall be constructed of high-grade stainless steel.

g. Shall be recessed surface mounted in rail car.

h. Shall be integrated into the train communications network, which consists of in-vehicle network, wireless transmitter, and the coachwork.

i. The T-TEL phones shall consist of outdoor-rated, vandal resistant, and ADA-compliant hands-free speakerphone communications device with stainless steel faceplate and metal buttons.

j. The T-TEL Phone shall have one red anodized aluminum tactile button labeled "EMERGENCY" and one red LED labeled "LIGHT ON INDICATES CALL RECEIVED”. The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond. The unit shall be totally hands-free on both sides after connection is initiated at the site or by an attendant. The unit shall be phone line powered, outside power source are not acceptable. The unit shall have a dedicated communication line.

k. Provide one-year maintenance Contract support as standard warranty at no additional cost to the City for all Contractor-provided system/sub-system components. Submit along with the bid submittal a proposal for post warranty maintenance and service. It is understood and agreed that time is of the essence in respect to all corrective work to be undertaken pursuant to the warranty mentioned herein and thereafter for any maintenance Contract. Therefore, commence corrective work within 24 hours upon receipt of written notice from the City.

l. All equipment shall be warranted against defects in material and workmanship, under normal use, for one year from date of installation. In the event the system is found by the manufacturer to be defective within the warranty period, manufacturer shall repair and/or replace defective parts, provided the equipment is returned to manufacturer.

m. All calls originating from the T-TEL phones on-board trains or elsewhere at facilities shall function as a standard telephone call (e.g. 2-way or full duplex communications) to the OCC and shall be transferable to the local E911 telephone system as required for incident management via an interface compatible with the local telephone company (HI Tel.).

n. The Work involves:
   1) Site surveys
   2) System and component design
   3) Design review and approval
   4) Manufacture and delivery of material and equipment
   5) Installation and construction
   6) Optimization, acceptance, testing, and commissioning
   7) Spares, documentation, training, and warranty

I. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the Telephone Systems.

2.02 SCOPE OF WORK

A. Provide VoIP Gateways for all Telephone System Equipment in 21 rail Stations, OCC, Maintenance and Control Center, and 60 Rail Cars.

B. Install new wiring and conduit where applicable for City engineering approval and Interface all telephones to the VoIP Gateway Applications Equipment via the station Train Control and Communication cross-connects and switches.

C. Use the Fiber Optic Communications Network (FOCN) to provide integrated OCC operator interface to all stations' Telephone Systems, Station Manager Booths, Control Center, and Maintenance Center.

D. Interface all Telephone Systems to the VoIP Gateway Application Equipment at each station to the dispatch and control equipment via the Fiber Optic Communications Network.

E. Provide ADA-Compliant E-TEL Phones in accordance with herein at all stations, at designated locations and interface to the OCC and to the monitoring and control equipment at the Maintenance Center.

F. Provide ADA-Compliant E-TEL telephones equipped with voice messaging capability and required cables at all stations. Connect E-TEL telephones to the Applications Equipment VoIP Gateway via the station Intermediate Distribution Frame.

G. Interface the E-TEL system to the computer assisted dispatch system at the OCC via the OCC Equipment Room, MDF, and other equipment.

H. Design, furnish, install, and test a functional E-TEL System in accordance with herein.

2.03 STATION AND TRAIN CAR TELEPHONE SYSTEMS REQUIREMENTS

A. The phones shall consist of an outdoor-rated, vandal resistant, and ADA-compliant hands-free speakerphone communications device with a stainless steel faceplate and metal buttons.

B. The phones shall have one red anodized aluminum tactile button labeled "EMERGENCY" and one 0.375-inch diameter red LED labeled "LIGHT ON INDICATES CALL RECEIVED." The unit shall be programmable from a remote location and have a two number dialing capability, reverting to the second number if the first is busy or does not respond.

C. The phones shall be totally hands-free on both sides after connection is initiated at the site or by an attendant.

D. The phones shall have a dedicated communication line.

E. The phones Chassis, back box and faceplate shall be constructed of stainless steel. A typical phone shall have the following measurements:

1. Faceplate shall be 12 Gauge #4 brushed stainless steel measuring 15 inches high x 7 inches wide minimum to ensure covering of present wall opening. Existing screw holes in pedestal shall be used for mounting new faceplate.

2. Unit weight shall not exceed 10 pounds.

F. The phones Signage shall be constructed of cast metal with lettering and Braille raised approximately 3/32 inch for the ADA-compliant phones.

G. The E-TEL phone shall have Word "EMERGENCY" and button in red. Push button and switch shall be a single assembly rated for 1,000,000 cycles.

H. The P-TEL phone shall have Word "PASSENGER INFORMATION" and button in red. Push button and switch shall be a single assembly rated for 1,000,000 cycles.

I. The T-TEL phone shall have Word "EMERGENCY" and button in red. Push button and switch shall be a single assembly rated for 1,000,000 cycles.

J. The phones speaker and microphone shall be protected by non-ferrous metal screen to provide a barrier against vandalism, rain, and snow.

K. The phones shall be totally line powered, requiring no outside power source or battery back-up. Dual in-line Package (DIP) switch programming, devices requiring external power are not acceptable.

L. One dedicated, twisted-shielded communication pair shall provide a minimum of 24 VDC and 20 mA while the phone is off hook.

M. The phones shall be available with Intelli-Voice Location Identifier.

1. Message shall transmit as soon as call is answered.
2. Message shall be repeatable upon request of operator.
3. Message duration shall be programmable as 5, 10, or 16 seconds.
4. Location identifier message and duration shall be programmable from remote location.

N. Other features of the phones shall be:

1. Unit shall be capable of operating on standard phone lines.
2. Unit shall dial at approximately 10 tones per second.
3. Output sound level shall be greater than 80 dB at one meter for normal conversation.
4. All programming shall be stored in non-volatile Electrically Erasable Programmable Read-Only Memory (EEPROM).
5. Button shall provide tactile feedback.
6. Unit shall be programmable from a remote telephone via keypad entry.
7. Call timer shall be programmable from 1 to 4,320 minutes.
8. LED for the hearing impaired shall illuminate to indicate when calling party may speak (when receiving party is silent).
9. Unit shall be programmable with two different telephone numbers of up to 18 digits each including pauses. If first number does not answer or is busy, unit shall automatically call the second number. If that number is busy or does not answer, unit shall call the first number again. Unit shall continue alternating until call is answered or call timer limit is reached.
10. Unit shall include two auxiliary outputs and one auxiliary input that are opto-isolated from the telephone line to 1,000 volts. Outputs shall be activated, providing a dry contact closure, either automatically when Phone is activated or manually by guard keypad operation. Input shall allow unit to be activated by any device or switch that provides a contact closure.
11. Incoming and outgoing volume shall be adjustable separately.
12. Unit shall be capable of automatically notifying attendant of location via programmable 6-digit ID.
13. Unit shall be capable of silent monitoring.
14. Unit shall utilize tone dialing.
15. When call is finished, unit shall automatically shut off.
16. Unit shall answer any call placed to it from any other telephone.
17. Two levels of programmable passwords shall be available.

18. Unit shall be varistor lightening suppressed and full wave polarity guarded.

19. Unit shall have parallel tip and ring connected to an RJ-11 connector for quick installation.

20. Unit shall have a Microsoft/Windows compatible diagnostics software base-station package.

21. Unit shall comply with Part 68 of the FCC rules for the United States.

O. The Phone's Operating Environmental features:

1. Speaker: Unit shall have a 3.5-inch waterproof speaker with a vinyl-impregnated cloth cone. Magnet and solid aluminum voice coil area shall be protected from ferrous and non-ferrous particles by a special sealed design. The speaker shall be capable of operating without deterioration of sound quality after total immersion in water for 96 hours. Speaker shall operate at temperatures of -67 degrees Fahrenheit to 185 degrees Fahrenheit. Steel basket shall have a zinc dichromate finish for protection against corrosion.

2. Microphone: Unit shall include a gold, water-resistant microphone.

3. Push Button/Switch: Button and switch shall be a single assembly. Epoxy seals shall protect contacts and terminals from hostile environments and solder flux. Unit shall be waterproof and submergible to 3 feet in water. Unit shall have a mechanical life of 1,000,000 cycles. Case shall be moisture-proof, dust-tight and designed to accommodate the high shock military specifications of MIL-STD-202, method 207. Case shall be aluminum alloy, anodized clear. Button shall be red anodized aluminum. Switch shall be rated to operate from -67 degrees Fahrenheit to 176 degrees Fahrenheit.

4. Personal Computer (PC) Boards and Other Electronic Components: Boards and components shall withstand a corrosive atmosphere of 90 percent H_2S for 16 hours. PC boards shall be rated R4. Unit shall be designed to operate at temperatures from -4 degrees Fahrenheit to 149 degrees Fahrenheit and humidity levels up to 95 percent relative humidity at 120 degrees Fahrenheit.

5. Protective Sealing of Completed PC Boards: Once the unit has been wave soldered and inspected and the completed boards tested, the entire circuit board apparatus shall be coated by dipping rather than spraying (Mil-I416058C amend 6). The microprocessor chip shall then be installed in its socket and sealed in place with a special electrical grade Room Temperature Vulcanizing (RTV) type sealant. At this point the boards can be sprayed with water without affecting the operation of the unit.

P. The emergency phone mounting shall include six vandal-resistant, truss-head spanner mounting screws for flush mounting. The flush mounting sleeve shall mount into a wall.

Q. Surface mount accessories shall allow for the surface mounting of the Phones. They shall be outdoor-rated, constructed of stainless steel, and available in brushed finish or painted bright "caution yellow," "emergency red," or "hospital blue" with the optional word "EMERGENCY" or "PASSENGER INFORMATION" on the side:

1. Surface Mount Accessory shall be included in the package

2. Hooded Surface Mount shall have weather-protective hood
3. Lighted Surface Mount shall have a weather-protective hood with lighted faceplate and translucent "EMERGENCY" and “PASSENGER INFORMATION” sign
4. Boxed Surface Mount shall have a door to enclose the Phone

2.04 VoIP INTERFACE GATEWAY

A. VoIP Interface(s)/Gateways shall be capable of handling multiple voice interfaces, one voice channel, two voice channels, four voice channels, and eight voice channels, and shall allow line-powered Emergency Phones to communicate over an IP Ethernet data network.

B. The Gateway shall provide remote monitoring of all major and minor alarm functions to the Station Manager Center, OCC, and Maintenance Center.

C. The Gateway shall be capable of providing remote control configuration from a Windows based central computer located at a centralized maintenance facility.

D. The Gateway shall be 19-inch rack mountable with appropriate dimensions.

E. Other Gateway features shall include the following:

1. Unit shall be programmable to operate as a field unit or head-end unit.
2. A minimum of 100 Emergency Phones shall be capable of communicating to a single Base Station.
3. Unit, when configured as base station, shall accommodate up to 1, 2, 4, or 8 analog telephone lines.
4. Unit, when configured as a field unit, shall provide line voltage to the selected Emergency Phones.
5. Units shall have an operating temperature range of -4 degrees Fahrenheit to +140 degrees Fahrenheit, 5 percent to 95 percent humidity.
6. Unit shall connect to data network via 10/100 Ethernet.
7. Unit shall be programmable to operate on SIP or H.323 protocols.
8. Unit shall accept an input of -48 Volts DC (VDC) or 115 Volts AC (VAC), 60 Hz. Otherwise, appropriate power supply module shall be provided.
9. Unit shall consume a maximum wattage of 5 W for the one line unit and no greater that 50 W for the 8-line unit.
10. Unit shall be free-standing and stackable.

2.05 SUPERVISORY ALARM MONITORING & CONTROL

A. Description: This section describes specifications for Telephone system supervisory alarm monitoring and control system.

B. Functional Design Requirements:

1. The system shall consist of all hardware/software/firmware package designed to work on a PC with Windows 2000/NT4/XP PRO/Vista.

2. The system shall function as a base station as well as an external voice modem, security dongle, serial modem cable, and specialized cables.

3. The system shall be capable of identifying the location of a calling telephone and storing the information.

4. The system shall also function as a diagnostic tool, polling the Telephone Systems Phones at least once per day to verify connections and basic functioning.

2.06 SYSTEM FEATURES

A. Unit shall be configurable with multiple users, each with their own password and permissions.

B. Automatic periodic screen refresh shall be customizable.

C. Remote operation shall enable multiple sites to be maintained from one location.

D. All programmed and recorded information shall be stored in a single, easily backed-up database.

E. Incoming calls shall trigger an alert sound from PC (sound card and speakers required).

F. Unit shall print a report with each incoming call. This feature shall be programmable according to administrative preferences.

G. Multiple incoming call windows shall be easily managed.

H. Emergency window shall show exact time and location of incoming call plus other critical information such as operator response time.

I. Unit shall, according to administrative preferences, optionally require an operator response to incoming calls.

J. Reports shall be available for on-screen viewing and printing including individual Emergency Phone incoming calls, all incoming calls over a period, and location information of all Emergency Phones.

K. User shall be able to poll with more than one phone line using multiple modems on the same computer.

2.07 SYSTEM DIAGNOSTICS

A. Unit shall be capable of polling an unlimited number of Emergency Phones, Station Manager Booth, and OCC phones.

B. Polling shall be initiated via three methods:

1. Poll at pre-programmed times

2. Poll all phones by a single mouse click

3. Poll an individual phone by a single mouse click

C. Each Emergency Phone shall be separately programmable with minute-by-minute polling times, up to once per minute 24 hours a day.

D. Unit shall test and report on status of communication line. Unit shall distinguish between a busy line, verified communications, no dial tone, and other line conditions.

E. Main display window shall indicate most recent polling results for all Emergency Phones (may require scrolling down list as all phones may not fit on screen).

F. Unit shall match the Emergency Phone with the phone number being dialed to confirm that the Emergency Phone is in its proper location.

G. Reports shall be available for on-screen viewing and printing including individual Emergency Phone poll results and results from a single polling run. Reports shall be customizable according to start and end dates.

H. Unit shall be compatible with standard report writing software, to allow user to write custom reports.

I. A Poll Status window shall countdown the time left until the next poll time.

2.08 SYSTEM HARDWARE AND ELECTRICAL REQUIREMENTS

A. Base station shall be compatible with Windows.

B. 2000/XP/NT/Vista Pentium PC with a minimum of high speed matched 4 GRAM pairs for a total of 8 GRAM, 250GB drive space, 4 USB ports and 2 native COM ports.

C. Two distinct communication lines shall be required: one for polling and one for receiving incoming calls. Incoming phone line shall be shared with telephone receiving incoming calls.

D. The Modem and Base Station shall be mounted on a desktop. The security dongle shall be installed in the printer port of the PC.

E. Networked computers shall be able to receive incoming calls and distribute them to different guard stations while maintaining a single database. Software and licenses to be supplied as required by system operational parameters, plus one additional copy of software per each additional computer. Structured Query Language (SQL) Anywhere Studio for Windows Base Server with one User (by Sybase) is also required.

PART 3 – EXECUTION

3.01 GENERAL

The execution phase of providing integrated and fully functional Telephone Systems shall consist of the following sub-phases:

A. Station site surveys.

B. Conduct of Definitive Design Review (DDR) for hardware and functionality.

C. Conduct of Final Design Reviews (FDR) for hardware and functionality.

D. Factory acceptance test.

E. Site by site installation, integration, test, and acceptance of A-TEL, BLS/E-TEL, E-TEL, P-TEL and T-TEL Systems at each station, BLS, MSF, and Passenger Vehicle.

F. Integration and test of existing LAN, WAN, and MAN for all Telephone Systems.

G. As-built documentation, testing, and training for all Telephone Systems.

H. Codes, Standards, and Regulations – Work under this Section shall be performed according to all appropriate city, state, and federal codes, standards, and regulations.

I. Test plans and reports as identified in the Contract Document and General Conditions requirements, shall be required during all testing phases of execution. The City reserves the right to include more tests procedures in the test plan.

J. Keep work area clean and clean up.

3.02 VoIP GATEWAY INTERFACE INSTALLATION

A. Install all telephone applications equipment VoIP Interface Gateways in cabinets at all Stations, OCC, Station Manager Booth (if any required), and maintenance facility.

B. Install connectors and or terminated cables as required to interconnect VoIP Interface Gateways and MDFs.

C. Connect -48 VDC and/or 115 VAC power, as required.

D. All power for the telephone systems shall be from the local UPS power source.

E. Cross-connect VoIP GATEWAY and Communications Alarm System to designated pairs of Fire Alarm Control Panel (FACP) block per specification requirements.

3.03 BLUE LIGHT STATION EMERGENCY TELEPHONES INSTALLATION

A. Install BLS Emergency phones at all BLS/E-TEL locations as shown in the drawings and Tables. Provide cable and conduit extensions as determined by conducting the cable tests and verification.

B. Terminate station cables on protection block at MDF, and cross-connect all telephones to the equipment side.

C. Cross-connect IP GATEWAY and communications alarm system to designated pairs of Telephone Systems block.

3.04 STATION EMERGENCY TELEPHONES INSTALLATION

A. Install Emergency phones at all E-TEL locations as shown in the drawings and Tables. Provide cable and conduit extensions as determined by conducting the cable tests and verification.

B. Terminate station cables on protection block at MDF, and cross-connect all telephones to the equipment side.

C. Cross-connect IP GATEWAY and communications alarm system to designated pairs of Telephone Systems block.

3.05 PASSENGER INFORMATION TELEPHONES INSTALLATION

A. Install Passenger Information phones at all P-TEL locations as shown in the drawings and Tables. Provide cable and conduit extensions as determined by conducting the cable tests and verification.

B. Terminate station cables on protection block at MDF, and cross-connect all telephones to the equipment side.

C. Cross-connect IP GATEWAY and communications alarm system to designated pairs of Telephone Systems block.

3.06 TRAIN EMERGENCY TELEPHONES INSTALLATION

A. Install Emergency phones at all T-TEL locations as shown in the drawings and Tables. Provide cable and conduit extensions as determined by conducting the cable tests and verification.

B. Terminate vehicle cables on protection block at MDF, and cross-connect all telephones to the equipment side.

C. Cross-connect IP GATEWAY and communications alarm system to designated pairs of Telephone Systems block.

3.07 ADMINISTRATIVE TELEPHONES INSTALLATION

A. Install Administrative telephones at all A-TEL locations as shown in the drawings and Tables. Both for MSF, Ancillary Buildings, Train Stations and Traction Electrification locations. Provide cable and conduit extensions as determined by conducting the cable tests and verification.

B. Terminate station cables on protection block at MDF/Switch and/or cross connect all telephones to the equipment side as required.

C. Cross-connect IP GATEWAY and communications alarm system to designated pairs of Telephone Systems block as required.

3.08 STATION MANAGER BOOTH ADMIN TELEPHONE INSTALLATION

A. Install A-TEL and E-TEL phones in all Station Manager booths.

3.09 MAINTENANCE AND CONTROL HARDWARE/SOFTWARE INSTALLATION

A. Install all hardware / software and interface to the FOCN Network at the OCC, Back-Up OCC, Temporary OCC, and MSF building facilities.

3.10 TELEPHONE CABLES TO STATION MANAGER BOOTHS (OPTIONAL IF REQUIRED)

A. Install all cables to the Station Manager booths via the Station Manager booth cabinet enclosures. Terminate cables on terminal blocks within the enclosure.

3.11 TELEPHONE SYSTEMS – AS-BUILT DRAWINGS

A. Provide as-built drawings for each telephone system. As-built drawings shall facilitate test and maintenance activities:

B. Show all system interconnection points including remote equipment type, terminal blocks, and MDFs from the remote equipment through to terminating equipment.

C. Provide at minimum the following information for each connection: physical location of interconnection point, pin or terminal numbers associated with the interconnection point and signal levels at each major system interface.

3.12 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within 2 working days of notification of the need for maintenance and support.

3.13 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: City shall have the option of purchasing directly from the appropriate Original Equipment Manufacturer(s) (OEMs) of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5 day / 8 hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and shall request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for all major components repair service, where each failed component is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective component and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed component unit at the Contractor's premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on a hourly basis

2. Engineering support, defined as work performed by employees not paid on a hourly basis

3. Software Maintenance support

3.14 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all software until successful completion of the 1 year warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for software shall be available from the Contractor, on site, within one hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the Contractor, on site, as a minimum, within 1 working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year warranty no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within this project. The City shall be placed on the Contractor’s mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. In addition, the City shall be placed, at no charge to the City, on any appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period. Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.15 TRAINING

A. The RTD will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

APPENDIX A

ADA COMPLIANCY DOCUMENT

As amended through January 1998

Accessibility Guidelines for Buildings and Facilities

The following are selected excerpts of the ADAAG. Sections dealing specifically with communications have been highlighted. The complete document can be found at: www.access-board.gov/adaag/html/adaag.htm a review of all sections is recommended.

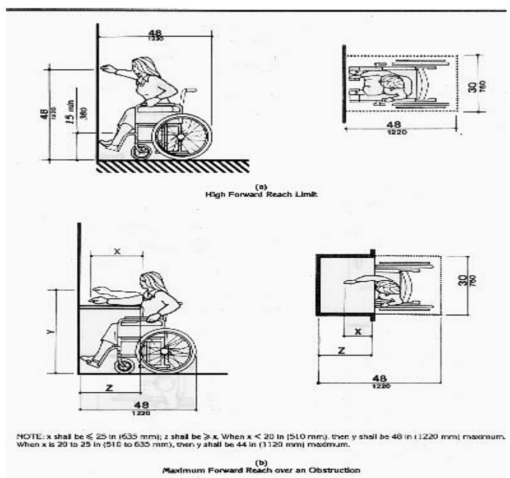
3.5 Definitions

Area of Rescue Assistance An area, which has direct access to an exit, where people who are unable to use stairs may remain temporarily in safety to await further instructions or assistance during emergency evacuation.

4.2.5 Forward Reach

If the clear floor space only allows forward approach to an object, the maximum high forward reach allowed shall be 48 in (1220 mm) (see Fig. 5(a)). The minimum low forward reach is 15 in (380 mm). If the high forward reach is over an obstruction, reach and clearances shall be as shown in Fig. 5(b).

Figure 5. Forward Reach

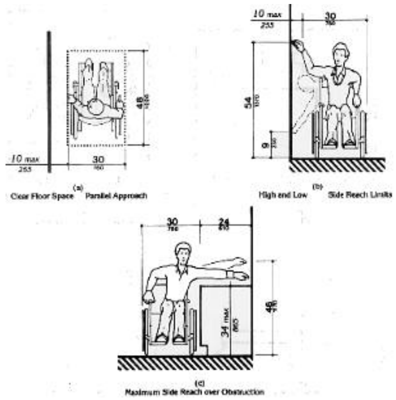


Forward Reach: the maximum high forward reach of 48 inches for a person sitting in a wheelchair is shown in Figure 5(a); the maximum high forward reach over an object, such as a shelf, is shown in Figure 5(b) for different shelf depths.

4.2.6* Side Reach.

If the clear floor space allows parallel approach by a person in a wheelchair, the maximum high side reach allowed shall be 54 in (1370 mm) and the low side reach shall be no less than 9 in (230 mm) above the floor (Fig. 6(a) and (b)). If the side reach is over an obstruction, the reach and clearances shall be as shown in Fig6(c).

Figure 6. Side Reach



Side Reach: the 30 by 48 inch clear floor space is shown in relation to an element at the side, a maximum of 10 inches from the vertical plane at the side of the wheelchair. The maximum high reach is shown as 54 inches and the minimum low reach is shown as 9 inches. If reaching over an obstruction, such as a counter no more than 34 inches high and 24 inches deep, the maximum high reach is 46 inches.

4.3.10 Egress

Accessible routes serving any accessible space or element shall also serve as a means of egress for emergencies or connect to an accessible area of rescue assistance.

4.3.11 Areas of Rescue Assistance

4.3.11.1 Location and Construction. An area of rescue assistance shall be one of the following:

(1) A portion of a stairway landing within a smokeproof enclosure (complying with local requirements).

(2) A portion of an exterior exit balcony located immediately adjacent to an exit stairway when the balcony complies with local requirements for exterior exit balconies. Openings to the interior of the building located within 20 feet (6 m) of the area of rescue assistance shall be protected with fire assemblies having a three-fourths hour fire protection rating.

(3) A portion of a one-hour fire-resistive corridor (complying with local requirements for fire-resistive construction and for openings) located immediately adjacent to an exit enclosure.

(4) A vestibule located immediately adjacent to an exit enclosure and constructed to the same fire-resistive standards as required for corridors and openings.

(5) A portion of a stairway landing within an exit enclosure that is vented to the exterior and is separated from the interior of the building with not less than one-hour fire-resistive doors.

(6) When approved by the appropriate local authority, an area or a room that is separated from other portions of the building by a smoke barrier. Smoke barriers shall have a fire-resistive rating of not less than one hour and shall completely enclose the area or room. Doors in the smoke barrier shall be tight-fitting smoke-and draft-control assemblies having a fire-protection rating of not less than 20 minutes and shall be self-closing or automatic closing. The area or room shall be provided with an exit directly to an exit enclosure. Where the room or area exits into an exit enclosure that is required to be of more than one-hour fire-resistive construction, the room or area shall have the same fire-

resistive construction, including the same opening protection, as required for the adjacent exit enclosure.

(7) An elevator lobby when elevator shafts and adjacent lobbies are pressurized as required for smokeproof enclosures by local regulations and when complying with requirements herein for size, communication, and signage. Such pressurization system shall be activated by smoke detectors on each floor located in a manner approved by the appropriate local authority. Pressurization equipment and its duct work within the building shall be separated from other portions of the building by a minimum two-hour fire-resistive construction.

4.3.11.2 Size. Each area of rescue assistance shall provide at least two accessible areas each being not less than 30 inches by 48 inches (760 mm by 1220 mm). The area of rescue assistance shall not encroach on any required exit width. The total number of such 30-inch by 48-inch (760 mm by 1220 mm) areas per story shall be not less than one for every 200 persons of calculated occupant load served by the area of rescue assistance.

EXCEPTION: The appropriate local authority may reduce the minimum number of 30-inch by 48-inch (760 mm by 1220 mm) areas to one for each area of rescue assistance on floors where the occupant load is less than 200.

4.3.11.3* Stairway Width. Each stairway adjacent to an area of rescue assistance shall have a minimum clear width of 48 inches between handrails.

4.3.11.4* Two-way Communication. A method of two-way communication, with both visible and audible signals, shall be provided between each area of rescue assistance and the primary entry. The fire department or appropriate local authority may approve a location other than the primary entry.

4.3.11.5 Identification. Each area of rescue assistance shall be identified by a sign that states "AREA OF RESCUE ASSISTANCE" and displays the international symbol of accessibility. The sign shall be illuminated when exit sign illumination is required. Signage shall also be installed at all inaccessible exits and where otherwise necessary to clearly indicate the direction to areas of rescue assistance. In each area of rescue assistance, instructions on the use of the area under emergency conditions shall be posted adjoining the two-way communication system.

4.10 Elevators

4.10.1 General

Accessible elevators shall be on an accessible route and shall comply with 4.10 and with the ASME A17.1-1990, Safety Code for Elevators and Escalators. Freight elevators shall not be considered as meeting the requirements of this section unless the only elevators provided are used as combination passenger and freight elevators for the public and employees.

4.10.14 Emergency Communications

If provided, emergency two-way communications systems between the elevator and a point outside the hoistway shall comply with ASME A17.1-1990. The highest operable part of a two-way communication system shall be a maximum of 48 in (1220 mm) from the floor of the car. It shall be identified by a raised symbol and lettering complying with 4.30 and located adjacent to the device. If the system uses handset then the length of the cord from the panel to the handset shall be at least 29 in (735 mm). If the system is located in a closed compartment the compartment door hardware shall conform to 4.27. Controls and Operating Mechanisms. The emergency intercommunication system shall not require voice communication.

4.27 Controls and Operating Mechanisms

4.27.1 General

Controls and operating mechanisms required to be accessible by 4.1 shall comply with 4.27.

4.27.2 Clear Floor Space

Clear floor space complying with 4.2.4 that allows a forward or a parallel approach by a person using a wheelchair shall be provided at controls, dispensers, receptacles, and other operable equipment.

4.27.3* Height

The highest operable part of controls, dispensers, receptacles, and other operable equipment shall be placed within at least one of the reach ranges specified in 4.2.5 and 4.2.6. Electrical and communications system receptacles on walls shall be mounted no less than 15 in (380 mm) above the floor.

EXCEPTION: These requirements do not apply where the use of special equipment dictates otherwise or where electrical and communications systems receptacles are not normally intended for use by building occupants.

4.27.4 Operation

Controls and operating mechanisms shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate controls shall be no greater than 5 lb/ft (22.2 N).

4.30 Signage

4.30.1* General

Signage required to be accessible by 4.1 shall comply with the applicable provisions of 4.30.

4.30.2* Character Proportion

Letters and numbers on signs shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10.

4.30.3 Character Height

Characters and numbers on signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case X. Lower case characters are permitted.

Height Above Finished Floor Minimum Character Height

Suspended or Projected Overhead in compliance with 4.4.2 3 in (75 mm) minimum

4.30.4 Raised and Brailled Characters and Pictorial Symbol Signs (Pictograms)

Letters and numerals shall be raised 1/32 in (0.79 mm) minimum, upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 5/8 in (16 mm) high, but no higher than 2 in (50 mm). Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 6 in (152 mm) minimum in height.

4.30.5* Finish and Contrast

The characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background --either light characters on a dark background or dark characters on a light background.

4.30.6 Mounting Location and Height

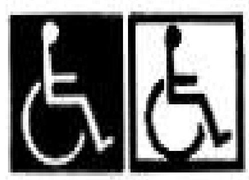
Where permanent identification is provided for rooms and spaces, signs shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting height shall be 60 in (1525 mm) above the finish floor to the centerline of the sign. Mounting location for such signage shall be so that a person may approach within 3 in (76 mm) of signage without encountering protruding objects or standing within the swing of a door.

4.30.7* Symbols of Accessibility

(1) Facilities and elements required to be identified as accessible by 4.1 shall use the international symbol of accessibility. The symbol shall be displayed as shown in Fig. 43(a) and (b).

(a)
Proportions
International Symbol of Accessibility

The diagram illustrates the International Symbol of Accessibility on a grid background. Figure 43a. International Symbol of Accessibility: Proportions



(b)
Display Conditions
International Symbol of Accessibility

The symbol contrast shall be light on dark, or dark on light. Figure 43b. International Symbol of Accessibility: Display Conditions

7.2 Sales and Service Counters, Teller Windows, Information Counters

(3)*In public facilities where counters or teller windows have solid partitions or security glazing to separate personnel from the public, at least one of each type shall provide a method to facilitate voice communication. Such methods may include, but are not limited to, grilles, slats, talk-through baffles, intercoms, or telephone hand devices. The method of communication shall be accessible to both individuals who use wheelchairs and individuals who have difficulty bending or stooping. If provided for public use, at least one telephone communication device shall be equipped with volume controls complying with 4.31.5. Hand-operable communications devices, if provided, shall comply with 4.27.

Note: Sections 11 and 12 have not been incorporated in the Department of Justice accessibility standards and are, therefore, not enforceable.

11. JUDICIAL, LEGISLATIVE AND REGULATORY FACILITIES

11.1.3* Two-Way Communication Systems

Where a two-way communication system is provided to gain admittance to a facility or to restricted areas within the facility, the system shall provide both visual and audible signals and shall comply with 4.27.

11.1.3 Two-Way Communication Systems

Two-way communication entry systems must provide both voice and visual display so that persons with hearing or speech impairments can utilize the system. This requirement may be met with a device that would allow security personnel to respond to a caller with a light indicating that assistance is on the way. It is important that signage be provided to indicate the meaning of visual signals.

APPENDIX B

SIP VS. H.323 – A COMPARISON

SIP versus H.323: The IETF standards are interoperable with the ITU-T standards on the voice transport level because ITU-T incorporated IETF's RTP protocol in its H.323 umbrella standard. However, different signaling protocols are proposed by both institutions: ITU-T uses the H.323 standard ("Visual Telephone Systems and Equipment for Local Areas Networks, which Provide a Non-guaranteed Quality of Service") whereas IETF pushes the SIP signaling. Currently, there are many controversial discussions and predictions on which approach will gain greater popularity.

Though SIP's deployment started later, it seems to gain momentum. **SIP was adopted by 3gpp**, big vendors are rolling out their products (e.g., Microsoft's Win XP Messenger or Cisco's IP phones, see the list of further SIP products) and big operators do so as well (WorldCom, AOL). The primary factors that encourage SIP's adoption are of technical nature: **SIP has been designed from scratch to scale and to remain simple**.

In the following paragraphs we refer and summarize existing comparisons of both, ITU and IETF. Early comparisons were published by SIP authors, Henning Schulzrinne's and Jonathan Rosenberg's. Their original documents (see 1 and 2) are somewhat outdated as version 4 of H.323 has been released (though not yet widely implemented). Another comparison was written by I. Dalgic and H. Fang. Yet another comparison was written within 3gpp -- it justified use of SIP in 3g mobile networks: s2-000505. A relevant article "SIP Rules!" appeared in May/2000 issue of Computer Telephony Magazine. An article on deploying SIP was issued in CWI World News.

For sake of completeness, there is also Packetizer's comparison. Note that its authors originate in H.323 crowd and are biased against SIP. Not only do they confuse bugs with features, but their numerous ascertains are technically incorrect.

	SIP	H.323	Implications
Encoding	textual	binary	textual encoding typically results in higher bandwidth overhead; as dramatically more bandwidth is consumed by multimedia, this really does not matter; textual encoding is easy to extend, debug and process by text-processing tools
Use in 3gpp	yes	no	many expect H.323 to disappear with deployment of 3gpp networks

	SIP	H.323	Implications
Call TELEPHONE-up delay	1.5 RTT	1.5 RTT Note: requirement to be backwards compatible with previous H.323 versions may increase call TELEPHONE up time up to 7 RTTs -- result of protocol design and TCP usage	
Complexity	adequate: HTTP-like protocol	high: ASN, use of several different protocols (H.450, H.225.0, H.245)	
Extensibility	the protocol is open to new protocol features	ASN.1 vendor specific 'nonstandard Param' at predefined positions only	debugging binary extensions difficult since they are unknown to protocol analyzers and unreadable to humans
Architecture	modular: SIP encompasses basic call signaling, user location and registration; other functions (QoS, directory accesses, service discovery, session content description) reside in separate orthogonal protocols	monolithic: The mix of services provided by the H.323 components encompasses capability exchange, conference control, maintenance operations, basic signaling, QoS, registration, and service discovery.	monolithic design makes component updates difficult and expensive
Instant Messaging Support	yes	no	
Loop detection	routing loops detected; "spirals" recognized and permitted	imperfect	a redirection may cause infinite request forwarding
Firewall support	comparable		
Addressing	any URL including E-mail address, H.323, http, E.164 URLs, ...	host (without username!), gatekeeper-resolved alias (arbitrary case-sensitive string, e.g. E-mail address), E.164 telephone numbers	

	SIP	H.323	Implications
Transport protocol	UDP and TCP, most implementations use UDP	UDP and TCP, most implementations use TCP	Usage of TCP results in higher call TELEPHONE-up time
Web-integration	integration with other Internet services (e.g. a caller may send an E-mail to an unreachable callee)	?	
Inter-domain call routing	hierarchically by DNS	statically by Annex G	
Service standardization	"Standardize protocols, not services": Only general interfaces standardized and examples shown.	"Standardize everything": Well-known services standardized in detail (H.450 series)	

Conclusion: The primary reason of existence of two non-interoperable signaling protocols is the both, the telecommunication and the Internet world, wanted to have protocols meeting their traditions. ITU wanted to have a sophisticated norm utilizing their other sophisticated norms, whereas IETF defined a protocol well fitting its puzzle of simple and powerful tools (see, what Henry Sinnreich of WorldCom says). The Internet telephony is located on the border of the both worlds and it is difficult to predict which approach will gain the most popularity eventually. However, if the technical aspects discussed in this section and introduction of novel integrated services will have the last word **SIP's chances are high.**

SIP VS. H.323 – A COMPARISON

As a manufacturer of telephone test equipment, we have to evaluate the potential market for both H.323 and SIP. H.323 is the more mature of the two, but problems may arise due to lack of flexibility. SIP is currently less defined, but has greater scalability that could ease internet application integration. Which protocol will win out in the end? It is still too early to tell, but our unbiased analysis will help you decide which protocol best suites your application.

	H.323	SIP
1. Architecture	H.323 covers almost every service, such as capability exchange, conference control, basic signaling, QoS, registration, service discovery, and so on.	SIP is modular because it covers basic call signaling, user location, and registration. Other features are in other separate orthogonal protocols.
Components	Terminal/Gateway	UA
	Gatekeeper	Servers

	H.323	**SIP**
Protocols	RAS/Q.931	SIP
	H.245	SDP
Call control Functionality		
Call Transfer	Yes	Yes
Call Forwarding	Yes	Yes
Call Holding	Yes	Yes
Call Parking/Pickup	Yes	Yes
Call Waiting	Yes	Yes
Message Waiting Indication	Yes	No
Name Identification	Yes	No
Call Completion on Busy Subscriber	Yes	Yes
Call Offer	Yes	No
Call Intrusion	Yes	No
	H.323 splits them across H.450, RAS, H.245 and Q.931	

	H.323	SIP
Advanced Features		
Multicast Signaling	Yes, location requests (LRQ) and auto gatekeeper discovery (GRQ).	Yes, e.g., through group INVITEs.
Third-party Call Control	Yes, through third-party pause and re-routing this is defined within H.323. More sophisticated control is defined by the related H.450.x series of standards.	Yes, through SIP as described in separate Internet Drafts.
Conference	Yes	Yes
Click for Dial	Yes	Yes
Scalability		
Large Number of Domains	The initial intent of H.323 was for the support of LANs, so it was not inherently designed for wide area addressing. The concept of a zone was added to accommodate wide area addressing. Procedures are defined for “user location” across zones for email names. Annex G defines communication between administrative domains, describing methods to allow for address resolution, access authorization and usage reporting between administrative domains. In multi-domain searches, there is no easy way to perform loop detection. Performing the loop detection can be done (using the Path Value field), but introduces other issues related to scalability.	SIP inherently supports wide area addressing. When multiple servers are involved in setting up a call, SIP uses a loop detection algorithm similar to the one used in BGP, which can be done in a stateless manner, thus avoiding scalability issues. The SIP Registrar and redirect servers were designed to support user location.

	H.323	SIP
Large Number of Calls	H.323 call control can be implemented in a stateless manner. A gateway can use messages defined in H.225 to assist the gatekeeper in performing load balancing across gateways.	Call control can be implemented in a call stateless manner. SIP supports n to n scaling between UAs and servers. SIP takes less CPU cycles to generate signaling messages; therefore a server could theoretically handle more transactions. SIP has specified a method of load balancing based upon the DNS SRV record translation mechanisms.
Connection State	Stateful or Stateless.	Stateful or Stateless. A SIP call is independent of the existence of a transport-layer connection, but instead signals call termination explicitly.
Internationalization	Yes, H.323 uses Unicode (BMPString within ASN.1) for some textual information (h323-id), but generally has few textual parameters.	Yes, SIP uses Unicode (ISO 10646-1), encoded as UTF-8, for all text strings, affording full character TELEPHONE neutrality for names, messages and parameters. SIP provides for the indication of languages and language preferences.
Security	Defines security mechanisms and negotiation facilities via H.235, can also use SSL for transport-layer security.	SIP supports caller and calle authentication via HTTP mechanisms. Cryptographically secure authentication and encryption is supported hop-by-hop via SSL/TSL, but SIP could use any transport-layer or HTTP-like security mechanism, such as SSH or S-HTTP. Keys for media encryption are conveyed using SDP. SSL supports symmetric and asymmetric authentication. SIP also defines end-to-end authentication and encryption using either PGP or S/MIME.

	H.323	**SIP**
Interoperability among Versions	The fully backward compatibility in H.323 enables all implementations based on different H.323 versions to be seamlessly integrated.	In SIP, a newer version may discard some old features that are not expected to be implemented any more. This approach saves code size and reduces protocol complexity, but loses some compatibility between different versions.
Implementation Interoperability	H.323 provides an implementers' guide, which clarifies the standard and helps towards interoperability among different implementations.	SIP thus far has not provided an implementation agreement.
Billing	Even with H.323's direct call model, the ability to successfully bill for the call is not lost because the endpoint reports to the gatekeeper the beginning and end time of the call via the RAS protocol.	If the SIP proxy wants to collect billing information, it has no choice but to stay in the call signaling path for the entire duration of the call so that it can detect when the call completes. Even then, the statistics are skewed because the call signaling may have been delayed.
Codecs	H.323 supports any codec, standardized or proprietary, not just ITU-T codecs. There have been codepoints for MPEG and GSM, which are not ITU-T codecs, in H.323 for a long time; many vendors support proprietary codecs through ASN.1 Nonstandard Parameters, which is equivalent to SIP's "privately-named codec by mutual agreement"; and any codec can be signaled via the Generic Capability feature that was added in H.323v3. Payload types can be specified statically or dynamically.	SIP supports any IANA-registered codec (as a legacy feature) or other codec whose name is mutually agreed upon. Payload types can be specified statically or dynamically.

	H.323	SIP
Call Forking	H.323 gatekeeper can control the call signaling and may fork the call to any number of devices simultaneously.	SIP proxies can control the call signaling and may fork the call to any number of devices simultaneously.
Transport protocol	Reliable or unreliable, e.g., TCP or UDP. Most H.323 entities use a reliable transport for signaling.	Reliable or unreliable, e.g., TCP or UDP. Most SIP entities use an unreliable transport for signaling.
Message Encoding	H.323 encodes messages in a compact binary format that is suitable for narrowband and broadband connections.	SIP messages are encoded in ASCII text format, suitable for humans to read.
Addressing	Flexible addressing mechanisms, including URLs and E.164 numbers.	SIP only understands URL-style addresses.
PSTN Interworking	H.323 borrows from traditional PSTN protocols, e.g., Q.931, and is therefore well suited for PSTN integration. However, H.323 does not employ the PSTN's circuit-switched technology--like SIP, H.323 is completely packet-switched. How Media Gateway Controllers fit into the overall H.323 architecture is well-defined within the standard.	SIP has no commonality with the PSTN and such signaling must be "shoe-horned" into SIP. SIP has no architecture that describes the decomposition of the gateway into the Media Gateway Controller and the Media Gateways.
Loop Detection	Yes, routing gatekeepers can detect loops by looking at the Call Identifier and destination Address fields in call-processing messages. If the combination of these matches an existing call, it is a loop.	Yes, the SIP message Via header facilitates this. However, there has been talk about deprecating Via as a means of loop detection due to its complexity. Instead, the Max-Forwards header seems to be the preferred method of limiting hops and therefore loops.

	H.323	**SIP**
2. Minimum Ports for VoIP Call	5 (Call signaling, 2 RTP, and 2 RTCP.)	5 (Call signaling, 2 RTP, and 2 RTCP.)
3. Video and Data Conferencing	H.323 fully supports video and data conferencing. Procedures are in place to provide control for the conference as well as lip synchronization of audio and video streams.	SIP has limited support for video and no support for data conferencing protocols like T.120. SIP has no protocol to control the conference and there is no mechanism within SIP for lip synchronization.
Microtronix Test System Available	Yes	Yes

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SECTION 27 60 00

SCADA SYSTEMS

PART 1 – GENERAL

1.01 SUMMARY

A. Description:

1. This Section includes the specifications for the design, furnish, installation, testing and commissioning of the Supervisory Control and Data Acquisition (SCADA) system. The term SCADA Communications Network will refer to the secure multi-point switched data transmission network using the fiber optic backbone by which all system indications, alarms, and controls are sent from Programmable Logical Controller (PLCs), Remote Terminal Unit (RTUs) and Remote input/output (I/O) devices back to a central SCADA server at the Operations Control Center (OCC) for processing, time stamping, display, and storage.

2. The system will provide effective supervisory control and monitoring of all the Honolulu High-Capacity Transit Corridor Project (HHCTCP) vital and non vital subsystems at the Maintenance and Storage Facility (MSF), ancillary buildings, train stations, traction power substations and vehicles. The SCADA System will be based on existing proven technology and the use of available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

B. Section Includes:

1. Supervisory Control and Data Acquisition (SCADA) System
2. Programmable Logical Controller (PLC)
3. Yard Shop Power Substation RTU
4. Passenger Station RTU or Remote I/O
5. Ethernet Managed EDGE Switch
6. SCADA Communications Interface Cabinet (CIC)
7. Drop Fiber Distribution (Patch) Panel (FDP) and Jumper Cables
8. SCADA Overview and Display System
9. Power Supply Requirements
10. Software
11. Electromagnetic Compatibility

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications Transmission System

3. Section 27 30 01 – Telephone Systems
4. Section 27 80 00 – Passenger Information System
5. Section 27 90 00 – Operations Control Center Ancillary Equipment
6. Section 27 90 01 – CCTV System
7. Section 27 90 02 – Station Local Area Network (SLAN)
8. Section 27 90 06 – Network Timing System
9. Section 28 36 00 – Seismic Detection
10. Section 34 20 05 – Prefabricated Enclosures
11. Section 34 20 35 – Control and Annunciation Systems

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. Note: The governing version of the listed documents shall be the latest as adopted and administered or approved or recommended by the City.

B. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE Std C37.1-1994 — IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control
2. IEEE 802.3 — Ethernet LAN Standard
3. IEEE 802.1p — VLAN Tagging Standard
4. IEEE 802.1u — Fast Ethernet: 100Base-TX and 100Base-FX
5. IEEE 1003.1 — Portable Operating System Interface for Computer Environments

C. Internet Engineering Task Force (IETF) Requests For Comments (RFC):

1. RFC 3209 — “RSVP-TE: Extensions to RSVP for LSP Tunnels”
2. RFC 3473 — “Generalized Multi-Protocol Label Switching (GMPLS) Signaling Resource Reservation Protocol-Traffic Engineering (RSVP-TE) Extensions”
3. RFC 3564 — “Requirement for the Support of Differentiated Services Traffic Engineering”
4. RFC 3630 — “Traffic Engineering (TE) Extensions to OSPF Version 2”

5. RFC 4875 — "Extensions to Resource Reservation Protocol – Traffic Engineering (RSVP-TE) for Point-to-Multipoint TE Label Switched Paths (LSPs)"

D. International Electrotechnical Institute (IEC):

1. IEC 61850 — Standard for the Design of Electrical Substation Automation
2. IEC 60870 — Standard for Telecontrol of Electrical Power Systems
3. IEC 61131-3 — Programming Standard for PLC Devices
4. IEC 60870 — Standard for Telecontrol of Electrical Power Systems
5. IEC 61131-3 — Programming Standard for PLC Devices

E. International Organization of Standardization (ISO):

1. ISO 9075 — Database Languages, SQL Part 1: Framework (SQL/Framework)

F. Military (MIL):

1. MIL STD-781 — Reliability, Test Methods, Plans, and Environments for Engineering, Development, Qualification and Production
2. MIL STD-1472E — Human Engineering
3. MIL STD-2167A — Data Item Description Specification

G. Simple Network Management Protocols (SNMP):

1. SNMP v1 and v2 — Network Management Protocols
2. SNMPv3 — Authentication and Encryption Security for Network Devices

H. Telcordia:

1. GR-1089 CORE
2. GR-63 CORE

I. United States Code of Federal Regulations (US CFR):

1. US CFR Title 47 — Telecommunications (Federal Communications Commission Rules & Regulations) Part 15, for Class A (Industrial) Devices

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Shop Drawings: Indicating actual device placements, number and type of wires and cables between devices, equipment mounting details, power requirements, data circuit requirements, point numbers, and equipment data addresses.

C. Point-to-point wiring diagrams indicating terminal-to-terminal connection between system components, type of connections, and other information necessary to make final terminations.

D. SCADA System Product Data: Submit product data for all products, including manufacturers catalog data sheets, model numbers, and specifications.

E. Power Schematics: Submit power schematics, voltage drop calculations for SCADA switching equipment, and standby battery calculations, in accordance with Division 26: Electrical Specifications.

F. SCADA System Software Programming:

1. Submit a backup copy of the latest software used to program the SCADA central processing system, in a Compact Disk (CD) format, with software revision number clearly labeled, and dated.

2. CD backup shall be kept current as outlined below:
    a. When a change is made to the software, a new backup shall be supplied.
    b. The backup shall include the complete system so that by following a procedure a usable system can be reproduced from the CD.
    c. Each CD shall contain a document that explains the changes made to the previous version of software that creates the new version.

3. Submit a hard and soft copy of sample of the SCADA screen layout plan for each screen to be provided. All screen layouts shall be subject to City approval.

4. Submit a copy of all detailed SCADA report formats that shall be supplied with the system.

5. All SCADA screen layouts and report display formats shall be subject to City approval.

G. Submit site-specific, comprehensive, SCADA indication and control points list for each signal building, signal case, within TPSS, GBS, BLS, TC houses, OCC, and Station Control Centers.

H. Submit a copy of all SCADA alarms and messages that shall be supplied with the system, including diagnostic alarms and messages.

I. Submit a Software Configuration Management Plan describing steps that will be taken to configure, maintain, and upgrade system software assuring maximum system operating reliability.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, configure, test, install and commission all the SCADA systems and subsystems to conform to the requirements of the

General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. The Contractor must employ factory-trained service personnel with a minimum of 5 years experience in servicing SCADA-related equipment.

C. Develop a complete quality assurance test plan. This shall include but not necessarily be limited to the following elements:

1. Verification of guaranteed SCADA data throughputs under full system load.

2. Determine SCADA data maximum latency under load to be within 100 milliseconds.

3. Verify total SCADA system timing and delay to be within 100 milliseconds under system load.

4. Verify Emergency Trip System (ETS) push button switch supervision and alarm continuity for hardwired connections to TPSS and Passenger Station PLCs.

D. All splicing associated with the installation of the SCADA system shall be of the fusion type. Mechanical splices of any type are expressly forbidden by this Contract.

1.06 GENERAL SCADA COMMUNICATIONS NETWORK REQUIREMENTS

A. The SCADA system shall perform monitoring and control, intrusion detection and access control, determination of third rail electrification status, status of switches and breakers, status of PA systems and other Passenger Information Systems, CCTV security systems, fire and other alarms, status and control of elevators and escalator machinery, supervisory testing of emergency phone and of emergency power trip circuits, and indications and alarms for communications systems such as VoIP telephones and wireless LAN (WLAN) systems.

B. SCADA Points Defined:

1. For purposes of the SCADA Points Matrix provided in Appendix A herein, the following definition of a SCADA Point shall apply. There shall be two types of SCADA messages Discrete (Binary) and Continuous (Quantitative).

2. A Discrete SCADA point shall be defined as an individual reporting point that sends an Open/Close, On/Off, or other binary condition.

3. Any particular device on the SCADA network may have multiple SCADA points associated with it (e.g. DC or AC breaker may have as many as 8 SCADA points) each of which shall be capable of being reported and logged as a discrete event to the main SCADA server at the OCC.

4. The following shall apply to a discrete SCADA Points:

   a. Default state is the normal condition and shall be binary 0.

   b. Change of state is the abnormal condition and shall be binary 1.

5. The PLC shall be capable of converting the discrete binary state to the appropriate Ethernet protocols to be sent by the SCADA Communications Network over the FOCN.

6. Each discrete SCADA point shall be capable of being located, addressed, and accessed by the SCADA Communications Network.

7. A database at the main SCADA server shall keep a master log of all SCADA points on the network. It shall not be necessary to continuously display all SCADA points on the network, but the status of any SCADA point shall be available on demand as required by Operations and Maintenance personnel.

8. Each SCADA Point shall be capable of having a control message sent to it (if necessary) by the main SCADA system software.

9. Each SCADA point shall be capable of being identified by the following:
   a. Name of equipment
   b. Location of equipment
   c. Type of indication send

10. Continuous (Quantitative) SCADA points shall be capable of reporting a quantity or value (e.g. temperature, current, voltage) to the main SCADA server.
    a. There shall be a Continuous SCADA Point for each equipment element requiring the monitoring of analog values.

11. The PLC shall be responsible for converting analog numerical values into the appropriate Ethernet data protocols to be sent by the SCADA Communications Network over the FOCN to the OCC.

12. Any device or element on the SCADA network may have any number or mix of either Discrete or Continuous SCADA points.
    a. Each separate reporting point, whether Discrete or Continuous, shall be considered a unique individual SCADA Point to be delivered and processed by the SCADA Communications Network.

13. It will be the responsibility of the PLC to conduct all polling of individual SCADA Points attached to that particular PLC and to report the status.

C. All SCADA messages shall be sent using the system wide FNOC specified in Section 27 13 01 – Fiber Optic Cabling Network.

D. The central SCADA processing system shall be installed at OCC, at a separate designated Maintenance Center, and also at a remote location where the OCC may be temporarily located during a planned sectionalized build-out.

   1. The SCADA system network maintenance and control functionality shall be capable of being extended by a single-mode fiber optic drop, to a new City-wide transit control center when that center becomes operational.

E. Reporting:

   1. Reports that can be generated by the software shall be capable of being viewed on screen, sent to a printer, or saved to a file in a variety of formats including but not restricted to RTF, CSV, HTML, and PDF formats.

   2. SCADA subsystem shall be able to report the exact location of any monitored device and the time of a control or indication is sent or arrives at the OCC to within 1/10 of a second (100 milliseconds) using a common system-wide timing network.

3. SCADA alarms shall remain active until cleared by an operator.

4. At a separate display location, Maintenance Center personnel shall be able to view SCADA indications and alarms for all selected systems requiring maintenance but shall not be able to send SCADA control signals or interview in OCC SCADA control operations.

F. SCADA Circuit Supervision:

1. Circuits under supervision shall use the SCADA communications subsystem to communicate the status of the supervisory signal to the OCC central control.

2. The RTU, Remote I/O module, or PLC shall be responsible for providing a supervisory capability by polling or some other suitable mechanism.

3. The SCADA Communications Network shall not have the ability to poll individual I/O SCADA control points. It is the responsibility of the local RTU, PLC, or Remote I/O to provide circuit supervisory messages out to local SCADA control points in a common 10/Base-T Ethernet data format.

4. The PLC shall be responsible for sending an alarm if the result of the supervisory operation performed on the I/O circuits under supervision indications a circuit break or fault condition.

   a. The alarm shall be in the form of an Ethernet protocol data frame suitable for transmission by the SCADA data system.

5. The main SCADA server at the OCC shall include capability to detect and respond by alarm to the monitoring messages of supervised SCADA circuits such as ETS push-button switches, PA systems used for fire evacuation purposes, CCTV and E-Tel systems, Intrusion and Access Detection, and other supervised circuits.

1.07 SCADA INTERFACES

A. General:

1. The SCADA system shall be designed to perform data acquisition, control, alarm monitoring, presentation, reporting, and archiving functions for centralized monitoring and supervisory control of the system via I/O sensors and controls.

2. The OCC shall have the ability to receive indications and send ETS control messages through the switched SCADA subsystem in order to trip breakers on any segment of the alignment including the mainline and the yard maintenance center breakers.

   a. This shall occur whenever the ETS trip signals fail to be properly delivered on the dedicated TPSS ETS fiber optic network.

3. SCADA indication and control signals to and from the OCC shall be sent using the CTS and the 10 Gbps Fiber Optic Carrier Ethernet Network (FOCN).

4. The SCADA transport system shall be application independent. SCADA devices and software that supports standard IP-over-Ethernet communications shall be able to seamlessly send, receive, process, log, and archive SCADA data using the SCADA Transmission System herein defined.

5. SCADA interfaces to the CTS shall be by means of Managed Ethernet Edge switches that shall provide a copper to optical physical layer media conversion to the CTS as well as guaranteed provisioned bandwidth allocated for each SCADA I/O device.

B. BLS SCADA Interface:

1. SCADA at BLS shall support the ETS, which shall be able to shut off power to a section of third rail when the user presses a button.

2. A supervisory communications signal shall be provided by the local RTU, PLC, or Remote I/O (for Passenger Station BLS) to monitor the continuity of the switch wiring to make sure that no electrical breaks occurred that would prevent the system from responding to the emergency power push button switch.
   a. Any lack of continuity of that circuit shall cause a signal to be sent back to the OCC via the SCADA Communications Network via the CTS and FOCN that shall cause an alarm to be raised.

3. An indication signal shall be transmitted by the SCADA Communications Network via the CTS and FOCN backbone to the OCC that the ETS push button switch has been activated.

4. A SCADA message, indicating the location of the station from which the button was activated, shall also be transmitted by the SCADA Communications Network back to the OCC.

5. An indication signal shall be transmitted by the SCADA Communications Network to the OCC when the ETS push button switch has been unlocked and return to its normal position.

6. Actual ETS trip activation and reset activation signals are designed to be directly acted on by the TPSS PLC and shall not be transmitted by the shared SCADA Communications Network or processed by the SCADA server at the OCC.
   a. These activation signals shall be sent via a dedication point-to-point fiber optic link between TPSS and are outside the scope of the shared SCADA Communications Network.

C. Fire Alarm Control Panels (FACP):

1. Fire alarms system monitoring at FACP locations shall occur via the SCADA Communications Network. Alarm I/O and FACP equipment shall be provided by a separate vendor under the Core Systems Contract.

2. Locations of FACP shall include:
   a. At all Passenger Stations (ground floor)
   b. At all TPSS and GBS locations
   c. MSF Wheel Turing Shop
   d. MSF Maintenance of Way (MOW) facility
   e. MSF Train Wash facility

3. For all FACP locations, there shall be an RTU interface to the CTS and FOCN (see Drawing “Fire Alarm Communications Block Diagram”):

a. Each FACP at a given location shall be connected to an RTU that shall monitor the FACPs for dry contact change of state.

b. Upon change of state, the RTU shall send a time-stamped alarm signal that shall be converted to Ethernet frame format in the RTU or by a media converter to be transported via the Station LAN (SLAN) Managed Ethernet Edge switch through the FOCN fiber optic backbone to the OCC.

c. Public announcement messages from the OCC back to all stations shall be through the Passenger Information System, or by SCADA activation of a pre-recorded message stored at each passenger station.

4. FACP shall also send supervisory messages about the status (e.g. continuity) of each alarm to the RTU. In addition, the RTU shall also monitor the health and status of the alarm system electronics though interfaces provided by the FACP equipment vendor.

   a. The signals corresponding to both supervision and alarm system self-tests shall be send as a separate trouble alarm though the SCADA Communications Network by the RTU.

   b. The network edge switch that interfaces the RTU to the FOCN shall tag or otherwise identify the trouble alarms as a separate and distinct message from the fire alarm message.

   c. Both fire and trouble alarms shall be sent via the SCADA Communications Network to the OCC and shall terminate at the appropriate console location(s) as determined by City Operational requirements.

   d. Upon receipt of the summary alarm message, the OCC shall annunciate an alarm notifying personnel of the fire alarm activation.

   e. Fire alarms received on the SCADA system shall be handled in a manner as all other emergency calls described in other sections of the Contract.

   f. FACP trouble alarms shall terminate in a separate alarm from fire and shall also be able be displayed on a separate Systems Maintenance console as determined by City Operational requirements.

5. SCADA Interface Equipment for FACP shall consist of the following equipment:

   a. RTU to provide SCADA signaling interface between the FACP and the SCADA switched network edge switch.

   b. Media Gateway that shall convert dry contact signaling to 10BaseT or IEEE 802.1u: Fast Ethernet data frames for transmission over the SCADA network. NOTE: This functionality may be combined with either the RTU or the Ethernet Managed Edge Switch.

6. Ethernet Managed Edge Switch to provide interface to the optical switched Ethernet CTS.

7. FDP and required jumper cables to provide fusion splice interface to from the FOCN to network switching equipment.

D. Intrusion Detection System:

1. SCADA O/I devices shall be placed to monitor secured areas for both access control and intrusion detection.

2. Maintenance Yard entrance gates and selected doors controlling access to secured areas shall equipped with SCADA I/O sensor to report and record attempts at access.

3. Monitoring and Control of Maintenance and Operations Areas shall include but not be limited to gates, shop entrances, and other access control points in the MSF.

4. Intrusion Detection for TPSS shall be interfaced to the SCADA Communications Network though the Traction Power PLC as referenced under Section 34 20 05 – Prefabricated Enclosures.

5. See Design Criteria Chapter 25- “System Safety and Security” for a list of intrusion points for SCADA monitoring.

6. See Chapter 21- “Fire and Intrusion Alarm” for definition of intrusion system.

E. OCC:

1. All SCADA indications, alarms, controls, and supervisory signals shall be transported by the CTS on the FOCN to and from the main SCADA application server at the Maintenance and Storage Facility (MSF) OCC.

2. The OCC shall be responsible for the display, annunciation, logging, and archiving of all SCADA signals for the entire system.

3. The main SCADA server at the OCC will be responsible for all programming logic with respect to the display of traction power third rail status (i.e. whether or not the section is or is not energized) by taking local breaker SCADA indications and applying the necessary control logic to determine third rail electrification status on a per section basis.

4. SCADA data transport shall be in the form of some combination or both of tagged data frames or labeled data packets, according to standards referenced in Article 1.03 herein.
   a. The OCC will terminate all SCADA signals at the main FDP and the optical network node.
   b. Signals with SCADA VLAN tags will be forwarded to the SCADA application servers for processing, display, and storage.

5. The SCADA OCC equipment shall consist of, but not be limited to, the following elements:
   a. Redundant High Availability Application Servers
   b. Redundant High Availability Database Servers
   c. Overview Display Server that manages the display of wall projected SCADA data for the system
   d. Dual Central Processing Units (CPUs)
   e. Data Storage Peripherals
   f. System printers
   g. Individual Control and Display Consoles

F. Maintenance Control Area (MCA):

1. SCADA indications shall be delivered to an MCA as well as to the OCC for monitoring by maintenance personnel.
    a. SCADA monitoring and alarms required for maintenance shall have a separate appearance at the MCA as well as being displayed at the OCC.
    b. This interface shall be capable of displaying a subset of the alarms and indications displayed at the OCC that have been deemed appropriate for maintenance level supervision.
2. The MCA Maintenance Control Center shall be maintained in a SCADA read-only data mode.
    a. MCA shall monitor selected SCADA status, alarms and indications only as determined by Technical Provisions (TP-03) of this document.
    b. The MCC shall not be able to alter data or send control signals back through the SCADA system to field PLCs.
    c. Maintenance personnel shall not have any capability to alter or block any SCADA data that is being displayed at the OCC.
3. Projection system or a multi-display LCD system shall be provided to display all relevant status and alarms for Maintenance support personnel to view and respond.
4. Two types of indications shall be logged and displayed at the Maintenance Center: Status Messages showing the position or condition of SCADA I/O points and Alarm Messages showing fault conditions for SCADA I/O points:
    a. All messages shall be location identified and time-stamped for storage in the MCA SCADA database for later retrieval.
    b. All archived SCADA indications and alarms shall be available for hard copy printout to a local laser printer.
    c. Any messages received at the MCA shall also be retrieved, logged, and stored by the main SCADA display server in the OCC operation's area.

G. TPSS and GBS:

1. The CTS shall be the means by which TPSS SCADA signaling is transmitted to central OCC and MCC control centers.
2. Connection to the CTS shall be through the Ethernet Managed Edge switch equipment located at TPSS and GBS stations.
3. The CTS interface for SCADA at the TPSS shall be at the output of the PLC.
    a. The PLCs and I/O devices, provided by the TPSS contractor shall interface with the CTS though an Ethernet Managed Edge switch or equivalent communications device to assure QoS and bandwidth guarantees on the data ingress side of the SCADA network.
    b. Communications at this interface (PLC to Ethernet Switch) shall be means of Cat6 coppering using the IEEE 10/100Base-T Ethernet data protocol.
    c. Physical termination of the Cat6 copper cabling shall be at the CIC provided by the SCADA Communications Network.
    d. The Traction Power vendor shall be responsible for protocol conversion from the native SCADA I/O fieldbus protocols (such as Profibus or Modbus) to

Ethernet10/100Base-T data frames for use by the SCADA Communications Network.

e. Close coordination with the SCADA Communications Network supplier and TPSS SCADA I/O vendor is highly desirable and recommended to ensure SCADA system compatibility with the underlying managed data protocols of the communications network.

f. SCADA equipment including PLCs, local SCADA display panels and I/O ports shall be provided by the TPSS vendor and housed in a separate cabinet from the CIC for access control and protection. Cat6 cable(s) will interconnect between the two cabinets.

4. ETS Operation: For ETS operations the following SCADA signals need to be sent:

   a. Supervisory signals to monitor the continuity and electrical integrity of the ETS circuitry shall be sent by SCADA system. These signals shall originate with the TPSS PLC. When ETS button is activated there shall be an ETS activation signal sent to TPSS to trip the breaker. The EST activation signal shall not require processing by the OCC or transmission by the SCADA Communications Network, but shall be transmitted by a dedicated pair of fiber optic strands using a protocol determined by the TPSS vendor.

5. Upon activation of the ETS, an SCADA indication/alarm signal shall be sent via the SCADA Communications Network to the OCC that an ETS button has been activated and the OCC shall be notified of the location of the station from which the ETS message was sent.

   a. The event time and date shall to be logged and archived by SCADA system software at both the local SCADA at the TPSS and central SCADA display servers at the OCC, Remote OCC (when activated) ,and Maintenance Operations Area (MCA).

6. When the ETS push button is reset, a reset notification message shall be sent to the OCC via the SCADA Communication Network.

7. Transfer Trip Signals (TTS):

   a. TTS shall be sent via a separate and independent fiber optic cable that shall provide a point-to-point connection between all TPSS and GBS locations along the alignment.

   b. TTS will be accomplished by dedicated breaker-to-breaker signaling done through the Protective Relay system and shall not require intervention by the SCADA Communication Network or its control software except for the following:

      1) A SCADA status message shall be sent to the OCC alerting the SCADA system when any TTS has been sent and report the time, date and location of the tripped breaker.

      2) This message shall be sent to OCC through the shared SCADA Communications Network though the CTS using the FOCN.

      3) The Transfer Trip system shall report supervision status messages using the shared SCADA Communications Network. Local circuits on the TTS shall be polled by installed system PLCs and any failure to determine signal continuity of a TTS circuit shall be sent to the OCC though using the SCADA Communications Network.

c. The SCADA system shall time stamp the message for recording by the main SCADA monitoring server platform at the OCC.

d. The interface for the TTS to the FOCN shall be optical Ethernet signal (100Base-FX) though the FDP at each TPSS or GBS.

8. System Reliability:

a. Edge switches TPSS and GBS shall be equipped with dual redundant output ports using two separate 100Base-FX optical interface output ports that shall automatically switch over if either output fiber optic cable is severed.

b. There shall be two fiber optic drop cable paths to alternate passenger station optical nodes to be connected independently to each of the two output ports.

c. Edge Switches shall support Small Form Factor Plugged (SFP) optical transceiver modules.

d. All circuits associated with emergency and transfer trip operations at facilities including TPSS, GBS, and BLS shall be optically isolated from stray or fault currents.

e. Ethernet Edge Switches for interface to TPSS and GBS shall be rated at 1,000,000 hours Mean Time Between Failure (MTBF) or better.

9. Ethernet Edge Switches shall be of the managed type and capable of meeting VLA tagging and VLAN requirements specified under IEEE 802.1p: VLAN Tagging Standard and other relevant standards specified in Article 1.03 herein.

H. MSF Shop TPSS:

1. RTU/PLC at MSF Shop TPSS shall have ability to be activated by a Emergency Power Breaker (EPB) switch that will shut off power to the entire shop area.

2. The circuit shall be a dedicated copper type capable of carrying current to test for continuity.

3. The RTU/PLC shall be capable of monitoring three states of the EPB switch: continuity, set, and reset.

4. The main SCADA system at the OCC shall be notified of a loss of continuity, of the switch being activated (set) and of the switch being in reset (pull-out) mode.

I. Passenger Station SCADA Interface:

1. SCADA at Passenger Stations shall be by means of the SLAN specified in Section 27 90 02 – Station Local Area Network (SLAN).

2. SCADA signaling shall be compatible with100Base-Fx standards used to interface the main optical node at the Passenger Station.

J. External User Interface to SCADA Communications Network:

1. The system network design shall provide a secure encrypted VLAN tunnel for all authorized users requiring off-site access to the SCADA Communications Network.

2. An external user switch/hub shall be provided to handle all different types of network interfaces required from the remote user equipment defined herein.

3. The unit shall be designed to provide for maximum bandwidth for all concurrent users that are logged in and flexibility to configure the routes that connected devices required.

4. The switching hub shall provide a common input path to the firewall server that shall provide a highly secure and encrypted VLAN connection to the SCADA control system at the main OCC SCADA application server.

K. SCADA Signaling for Automatic Emergency Defibrillator (AED):

1. Upon opening the panel of AED device, notification shall be sent of such access to the OCC via the SCADA signaling system.

2. This activation (alarm) shall be in the form that alerts the emergency system operator at the OCC as to the event, its exact location, and time and date of the activation of the AED panel.

3. The OCC shall be equipped to respond to such notification using the same 9-1-1 procedures as it does for emergency telephone calls.
   a. Emergency Medical Service (EMS) teams at the City Public Safety Answering Point (PSAP) shall be notified upon the receipt of such an alarm by the intervention of the OCC attendant.
   b. The alarm showing date, time and exact location shall be logged and archived automatically by SCADA system software without operator intervention.

4. The CCTV camera with the closest view of the AED shall be automatically activated or activated shall be by OCC personnel by remote command.

5. SCADA alarm signals for AED shall terminate at the appropriate console location at the OCC as determined by City Operations.

6. Other notifications concerning AED deployment shall be determined by the Authority Having Jurisdiction.

L. Ticket Vending Machines (TVM):

1. TVMs, when installed, will need to be monitored for tampering, power-off state, low ticket state, and other alarmable conditions. Alarms shall be transmitted using the shared SCADA system via the FOCN to the central controller at the OCC, and to any third party reporting center required in the Contract.

2. The SCADA system shall also provide a method of sending card reader information (data) to a future clearing house operation.

3. This data shall be in the form-encrypted information to be terminated by the SCADA Communications Network at the Fare Collection Controller located at the OCC.

4. Future applications shall include provisioning of a secure encrypted data connection from the Fare Collection Controller to a third party bank or financial data processing entity.

5. For purposes of the current scope of the Core Systems Contract, testing of the system's ability to read and send swiped card information in an encrypted form shall only involve delivering that data via the SCADA system to the Fare Controller.

6. See Section on “Fare Collection System” for details of SCADA requirements.

M. Uninterruptable Power System SCADA:

1. Uninterruptable Power System (UPS) shall have the following SCADA interface points to the shared SCADA Communications Network reporting to the OCC:
   a. Loss of utility power
   b. Generator running
   c. Generator low fuel alarm
   d. Generator in alarm condition
   e. UPS on battery
   f. UPS/Battery in alarm condition

2. The above I/O points shall send alarms, status indication messages to a Managed Ethernet Edge switch on the SLAN network for transmission by the CTS to the main SCADA server at the OCC.

N. Operations and Servicing (ONS) Building Automation System (BAS):

1. SCADA alarm messages to be sent to the OCC through the SCADA Communications Network shall originate with the BAS server located in the ONS.

2. The BAS server is the central reporting and processing point for building HVAC status and alarms at the ONS. The BAS server shall be responsible for parsing and delivering alarms that require transmission by the SCADA Communications Network to the OCC.

3. The main physical interface point from the BAS system server to the SCADA Communications Network is the CIC located in the same area of the BAS server.

4. The CIC shall contain an Ethernet Managed Edge Switch, a terminal block for either CAT5e/6 or optical fiber, and 48-volt DC power with breakers to supply the Edge Switch.

5. The BAS server shall deliver alarm messages in the form of 10BaseT Ethernet data frame for input to the SCADA Communications Network via the Ethernet Managed Edge Switch.

6. The Edge Switch shall tag the SCADA alarm data and transmit the data using the CTS to the OCC for delivery, display, processing, and storage of the ONS building alarm network server.

1.08 MAINLINE AND YARD SCADA NETWORK MANAGEMENT

A. SCADA data from the Main Revenue Line (Mainline) shall be a separate service flow from the Yard SCADA:

1. Mainline SCADA data shall include all SCADA from revenue service operations including systems monitoring data, Passenger Station SCADA, track switch data, TPSS data, BLS ETS, fire alarms, intrusion control and detection data, and all other SCADA monitoring, alarm status and control to support operations along the alignment.

2. Yard SCADA shall include traction power breakers and EOS and all TC motorized track switches associated with Maintenance Yard and Storage Facility operations.

B. Mainline SCADA shall be delivered to the OCC and to the Maintenance Center for processing, control, and storage.

1. Yard SCADA shall be delivered to the Yard Control Tower for the use by Yard personnel in MSF during vehicle operations and servicing.

C. Handling of SCADA Data shall be performed in the following manner:

1. During normal operations, the Tower shall have full control of Yard SCADA systems:
   a. In this mode, the OCC shall be locked out of Yard SCADA control.
   b. In this mode, the OCC can only monitor alarms and indications from the Yard SCADA system.

2. During this mode of operation, data shall be written to the common SCADA database from Tower only.
   a. Stored data shall be able to be read by both Tower and OCC but not altered by the OCC.

3. During the times that Tower operations are shut down, Yard SCADA shall be available to be transferred to OCC control.
   a. During this mode of operations, the OCC shall have full Yard SCADA system control and access.
   b. OCC shall be able to monitor indications and alarms and send control/activation messages to the Yard SCADA system.
   c. All Yard SCADA data obtained by the OCC when the Tower is not in operation shall be stored in the main common SCADA database. OCC will have both read and write privileges to this database.

4. When Tower operations are resumed the following shall occur:
   a. Yard SCADA data collected during OCC control of Yard SCADA system shall be available to be uploaded, accessed and processed by the Tower once the Tower resumes operation.
   b. Once the Tower takes back control of its Yard SCADA the OCC shall be again locked out of control of Yard SCADA system.
   c. The OCC shall still be able to receive Yard SCADA indications, but shall not be able to send control/activation messages to the Yard SCADA system.

5. During these operations, the OCC shall retain all control of the Mainline SCADA system:
   a. At no time during the transfer of Yard SCADA to and from the Tower shall normal Mainline SCADA operations be interrupted at the OCC.
   b. At no time shall the Tower have control or access to the OCC's Mainline SCADA system.

1.09 SCADA COMMUNCIATIONS SERVICE MAPPING

A. The SCADA system shall rely on the shared transmission backbone network for the communications of indications, controls and alarms back to the central SCADA controller at the OCC.

B. To separate SCADA traffic from other communications on the shared network, the CTS switching network shall be provisioned to provide each SCADA service with its own service domain.

1. Domains shall be provisioned for SCADA traffic for the following entities:
   a. Traction power SCADA
   b. TC SCADA
   c. Access and intrusion detection SDADA
   d. Fire alarm SCADA
   e. Communications subsystem equipment monitoring SCADA

2. It shall be possible to identify each SCADA I/O on the network by name and location by means of network addresses or other suitable means.

3. Each network domain shall be controllable by only one network server to ensure the security and integrity of different SCADA systems.

4. Each network domain shall be separately configurable without affecting the status or security of the other domains.

5. Bandwidth and other classes of service to ensure SCADA network integrity shall be independently configurable for each SCADA domain.

6. It shall be possible to combine all SCADA domains into a single common Network Management System (NMS) platform using common communications protocols such as SNMPv2 and SNMPv3.

7. It shall be possible to view each SCADA domain selectively from one NMS platform as required by OCC, MCA operations, and security personnel.

8. It shall be possible for Maintenance personnel at the MCA OCC to view SCADA indications and alarms separately from the OCC without the capability to send SCADA control messages (i.e. partial system lockout.) or otherwise interfere with OCC SCADA operations.

9. It shall be possible to configure a Remote OCC SCADA monitoring system outside the OCC for all SCADA domains and for them to operate in the same management environment that they operate at the OCC.

10. All SCADA domains shall be part of a closed and secured. They shall be prevented from either access to or access from the Public Internet.

C. TPSS:

1. SCADA PLU for each individual TPSS and GBS (TPS SCADA) shall be segregated from other SCADA PLUs on the network.

2. TPS SCADA shall be separated tagged and identified as from a separate TPSS or GBS for later recovery and processing by the main TPS SCADA at the OCC.

D. Train Control:

1. SCADA PLU for each individual TC house shall be segregated from other SCADA PLUs on the network.

2. TC SCADA shall be delivered at a guaranteed 64 Kbps data rate with message latency of no more than 500 milliseconds and over all round trip delay within 1 second or less.

3. TC SCADA shall be separated tagged and identified as to operation and location so that the TC SCADA server shall know that data is for processing TC operations and shall be protected from ingress from other data services on the network.

1.10 NETWORK TIME AND SYNCHRONIZATION FOR SCADA

A. All SCADA components shall support the Network Time Protocol (NTP) and shall update their clocks at regular intervals to receive precise accurate network time from the master GPS-based clock server at the OCC.

1. Updates to clocks may occur using NTP main network server or by accessing a System Synchronization Unit to provide a stable one second clocking pulse or a precise frequency stable source depending on the equipment.

2. Updates shall occur at intervals sufficient to keep a 1-millisecond time accuracy with the Primary Reference Source.

B. Refer to Section 27 90 06 – Network Timing System, for details of the Network Timing Synchronization Subsystem.

PART 2 – PRODUCTS

2.01 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) SYSTEM

A. Elements of a SCACA network will include but not be limited to the following:

1. SCADA Local I/O devices

2. PLCs, RTUs and Remote I/O devices

3. Media Gateways to covert native I/O protocols to the Ethernet data protocol

4. Ethernet Managed Edge Switches to enforce bandwidth and Quality of Service (QoS) guarantees on ingress to the SCADA Communications Network

5. Fiber Optic distribution panels, drop cables, and backbone (provided by the Fiber Optic Cabling Network (FOCN))

6. Central SCADA platform for processing, time stamping, annunciation, and archiving of SCADA information at the OCC

7. Secondary SCADA display platforms at the Train Control (TC) Tower and OCC Maintenance group

B. The SCADA network will include the transmission of both status, alarm, and control signaling to any point in the SCADA network using the shared Communications Transmission System (CTS).

C. The SCADA network will utilize managed Ethernet Edge switches to create a virtual private LAN (VLAN) within the main digital CTS designed to give all network SCADA traffic bandwidth and priority consistent with the requirements described herein.

D. Major SCADA interfaces include.

1. Mainline Traction Power Substations (TPSS) and Gap Breaker Stations (GBS)
2. Yard and Shop TPSS
3. Electrically Operated Switches (EOS)
4. UPS Power Systems
5. Passenger Stations
6. TC Facilities
7. Blue Light Stations (BLS)
8. Fire Management Panels
9. Elevators and Escalators
10. Access and Intrusion Controlled Areas
11. Automatic Emergency Defibrillator Panels
12. AC and Ventilation Equipment
13. Communications System Equipment
14. Maintenance Shop and Yard Entrances
15. Seismic Detection Points
16. Wind Warning System Sensing Points
17. Fare Vending Machines

E. The Work involves:

1. Site surveys
2. System and component design
3. Design review and approval
4. Manufacture and delivery of material and equipment
5. Installation and construction
6. Optimization, acceptance testing, and commissioning
7. Spares, documentation, training, and warranty

2.02 PROGRAMMABLE LOGICAL CONTROLLER (PLC)

A. PLCs are the interface devices between SCADA monitoring points (see SCADA Points List in Appendix herein) and the shared SCADA Communications Network reported back to the OCC.

B. PLCs shall be provided at Passenger Stations, TPSS, GBS, the OCC, Maintenance Facility Yard and Shop, and TC Houses.

1. All PLCs shall be provided under the Core Systems Contract. Furthermore, TPSS and GBS PLCs shall be provided by the supplier of TPSS and GBS, respectively.

2. Interface to the CTS and SCADA subsystem by these PLCs shall be by using standard IEEE 802.3 Ethernet 10Base-T, or IEEE802.3u 100Base-T Fast Ethernet data protocols, or 100Base-FX Optical Ethernet data protocols.

3. PLCs shall be responsible to convert any vendor-provided SCADA I/O-side protocols into Ethernet protocols designated above for transmission by the Ethernet Managed Edge Switch equipment provided by CTS.

4. The PLC shall be fully capable of sending supervisory polling signals to the local I/O devices attached to them and providing a SCADA alarm in the event of circuit discontinuity or other I/O malfunction.

5. It shall be the responsibility of the PLC to convert these supervisory polling alarms or status and alarm notifications to one of the Ethernet data transmission formats listed above for interface to the for transmission by the SCADA Communications Network.

6. The PLC shall have a failsafe mode whereby if loss of communication with the central SCADA server occurs, the PLC shall be capable of continuing normal automatic safe operations in a stand-alone mode until communications over the SCADA subsystem are restored.

   a. Automatic operation in a stand-alone mode shall be defined those operations involving the I/O that are normal and appropriate to safe operations of the I/O device being monitored and that shall not require any external control or intervention from the OCC.

   b. Restoration of l SCADA Communications Network after SCADA network outage shall not disrupt normal operations of the PLC.

7. The means to override the automatic SCADA operation, by manual means, shall be provided at the local PLC to be used by authorized technicians in troubleshooting and maintenance of the system.

8. Automatic operation shall allow safe operation of all equipment for as long as it takes to get a certified technician(s) into the field to diagnose and repair the communications failure.

C. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and implementation of the SCADA System.

2.03 YARD SHOP POWER SUBSTATION RTU

A. An RTU shall be provide and located in the Shop Substation Communications Interface Cabinet to collect process and transmit in Ethernet frame data format Emergency Power Breaker (EPB), power control and stinger power panel status and alarms to the CTS network for transmission on the SCADA system-wide communications network.

B. Connectivity to alarm and other I/O points out from the RTU shall be hardwired using any fieldbus Protocol appropriate to the functional task of polling and reporting dry contract points or sending control information to operate devices when necessary.

C. Connectivity from this RTU out to the SCADA communications network shall be via a Cat5e, Cat6 or Fiber Optic jumper cable the Shop Power Substation CIC to the managed Ethernet Edge switch which shall also reside at the Stop Power Substation CIC.

D. The managed Ethernet switch shall be the interface to the CTS though a Cat5e or Cat6 access cable to the nearest MSF local network switching node which shall interface to the 1000Base-FX MSC fiber optic ring to be transported to the appropriate SCADA application server located in MSF Yard Control Tower (YCT).

E. RTU shall provide it own local synchronized clock in order to locally time stamp SCADA status and alarm messages sent to the YCT.

F. RTU shall have a self test mode and provide all the functionality listed in Article 2.04B herein.

2.04 PASSENGER STATION RTU OR REMOTE I/O

A. RTUs Remote I/O devices shall be provided at the Passenger Station to process Emergency Trip Information from the four BLS sat Passenger Station platforms.

B. RTUs Remote I/O devices shall be capable of the following:

1. Mapping four input ports to the location of the push button switches attached to these ports.

2. Providing location information of the push-button switch for digital transmission both to the OCC SCADA server through the main SCADA network, and when necessary, through the dedicated point-to-point fiber optic pairs to the TPSS for ETS or Transfer Trip activation.

3. Convert dry contact SCADA I/O interface to digital 10-Base-T (copper) Ethernet protocol for interface to the SLAN Managed Ethernet Edge Switch.

4. Provide supervisory monitoring of hard-wired connections to the local BLS push button switches by monitoring the current continuity of the hard-wired circuit.

   a. Be capable of detecting zero current condition (e.g. break in the hard-wired connections to the push button switches) and convert this condition into an alarm message that is compatible with digital transmission supervisory status messages using to digital 10-Base-T (copper) Ethernet protocol for interface to the SLAN Managed Ethernet Edge Switch.

5. Report both the set (e.g. pushed in) and the reset (e.g. released) status of the BLS push button switch to OCC SCADA server through the SCADA Communications

Network and to the appropriate TPSS via the dedicated fiber optic pair allocated for ETS.

a. The means of communication of set and reset conditions shall be the following:

1) Ethernet data frames for reporting to SCADA server at the OCC

2) Any required protocol for the dedicated fiber optic pairs to the next TPSS consistent with the Contracts ETS activation mechanism

C. RTU / Remote I/O devices shall send the following indications:

1. Time-stamped ETS activation message and BLS location message to TPSS via dedicated point-to-point fiber pairs.

2. Indication message to the main SCADA service at the OCC that the ETS push-button switch has been returned to it unlocked reset state for purposes of safely allowing traction power to be restored.

3. Results of polling or other supervisory messages sent on analog, hard-wire lines to the push-button switches at the four Passenger Station BLS.

a. Analog circuit supervisory alarm indicating the time and location of the four BLS circuits that have failed continuity.

4. Alarm indication back to main SCADA server at the OCC when a connectivity fault is detected between in the dedicated fiber optic stands that provide ETS communications links between Passenger Station and TPSS/GBS facilities.

5. Time-stamped internal trouble alarm sent to the SCADA server at the OCC when RTU/ Remote I/O has a self-test failure.

D. Passenger Station SCADA RTU / Remote I/O shall:

1. Be capable of operation on 24 VDC/ 48 DVC power provided by the Passenger Station UPS.

2. Be capable of operation to 145 degrees Fahrenheit at 90 percent non-condensing humidity without the use of cooling fans.

3. Be capable of 10BaseT or 100BaseFX protocol conversion to interface with the (SLAN Ethernet Managed switch.

4. Be capable of stand-alone operation in the event of SCADA Communications Network interruption or failure.

5. Be capable of self-test diagnostics and fault reporting that can be locally stored and transmitted.

2.05 ETHERNET MANAGED EDGE SWITCH

A. General Requirements:

1. The Ethernet Managed Edge Switch is the main interface to the SCADA system from the PLC units and the CTS and backbone FOCN

2. The Ethernet Managed Edge Switch shall be capable of providing a media conversion (e.g. media gateway) functionality if such functionality is not provided by the TPSS PLC. In such case it shall:

   a. Support the conversion of 10/100Base-T copper physical layer to 100Base-FX or 1000Base-FX fiber optic physical layer for transmission over single-mode drop optical fiber to the main CTS optical switching nodes at the Passenger Stations.

   b. Provide media conversion from copper base Unshielded Twisted Pair (UTP) Cat6 cabling to single mode fiber optic signals as required for transmission on the Passenger SLAN or to the FOCN backbone.

   c. Be capable of converting 10Base-T SCADA IEEE 802.3 Ethernet or IEEE 802.3u Fast Ethernet or signals from the PLUs into VLAN tagged Ethernet frames to establish a guaranteed QoS for all SCADA traffic in the network and isolate SCADA from the traffic demands of the other communications systems.

3. The Ethernet Managed Switch shall be capability of providing hard QoS and bandwidth service guarantees to the SCADA signaling coming from the PLC.

   a. Bandwidth shall be compatible with SCADA PLC vendor's requirement for the transmission and control, alarm, and status indications.

   b. Data latency shall be better than 100 milliseconds.

   c. Failover times shall be 50 milliseconds or better.

   d. Other QoS requirements shall be detailed in Article 2.05B herein.

B. QoS Requirements:

1. The Ethernet Edge Switch shall be capable of providing guaranteed data bandwidth at the ingress ports using VLAN tags according to IEEE 802.1p standards or other equivalent open-standard industry accepted communications protocols and other relevant standards cited in Article 1.03 herein.

2. QoS shall be granted on ingress to the Ethernet edge switch and shall represent a Committed Information Rate (CIR), which shall be provisioned for SCADA regardless of other voice, data, or video traffic on the network.

   a. CIR shall be 64 Kbps (minimum) per each SCADA I/O device or provisionable according to particular vendor PLC minimum data requirements.

   b. Data latency shall be 500 milliseconds or better.

   c. CIR shall be scalable and user programmable at either the Local Controller or at the OCC.

3. Regardless of network congestion the CIR shall always be in force. During times of no congestion, an Excess Information Rate (EIR) of up to 650 Kbps will be available to the SCADA edge switching system.

   a. EIR shall be scalable and user programmable at the Local Controller or OCC depending on system requirements.

   b. The Ethernet Managed Switch shall tag the incoming Ethernet data frames for the appropriate class of service and bandwidth be upgradable and scalable up to 100 percent (two times data capacity) to support future system expansion by the City network administrator.

c. Hard QoS will be enforced on data ingress points on the network. Limits shall be provisioned using system hardware settings such that minimum data guarantees for SCADA traffic on the CTS shall always be met regardless of traffic load from other communications devices using the CTS network.

C. System Reliability:

1. The SCADA Ethernet Edge Switches shall support hot-swappable GBIC interface card exchange and expansion without interruption of SCADA data network services.

2. Edge switches shall be equipped with dual redundant output ports using either a 100Base-FX optical interface or a 1000Base-FX GigEthernet interface.

3. These cards shall be capable of automatically switching over if either output fiber optic drop cable back to the passenger station node is severed.

4. Shall support Small Form Factor Plugged (SFP) optical transceiver modules. Connectors shall be LC or SC types.

5. Shall provide 1,000,000 hours Mean Time Between Failure (MTBF) or better.

D. VLAN Tagging at the Ethernet Edge Switch:

1. A physical SCADA access port (e.g. PLU) shall be capable of being configured in conjunction with a single network VLAN, MPLS label, IP address, or other open-standard network addressing scheme. All packets arriving to and from the SCADA PLU shall be transmitted to the network using the same secure VLAN path.

2. Priority of SCADA traffic using these methods shall be user programmable and expandable by means of the local controller or by means of the central OCC.

3. VLAN tagging shall be capable of supporting at least 10,000 separate virtual circuits per edge switch.

   a. Provide data latency and jitter and bandwidth that meets or exceeds the SCADA PLC and I/O device design requirements.

4. Each user VLAN shall be capable of being configured in conjunction with a network VLAN. Since different networks using the same VLAN may be connected to different SCADA PLU ports, the user VLAN shall be used in conjunction with a specific SCADA port number to define the SCADA I/O address register.

5. Each combination of source and destination IP addresses or IP masks shall be associated with a network VLAN domain. Each IP combination shall be capable of being configured in conjunction with a specific SCDAD PLU. In addition, each IP can be used in conjunction with a specific user VLAN tag or the specific piece of communications equipment connected to the port.

6. Network domains shall be under the control of a single database and application server while also being capable of future integration into a common master NMS system depending on City’s future data system needs.

E. Ethernet Edge Switch Hardware:

1. Ambient temperature operating range shall be to -45 to 145 degrees Fahrenheit 95 percent humidity (non-condensing) using no fans.

2. Shall support 24 volt DC operation or provide internal DC-to-DC conversion to operate on the Passenger Station UPS.

3. Fiber Optic Ports:
   a. Provide two redundant 100Base-FX output ports for providing fail safe dual homing to two separate fiber optic cables.
   b. Provide multiple standard 10/100Base-T ports on input.

4. Optical duplex communications distance 2.5 miles or better using Single Mode 1330 nm single-mode fiber optic transmission,

5. Link loss recovery time shall be better than 50 milliseconds in single hop service.

6. Ethernet/AC Isolation shall be 1500 VRMS for 1 minute.

7. User interface and display shall be PC based using Windows 2000/XP operating system.

F. All SCADA Ethernet Managed Edge Switches and/or Ethernet Media Converters furnished under this Contract shall be provided by the same vendor to assure consistent interfacing of equipment and data protocols.

2.06 SCADA COMMUNCIATIONS INTERFACE CABINET (CIC)

A. A CIC shall be provided in each of the following facilities: TPSS, GBS, Passenger Station Train Control and Communications Room (TCCR), Passenger Vehicle, and OCC Communications Equipment Room. The CIC shall be the interface between the SCADA/Com System being furnished and installed by the SCADA supplier of the Core Systems Contract on one side, and the SCADA I/O equipment to be monitored (i.e. PLC and I/O points) on the other.

B. The CIC and all equipment in it shall be designed, furnished, and installed by the Core Systems Contractor, which shall provide the necessary coordination between the SCADA system elements and Communication Transmission System switching elements and the providers of the SCADA PLCs and I/O devices.

C. The CIC shall be the main interface point for all devices and I/O elements needing SCADA network services back to the main SCADA server at the OCC and the master NMS of the Maintenance Control Center.

D. The CIC shall consist of the following equipment:

1. Cabinet, Racks, and Mounting Hardware:
   a. A secure metal communications-grade cabinet shall be provided with separately lockable doors the design of which shall permit proper cooling and ventilation of electrical and network equipment contained within.
   b. Two 7 foot 19-inch or 23-inch wide equipment racks welded and rated for service in communications systems environments.
   c. Proper power, grounding and floor mounting hardware to secure the cabinet to Telcordia GR-1089 CORE and GR-63 CORE standards.

2. Fiber Optic Distribution Panel (FDP):
   a. The FDP shall be the interface between the Managed Ethernet Edge communications switching equipment and the FOCN.
   b. Shall supply communications-side termination of the incoming fiber optic drop cabling to the network switching equipment.
   c. Shall be rack mountable within the two rack wide space of the CIC.
   d. Fiber on the FOCN network side shall be spliced using fusion splicing only with prefabricated factory installed pigtail connectors to secure a place on the FDP bulkhead.
   e. Connectors shall be LC or SC type and be rated for a rail and transit operating environments.

3. RTU/Remote I/O:
   a. Provides cabling interface to the SCADA local I/O device side.
   b. Shall provide hardwire capability for alarms where necessary.
   c. Shall provide media conversion from native fieldbus protocols to standard 802.3 Ethernet data protocols.

4. Manage Ethernet Edge Switch:
   a. Provides network access to the CTS and FOCN.
   b. Provides data aggregation from multiple sources of SCADA information and devices.
   c. Provides class or service and hard QoS at the ingress points to the network.
   d. Provides the Copper (10 Base-T) to Optical Ethernet interface capability from the SCADA PLC or I/O side of the network to the FOCN.
   e. Provides VLAN tagging or other suitable labeling to support guaranteed bandwidth and class of service to and manage SCADA traffic flows.

5. Network Synchronization Supply Unit (SSU):
   a. The SSU shall be responsible for acquiring network time using the NTP protocol over the CTS from the main (or backup) network time server and proving a synchronization signal of either a known stable frequency or a UTC reference one second pulse.
   b. The SSU shall be the local source of synchronization by frequency or TCU second pulses-for all SCADA, TC, and Traction Power devices requiring a uniform timing source.
   c. The SSU shall be provided with UPS power to ensure reliability and have independent dual DC feed power supplies or the functional equivalent to maintain 99.999 percent system reliability.
   d. Shall be installed provisioned in the available communications rack space in the CIC.
   e. Ground via the general communications signal and frame ground system supplied by the CIC.
   f. Refer to Section 27 90 06 – Network Timing System, for details concerning network timing and synchronization.

6. CIC shall contain space for and provide power and ground to VoIP Optical Ethernet Gateway (if required to support BLS telephone functions).

7. CIC shall provide circuit breakers to accommodate four 24 DVC circuits (provider b y TPSS vendor).

8. Provide Optional DC-DC converter for 48 VDC interface to optical gateways and switching equipment if needed to run on 24 DVC TPSS supply systems.

E. Communication Interface Cabinets for Passenger Vehicles:

1. Provide a CIC for the passenger vehicle to store network switching devices and radio system elements as well as the local LAN in the vehicle for interface with the MDS.

2. Elements of the CIC: Shall include a 19-inch wide communications-grade metal rack with a height consistent with the design space available in the passenger vehicle to be procured.

F. Splices:

1. Splicing interfaces shall be on the communications-side terminal blocks and shall be heat-fusion type.

2. The Core Systems Contractor shall provide the wiring from the CIC terminal blocks to all TPSS-related equipment Local SCADA I/O ports, which shall be provided by the TPSS supplier.

3. The TPSS supplier or other vendors that interface with the SCADA Communications Network shall assist the Core Systems Contractor in the provisioning and testing of SCADA system.

G. Interface Wiring for Facility-side Functions:

1. Cable termination blocks shall be provided by the CIC for facilities-side vendors. There may include Hardwire connections to alarms and other devices shall be terminated inside the CIC but not be provided by the communications vendor under the Core Systems Contract.

2. Wiring for remote control functions in the substation switchgear shall be terminated on terminal blocks in the CIC for interface with dry SCADA contacts.

3. The TPSS contractor shall verify that the SCADA contacts have adequate current and voltage ratings considering the switchgear control circuits to where they are wired.

4. If the contact ratings are inadequate, the TPSS contractor shall provide interposing relays with appropriately rate output contacts.

H. Interface Wiring for Alarms and Status Indicators:

1. Wiring from Dry Contacts for equipment status indicators and various alarms shall be terminated on terminal blocks location in the CIC.

2. The circuit for remote status, position and alarm monitoring shall be as indicated in the Contract Documents. They shall include:

   a. Open and Closed status

b. Test and disconnected position indications for all high voltage (above 600V) circuit breakers

c. All alarms raised at the substation annuiciator panel

I. CIC Security: CIC cabinet shall be provided with lockable doors the design of which shall permit proper cooling and ventilation of equipment.

2.07 DROP FIBER DISTRIBUTION (PATCH) PANEL (FDP) AND JUMPER CABLES

A. SCADA points shall be connected to the FOCN through FDPs located at TPSS, GBS, TCH, BLS, and other SCADA endpoints.

1. FDP shall support two 24 stand cables each going to separate Passenger Station Switching Nodes via underground conduit.

2. The FDP shall utilize and pre-fabricated connectors with pigtails to minimize optical loss.

3. Maximum Connector Loss at the patch panel shall be 0.3 dB and average connector loss shall be 0.25 dB or better per connector.

4. Maximum Splice Loss at the patch panel shall be 0.3 dB per splice and average splice loss shall be 0.2 dB or better.

B. FDP shall consist of a front mounted Cable Management Tray (CMT), Splice Trays with splicing block to hold and protect the spliced cable, Bulkhead plates for accommodating connectors, mounting brackets, and cable attachment and ground materials.

C. The SCADA FDPs shall terminate in bulkhead supporting ST type fiber optic connectors or SFP LC types.

1. Jumper cables shall connect FDP bulkheads with Managed Ethernet Optical Edge Switch.

2. Jumper cables shall be supplied with ST connectors and shall be sized a permit connection without undue stress on the fiber optic cable or without exceeding the permitted bend radius.

D. FDP shall be expandable accommodate future expansion up to 48 splice endpoints.

1. All splicing shall be of the optical fusion type.

2. Mechanical splices are expressly forbidden under this Contract.

E. FDP shall support NEMA 5 requirements for outdoor cabinets.

F. All patch panels for operation shall be storable in the CMT.

G. FDP shall be a front-access drawer mounts in 19- or 23-inch racks as determined by layout and space considerations.

H. Fiber optic cable shall be routed to the chassis of the FDP from either overhead or underneath as requires. Best entry point through the chassis shall be determined based on site requirements.

I. FDP shall include adapter packs provide bend radius protection to protect cables from sharp angles at bend points in the cable routing.

   1. Include rear radius limiters, sliding radius limiters or equivalent structures to provide cable management for incoming and outgoing fibers.

J. Pigtails shall be at least 80 inches long to facilitate splicing.

2.08 SCADA OVERVIEW AND DISPLAY SYSTEM

A. Provide a complete and integrated SCADA system for the following facilities:

   1. The OCC at the MSF.

   2. The Maintenance Control Center located at the MSF.

   3. Standby Operations and Control Center (SOCC) location as determined by the City.

B. All hardware shall be manufactured, fabricated, assembled, finished, and documented with workmanship of the highest production quality and shall conform to all applicable quality control standards of the original manufacturer and the Contractor. All hardware components shall be new and suitable for the purposes specified.

C. SCADA at the TPSS shall have a local display for maintenance personnel:

   1. SCADA displays shall be 21-inch flat screen panel.

   2. Local and remote control of SCADA system shall be available to maintenance personnel for testing and troubleshooting purposes.

   3. Maintenance personnel shall be able to override remote control and place the SCADA system in local control.

      a. During local control, the OCC SCADA software shall not be able to send control messages to interfere with troubleshooting and maintenance operations.

      b. The SCADA server shall continue to receive SCADA indications as in normal operations.

   4. There shall be a display to indicate the mode: Local-Remote at the TPSS panel.

D. To fulfill both functional and system redundancy requirements, SCADA Network Main (Master) Central Server shall consist of a set of redundant processors configured in a primary/backup mode of operation and shall support automatic failover of the functions to the backup processor(s) upon failure of the primary processor(s).

   1. Both processors shall be active simultaneously and through a self check diagnostic routine, and the processor exhibiting the highest level of performance shall act as the primary unit.

   2. The system shall provide for the reliability and availability requirements of 99.99 percent or better.

E. A Central Display Panel shall be provided at the OCC that shall display all relevant system SCADA information.

F. The central SCADA server shall be fault tolerate as specified above including the following and not limited to:

1. Redundant internal CPUs
2. Redundant backplanes
3. Redundant Power Supplies
4. Redundant Application Servers
5. Redundant Database Servers

G. Local SCADA Display Panels:

1. The SCADA system shall be provided with SCADA Local Display Panels to display and log SCADA indicators and provide a means of sending SCADA control signals to operate remote I/O devices as required. Local display panels shall be located at each TPSS, GBS, and TC houses.
2. At the TPSS, a Local SCADA Display Panel shall provide a display of all the monitored and controlled I/O devices that use the SCADA system, as well as annunciation of and logging of alarms and shall provide a means of local control during maintenance operations.
3. The SCADA system shall be designed to operate locally from the remote panel so that a qualified service technician may initiate and maintain control of and perform maintenance and diagnostic tests on all local systems independently from the OCC.
4. The panel shall allow local control such that the settings placed there by local service personnel cannot be changed or overridden by the OCC during the field maintenance operations.
5. The Local SCADA Display Panel shall allow the maintenance personnel to return control to the OCC via Remote/Local setting, and give visual indication that the remote status of the system has been restored before the technician leaves the area.
6. The Local SCADA Display Panel shall be a flat screen display device of at least 17 inches in size and shall be used to show the status and configuration of the system including alarms.

H. Processors and Peripheral Devices:

1. Application processors (also referred to as hosts or servers) shall be provided to execute the SCADA system application programs.
2. User interface and display shall be PC based using Windows XP/VISTA operating system.
3. Communication processors (also referred to as front-end processors) shall be provided to retrieve data from, and transmit data to, remote sources, particularly RTUs and other control host system. These processors typically operate on commands from the application processors. Data retrieved and processed from sources may be temporarily stored in a communication processor, which shall then distribute the data to other processors periodically or on command.

4. Workstations shall be provided to present displays and process user requests and shall be typed as peripheral devices.

5. The main memory of each processor and workstation shall be available for data storage, program execution, and all input/output operations. The main memory of each delivered processor and workstation shall be expandable to twice the size of the initially delivered memory. Main memory shall be delivered with a minimum of 25 percent spare capacity.

I. Networks:

1. The LAN used to connect processors to other processors or other devices to processors shall conform to IEEE 802 series standards.

2. Category 6 shielded twisted-pair wiring or fiber-optic cable shall be used for all OCC LAN wiring/cabling.

3. The LAN network shall be 100-Base TX capable of data transmission speeds of 100 Mbps; the installed structured cabling system shall be capable of supporting a 1-Gigabit LAN backbone.

J. Interface to Future Maintenance Management Information (MIMS) System:

1. SCADA system database shall be available for interface to a comprehensive system to identify and track every component and monitored SCADA port device.

2. The device's serial number (or suitable identification), location and names shall be available for retrieval and use by the NIMS though an open, common information protocol to implement a universal network element management system.

K. Firewall Server: A firewall server shall be provided between the switching hub and the OCC LAN. This server shall be customized with network security software to limit access to the SCADA system and provide firewall protection software to guard against unauthorized entries.

L. Processor Interconnections: Communication paths shall be provided over which processors can exchange data and system-related information, such as equipment operational status and program or data control. These interconnections may be dedicated redundant paths or may be implemented on paths shared with other devices.

M. Auxiliary Memory: The auxiliary memory supplied with each processor shall have sufficient storage capacity to satisfy the requirements of all SCADA system functions under the normal and peak conditions. Each auxiliary memory shall also be expandable in the field within its delivered enclosure to at least twice the initially delivered capacity, and shall be delivered with a minimum of 25 percent spare capacity.

N. Archive Storage: Archive storage devices shall be used for backup of the SCADA system data and software, and archival storage for the Information Archiving and Retrieval functions. These devices shall include, but not be limited to:

1. Rewritable DVD (digital video disk) drive for long-term archive storage

2. External hard drive (magnetic) storage

O. Administrator Workstations: One desktop Administrator Workstation shall be provided with each application processor.

P. Printers: Printers shall be provided for the OCC SCADA system for printed output of selected data and formatted reports. All printers shall have the following characteristics and features:

1. A minimum B/W print speed of 12 pages per minute with a minimum resolution of 600 dpi.

2. A minimum color print speed of 4 pages per minute.

3. Printers shall be connected directly to the OCC LAN.

Q. Consoles: A console shall consist of one or more SCADA workstations driving one or more monitors, a single keyboard, and a cursor control device.

1. A workstation shall consist of a processor with display generation electronics, associated peripheral I/O channels, network interface cards, main memory, and auxiliary memory. The workstations shall support a minimum display resolution of 1280(W) x 1024(H) pixels at a refresh rate of 60 Hz or higher, non-interlaced.

2. Monitors shall be 21 inch diagonal, flat panel displays using active matrix, thin film transistor (TFT), liquid crystal display (LCD) technology, or equivalent. The display screens shall have a minimum viewable image size of 20 inches (measured diagonally), and shall be capable of displaying full color images at a minimum resolution of 1280 x 1024 pixels. The nominal horizontal viewing angles shall be 160 degrees (80 degrees right/80 degrees left), and the nominal vertical viewing angles shall be 160 degrees.

3. A keyboard shall be included for each user at each console.

4. The cursor control device (CCD) shall be a trackball or mouse. One device shall be provided at each console.

5. Each console shall be equipped with an audible alarm tone generator that is capable of producing a minimum of four different distinct sounds. The tone/pattern characteristics of the annunciation shall be adjustable.

6. A trouble light shall be provided at the OCC, The light shall be activated by the SCADA system whenever fire/life/safety critical alarms for the rail system remain unacknowledged for a period of 5 minutes after initial system annunciation. The light shall be installed in the control room at a location visible from all consoles.

7. Large Screen Display Unit: Provide a Large Screen Display, in accordance with the requirements of the OCC Ancillary Equipment in Section 27 90 00 – Operations Control Center Ancillary Equipment, and as indicated in the RFP Plans.

R. The SCADA NMS shall be developed with reference to IEEE Standard C37.1-1994 - IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control.

2.09 POWER SUPPLY REQUIREMENTS

A. The SCADA system shall be capable of operation with the power sources that are supplied from an uninterruptible, conditioned power source (UPS) that supports single-phase 120-VAC, 60-Hz power.

B. SCADA system devices operating at the TPSS shall be able to operate from the existing 125-volt battery system VDC supply or provide their own DC-DC conversion to operate on a 24 VDC supply.

C. A single input power circuit shall be provided to each CIC enclosure as required.

D. Overload and Surge Withstand Capability: SCADA system input and output signals shall operate under specified overload conditions, recover to normal operation after other specified overload conditions, and limit damage that can be caused by other, more severe, overload conditions. The overload and surge withstand requirements are described in the following:

1. No damage shall occur to any field signal input or output due to continuous normal mode overload of up to 12 V (dc or peak ac at 60 Hz) or due to imposition of up to 200 V (dc or peak ac at 60 Hz) between any terminal and ground.

2. Recovery from either type of overload to nominal accuracy shall require less than five minutes.

3. Overloads of one discrete input shall not cause false indications on any other discrete input.

4. Overloads greater than specified above, but less than 750 V (dc or peak ac) shall not result in any damage beyond the single input or output point at which the overload has Occurred Communication System Equipment shall be on a battery backup UPS that shall provide up to 90 minutes of operation for the optical switching and Ethernet Edge switches.

2.10 SOFTWARE

A. Software Standardization: The SCADA system software provided by the Contractor, the original computer system software manufacturer(s), and all third-party COTS (Commercial off the Shelf) software suppliers participating in this project, shall comply with consistent, industry-accepted software standards in order to facilitate SCADA system maintenance and enhancement.

1. Software shall be provided that complies with industry standards produced by standards organizations, such as ANSI, ISO, IEC, IEEE, OSF, and X/Open.

2. Software upgrades and support shall be a required part of this Contract.

B. Programming Languages: The following programming languages and language features shall be included with the SCADA system:

1. C, compliant with ISO 9899 and C++, compliant with the latest drafts of ISO WG21 and ANSI NCITS/J16 standards.

2. SQL, compliant with ISO 9075 with extensions to support input and output forms definition, screen-based, and printed report definition.

3. Other industry-accepted high-level languages used by the Contractor in the development and maintenance of the SCADA system.

4. Libraries for each programming language containing subroutines and functions that can be merged with programs or called during program required by the SCADA application shall be provided as part of this Contract.

C. System Services: The system services provided shall include word processing, spreadsheet creation, and other application support programs as included in Windows Office or other City approved application software packages.

D. In the event of a company going out of business or when not otherwise available to provide required application software, the existing system software shall be retained and sole ownership will revert to City or the appropriate City of Honolulu agency.

E. All software upgrades shall be accomplished in such a way as to allow the system to recover to an earlier installed version in the event of any failure in the upgrade process.

F. Operating System:

1. The operating system for processors and workstations shall comply with the POSIX standards defined by IEEE 1003.X including real-time extensions defined by IEEE 1003.1b.

2. The operating system shall include the following characteristics:
   a. It shall be event-driven and respond to demands for service resulting from an event in the system or from a user request.
   b. It shall assign resources and process simultaneous events according to priority levels.
   c. It shall include facilities for scheduling the sequence of program operation such as time-based sequences.

G. Input/Output (I/O) Programs: I/O programs shall transfer data between main memory and the I/O devices.

H. Database Access Routine: All access to SCADA system data shall be through a single set of database access routines included with the SCADA system. Software that accesses data directly or through routines internal to that function will not be accepted. In systems with a distributed database, the database access services shall have access to all portions of the database wherever stored.

I. Time and Calendar Maintenance:

1. The time and date shall be maintained for use by SCADA system software.

2. Time shall be maintained in 24-hour in hours, minutes, and seconds. The date shall be maintained as day, month, and year; the day of the week; and the day of the year.

3. Leap years, century rollover, and holidays shall be recognized and data processing shall be adjusted to accommodate these non-periodic occurrences.

4. Orderly adjustments for hourly data and other time-oriented functions shall be made, accommodating 23-hour and 25-hour days.

5. The SCADA system shall receive system standard time messages from the Network Time Synchronization Subsystem (NTSS) master clock system located at the OCC. The Active Network Time Server shall be the Primary Reference Source (PRS) as defined by the ANSI/T1.101 standard.

6. This message shall be stored and compared to the time and date maintained by the time and calendar function at least every 15 minutes.

   a. The Network Time Protocol (NTP) shall be implemented on the SCADA server as the means to query the Network Time Server and obtain exact system time.

7. Refer to Section 27 90 06 – Network Timing System, for more details concerning networking timing and synchronization.

J. Network Software: The SCADA system shall include software that supports data communications within the SCADA configuration itself (OCC LAN), and with other OCC systems. The specific software requirements are described in the following:

1. Users and processors shall be able to communicate within the SCADA system network of the local and remote workstations, processors, and peripheral devices. A common network communications design shall be provided, using the standardized network protocols including TCP/IP, UDP/IP, and IPX.

2. The SCADA Communications Network shall allow access by authorized users at local and remote workstations, and local and remote programming terminals. Network security features shall be provided that control user access to the SCADA Communications Network. A user authentication scheme requiring at least a user identification and password shall be provided to confirm the user's authorization before the user may request a connection to any network node. The network security software shall protect against infiltration by self-propagating programs, including those termed "viruses" and "worms".

3. Window system software shall be provided with the SCADA system workstations. The window system shall conform to the standards contained in the X Consortium's ICCCM or Microsoft Windows NT/2000. The window system shall work with the graphical user interface provided (either OSF/Motif or Microsoft Windows), and allow windows created on the SCADA system workstations to communicate with processors equipped with X Windows-compatible software on their respective LANs. The X Windows-compatible software provided for PC-based consoles shall execute as an application in the Microsoft windows environment.

K. Database and Database Management:

1. A global database shall be provided that contains all structure definitions and initialization data for the functional requirements of the SCADA system. The database shall be client server based and support the ANSI standard Structure Query Language (SQL) for queries.

2. Run-time databases required for implementation of SCADA system functions shall be derived from the global database. All databases deriving from the global database, except the run-time databases, shall be based upon a relational database model.

3. All SCADA system database items shall be identified by symbolic names when the database items are defined. Subsequent references and linkages to any database item shall use these symbolic references. Each database item name shall be unique.

4. The database management functions provided shall be able to operate in a batch mode from auxiliary memory files and the archive storage, and interactively from any processor terminal, workstation, or programming terminal. The database management software shall locate order, retrieve, update, insert, and delete data; ensure database integrity; and provide for backup and recovery of database files. Data normalization techniques and procedures shall be used to remove data redundancy.

L. Display Generation and Management:

1. SCADA system displays shall be generated and edited using interactive display generation software delivered with the SCADA system. The displays generator features specified herein shall be available at all workstations regardless of the residency and execution location of a feature. All displays, symbols, segments, and user interaction fields shall be maintained in libraries.

2. Displays shall be generated in an interactive mode. The user shall be able to interactively develop display elements, link display elements to the database via symbolic point names, establish display element dynamics via database linkages, and define linkages to other displays and programs. The display generator shall support all workstation features and user interface features defined herein.

3. The elements available to create a display shall consist of circles, arcs, rectangles, special symbols, segments, and layers for static portion of a display. These elements shall be available to be linked to the database and dynamically transformed on the display as governed by the linkages to the database.

4. The display generation software shall support the integration of new and edited displays into the active display library. The display generator shall verify the display for completeness and errors before integrating the display into the active library.

M. Report Generation Software: The SCADA system shall include facilities to generate new report formats and edit existing report formats. It shall be possible to define the basic parameters of the report, such as the report database linkages as symbolic point names, the report format, the report activation criteria, the report destination, and retention period for the report data. The user shall be able to construct periodic reports and queries via interactive procedures.

N. Software Utilities:

1. All software utilities used to develop and maintain SCADA system software shall be delivered with the SCADA system. The software utilities shall operate on-line without jeopardizing other SCADA system application functions that are running concurrently.

2. A text editor shall be provided to create and maintain source code, SCADA system documentation, and other miscellaneous text. The user shall be able to create new text files, edit existing files, and save file edits as an audit trail.

3. A code management utility shall be provided for documenting and controlling revisions to all SCADA system programs. The utility shall maintain a library of SCADA system source, object, and executable image code and provide a controlled means for changing library files containing this code.

4. Shall be provided for all programming languages supplied with the SCADA system. Program linker and loaders shall be provided to link any object module from an assembled or compiled source to produce an executable module and to load the executable module into the SCADA system.

5. An interactive symbolic debugger shall be provided to enable the user to test new software code and inspect the characteristics of existing software. The following features shall be supported:
   a. Breakpoint control
   b. Sequence tracing
   c. Display and modification of variables
   d. Attachment of specifically written debug code to the program under test

6. System configuration services shall be provided for the user to modify the configuration parameters to meet the changing needs of City. Examples of configuration parameters include user definitions, user access privileges assignments, redefinition of alarm classes and types, addition or modification of alarm categories and subcategories, resizing of data tables, reassignment of, and addition to, network routing tables, and changes to the RTU/PLC scan tables.

7. System generation software and procedures shall be provided to generate an executable object file of all software, databases, displays, and reports. The procedures necessary to perform a complete system generation shall be provided as a complete sequence of interactive or batch commands maintain on auxiliary memory and on archive storage, source listings, and detailed manuals.

8. File management utilities shall be provided that allocate, create, modify, copy, search, virus-scan, list, compress, and delete program files, display files, and data files on auxiliary memory and archive storage.

9. Device diagnostic programs shall be provided for testing every system device including processors, main and auxiliary memory, peripherals, workstations, data links, and communication interfaces.

10. System performance monitoring software shall be provided in every host and workstation processor to monitor hardware and software performance continuously and gather performance statistics. The SCADA system shall include on-line services to enable, disable, and initialize individually each performance monitor function.

2.11 ELECTROMAGNETIC COMPATIBILITY

A. The access control system shall comply with all Electromagnetic Compatibility (EMC) regulations regarding electromagnetic compatibility within the system and with other systems installed within the same locations.

B. The equipment supplied for herein is to be used in substations where it will function with other systems of a completely different nature. All systems are to operate so that there is no mutual interference; electrostatic, electromagnetic, or other between them.

C. The intent of this requirement is to limit the electrical noise generated by the vendor's equipment and to ensure reliable operation of this equipment when subjected to external system noise of various types.

1. In addition to the requirements on noise generation and immunity, the system shall be designed so that internal system noise shall not falsely activate any internal circuit under any conditions.

2. The system design shall incorporate good engineering EMI/RFI practices such as the use of shielded cable, power ground, signal grounds, and effective shielding materials.

PART 3 – EXECUTION

3.01 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

A. During the Installation and testing phases of the Work, maintenance and support shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days a week.

B. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support shall be available from the Contractor, on site, as a minimum, within 1 working day of notification of the need for such maintenance and support.

C. The Contractor's cost of providing such support shall be included in his price to design and build the system.

3.02 TRAINING

A. A minimum of four members of staff must receive sufficient training on the operation and configuration of the system to enable these operators to train others. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

APPENDIX A

Master SCADA Points List

	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
AC Circuit Breaker	X	X		TPSS	1 per TPSS	
Loss of Utility Power		X		TPSS	1 per TPSS	
Transformer Winding Over temperature		X		TPSS	1 per TPSS	
Rectifier Over temperature		X		TPSS	1 per TPSS	
Rectifier Diode Failure		X		TPSS	1 per TPSS	
Rectifier Surge Suppressor Failure		X		TPSS	1 per TPSS	
Rectifier Reverse Current Trip		X		TPSS	1 per TPSS	
Rectifier Enclosure Alive		X		TPSS	1 per TPSS	
Rectifier Enclosure Grounded		X		TPSS	1 per TPSS	
Main (Cathode) Breaker	X	X		TPSS	1 per TPSS	
Feeder Breakers	X	X		TPSS	1 per TPSS	
Transfer Trip System Trouble		X		TPSS	1 per TPSS	
Feeder Breaker Re-Closure Failure		X		TPSS	1 per TPSS	
Feeder Breaker Multi-Function Relay Trouble		X		TPSS	1 per TPSS	
Lockout Relay Trip		X		TPSS	1 per TPSS	
DC Switchgear Enclosure Alive		X		TPSS	1 per TPSS	
DC Switchgear Enclosure Grounded		X		TPSS	1 per TPSS	
Contact Rail Energized (Each Section)		X		TPSS	1 per TPSS	
NGD Trouble		X		TPSS	1 per TPSS	
NGD Closed		X		TPSS	1 per TPSS	
NGD High Current		X		TPSS	1 per TPSS	
TPSS Local Control Enabled		X		TPSS	1 per TPSS	
Loss of Low-Voltage Station Service Power		X		TPSS	1 per TPSS	
Intrusion Detection		X		TPSS	1 per TPSS	
Fire Alarm System Trouble		X		TPSS	1 per TPSS	
Fire Alarm System Power Supply		X		TPSS	1 per TPSS	

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
Fire Alarm System Fire Alarm		X		TPSS	1 per TPSS	
Loss of 125 V dc Control Power		X		TPSS	1 per TPSS	
Loss of 24 V dc Control Power		X		TPSS	1 per TPSS	
125/24 DC/DC Converter Failure		X		TPSS	1 per TPSS	
125 V dc Battery-Charger System Trouble		X		TPSS	1 per TPSS	
TPSS High Air Temperature		X		TPSS	1 per TPSS	
TPSS Emergency Shutdown (from Local ETS)		X		TPSS	1 per TPSS	
Blue Light Station Trip		X		TPSS	1 per TPSS	
TPSS Air Flow Malfunction		X		TPSS	1 per TPSS	
Typical Mainline TPSS SCADA Alarm Interfaces						
	Control	Status / Indications	Alarm			
12kV AC BREAKER A01 - OPEN	X	X				
12kV AC BREAKER A01 - CLOSED	X	X				
12 Kv AC BREAKER A01 POSITION - CONNECTED		X				
12Kv AC BREAKER A01 POSITION - TEST		X				
12 Kv AC BREAKER A01 POSITION - DISCONNECTED		X				
AC PHASE OVERCURRENT TRIP - 50/51			X			
AC GROUND OVERCURRENT - 50N/51N			X			
AC OVERVOLTAGE/LOSS OF VOLTAGE/LOSS OF PHASE - 47			X			
DC MAIN BREAKER B01 - OPEN	X	X				
DC MAIN BREAKER B01 - CLOSED	X	X				
DC MAIN BREAKER B01 POSITION - CONNECTED		X				
DC MAIN BREAKER B01 POSITION - TEST		X				
DC MAIN BREAKER B01 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B02 - OPEN	X	X				
DC FEEDER BREAKER B02 - CLOSED	X	X				
DC FEEDER BREAKER B02 POSITION - CONNECTED		X				

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
DC FEEDER BREAKER B02 POSITION - TEST		X				
DC FEEDER BREAKER B02 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B02 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B02 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B03 - OPEN	X	X				
DC FEEDER BREAKER B03 - CLOSED	X	X				
DC FEEDER BREAKER B03 POSITION - CONNECTED		X				
DC FEEDER BREAKER B03 POSITION - TEST		X				
DC FEEDER BREAKER B03 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B03 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B03 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B04 - OPEN (KICKER RAIL)	X	X				
DC FEEDER BREAKER B04 - CLOSED (KICKER RAIL)	X	X				
DC FEEDER BREAKER B04 POSITION - CONNECTED (KICKER RAIL)		X				
DC FEEDER BREAKER B04 POSITION - TEST (KICKER RAIL)		X				
DC FEEDER BREAKER B04 POSITION - DISCONNECTED (KICKER RAIL)		X				
DC FEEDER BREAKER B04 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B04 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B05 - OPEN	X	X				
DC FEEDER BREAKER B05 - CLOSED	X	X				
DC FEEDER BREAKER B05 POSITION - CONNECTED		X				
DC FEEDER BREAKER B05 POSITION - TEST		X				
DC FEEDER BREAKER B05 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B05 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B05 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B06 - OPEN	X	X				

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
DC FEEDER BREAKER B06 - CLOSED	X	X				
DC FEEDER BREAKER B06 POSITION - CONNECTED		X				
DC FEEDER BREAKER B06 POSITION - TEST		X				
DC FEEDER BREAKER B06 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B04 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B05 - OPEN		X				
DC FEEDER BREAKER B05 - CLOSED		X				
DC FEEDER BREAKER B05 POSITION - CONNECTED		X				
DC FEEDER BREAKER B05 POSITION - TEST		X				
DC FEEDER BREAKER B05 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B05 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B05 - CONTACT RAIL VOLTAGE						
DC FEEDER BREAKER B06 - OPEN						
DC FEEDER BREAKER B06 - CLOSED						
DC FEEDER BREAKER B06 POSITION - CONNECTED						
DC FEEDER BREAKER B06 POSITION - TEST						
TRANSFORMER X01 OVERTEMP ALARM - 49T1			X			
TRANSFORMER X01 OVERTEMP TRIP - 49T2			X			
TRANSFORMER DOOR OPEN - 33T			X			
RECTIFIER Z01 OVERTEMP ALARM - 26R1			X			
RECTIFIER Z01 OVERTEMP TRIP - 26R2			X			
RECTIFIER Z01 DIODE FAILURE ALARM - 80D1			X			
RECTIFIER Z01 DIODE FAILURE TRIP - 80D2			X			
DC FRAME LIVE/GROUNDED - 64			X			
RECTIFIER DOOR OPEN			X			
LOSS OF AUXILIARY AC POWER - 27			X			
24 VDC SYSTEM FAILURE LOCAL AND REMOTE			X			
125 VDC BATTERY SYSTEM FAILURE			X			

Master SCADA Points List

	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
POSITIVE GROUND FAULT			X			
NEGATIVE GROUND FAULT			X			
BATTERY VOLTAGE TOO HIGH			X			
BATTERY VOLTAGE TOO LOW			X			
AC POWER FAILURE			X			
BATTERY CHARGER FAILURE			X			
HECO - AC PRIMARY VOLTAGE		X				
TPSS POWER CONSUMPTION (KW)		X				
Mainline Gap Breaker Station						
DC FEEDER BREAKER B01 - OPEN		X				
DC FEEDER BREAKER B01 - CLOSED		X				
DC FEEDER BREAKER B01 POSITION - CONNECTED		X				
DC FEEDER BREAKER B01 POSITION - TEST		X				
DC FEEDER BREAKER B01 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B02 - OPEN		X				
DC FEEDER BREAKER B02 - CLOSED		X				
DC FEEDER BREAKER B02 POSITION - CONNECTED		X				
DC FEEDER BREAKER B02 POSITION - TEST		X				
DC FEEDER BREAKER B02 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B02 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B02 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B03 - OPEN (KICKER RAIL)		X				
DC FEEDER BREAKER B03 - CLOSED (KICKER RAIL)		X				
DC FEEDER BREAKER B03 POSITION - CONNECTED (KICKER RAIL)		X				
DC FEEDER BREAKER B03 POSITION - TEST (KICKER RAIL)		X				

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
DC FEEDER BREAKER B03 POSITION - DISCONNECTED (KICKER RAIL)		X				
DC FEEDER BREAKER B03 - OVERCURRENT TRIP (KICKER RAIL)			X			
DC FEEDER BREAKER B03 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B04 - OPEN		X				
DC FEEDER BREAKER B04 - CLOSED		X				
DC FEEDER BREAKER B04 POSITION - CONNECTED		X				
DC FEEDER BREAKER B04 POSITION - TEST		X				
DC FEEDER BREAKER B04 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B04 POSITION - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B04 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B04 - OPEN		X				
DC FEEDER BREAKER B04 - CLOSED		X				
DC FEEDER BREAKER B04 POSITION - CONNECTED		X				
DC FEEDER BREAKER B04 POSITION - TEST		X				
DC FEEDER BREAKER B04 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B04 POSITION - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B04 - CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER B05 - OPEN		X				
DC FEEDER BREAKER B05 - CLOSED		X				
DC FEEDER BREAKER B05 POSITION - CONNECTED		X				
DC FEEDER BREAKER B05 POSITION - TEST		X				
DC FEEDER BREAKER B05 POSITION - DISCONNECTED		X				
DC FEEDER BREAKER B05 - OVERCURRENT TRIP			X			
DC FEEDER BREAKER B05 - CONTACT RAIL VOLTAGE		X				
INTRUSION ALARM			X			
INTRUSION ALARM - RESET			X			

Master SCADA Points List

	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
FIRE ALARM - LOSS OF POWER			X			
FIRE ALARM - TROUBLE			X			
FIRE ALARM - FIRE			X			
FIRE ALARM - RESET		X				
GBS PLC FAILURE			X			
TRANSFER TRIP FAILURE - TRACK 1 WESTBOUND			X			
TRANSFER TRIP FAILURE - TRACK 1 EASTBOUND			X			
TRANSFER TRIP FAILURE - TRACK 2 WESTBOUND			X			
TRANSFER TRIP FAILURE - TRACK 2 EASTBOUND			X			
TRANSFER TRIP SYSTEM FAILURE - TROUBLE			X			
NEGATIVE GROUNDING DEVICE (NGD) - ON/OFF		X				
NGD - HIGH RUNNING RAIL POTENTIAL			X			
NGD - HIGH/SUSTAINED CURRENT			X			
NGD - TROUBLE			X			
NGD DISCONNECT SWITCH POSITION - OPEN/CLOSE		X				
DC LOCKOUT RELAY - 186			X			
LOSS OF DC CONTROL VOLTAGE			X			
HVAC UNIT #1 - FAILURE			X			
HVAC UNIT #1 - FILTER PRESSURE - HIGH			X			
HVAC UNIT #1 AIR FLOW SWITCH - NO AIR FLOW IN TPSS			X			
HVAC UNIT #2 - FAILURE			X			
HVAC UNIT #2 - FILTER PRESSURE - HIGH			X			
HVAC UNIT #1 AIR FLOW SWITCH - NO AIR FLOW IN TPSS			X			
SUBSTATION SPACE TEMPERATURE - HIGH			X			
TPSS EMERGENCY SHUTDOWN - EPB/ETS			X			
TPSS EXTERIOR BLUE LIGHT - LAMP FAILURE			X			

Master SCADA Points List

	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
SCADA LOCAL/REMOTE SWITCH - LOCAL		X				
SCADA LOCAL/REMOTE SWITCH - REMOTE		X				
DC REVERSE CURRENT TRIP			X			
LOSS OF AUXILIARY AC POWER - 27			X			
24 VDC SYSTEM FAILURE LOCAL AND REMOTE			X			
125 VDC BATTERY SYSTEM FAILURE			X			
POSITIVE GROUND FAULT			X			
NEGATIVE GROUND FAULT			X			
BATTERY VOLTAGE TOO HIGH			X			
BATTERY VOLTAGE TOO LOW			X			
AC POWER FAILURE			X			
BATTERY CHARGER FAILURE			X			
Shop Traction Power Substation SCADA Points (to be monitored at Yard Control Tower and alternatively at the OCC)						
MAIN 480 VAC BREAKER		X				
LOSS480 VAC POWER			X			
DC FEEDER BREAKER		X				
DC FEEDER BREAKER			X			
DC FEEDER BREAKER POSITION		X				
DC FEEDER BREAKER POSITION		X				
DC FEEDER BREAKER POSITION		X				
DC FEEDER BREAKER OVERCURRENT TRIP			X			
DC FEEDER BREAKER CONTACT RAIL VOLTAGE		X				
DC FEEDER BREAKER MULTIFUNCTION PROTECTIVE RELAY TROUBLE			X			
DC LOCKOUT RELAY 186			X			
RECTIFIER TRANSFORMER OVERTEMP			X			

Master SCADA Points List

	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
RECTIFIER TRANSFORMER OVERTEMP		X				
RECTIFIER TRANSFORMER DOOR OPEN			X			
RECTIFIER OVERTEMP			X			
RECTIFIER OVERTEMP		X				
RECTIFIER DIODE FAILURE			X			
RECTIFIER DIODE FAILURE		X				
DC FRAME LIVE			X			
DC FRAME GROUNDED			X			
RECTIFIER DOOR OPEN			X			
INTRUSION DETECTION			X			
INTRUSION ALARM - RESET		X				
SUBSTATION FIRE DETECTION			X			
SUBSTATION PLC FAILURE			X			
FIRE ALARM PANEL - FIRE			X			
FIRE ALARM PANEL - RESET		X				
SUBSTATION PLC FAILURE			X			
LOSS OF 125 VDC CONTROL POWER			X			
LOSS OF 24 VDC CONTROL POWER			X			
NO AIR FLOW IN SHOP SUBSTATION ROOM			X			
SHOP SUBSTATION SPACE TEMPERATURE - HIGH			X			
SHOP SUBSTATION EMERGENCY TRIP SYSTEM TROUBLE			X			
SHOP SUBSTATION EMERGENCY SHUTDOWN - EPB			X			
125 VDC BATTERY SYSTWM FAILURE			X			
POSITIVE GROUND FAULT			X			
NEGATIVE GROUND FAULT			X			
BATTERY VOLTAGE TOO HIGH			X			
BATTERY VOLTAGE TOO LOW			X			
AC POWER FAILURE			X			

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
BATTERY CHARGER FAILURE			X			
LOSS OF SHOP SUBSTATION 208/120 VAC AUXILIARY POWER			X			
Train Control SCADA						
Switch Normal	X	X		TCCR	1 per switch	
Switch Reverse	X	X		TCCR	1 per switch	
Switch Locked		X		TCCR	1 per switch	
Route Request	X	X		TCCR	2 per signal	
Route Locked		X		TCCR	2 per signal	
Signal Clear		X		TCCR	1 per signal	
Route Fleet	X	X		TCCR	1 per signal	
Route Cancel	X			TCCR	1 per signal	
Train Detection		X		TCCR	numerous	
Train Doors Open		X		TCCR	1 per platform	
Terminate Dwell	X			TCCR	1 per platform	
Hold with Doors Open	X			TCCR	1 per platform	
Hold with Doors Closed	X			TCCR	1 per platform	
Train Un/Coupling	X	X		TCCR		
Power		X		TCCR	1 per TCCR	
UPS		X		TCCR	1 per TCCR	
Local Control	X	X		TCCR	1 per TCCR	
Train Number		X		TCCR	1 per Train in System	
Train Destination		X		TCCR	1 per Train in System	
Number of Trains in Consist		X		TCCR	1 per Train in System	
Elevator and Escalator SCADA						
Elevator Emergency Stop		X		Stations	1 per elevator	
Elevator Stopped		X		Stations	1 per elevator	

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
Elevator Malfunction		X		Stations	1 per elevator	
Escalator Emergency Stop		X		Stations	1 per escalator	
Escalator Stopped		X		Stations	1 per escalator	
Escalator Malfunction		X		Stations	1 per escalator	
Intrusion and Access Control SCADA						
Digital Input - used to trigger an alarm and any selected output.		X		Detector		
Digital Output- used to trigger a selected input without alarm notification.	X			Detector		
Digital Input/Output - disabled/inactive.		X		Detector		
Power on/off	X					
Low Battery		X		Detector		
Readers online/offline	X			ACS		
Doors lock/unlock	X	X		ACS		
Alarm monitoring on/off	X	X		ACS		
Inputs enabled/disabled	X			ACS		
Outputs on/off	X			ACS		
Power on/off	X			ACS		
Low Battery		X		ACS		
Seismic and Wind SCADA						
Seismic Digital Input - used to trigger an alarm and any selected output.		X		Detector		
Seismic Digital Output- used to trigger a selected input without alarm notification.	X			Detector		
Seismic Digital Input/Output - disabled/inactive.		X		Detector		
Seismic Power on/off	X					
Seismic Low Battery		X		Detector		
Wind Digital Input - used to trigger an alarm and any selected output.		X		Detector		

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
Wind Digital Output- used to trigger a selected input without alarm notification.	X			Detector		
Wind Digital Input/Output - disabled/inactive.		X		Detector		
Wind Power on/off	X					
Wind Low Battery		X		Detector		
Station HVAC SCADA						
TCCR High Air Temperature		X		TCCR	1 per TCCR	
TCCR Air Flow Malfunction		X		TCCR	1 per TCCR	
UPS/Electrical Room High Air Temperature		X		UPS/Elec	1 per UPS/ Elec Room	
UPS/Electrical Room Air Flow Malfunction		X		UPS/Elec	1 per UPS/ Elec Room	
Station Guideway Lighting SCADA						
Guideway Safety Walk Lighting Control, West	X			Elec Room	1 per Pass. Station	
Guideway Safety Walk Lighting Control, East	X			Elec Room	1 per Pass. Station	
Loss of utility power			X	Elec Room	2 per Pass. Station	
UPS on battery			X	Elec Room	3 per Pass. Station	
UPS/Battery in alarm condition			X	Elec Room	4 per Pass. Station	
Station UPS SCADA						
Loss of utility power			X	Elec Room	1 per Pass. Station	
Lighting UPS on battery			X	Elec Room	1 per Pass. Station	
Lighting UPS/Battery in alarm condition			X	Elec Room	1 per Pass. Station	

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
TCC UPS/Battery in alarm condition			X	Elec Room	1 per Pass. Station	
TCC UPS/Battery in alarm condition			X	Elec Room	1 per Pass. Station	
MSF UPS Generator SCADA						
Loss of utility power			X	Elec Room		report to OCC/SCADA via Building Automation System
Generator Running		X		Elec Room		report to OCC/SCADA via Building Automation System
Generator Low Fuel Alarm			X	Elec Room		report to OCC/SCADA via Building Automation System
Generator in alarm condition			X	Elec Room		report to OCC/SCADA via Building Automation System
UPS on battery		X		UPS Room		report to OCC/SCADA via Building Automation System
UPS/Battery in alarm condition			X	UPS Room		report to OCC/SCADA via Building Automation System

Master SCADA Points List						
	Control	Status / Indication	Alarm	Location	Quantity (approx)	Comments
TVM SCADA (per each Passenger Fare Vending Machine)						
TVM Operating Status		X				
Coin Status		X				
Change Status		X				
Change Status (No Bills Accepted)		X				
Module Operating Status (For each module)		X				
Patron Selection Button Status		X				
Ticket Stock Status (For each stack)		X				
Bill Vault Status (with serial number)		X				
Coin Vault Status (with serial number)		X				
SSMM Status		X				
Power Status		X				
Communications Status		X				
Security Status		X				
Intrusion Alarm Status		X	X			
Impact Alarm Status		X	X			
Silent Alarm Status		X				
SCADA Security Relay Status		X				
SCADA Attention Relay Status		X				
Bank Card System Status		X				
Receipt Status		X				
Bank Card Module		X				
Receipt Printer Status (If separate)		X				
Receipt Stock Status (If separate)		X				
Battery Alarm			X			

END OF SECTION

SECTION 27 70 00

WIRELESS COMMUNICATIONS SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section includes the specifications for the design, furnish, installation, testing and commissioning of the Wireless Communications System (WCS). The system will provide effective wireless communications for the Honolulu High-Capacity Transit Corridor Project (HHCTCP). The Wireless Communications System will be based on existing proven technology and the use of available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

B. Section Includes:

1. Wireless Communications System
2. Mobile Data System (MDS): Trackside Equipment
3. Radio Frequency (RF) Antenna for Mobile Data System
4. Antenna for MSF Yard and Shop Wireless Data System
5. Voice Radio System Antenna
6. Antenna System Grounding
7. Voice Radio Communications System (VRCS)
8. Yard and Maintenance Area WLAN System
9. Network Management System
10. Master Time Base (MTB)
11. Electromagnetic (EMC) Compatibility
12. Testing

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications Transmission System
3. Section 27 30 01 – Telephone Systems
4. Section 27 60 00 – SCADA System
5. Section 27 80 00 – Passenger Information System
6. Section 27 90 00 – Operations Control Center Ancillary Equipment
7. Section 27 90 01 – CCTV System

8. Section 27 90 06 – Network Timing System

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. Note: The governing version of the listed documents shall be the latest as adopted and administered or approved or recommend by the City.

B. American National Standards Institute (ANSI):

1. ANSI C95.1-1999 Human Exposure to Electromagnetic Radiation

2. ANSI C62.41 IEEE Standard 587, Guide on Surge Voltages in AC Power Circuits Rated up to 600V

C. Associate of Public Safety Officials (APCO):

1. Project 25 EIA/TIA 102 Digital Wireless Radio Communications

D. Electromagnetic Compatibility (EMC):

1. EMC Emission –EN55022 Class A

2. EMC Immunity – EN50082-1

E. Electronic Industries Association (EIA):

1. EIA 603 Radio Transmitters

2. EIA 204-D Radio Receivers

3. EIA 329-A, 1 Radio Antennas

4. EIA RS-316 Radio Electrical Performance

F. Federal Communications Commission (FCC):

1. 47 CFR Telecommunications, Part 15: Radio Frequency Devices, Subpart C: Intentional radiators, Section 15.247: Operations in 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz unlicensed bands

2. 15 CFR 203 Part 15 Intentional Radiators: Antennas

3. 15 CFR 204 Part 15 Intentional Radiators: Complete System Requirements

4. 47 CFR 1.1307 Exposure to Radio Frequency Transmissions

5. 47 CFR 15.247 Operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

6. FCC Bulletin OET-65C Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

7. 47 CFR 90 Private Land Mobile Radio

G. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE Std C37.1-1994 - IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control

2. IEEE 720 IEEE Standard for Software Quality Assurance Plans

3. IEEE 802.3 Ethernet-based LAN Standard

4. IEEE 802.1D Additional Capabilities for MAC Bridges: Spanning Tree Protocol

5. IEEE 802.1E MAC Layer Enhancements to 802.11 to Support Delay Sensitive Data Services

6. IEEE 802.1X Port-based Network Access Control

7. IEEE 802.11a 5 GHz Mbps Wireless Local Area Network Standard

8. IEEE 802.11b 2.4 GHz Wireless Local Area Network Standard

9. IEEE 802.11g 2.4 GHz Wireless Local Area Network Standard

10. IEEE 802.11N 5.0 Wireless Local Area Network Standard supporting MIMO interfaces

11. IEEE 802.11i Encryption standards including the Advanced Encryption System (AES) and Temporal Key Integrity Protocol (TKIP) and WPA2

12. IEEE 802.11n 100 Mbps Wireless Local Area Network (WLAN) Standard

13. IEEE 802.3af Power Over Ethernet (POE)

14. IEEE C95.1-1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz

15. IEEE 1012 IEEE Standard for Software Verification and Validation

H. International Electrotechnical Commission (IEC):

1. IEC 60096 Radio-frequency Cables

2. IEC 60529 Ingress Protection (IP) 66

3. IEC 61000 Electromagnetic Compatibility (EMC)

4. IEC 801 Parts 2, 3, and 4 for Electronic Static Discharge (ESD), radiated RF immunity and power line bursts

5. IEC 60529: Ingress Protection (IP) 66

I. Military (MIL):

1. MIL 810C, D, & E — Radio Equipment Temperature, Shock, Vibration, and Moisture

J. Motorola R-56, "Standards and Guidelines for Communications Sites”

K. National Electrical Manufacturers Association (NEMA):

1. NEMA ICS 6-1993 — Industrial Controls And Systems Enclosures
2. NEMA Type 1 — General Purpose Enclosures
3. NEMA Type 4 — Watertight and Dusttight-Indoor and Outdoor Enclosures

L. National Electrical Safety Code (NCSC)

M. National Fire Protection Association (NFPA):

1. NFPA 70 — National Electrical Code
2. Article 770 — Optical Fiber Cables and Raceways
3. Article 800 — Communications Circuits
4. Article 810 — Radio and Television Equipment
5. Article 830 — Network-Powered Broadband Communications Systems

N. Railway Industry Association (RIA):

1. RIA 20, Category 1

O. Telecommunications Industry Association (TIA):

1. TSB-88B: — “Wireless Communications Systems Performance in Noise and Interference-Limited Situations: Recommended Methods for Technology Independent Modeling, Simulation, and Verifications”

P. Underwriters Laboratory (UL):

1. CSA C22.2 No. 60950-1/UL 60950-1, First Edition: Safety Standard for Information Technology Equipment

1.04 SUBMITTALS

A. General: Refer to General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.

B. Mobile Data System Radio Test Plan:

1. Provide detailed Factory Test Procedure documentation.
2. Provide a detailed Test Plan as to how RF interference and noise level measurements will be made for the frequency bands of interest.

a. Test procedures shall include an initial site survey to measure RF noise floor and assess potential co-channel and adjacent channel interferers.

b. Test Plan shall contain any band plans required to acquire new spectrum as well as an assessment of unlicensed band availability along the entire length of City alignment.

c. Test Plan shall contain a complete equipment list including type, make manufacturer, serial number, and documented dates of calibration.

3. Develop and submit a complete Testing Schedule detailing when various tests shall commence and be completed and who shall perform the tests.

4. Submit detailed Test Procedure including equipment to execute necessary in-field measurements that will be made to verify the predicted RF coverage.

   a. List locations to be tested, or retested, and compare predicted signal levels to actual measured signal levels.

   b. Describe procedures and test equipment used to do field strength and other radio path measurements.

5. Develop and submit an Action Plan that details procedures to be used when test results do not agree with predicted signal levels. Action Plan shall include list of the steps to be taken to achieve compliance.

6. The City shall be notified before each test and be permitted to inspect and witness any of the tests or surveys conducted under the Test Plan.

C. Mobile Data System Initial Site Survey:

1. Before build out, assess the existing noise floor in the unlicensed and licensed bands between 2.4 and 5.8 GHz over the area of proposed current and future City transit operations.

2. Perform and provide spectrum analysis plots of frequencies to be used in the MDS.

3. Perform interference measurement to assess the levels of RF noise and interference in the frequency bands of operation (e.g. co-channel interference).

4. Perform tests to assess potential out-of-band band interference in the unlicensed bands of 2.4 and 5.8 GHz over the area of proposed current and future City transit operations (e.g. adjacent channel interference), including but not limited to US Army and US Navy radar and other microwave stations.

5. Characterize the RF path under the proposed City transit alignment including curves and vertical height changes to determine the beamwidth of antenna necessary to achieve at least 25 dB S/I (signal to interference) levels at all times along the elevated guideway.

6. Access line-of-sight vs. non-line-of-sight radio path environments for antenna placement and coverage planning purposes.

   a. Document how the presence of buildings, poles, lights, and foliage and any reflective services along the proposed guideway shall affect planned placement of trackside antenna.

   b. Document grounding and lightning arrestor requirements including site placement of RF system ground rods or ground mats, as necessary.

7. Provide a formal report including a detailed map of potential interference zones over the area of proposed by current and future City guideway transit operations.

8. Provide a mitigation analysis describing how any RF impairment shall be overcome in the proposed final design.

D. Mobile Data System Final Report and Coverage Maps:

1. As part of the Final Report submission contractor shall provide composite coverage maps using tiles or radial studies over the area of proposed current and future City transit operations.
   a. Use commercial grade state-of-the-art RF simulation software tools to perform all coverage map simulations for the MDS and the Private WLAN subsystems.
   b. Clearly document all RF engineering assumptions and propagation models to be used in the analysis.
   c. All simulations shall be run using actual pattern data from the vendor of the same commercially available antenna that will be deployed as part of the trackside wireless network or the Yard WLAN respectively, which shall be imported into the simulation software to provide the most realistic simulation possible.

2. Results of study shall include a detailed signal strength map of proposed coverage areas for current and future City transit operations. Coverage maps shall be generated using the latest 30-meter terrain database and colored coded as follows:
   a. Green: Denote tiles that maintain a 25 dB or greater S/I for at least 9 percent of the Designated Coverage Area (DCA).
   b. Orange: Denote tiles denote tiles that maintain an S/I below 25 dB but above 20 dB for at least 95 percent of the DCA.
   c. Red: Denote tiles that have 20 dB S/I or below for at least 95 percent of the DCA.
   d. NOTE: System Coverage Requirements including Coverage Area definitions are further detailed in Article 1.08 herein.

3. Maps and simulations shall utilize commercially proven and available microwave RF simulation software (e.g. Comsite Design, SoftWright TAP).

4. State in the coverage report all RF engineering assumptions made including the propagation models chosen and the terrain database used to generate the coverage maps.

5. Tests and analysis shall be completed to determine the Effective Isotropic Radiated Power (EIRP) for a given combination of radio transceiver, frequency and antenna does not exceed FCC provisions for unlicensed band operation under FCC CFR 15.203: Part 15 for Intentional Radiators.
   a. Under no circumstances shall the vendor permit testing operations to occur that violate the power limits specified by the FCC CFR 15 for unlicensed band operation.

6. All work products shall be able to be printed and imported into MS Word documents.

7. All propagation maps shall present graphical results for coverage shall be exportable to shape file format supporting ESRI software.

8. Submit certification that the system antenna and transceiver equipment meets the requirement of FCC CFR 15.204: Part 15 Complete System Requirements.

9. Submit test results to verify that the integrity, design, and resistance of RF ground systems to meet a 5-ohm or better resistance value.

10. Submit test results to verify the integrity of all lightening protection systems to meet manufacturer RF antenna system impedance requirements and comply with all applicable IEEE standards.

E. Enhanced Digital Access Communications System (EDACS) Trunked Radio Traffic Load Study for Installed City Portable and Mobile Units:

1. Verify that the addition of three new talk groups and 125 portables and mobiles will not adversely affect current users of the City of Honolulu's 800 MHz trunked EDACS system.

2. Use commercial grade industry-accepted simulation models for call loading using Erlang C-based calculations.

3. Generate a probability that calls from the new work groups loading the system will not exceed the desired call queue delay of not more than 2.5 seconds.

F. EDACS Trunked Radio Current Coverage Study for City Mobile and Portable Units:

1. For 800 MHz EDACS system results shall detail areas where there is a 95 percent or greater probability of least a 3.4 Delivered Audio Quality (DAQ) as described in TSB-88B referenced in Article 1.03 herein.

   a. These areas shall be color-coded as green on coverage maps.

2. Reports shall clearly document all radio engineering and terrain and propagation assumptions made in the analysis.

   a. Create with a digitized terrain database of 30-meter data points.

3. NOTE: System Coverage Requirements are further detailed in Article1.08 herein.

G. 800 MHz EDACS Coverage Study for Proposed City Alignment:

1. Provide Composite Coverage using of tile or radial studies over the desired coverage areas.

2. Work product should be able to be printed and imported into Microsoft Word documents.

3. Propagation maps shall present all graphical results for coverage and be exportable to shape file-formatted files supporting ESRI software.

4. Reports shall document all radio engineering and propagation modeling assumptions made in the analysis.

H. Maintenance Shop and Yard Wireless Data Coverage Analysis:

1. For Private Yard and Maintenance Shop area, WiFi system shall detail areas for which there is at least a 95 percent or better chance for a 250 Mbps data throughput at corrected bite error rates (BER) of 10E-6 for an 802.11N WLAN system operating in the 5 GHz unlicensed band.

2. Provide point-to-point link budget with system margin of at least 25 dB.

3. Work product shall be able to be printed and imported into Word documents.

4. Propagation maps shall present all graphical results for coverage and be exportable to shape-file format supporting ESRI software.

5. Provide Composite Coverage using tile or radial studies over the desired coverage areas.

6. NOTE: System Coverage Requirements is further detailed in Article 1.08 herein.

I. Handset and Mobile performance under MIL-STD-810F environmental tests including:

1. High Temperature (both storage and operating)

2. Rain

3. Humidity

4. Salt Fog

5. Sand and Dust

6. Leakage

7. 1 meter drop tests

J. “Manufacturers Federal Communication Commission Declaration of Conformity Statement” documenting that any wireless systems operating in unlicensed bands are certified as a complete system as defined under FCC CFR 15.204.

K. Shop Drawings: Indicating actual device placements, rack elevation drawings, number and type of wires and cables between RF devices, equipment mounting details, power requirements, data circuit requirements, equipment names and equipment location, and site and building floor plans showing conduit size and routing, spare and slack cable lengths, and location.

L. Point-to-point wiring diagrams for WLAN Access Point (AP) devices indicating WLAN to LAN interface connections, type of connections, and other information necessary to make final terminations;

1. Mobile Data Radio Communications System Product Data: Submit equipment lists and manufacturer data for the following: System descriptive information and product data sheets

2. Work stations display layouts and control arrangements

3. OCC EDACS Radio Dispatch Unit: layouts and controls arrangements

4. Trackside wireless nodes equipment manual and installation documentation

5. Wi-Fi Yard WLAN controller: display layouts and control arrangements

6. Antenna specifications and manufacturer’s elevation and azimuth power patterns at the frequencies of operation

7. Antenna vendor installation manuals

8. Product specifications involving alarm monitoring and alarm notification features of Wireless Nodes and APs

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, configure, test, install and commission all the Wireless Communications Systems to conform to the requirements of the approved General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in 1.03 of this document.

B. The Contractor must employ factory-trained service personnel with a minimum of 5 years experience in servicing RF related equipment.

C. Provide initial system provisioning and additional system provisioning as City guideway segments are built out.

D. Provide complete System Integration tests and submit results.

E. Comply with the following:

1. RF and cabling safety standards
2. Antenna grounding for RF data systems
3. Lightning protection standards for elevated antenna structures
4. Manufacturer's recommendations and applicable codes and standards
5. FCC requirements for Exposure to RF Radiation as cited in Article 1.03 herein
6. All applicable standards quoted in Article 1.03 herein

F. Comply with all testing provisions outlined in Article 1.06 herein.

G. All optical splices made as part of the WCS as specified herein, shall be of the fusion type. Mechanical splices are expressly forbidden under this Contract.

1.06 MOBILE DATA SYSTEM

A. The MDS shall provide revenue-vehicle-to wayside-communication in order to support the following performance requirements:

1. Operations Control Center (OCC) personnel shall be able to transmit pre-recorded and ad hoc Variable Message Sign (VMS) and PA announcements to any vehicle running on the alignment at any time of day using the MDS.
2. On command from personnel at the OCC, selected cameras onboard moving vehicles shall be able to transmit for view at the OCC on-command live video feed from the selected cameras.
3. The MDS system shall permit the transmission of live video feed from any camera or group of cameras in the transit consist.
4. The MDS system shall permit the activation of real-time CCTV images from onboard cameras any time a passenger presses the T-TEL emergency communications button.

a. At least two of the CCTV cameras closest to the T-TEL button shall be activated.

b. Multiple views shall be made available on command from the OCC.

5. The radio transmission shall provide dedicated bandwidth to support 4CIP MPEG4 video at 15 frames per second (fps) with and end-to-end real-time video delay of no greater than 2.0 seconds.

6. The CCTV system shall be provisioned using virtual private LAN (VLAN) and hard Quality of Service (QoS) to provide a guaranteed bandwidth of 3.0 Mbps per camera for MPEG-4 CIF-4 15 fps video.

7. The MDS shall be designed to support minimum latency and jitter requirements as specified in Section 27 90 01 – CCTV System.

8. The MDS shall be designed to support the minimum latency and jitter requirements as specified in the VoIP Telephone Technical Requirements (Section 27 30 01– Telephone Systems).

9. The MDS shall support the continuous recording of video feeds from all cameras regardless if these feeds are being transmitted over-the-air.

10. There are no requirements for continuous RF video streaming from all cameras at all times.

B. MDS shall consist of the following:

1. Car-borne mobile data LAN and Wireless Transmission Module

2. Trackside Wireless Nodes that contain the guideway mounted radio transceiver subsystem at wireless APs

3. UPS power to Trackside Wireless Nodes (by Core Systems Contractor)

4. Ethernet Managed Edge switch to convert RF subsystem data traffic to 100BASE-FX Ethernet suitable for transport over single-mode fiber optic drop cables

5. Fiber Distribution Panels (FDP) to provide fiber optic drop cable access terminations to the nearest passenger station network node

6. NEMA and RIA 20 complaint enclosures to house the radio transceiver, FDP, and Ethernet Managed switch subsystems

7. Antenna that support two frequency bands at 2.4 GHz and 5.4 GHz unlicensed or whatever licensed spectrum the City acquires for this purpose

8. Antenna poles, RF connectors, cables, grounding, lightning arrestor, and associated mounting and terminating hardware

C. MDS shall support multi-channel multiband operation in the 2.4 GHz and 5.8 GHz public unlicensed bands. Support for licensed band operation shall be provided if the City obtains such licenses.

1. Equipment shall support plug-and-play insertion of multi-channel RF cards in 2.4 and 5.8 GHz bands.

2. RF equipment shall support the full power consistent with the FCC rules for these bands.

3. In the event that the City acquires licensed spectrum for the MDS, the system shall support operation in those licensed frequencies at the maximum power levels designated by applicable FCC rules.

D. MDS shall provide VLAN tagging of separate application streams to maintain separate guaranteed Committed Information Rates (CIR) for each service. The MDS shall map client device QoS categories to internal 802.1p user packet priority. Minimum CIRs for MDS services shall be as follows:

1. CIR for Video shall be at least 15 Mbps per transit vehicle consist or 3 Mbps per camera

2. CIR for Push-to-Call (T-TEL) system shall be at least 64 kbps per transit consist

3. CIR for passenger information VMS shall be at least 64 kbps per vehicle

4. CIR for PA system shall be at least 64 kbps for each vehicle

5. CIR for Train Health and monitoring shall be at least 64 kbps per vehicle

6. CIR for Train Control Systems shall be at least 64 kbps per vehicle

E. Future Support for Other IP-based Applications and Scalability:

1. The wireless system shall be transparent to standard TCP/IP based applications such as email and web browsing, including VPN operations.

2. System shall be designed in such a fashion that adding additional applications based on open and industry accepted IP network protocols shall be seamless and not require MDS network modification, upgrade, or redesign.

3. Addition equipment shall be supported on the Wireless Network with a minimum of provisioning by adding IP addresses to the MDS Network Management System (NMS) database.

4. Operation of new applications shall have their own secure VLAN within the MDS communication network

5. Bandwidth and QoS metrics shall be able to be implemented by Train Control systems without disruption of services for any other existing communications system on the MDS. Any excess bandwidth bursts by other systems shall not disrupt the minimum guaranteed bandwidth and latency requirements assigned to Train Control communications system.

F. Handoffs in the MDS:

1. The MDS shall be designed capable of supporting automatic mobility management and handoff operations (train-to-trackside) between adjacent wireless nodes as trains move along the entire length of the elevated guideway.

2. Handoffs shall be supported at speeds of up to 65 miles per hour so that transmissions shall be switched from one wireless AP to the one with the strongest

radio signal such that the vehicle communication system will not experience latency or loss of data exceeding 100 milliseconds in length.

a. System shall demonstrate robustness and recovery from any data lost due to handoffs along the alignment at normal operating vehicle speeds.

3. Handoffs between wayside wireless nodes shall be designed to maintain minimum S/I levels to support a radio channel with low delay and jitter to maintain 4 CIP MPEG4 video at 15 fps per camera when live feed CCTV is required.

4. Handoffs shall not result in dropped calls or disruptions of service to the T-Tel train based voice emergency telephone system.

5. Handoff shall not result in a loss of normal OCC control and command of the Passenger Information System (PIS) or the CCTV monitoring system as described herein.

6. Handoffs shall not result in the disruption of normal Train Control functions including but not limited to the following:

a. Automatic Train Protection (ATP)

b. Automatic Train Supervision (ATS)

c. Automatic Train Operation (ATO)

G. Operational Compliance and Interference Immunity:

1. The MDS shall be capable of operating in the presence of EMI caused by nearby third rail traction power and rail switching systems.

2. The MDS shall not cause harmful interference to or compromise train signaling systems operating on the guideway.

3. The MDS shall comply with FCC CFR 15.204 requirements to ensure that the system is deployed as a complete system without unauthorized power amplifiers and other equipment that may cause FCC radiated power limits to be exceeded.

4. Comply with IEC 60096 standard radio-frequency cables or superseding standard.

5. MDS shall support future migration to 802.11N standard in the 4.4-GHz unlicensed band.

H. In-train Push-to-Talk Call Box (T-TEL):

1. Passengers shall be able to initiate an emergency full-duplex voice call between the vehicle and the OCC within 2 seconds of depressing a push-to-call button located at the box.

2. Connection shall be direct dial-down to the OCC without any intervening need for a dial or access codes by the passengers.

3. Calls by passengers on the T-TEL system to any destination outside the City system shall not be permitted.

4. OCC personnel shall have the capability to directly connect the caller to 9-1-1 call handling center while either remaining on the call (conferencing) or dropping out of the call.

5. Location of the passenger's vehicle shall be reported automatically while the call is in progress and shall be displayed on the appropriate operator's screen or terminal.

6. The system shall maintain a record of all push-to-call T-TEL calls, which shall include a digitally archived recording of the both sides of the conversation and a time/location stamp as to when the call was made and which vehicle it was made from.

I. MDS Wireless Security:

1. The MDS shall support full 128-bit encryption using WPA2.

2. Shall be upgradeable to new 802.11i encryption standards including the Advanced Encryption System (AES) and TKIP/WPA2.

3. Employ a digital spread spectrum RF modulation format to prevent casual eavesdropping and resists deliberate or malicious interference.

J. MDS shall provide continuous monitoring and vehicle health data from the moving train vehicles as defined in the Passenger Vehicle Technical Provisions.

K. Data backhaul from wayside wireless nodes shall be by means of a fiber optic drop cables from each trackside wireless node back to the main optical switch node at the closest Passenger Station.

1. The MDS Radio transceiver subsystem shall permit direction interface with a 1000Base-Fx Gigabit optical fiber Ethernet link at the guideway. Separate media conversion boxes shall not be employed.

2. The radio transceiver subsystem shall provide for the interface and termination of the backhaul traffic on a 12-strand fiber optic drop cable without the need for separate FDPs at the trackside wireless nodes.

3. Two fiber strands shall be used for full duplex data communications and four stands shall be terminated as spares.

L. MDS Support for Train Control:

1. Available vehicle-to-wayside bandwidth and frequencies shall be provisioned for use by Train Control to include ATP, ATO, and ATS operations.

2. Where an open public communication medium such as 802.11a/b/g/n is utilized for any vital ATP functions, a comprehensive RF site survey shall be performed to evaluate potential interference by other users of that band including but not limited to co-channel and adjacent channel users operating on the same system or on nearby systems.

   a. Such testing shall be done as described as a submittal described in Article 1.04 herein.

3. Refer to Section 34 44 00 – Train Control System, for details and provisions concerning operation and technical provisions.

4. Train Control operations that utilize the MDS shall be provisioned as a secure VLAN or equivalent within the overall MDS system.

a. Train Control data shall be switched to the appropriate Train Control servers as outlined in Section 34 44 00 – Train Control System.

b. Train Control data latency shall not exceed 500 milliseconds per train control signal packet.

c. Indications from the vehicle shall be received by the central train control facility in not more than 500 milliseconds from the time of transmission.

d. Routing trip train control indications, alarms, and acknowledgements shall not exceed 1.0 seconds.

e. Data rates for the Train Control application shall allow data burst rates of up to 250 Kbps and an average data rate of 64 Kbps.

f. RF Communications reliability shall meet the current accepted industry standard for reliability and availability.

g. The Core System Contractor shall be responsible for the system availability at train speeds of up to 65 mph along the entire alignment.

1.07 MAINTENANCE YARD AND SHOP WIRELESS DATA SYSTEM

A. General:

1. The Maintenance Yard and Shop Wireless Data System shall be deployed at MSF and another other vehicle storage and service locations and shall have the capability to deliver 5.0 GHz 802.11N encrypted WLAN service to areas within the Shops and Maintenance Yard at system data rates of up to 145 Mbps.

2. The purpose of the system is to allow maintenance and service operations and data downloading on vehicles not in revenue service to be conducted in the outdoor areas of the shops, maintenance and storage facilities.

3. The Yard WLAN shall be a data and video system only. There are no requirements to support real-time voice services over this network.

4. Maintain system-wide data latencies and jitter requirements at 500 microseconds (maximum).

5. Provide 100 percent coverage of Yard, Storage, and Shop areas such that there will be a probability of at least 95 percent of achieving Signal-to-Interference Ratios (S/I) sufficient to support minimum data rate of 145 Mbps at a corrected BER of 10E-6 over the RF link.

6. Design to prevent unauthorized tampering with the power or antenna interfaces that would result in the system exceeding allowable system power requirements under FCC CRF 15 and other applicable safety regulations.

7. Shall be a secure, SSID encrypted and MAC address limited private WLAN.

8. Shall be completely protected by a commercial grade firewall from the public Internet or any unauthorized access whatsoever.

9. Enclosures for wireless APs shall be NEMA 4 rated to protect against dust and moisture.

10. FDPs shall be part of the NEMA 4 box to protect fiber splicing that terminates at the APs.

B. Operations:

1. System shall support a Wireless Mobile Router capability and be a wireless extension of the maintenance and storage databases contained on the main MSF maintenance and operations LAN.

2. System shall support the capability to allow the wireless downloading of CCTV video stored on vehicle Digital Video Recorders (DVRs) without having to remove the storage devices from the vehicles or attach cables to the vehicles.

    a. Shall be capable of interfacing with on-vehicle mobile (e.g. wireless) routers to access digital video storage devices and establish a secure wireless VLAN connecting the vehicle's CCTV storage devices to the main CCTV storage servers at the OCC.

    b. Shall be capable of automatic and pre-programmable downloading of data a user-selected off peak-hours without the intervention of City personnel.

3. Shall be certifiable as a complete system as defined under FCC CFR 15.204.

4. Shall prevent any operation in the 4.9 GHz band unless under licensed operation by qualified Public Safety operators as defined in section 90.20 of the FCC rules.

    a. The installation and operation of equipment in the Public Safety band without a documented FCC license granted to the City is expressly forbidden under this Contract.

C. WLAN AP Placement:

1. WLAN AP placement shall be determined under terms of the Contract only after the required pre-deployment site survey described in Article 1.04 herein.

2. APs shall be placed in such a manner to assure compliance with outdoor and indoor MSF Maintenance Yard, Shop, and Storage Facilities coverage requirements and data rates specified in Article 1.05 herein.

3. APs shall be placed to maintain a minimum of 8 inches co-located separation distance from any other FCC-approved outdoor radiating device(s).

4. The AP's co-located separation distance from any 2.4 GHZ and 5 GHz integrated antennas shall be 3.5 inches or greater.

5. AP placement shall comply with applicable FCC RF exposure limits when several APs are transmitting simultaneously.

D. Yard and Shop WLAN Security:

1. Implement at least 128-bit data encryption of the AES as specified in 802.11i standard cited in Article 1.03 herein.

2. Provide system with dedicated channels and configured in such a way that any transmissions from WLAN devices will not interfere with or compromise any other wireless data systems including any wireless train control systems in operation.

3. Guest Services Lockout: Prevent system from granting temporary access that would cause any third party or visiting wireless computer or appliance to have access to the Yard and Shop wireless network domain.

4. Applicable and state-of-the-art security protocols shall be implemented including but not limited to IDS (Intrusion Detection System) and IPS (Intrusion Protection System) functions that detect unauthorized access attempts or malicious denial-of-service attacks.

5. Provide support for IETF's PKIX Certificate and CRL Profile of the X.509 v3 certificate standard, as specified in RFC 3280, commonly referred to as PKIX for Public Key Infrastructure (X.509).

1.08 VOICE RADIO COMMUNUICATIONS SYSTEM (VRCS)

A. General: The City’s existing Provoice 800 MHz EDACS trunked radio system shall be used for the VRCS to support rail MOE, MOW operations, Passenger Station supervision and security.

B. VRCS shall consist of the following:

1. Portables operating on the City’s 800 MHZ EDACS trunked radio system

2. Mobiles operating on the City’s 800 MHZ EDACS trunked radio system

3. Two additional talk groups shall be added which shall include:
   a. Transit Operations Group
   b. MOW and MOE Groups

4. Three Dispatch Control Consoles (including one for OCC, one for Remote OCC (ROCC), and one for backup) shall be furnished for acquiring an EDACS control channel from the existing City system and assigning and establishing radio communications with the portables and mobiles in each of the transit talk groups.
   a. The Dispatch Control facility to include but not limited to the following functionality:
      1) Patching calls to other City agencies as required
      2) Record and archive both sides of the radio communications with the City talk groups
      3) Contacting the City’s existing 9-1-1 PSAPs on behalf of any portable and mobile users that shall require emergency attention

5. Bidirectional RF Amplifier (BDA) and Indoor Radiating Antenna System to assure VRCS indoor coverage in all areas of the OCC and MSF shop and storage areas, as necessary.

C. Furnish and program 75 portable and 75 mobile radios. Portable and mobile units shall be added to the system in accordance with PSOC procedures and recommendations.

D. Handsets and Mobiles shall be fully capable of operation on the City’s existing EDACS 800 MHz system and able to be programmed into new and existing talk groups as required.

1. Handset shall be upgradable to meet APCO PROJECT- 25 standards and all applicable FCC narrowband standards

2. Meet MIL-STD-810F standards

3. Meet City of Honolulu frequency rebanding plan

4. Meet humidity to 95 percent non-condensing

5. Meet FCC Part 15 EN55022 for Class A Equipment

6. Operate in the temperature range of -45 to 145 degrees Fahrenheit

7. Field upgradable to accommodate future data channel communications as other City agencies upgrade to this capability

E. Design, furnish, and install voice radio system consoles and related equipment at the OCC and the MSF, including, but not limited to coordinating the interface between the City voice radio consoles and the existing City voice radio system administered by the Department of Information Technology (DIT).

1. Consoles shall be capable of connecting users of the City Wireless Voice Systems with dispatch personnel at the OCC or off-site control centers.

2. Console shall provide but not be limited to the following functional capabilities:
    a. Windows XP O/S
    b. Over-the-air programming
    c. P-25 digital trunk mode
    d. Patch call capability
    e. Simulselect
    f. Call history (up to forty calls)
    g. Request-to-Talk directly with dispatcher without using talk group radio channel
    h. Tracking modules (allow dispatch to review calls on a particular programmed talk group)

1.09 WIRELESS COMMUNCIATION SYSTEM COVERAGE AREAS

A. For the MDS, the DCAs shall be defined as areas where the radio signal has at least a 95 percent probability of being able to deliver data rates of the following:

1. A 35 Mbps and a corrected BER of 10E-6 at 65 mph mobility

B. For the MSF Shop and Yard WLAN, DCAs shall be defined as those areas where the radio signal has at least a 95 percent probability of being able to deliver data rates of 300 Mbps (Yard AP shared data rate) at a corrected BER of 10E-6 at zero mobility.

C. For purposes of 800 MHz EDACS VRCS the Channel Performance Criterion (CPC) shall be defined as an area of coverage with at least 95 percent probability of achieving a DAQ of 3.4 as defined in TSB-88 Annex A Table 1 and Table 5.

D. The coverage areas for which these performance criteria shall apply are as follows:

1. For MDS: Complete coverage of the area along the entire installed length of the elevated guideway for both tracks running the width of the guideway.

2. For MSF Shop and Yard WLAN:
    a. Complete coverage in any outdoor maintenance yard area where transit vehicles will be in non-revenue operation

b. Complete coverage in any outdoor storage areas

c. Complete coverage in any indoor or in open shop, maintenance or administrative areas

d. Complete coverage in areas where normal non-revenue train vehicle operations would likely occur

3. For VRCS involving Operations and Maintenance Talk Groups:

a. Coverage shall be designed and engineered to provide a probability of 95 percent for DAQ of 3.4 or greater as described in TIA Technical System Bulletin (TSB)-88B over of the following coverage areas:

1) Within an area of at least 1 mile radius from the center of the elevated guideway

2) Beneath the elevated guideway

3) Inside all Maintenance areas, shops, and MSF storage areas including all outdoor areas associated with those facilities

4) Inside the OCC and the Maintenance OCC

5) Inside all Passenger Station platforms, mezzanines, and street level areas

6) Within an area of at least a 1-mile radius from all passenger stations

7) Inside Traction Power Substations and Gap Breaker Stations

8) Inside all Blue Light Stations

9) Inside all revenue train vehicles operating along the entire guideway

10) Inside all non-revenue train vehicles

4. Coverage for the 800 MHz EDACS VRCS shall be from existing City radio tower sites.

5. Coverage simulations and mapping shall be conducted as detailed by Article 1.04 herein.

6. Contractor shall be responsible for surveying existing coverage and adding such equipment to maintain the maximum EDACS system-wide call queue delay of not more than 2.5 seconds.

a. Traffic load shall be computed using Erlang-C tables specifying this maximum allowable delay.

1.10 SYSTEM AVAIABLITY

A. The Wireless VRCS installed and added to the City’s existing EDACS system shall have the following availability:

1. Mean Time To Repair: Equal or superior to City’s existing EDACS emergency radio system.

2. Mean Time Between Service Failures: Equal or superior to City’s existing EDACS emergency radio system.

3. Mean Time Between Failures: Equal or superior to City’s existing EDACS emergency radio system.

PART 2 – PRODUCTS

2.01 WIRELESS COMMUNICATIONS SYSTEM

A. The WCS will be comprised of the following major elements:

1. The Mobile Data Subsystem (MDS)

2. Maintenance and Storage Facility (MSF) Yard and Shop Private Wireless Local Area Network (WLAN)

3. The Voice Radio Communication System (VRCS)

4. A Global Positioning System (GPS)-based Timekeeping System

B. The MDS to support real-time vehicle-to-trackside communications in radio frequency (RF) spectrum using unlicensed 2.4, 5.8, or 5.9 GHz frequency bands or, alternatively, licensed 2.3, 2.5, or 4.9 GHz bands. The MDS will perform the following functions:

1. Passenger train telephone system (T-TEL) to support full duplex push-to-call emergency communications with the Operations Control Center (OCC) security personnel.

2. On-demand display of CCTV camera during an emergency activated automatically by passenger use of the T-TEL system or on external command from the OCC.

3. OCC controlled Variable Message Sign and Public Address (PA) system to provide real-time passenger information delivery to moving vehicles while in revenue service and to non-revenue service vehicles.

4. Train Control both vital and non-vital.

5. Vehicle health data monitoring and alarms.

6. In-vehicle downloading of CCTV camera data from all cameras whether or not they have been activated for real-time viewing.

C. MSF Yard and Shop Private WLAN will provide the following functions:

1. WLAN for City personnel to interface with wired LAN in order to maintain and update vehicle service records and download critical system information during vehicle Yard maintenance intervals.

2. High-speed Wireless data system to offload CCTV video images from the on-vehicle Digital Video Recording system to a central mass storage server located at the OCC.

D. The VRCS will provide the following functions:

1. Provide City personnel for field mobile and hand-held portable devices to conduct Maintenance of Way (MOW) and Maintenance of Equipment (MOE)

2. Wireless voice access to other City agencies as determined by the City's Public Safety Oversight Committee (PSOC) procedures and recommendations

3. Tactical and emergency communications for security purposes as determined by the City's PSOC procedures and recommendations

E. A GPS-based timekeeping system to provide system wide timing and synchronization for Train Control, CCTV, and SCADA message time stamping.

F. The Work involves:

1. Site surveys
2. System and component design
3. Design review and approval
4. Manufacture and delivery of material and equipment
5. Installation and construction
6. Optimization, acceptance testing, and commissioning
7. Spares, documentation, training, and warranty

2.02 MOBILE DATA SYSTEM (MDS) TRACKSIDE EQUIPMENT

A. Trackside Wireless Node Subsystem:

1. 802.11 a/b/g Wireless Access Nodes are designed to transmit signals to and receive signals from the transit vehicle(s) while in service on the elevated guideway.

2. The Trackside Wireless Node shall include:
   a. All the electronics and RF receiver/transmission equipment to operate in an 802.11 a/g protocol to send a receive data/voice and video signals from the moving vehicle
   b. Media Conversion to fiber optic Base100-FX
   c. NEMA 12 compliant enclosure
   d. All fiber terminating panels for heat fusion splicing
   e. Antenna and RF connectors, lightning protection, and ground hardware
   f. All mounting hardware required to secure the system under the tracks of an elevated guideway

3. Protection against Moisture and Dust Ingress:
   a. The equipment shall be adequately sealed to minimize the effects of dust pollution particularly that of the carbon and metallic dust prevalent in railways.
   b. The equipment shall comply with the IP 55 rating.

4. Protection against Heat: The electronic equipment will not be forced air-cooled; therefore, it shall be able to operate at an ambient air temperature up to 145 degrees Fahrenheit at 100 percent condensing humidity without the use of fans.

5. Shock and Vibration:
   a. The Trackside Radio Node equipment shall be protected from damage or reliability degradation due to the shock and vibration.
   b. The Trackside Radio Node equipment shall operate without vibration and with the least practicable amount of audible noise.

c. The Trackside Radio Node equipment shall withstand a shock and vibration level of Railway Industry Association, RIA 20, Category 1.

B. Trackside and Guideway Mounted Antenna Including:

1. Antenna that supports two frequency bands at 2.4 GHz and 5.4 GHz unlicensed or whatever nearby licensed spectrum the City acquires for this purpose

2. Poles, cables, grounding, lightning arrestor, and associated mounting hardware

3. All RF connectors, cabling, and terminating hardware including antenna grounding and antenna vendor approved lightning arrestor system

C. Wayside RF Radio Transceiver shall internally accommodate a radio-data-to-100BASE-Fx interface to the single mode fiber optic drop cable.

1. This interface shall permit a direct fusion spliced connection to the wayside fiber optic drop cable without the need to install additional external media gateways at each wireless node.

2. Shall accommodate the termination of 24-strand single-mode fiber optic drop cable to be used as data backhaul to the optical switched network nodes at the Train Control and Communications Room at Passenger Stations.

3. Shall be expandable to up to 100 percent (2 times) that capacity for future use.

4. Shall remain operational at humidity levels of up to 100 percent condensing.

5. Shall be IP66 compliant.

6. Provide all necessary fiber optic equipment required to complete this interface including any FDPs, splices, jumper cables, grounding, and terminating hardware to connect with the fiber optic drop cable back to passenger station optical node points.

   a. Shall procure and install FDP on each Wireless Node if not already integrated in the radio transceiver subsystem. Shall be NEMA 12 / IP66 compliant

   b. Shall employ fusion splice only and utilize pre-provisioned fiber optic connectors on pigtails to FDP bulkhead

   c. Shall be accessible from outside the elevated guideway without interfering with revenue service operations

   d. Shall support the use of fiber optic SC or LC low form factor optical connectors

D. SCADA Interface for Wind Speed Indication at Selected Trackside Wireless Nodes.

1. There shall be ports located on the Wayside RF Radio Transceiver that shall accept a digital SCADA signal to determine wind speed at selected antenna/pole locations and multiplex the wind speed indications using the available fiber optic drop cable associated with that particular trackside location.

2. The interface shall allow the use of two fiber strand pairs not associated with the MDS transmission to be used to transmit the SCADA data from the wind speed device back to the Passenger Station Optical Switching Node.

E. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and implementation of the Wireless Communications System.

2.03 RADIO FREQUENCY (RF) ANTENNA FOR MOBILE DATA SYSTEM

A. Antenna shall be designed to permit maximum concentration of maximum allowable signal energy down the elevated guideway and permit handovers as vehicles move along the elevated guideway.

1. Design and deploy such that the RF signal quality shall be maintained at all times as the vehicle moves down the guideway at speeds of 65 mph.

2. Design and deploy to permit system handoffs as described in Article 1.06F herein, such that the vehicle communication system will not experience latency or loss of data exceeding 50 milliseconds.

3. Antenna shall be positioned no closer than 6.56 feet direct and unobstructed distance from any human body and conform to FCC CFR 47 Section 1.1307: "Exposure to Radio Frequency Transmissions and to FCC Bulletin OET-65 C: Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".

B. Separate antenna shall be provided to support operation in the 2.4 GHz and 5.4 GHz unlicensed bands or whatever licensed spectrum the City acquires for this purpose.

1. Each band shall have it own set of antenna which shall be optimized for operation in that particular frequency band.

2. Maximum Antenna Gain shall be 8 dBi for 2.4 GHZ operation and 17 dBi for 5 GHz operation or consistent with maintain EIRP requirement under FCC Part 15 rules.

C. Antenna shall be 50 ohm impedance and be matched to provide for VSWRs of 1.4 or lower.

1. Antenna for each frequency band at with antenna gains, horizontal and vertical beamwidths to accommodate and optimize to met the required 100 percent coverage of all vehicles operating on the entire length of the elevated guideway.

2. Antenna systems shall be designed and deployed in accordance with maintaining data throughputs, corrected bit error rates and minimum handoff times specified in Article 1.06 herein.

3. Antenna connectors shall be N type RF connectors.

4. Antenna shall be sectorized whenever possible to direct the maximum allowable RF signal power to the DCAs while minimizing interference to other radio-based transit systems.

   a. Specific antenna gains shall match to system needs in such as way as not to exceed effective power limits under FCC Part 15 rules

   b. Absolute maximum allowable antenna gains for all APs shall be:

Frequency Band	Antenna Type	Maximum dBi Gain
2.4 GHz	Omnidirectional	8 dBi
5 GHz	Omnidirectional	7 dBi
5 GHz	Patch	17 dBi

D. Antenna shall be equipped with all RF filters necessary for the optimizing the performance and minimizing co-channel, adjacent channel, and stray RFI interference as determined by the initial site survey.

E. Trackside Radio antenna shall be mounted on 15-foot poles 4 inches in diameter (or equivalent) poles at placed on the guideway a places determined in advance by the initial coverage survey.

1. Antenna shall be installed on the elevated guideway walkway in such a manner to ensure at least 30-inch clearance from areas where passengers may walk.

2. Walkway antenna shall be located in such a manner to utilize pre-existing knockouts for transmission and power cables.

F. MDS Antenna Cabling Connectors:

1. Antenna coax shall exhibit loss of no more than 3.0 dB per 100 feet at 5.0 GHz or 1.5 dB per 100 feet at 2.4 GHz.

2. Antenna RF cabling shall be installed and dressed in such a manner as not to expose cable to damage from prolonged transit vehicle operations and in such a way to not exceed manufacturer's cable bend radius.

3. RF connectors shall all be Type N and installed in such a manner to withstand without degradation in RF performance vibrations for transit vehicles moving at speeds up to 65 mph on an elevated guideway.

4. All mounting hardware, brackets, tie-downs, and supports necessary for installation shall be supplied by the Contractor.

5. RF signal, power and grounding cable, and optical fiber terminations and their associated connectors shall be supplied by the Contractor.

G. Wayside Antenna Mounting Poles:

1. Antenna mounting pole shall be provided by the Core Systems Contractor as part of the wayside MDS.

2. Mounting shall be on the outside of the elevated guideway by means brackets or other suitable mounting hardware.

3. Holes for antenna cabling and power and fiber optic drop cables shall be drilled in the appropriate manner in coordination with the guideway contractor.

4. Poles shall non-corrosive, 4 inch tapered, 15 feet in height with hollowed interior to allow RF transmission cable to travel up to the antenna structure.

5. Antenna shall be affixed to pole in a manner consistent with antenna manufacturer's requirements and best RF system installation practices.

2.04 ANTENNA FOR MSF YARD AND SHOP WIRELESS DATA SYSTEM

A. Antennas for the Yard Wireless Data System shall be designed to provide coverage of 100 percent over the designation coverable Yard and Shop areas including indoor work areas where maintenance and operations personnel will be working.

B. Directional antennas shall be employed where necessary to keep the WLAN RF signal confined as much as possible within City property and prevent possible eavesdropping by external unauthorized users.

C. Antenna for the MDS shall provide 100 percent coverage for transit vehicles operating on the elevated guideway.

D. Indoor Radiating Antenna for ONS and OCC Offices and Shops:

1. Coverage field studies shall be completed to assess the need for an indoor antenna system to provide 800 MHz EDACS voice coverage to mobiles and portables where the outdoor radio system shall not be strong enough to penetrate.

2. If a 95 percent probability DAQ 3.4 call quality or better cannot be maintained in those indoors areas, an indoor radiating coax antenna system shall be designed, procured, and installed.

3. Elements of this indoor antenna system shall be:
   a. Outdoor capture antenna
   b. BDA
   c. Fiber Optic transmission cable
   d. Indoor antenna

2.05 VOICE RADIO SYSTEM ANTENNA

A. OCC Radio Dispatch Antenna: Andrew/Decibel DB810EPS 746-869 MHz, 10 dBd gain omnidirectional, 7/16 DIN (F), vertical or similar

B. Roof-Mounted Indoor Repeater Antenna (if required): Andrew/Decibel DB810EPS 746-869 MHz, 10 dBd gain, omnidirectional, 7/16 DIN (F), vertical or equivalent

2.06 ANTENNA SYSTEM GROUNDING

A. All wayside wireless nodes and antenna shall have proper grounding consistent with established and acceptable RF standards for equipment operating in the 2.4 and 5.9 GHz frequency bands.

B. Ground shall be designed to optimize antenna RF patterns and coverage.

C. Grounding shall be by means of the guideway vertical structure. Each trackside wireless node shall have its own grounding cable and ground rod or net that shall be independent of the stray current ground grid on the guideway deck or the traction power ground system.

D. Communication signal and RF grounds shall present an ohmic resistance of 5 ohms less when measured using standard ground resistance procedures. (See Motorola R-56 ground specifications.).

E. Grounding shall conform to all NEC requirements.

F. Vehicle Mounted Antenna for MDS:

1. Vehicle Antenna shall be provided by the vehicle Contractor.

2. It is highly desirable that vehicle antenna design be closely coordinated with the design of the trackside wireless node antenna systems and that antenna patterns be optimized to match that of the trackside node antenna.

G. Lightning Arrestors:

1. Each antenna in the wireless system shall be provisioned with a lightning arrestor.

2. Lightning arrestors shall meet or exceed IEEE requirement to trigger a path to ground in less than 8 microseconds.

3. Frequency response of lightning arrestors shall be at least 3 GHz for 2.4 GHz RF operation and at least 6.0 GHz for 5 GHz RF operation.

4. Impedance of the arrestor shall match the antenna subsystem (e.g. 50 ohms).

5. Arrestor connector type shall match the ones on the RF system being used.

6. Insertion loss shall be 0.1 dB or less.

H. MDW Antenna Operation and Survivability:

1. Remain operational at wind speeds of up to 100 mph.

2. Remain survivable at wind speeds of up to 160 mph.

I. All trackside antennas shall be installed in such a manner to permit normal maintenance and servicing to be conducted from the street without radio system maintenance personnel being on the guideway and without disruption of City revenue service operations.

J. Onboard vehicle antenna shall comply with requirements for the in-vehicle wireless transceiver subsystem.

2.07 VOICE RADIO COMMUNUICATIONS SYSTEM (VRCS)

A. Propose, design, and install a VRCS complete and Furnish and program 75 portable and 75 mobile radios. Portable and mobile units shall be added to the system in accordance and approval from the City's PSOC procedures and recommendations.

B. Two additional talk groups shall be provisioned within the City's existing Provoice 800 MHz EDACS radio system in accordance and approval from the PSOC.

1. A maintenance group channel with talk priority to be determined by the wireless network system administrator.

2. An operations group channel with talk priority to be determined by the wireless network system administrator.

3. An emergency calls shall be handle by calling the OCC radio dispatcher who shall take further action.

4. All talk groups shall be assigned a priority after consultation with the City's Department of Information Technology.

C. BDA and Indoor Antenna System (Optional):

1. A BDA shall be employed at the Operations and Servicing (ONS) Building if signal levels inside any part of the building, including the Communications Equipment Room and OCC fall below levels necessary to provide the 3.4 DAQ as specified in Article 2.04D.2 herein.

2. An indoor radiating coax network shall be provided to achieve the signal levels specified herein over areas inside MSF buildings that do not receive the desired signal strength from existing City EDACA's towers.

3. Results of field testes as described in Article 1.05F herein, shall be used to determine if an optional BDA and indoor antenna system is required.

4. Conduit for 110V AC power shall be provided to support the BDA. This power shall be UPS protected by battery for 2 hours and thereafter by portable generator.

5. Two omnidirectional outdoor antenna, one transmit and one for receive for 809-850 MHz rebanded City of Honolulu EDACS band shall be provided at a 10 foot vertical separation.

6. A RF duplexer or combiner shall interface the two antennas to provide RF isolation between the transmitter and receiver electronics.

7. Associated radio frequency transmission coax cables from the two desk radios inside the OCC to the outdoor antenna.

D. Voice Radio Communications Operating Consoles:

1. The Operating Console shall intercept the simulcast control channel originating from the City's existing EDACS in order to assign RF voice channels to either operations or maintenance talk groups.

2. The OCC Operating Consoles shall include the following equipment:
   a. Two desk top mounted radios, one to monitor the City transit Operations Talk Group the other to monitor the City Maintenance Talk Group control channels on the City-wide EDACS system
   b. Speakers and headsets
   c. Footswitch
   d. Headset Jack Box
   e. Keyboard
   f. Mouse
   g. Rack mounting for speakers and volume controls
   h. Call-director
   i. Call-check Recorder

E. Computer Platform (PC) for System Console Minimum Hardware Requirements:

1. OX shall be Windows XP

2. CPU Type: Intel© Xeon or equivalent

3. DDR2 SDRAM Memory 400MHz

4. 40 GB SATA 7200 RPM hard drive

5. Hard Drive Access Times: 11 milliseconds or faster

6. 64 MB Video RAM

7. One enhanced parallel port

8. Three expansion PCI slots

9. Power Supply: 120/240 VAC auto-sensing

10. 101/102-key keyboard, 2-button mouse with PS/2 compatibility and mouse pad

F. Handsets:

1. Handsets shall be MA-COM Provoice P7200 or equivalent and shall be dual-band 700 MHz/800 MHz capable

2. Shall be capability to interoperate with existing City of Honolulu equipment

3. Shall be upgradable to APCO EIA P-25 standards as migration to these systems becomes necessary

4. Shall be compatible with all current FCC narrow-banding mandates (e.g. 12.5 KHz) and have a migration path to future FCC narrow-banding requirements (e.g., 6.25 KHz)

5. Shall be upgradable to future FCC data transmission standards for Trunked Land Mobile Systems

6. Shall be capable of over-the-air provisioning

7. Capable of individual radio password protection

G. Chargers and Batteries:

1. Portable chargers

2. Vehicular chargers

H. Carrying and Audio Accessories.

2.08 YARD AND MAINTENANCE AREA WLAN SYSTEM

A. The Yard and Maintenance area WLAN shall consist of the following:

1. Pole mounted wireless APs, which shall both transmit and receive wireless 802.11N broadband data signals from mobile computing devices.

2. Media Converter necessary to interface high-speed 802.11N to 1GigEthernet 1000BASE-FX physical interface for transmission on single mode fiber optic drop cable.

3. A Gigabit Ethernet access switch that meets outdoor specifications.

4. Yard side Local Drop FDP.

5. Fiber Optic Drop Cable specified under by FOCN Section 27 13 01 – Fiber Optic Cabling Network back to OCC LAN Gig Ethernet switch.

6. Multiple Input/Multiple Output (MIMO) antenna configurations to support the maximum over-the-air data transmission speeds (up to 180 mbps).

7. Wireless Network Radio Controller for Wireless Network Management and Security Access Control.

8. All RF transmission and cabling hardware to support light pole mounting including and required streetlight power tap adaptors.

B. Power:

1. APs shall be powered from either POE or Power over Twisted Pair or 220/100 AC power from pole mounted electric lights.
   a. IF POE is selected a Cat6 Ethernet cable shall be outdoor rated with at least a 0.2 inch diameter.
   b. Power Injector shall be provided for POE or power over twisted pair operations.
   c. APs that are powered over twisted pair cabling must use an AWG wire size no. 26 or larger telecommunications line cord.

2. APs shall contain an internal battery backup system or have access to a UPS power source.

3. AP mounted outdoors shall have an AC branch circuit with ground fault protection (GFCI) as required by Article 210 of the NEC.

4. Data backhaul network from the wireless APs to a central LAN server at the OCC.

5. Antenna, mounting poles, RF transmission cables, and associated hardware for wireless APs.

6. Hardware and software for NMS and system configuration.

C. MSC Yard Wireless APs:

1. Support multiple antenna ports for Multiple Input Multiple Output operation under IEEE 802.11N

2. Protection against Moisture and Dust Ingress:
   a. The equipment shall be adequately sealed to minimize the effects of dust pollution particularly that of the carbon and metallic dust prevalent in railways.
   b. The electronic equipment will not be forced air-cooled and shall be able to operate at ambient temperatures of up to 145 degrees Fahrenheit without fans.
   c. The equipment shall comply with the IP 66 rating.

3. Shock and Vibration:
   a. The Trackside Radio Node equipment shall be protected from damage or reliability degradation due to the shock and vibration.
   b. The Trackside Radio Node equipment shall operate without vibration and with the least practicable amount of audible noise.

c. The Trackside Radio Node equipment shall withstand a shock and vibration level of Railway Industry Association, RIA 20, Category 1.

4. AC grounding shall be using an insulated 6 AWG copper ground wire.

5. Separate all omnidirectional antennas by at least 2 feet to avoid receiver damage or at least 25 feet to avoid Packet Error Rate degradation due to receiver de-sensing.

6. Site Survey shall be completed before WLAN system is deployed.

7. Antenna heights shall be set to no higher than that need to achieve line-of-sight radio path to the other wireless APs given the likely position of transit vehicles in the maintenance and storage areas.

8. Provide with a metal enclosure that can accommodate both indoor and outdoor operating environments.
   a. Be operable to a temperature of 145 degrees Fahrenheit.
   b. APs shall comply with NEMA 12 and IP66 requirements for weather and ingress protection.
   c. Support outdoor operation up to 100 percent condensing humidity levels.

9. Remain operation at wind speeds of up to 100 mph and be survivable at wind speeds of up to 160 mph.

10. Maximum RF power shall be 28 dBm connected to antenna.

D. Wireless Access Security:

1. Yard and Shop WLAN shall be designed, provisioned, and maintained as a closed and access controlled private network.
   a. Access to the Yard and Shop WLAN from the public internet shall be expressly prohibited.
   b. Access to the public Internet from the Yard and Shop WLAN shall be expressly prohibited.

2. Wireless Access Security shall be upgradeable to new 802.11i encryption standards specified in 802.11i including the AES and TKIP/WPA2.

3. All wireless communications shall go through a Wireless Access Controller or an equivalent hardware platform.
   a. A wireless controller system shall be implemented such that only the MAC address of the authorized APs deployed in the Shop and Maintenance Yard areas and operated by the City shall be able to gain access to the MSF LAN.
   b. System shall allow low-level Network Administrator access privileges to view MAC address filter list to monitor security compliance. A separate layer of security access shall be required to change this list.
   c. Attempts made to alter MAC address filter or any port part of the security base shall result in immediate alarm and system lockout.
   d. The controller shall only accessed and reachable by these devices and no rogue or third party wireless APs.
   e. Anti-virus and robust network protection software shall be installed, upgraded, and maintained on the system at all times.

4. In the event that an integrated single-source (i.e. vendor proprietary) security database not be provided, a RADIUS Authentication Database shall be required.

5. Conduct a complete security inventory of the installed system that shall document:
   a. Known security flaws, notices, responses, and fixes available from equipment/software vendors.
   b. A Security Test Plan and Summary of Test Results of attempts made to obtain break in and obtain unauthorized access to the WLAN.
   c. Results shall include a description of alarms raised and defensive measures taken by the system in response to detected security attacks.

2.09 NETWORK MANAGEMENT SYSTEM

A. Provide a NMS that permits configuration management, fault reporting, and wireless network management for the following systems:

1. Train to wayside MDS

2. Yard WLAN

3. VRCS

B. Network Management Software shall be developed to conform to the applicable IEEE standards for software development and quality assurance including but not limited to the following:

1. IEEE 720: IEEE Standard for Software Quality Assurance Plans

2. IEEE 1012: IEEE Standard for Software Verification and Validation

3. IEEE Std C37.1-1994 - IEEE Standard Definition, Specification, and Analysis of Systems Used for Supervisory Control, Data Acquisition, and Automatic Control

2.10 MASTER TIME BASE (MTB)

A. This system shall be the master source of time for all communications systems and related devices. The system shall be designed to capture time from the GPS network and distribute time and other reference synchronization signals as required to all communications systems or sub-systems.

1. The distribution network shall be designed with specific interfaces as required for each communications subsystem (e.g. CCTV, SCADA, PA/VMB, Communication-Based Train Control, Passenger Station clocks) referenced to the MTB.

B. The MTB shall be designed to provide a reliable synchronous system-wide time stamp accurate to within 1 millisecond or better for all network devices at all network locations.

C. “System Time” shall be derived from the Network Time (NT) system. A link from the MTB system to SCADA shall transmit the system time information and distribute time signals as required to other interconnected systems. In the event the NT system fails completely, SCADA shall maintain an internal clock to maintain system time until the NT link is restored.

D. The Master Time Base is described in Section 27 90 06 – Network Timing System.

2.11 ELECTROMAGNETIC (EMC) COMPATIBILITY

A. Radio consoles shall comply with IEC 801 Parts 2, 3, and 4 for electronic static discharge (ESD), radiated RF immunity, and power line bursts.

B. Trackside Wireless Access Nodes shall be able to withstand all noise from 750-volt 4,000 amp third rail train operations including gap/arcs at crossovers due to interruption of third rail power.

C. System shall comply with EMC standards outlined in Article 1.03 herein.

2.12 TESTING

A. Notification of CTS System Testing: The City reserves the right to be notified before any major CTS testing in sufficient time to have a representative present for the tests.

B. City shall have unrestricted access to all results of system tests.

PART 3 – EXECUTION

NOT USED

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SECTION 27 80 00

PASSENGER INFORMATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description:

1. This Section includes the requirements to furnish, install, test, and make operational an integrated PASSENGER INFORMATION SYSTEM consisting of the Public Address and Variable Message Sign (PA/VMS) system for the City of Honolulu High-Capacity Transit Corridor Project (HHCTCP) Stations and facilities. The PA system will be extended to the MSF building, yard, and facilities.

2. This Section also includes the PA/VMS system consisting of head end servers, PA zones and VMS controllers, workstations, announcement and message control systems software, pre-amplifier/mixer, power amplifiers, speakers, microphones, Passenger Information System, train information display panels, conduit, cabling, and other communications materials and equipment to provide for a complete and operational PA/VMS system in compliance with all Americans with Disabilities Act (ADA) requirements for both audio and visual messages.

B. Section Includes:

1. Passenger Information System
2. Speaker Equipment
3. Equipment Cabinets
4. Cabling and Connectors
5. Maintenance and Testing Equipment

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications Transmission System
3. Section 27 30 01 – Telephone Systems
4. Section 27 60 00 – SCADA System
5. Section 27 70 00 – Wireless Communications System
6. Section 27 90 00 – Operations Control Center Ancillary Equipment
7. Section 27 90 01 – CCTV System
8. Section 28 13 00 – Access Control System
9. Section 28 36 00 – Seismic Detection

1.02 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment: General: Separate measurement of payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Condition's requirements, or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. The governing version of the listed documents shall be the latest as adopted and administered by the City and County of Honolulu. Included in the following References are standards and codes deemed pertinent to the final design of the system defined herein.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO LTS-5 — Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals"

C. Code of Federal Regulations (CFR):

1. 49 CFR — ADA requirements defined in Parts (37, 38)

D. Electronic Industries Association (EIA):

1. EIA RS-160-51 — Sound Systems
2. EIA RS-174 — Audio Transformers for Electronic Equipment
3. EIA RS-232 — Interface between Data Terminal Equipment Employing Serial Binary Data Interchange
4. EIA RS-276-A — Acceptance Testing of Dynamic Loudspeakers
5. EIA RS-422 — Electrical Characteristics of Balanced Voltage Digital Interface Circuits
6. EIA RS-485 — Electrical Characteristics of Generators and Receivers for use in Balanced Digital Multipoint Systems
7. EIA RS-310-D — Cabinets, Racks, Panels, and Associated Equipment
8. EIA RS-359 — Standard Colors for Color Identification and Coding
9. EIA RS-426-A — Loudspeakers, Power Rating, Full Range

E. Hawaii Occupational Safety and Health Plan

F. Institute of Electrical and Electronic Engineers (IEEE):

1. IEEE 802.3 — 10-100 Base Ethernet

G. Insulated Cable Engineers Association (ICEA):

1. ICEA S-80-576 — Insulated Cable Engineers Association
2. ICEA S1.13 — Methods for the Measurement of Sound Pressure Levels
3. ICEA S1.4 — Specification for Sound Level Meters

4. ICEA S3.5 — Methods for the Calculation Of the Speech Intelligibility

H. International Electrotechnical Commission (IEC):

1. IEC 801-2 Part 2 — Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment
2. IEC 60268-16 — The Objective Rating Of Speech Intelligibility by Speech Transmission Index (STI)
3. IEC 60849 — Sound systems for emergency purposes
4. IEC 62305 — Protection against Lightning

I. National Electrical Manufacturers Association (NEMA):

1. NEMA Publication — National Electrical Safety Code (NESC)
2. NEMA WC63.1-2000 — Performance Standard for Twisted Pair Premise Voice and Data Communications Cables

J. National Fire Protection Association (NFPA):

1. NFPA 70 — National Electrical Code (NEC)
2. NFPA 72 — National Fire Alarm Code
3. NFPA 101 — Life Safety Code
4. NFPA 130 — Standard for Fixed Guideway Transit Systems (2007)

K. Underwriters Laboratories (UL):

1. UL 65 — Standard for Wired Cabinets
2. UL 467 — Standard for Grounding and Bonding Equipment
3. UL 1449 — Standard for Transient Voltage Surge Suppressors
4. UL 1480 — Speakers for Fire Protective Signaling Systems
5. UL 1666 — Standard Test for Flame Propagation Height of Electrical and Optical- Fiber Cables Installed Vertically in Shafts

1.04 SUBMITTALS

A. General: Refer to General Condition requirements for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. The PA/VMS fully equipped, developed, installed, and tested as defined herein.

C. Four fully equipped, developed, installed, and tested PA/VMS workstations plus backup units, including all supporting documentation, as defined herein.

1. The proposed workstations are as follows:
   a. One for OCC Dispatch
   b. One for OCC Backup Center Dispatch

c. One for OCC Communications Room/Temporary OCC

d. One for Maintenance Group

D. A fully developed, installed and tested PA/VMS software, to include a GUI and required hardware, for all workstations in the OCC, including all software keys, licenses, and supporting documentation.

E. A fully equipped, developed, and tested PA/VMS database, populated with all data necessary to meet the functionality specified herein, including all supporting documentation.

F. Complete "As-Built" final hardware drawings and system/software architecture diagrams. The As-Built diagrams shall include a complete material list of all utilized hardware and software components, wiring diagrams, and termination diagrams in hard copy and in electronic format. Text documents shall be in Microsoft Word.

G. Electronic files of all drawings. The submitted drawings shall be in AutoCAD (City latest version) format as per City CAD standards. All blocks developed by the Vendor shall be prepared as per City CAD Manual and shall be approved by the City. CAD files converted from other CAD packages are not acceptable. It shall be acceptable for the electronic files to be supplied on CD-ROM, as approved by the City. It shall be the responsibility of the Vendor to ensure that all the supplied electronic CAD files are free from viruses.

H. Hardcopy and electronic files of all Software Materials.

I. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

J. Shop Drawings: Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in Hawaii, who is responsible for their preparation.

   a. Design Calculations: Calculate requirements for selecting seismic restraints.

   b. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

K. Field quality control reports.

L. Operation and maintenance data.

1.05 ABBREVIATIONS AND ACRONYMS

A. American National Standards Institute (ANSI)

B. National Electric Code (NEC)

C. Americans with Disabilities Act (ADA)

D. Americans with Disability Act Accessibility Guidelines (ADAAG)

E. Electronic Industries Association (EIA)

F. Light Emitting Diode (LED)

G. Variable Message Sign (VMS)

H. Liquid Crystal Display (LCD)

1.06 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test and install the Passenger Information System to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Conditions for Quality Assurance requirements and procedures.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. All electrical components, devices and accessories shall be UL 864 listed, and compliant with NFPA 72 and NFPA 101.

F. Quality Control:

1. Qualifications: The Work shall be performed by a professional Audio/Visual System Contractor who shall provide references upon request to verify that they have experience and abilities with installation of similar systems of this size and complexity.

2. The Contractor shall be an authorized system integrator of the manufacturer's equipment offered. The Contractor/subcontractor shall have manufacturer's training and be certified and factory authorized in the installation of all PA/VMS equipment.

G. Quality of Materials:

1. All materials and equipment supplied by the Contractor shall be new and meet or exceed the latest published specification of the manufacturers in all respects.

2. Reliability Maintainability Availability Criteria:
   a. The systems shall be reliable, and shall provide full functionality in all operational and environmental conditions encountered in the Honolulu Rail Transit stations and the OCC.
   b. Systems shall have a MTBF of greater than or equal to 100,000 Hours.
   c. Systems shall have a Mean Time To Repair of less than or equal to 2 hours.
   d. All main items of systems equipment shall employ a modular construction, and will be designed for field serviceability.

H. Warranty Statement:

1. Provide a statement of warranty on the entire system and on the individual components of the equipment. The system warranty terms and conditions must be as

approved by the City. During the warranty period, provide all replacement equipment, material, and labor at no cost to the City.

2. Provide a 2-hour response time for service calls during the installation and warranty period.

I. Alternate Equipment:

1. Where necessary, provide recommendations for alternative equipment that would enhance the performance and reliability and reduce complexity of the system. Provide cost comparisons for such proposed modifications to the City. Proposer/bidder should clearly identify procurement and long-term cost deltas associated with these alternatives/enhancements.

2. Examine herein, in detail and take responsibility to complete the installation and ensure that performance requirements are met. This applies to alternate equipment and non-alternate equipment.

3. Submit the following to the City for review and approval:
   a. PA/VMS System Layout Drawings
   b. Functional Site Block Diagram
   c. System Integration Plan
   d. System Test Procedures
   e. PA/VMS Installation Plan shall include:
      1) System Wiring Plan.
      2) List of Materials: list proposed manufacturers with model or catalog numbers, identifying the materials and equipment proposed.
      3) Shop drawings.
      4) Product Data Sheets and Specifications.
      5) System Power and Heat Load Calculations.
      6) System Test Reports in accordance with Article 3.06 herein.
      7) Submit samples of any materials for review when requested by the City. Samples shall be sent to the site and stored by the Contractor.

PART 2 – PRODUCTS

2.01 PASSENGER INFORMATION SYSTEM

A. The Passenger Information System shall provide visual information from the PA/VMS system. Signs shall be located on the Mezzanine, Transfer, Platform Levels of the Honolulu Rail Transit Stations and the Rail Cars. Provide samples of each type of sign, with the enclosure and mounting details, for review and approval by the City.

1. All signs shall be a commercially available microprocessor-based unit consisting of the housing and the interior electronics.

2. Each sign shall have an IP input capability and shall be capable of communicating with a host PA/VMS server over the facility Distribution Network device for simultaneous operation with the audio message system. In the event of a loss of

communication, the display should clear until communications is re-established such that old train information should not continue to be displayed.

3. Programmable display effects shall include static, pause, flash, blink, scroll, center, up, down and jump. The speed of the effects shall be electronically and remotely adjustable. Scrolling and other display effects must appear smooth and continuous when observed by the human eye at all available rates of movement. Characters to be displayed shall include the entire 128-ASCII character set along with the selected internal characters and shall support pixel-based graphics. Character size and font shall be configurable. Video graphics can be generated at the server and multicast to the appropriate displays.

4. The sign shall have the minimum memory to contain 80 messages of 80 characters for each message including the display attributes. Multiple fonts shall be available, including but not limited to ADA-compliant aspect ratios, narrow, bold and wide characteristics. Characteristics per message, scroll rates, blink rates; character sizes shall adhere to the ADA guidelines.

5. Communications with each sign shall be by means of fault-tolerant, noise resistant protocol (i.e. TCP/IP, RS-422 or RS-485). Each display shall have the ability to be uniquely addressed, or be addressed by groups. There shall be a minimum of one million unique addresses and 10,000 different addressable groups.

6. All signs shall provide diagnostic information to the VMS zone controller upon power-up when requested, and shall notify the OCC via the PA/VMS server if a failure condition is detected.

7. Each sign shall be capable of being connected to another sign and to the VMS controller connected to the PA/VMS server to allow for synchronization with the audio portion of messages. All displays shall provide positive feedback on every command or request received from the PA/VMS head end servers.

8. All signs shall have a real-time clock that can be set via the Ethernet network. The clock shall be accurate to within one second per month. Each display shall maintain the time and day. Time and day data shall also be maintained during power loss.

9. Shielding shall be used to reduce glare from lighting fixtures. Applicable sign and enclosure shall have anti-glare shielding as required.

10. Each sign shall operate in the range from -22 degrees Fahrenheit to 140 degrees Fahrenheit with humidity ranging from 5 percent to 95 percent non-condensing.

11. Programmable sign effects shall include static, pause, flash, blink, scroll, center, open, wipe, up, down, jump, and time. The speed of the effects shall be adjustable. Characters to be displayed shall include the entire 128 ASCII character set along with the selected internal characters, and shall support pixel-based graphics. Message memory shall be 24 KB, minimum.

12. Communications with each sign shall be by means of Ethernet, RS-422 or RS-485. Each sign shall have a unique address, selectable by an internal dipswitch. There shall be a minimum of 99 different addresses. Each sign shall operate at a communications rate of 9,600 bps minimum.

13. The sign and enclosure shall be UL-listed.

14. Each sign shall be operational between 105 VAC to 130 VAC and be equipped with a disconnect switch for removing ac power for maintenance purposes. Line filtering shall be part of the design to minimize faults due to power line transients.

15. The Passenger Information System shall be synchronized with the Master Time Base (MTB) System from the OCC and Station.

B. General Requirements: The PA/VMS system shall be fully integrated. The audio and visual portions of messages from all sources shall be delivered to designated speaker zones and signs through a single PA/VMS system. PA/VMS message sources include, but are not limited to, the following:

1. Manually selected prerecorded messages stored within a database.

2. Scheduled prerecorded messages stored within a database.

3. Ad-hoc prerecorded messages stored within a database.

4. Live announcements made directly from the Operations Control Center (OCC) microphones (i.e. at console workstations).

5. Announcements made directly from Fire Alarm Control Panels (FACP) microphones.

6. Announcements made directly from two spare microphones interfaces, to be provided in the system.

7. The system should have the capability of expanding seamlessly to include the capability to trigger prerecorded message externally.

C. Description: The PA/VMS system shall be designed, provided, and installed as a complete integrated turnkey system. PA/VMS head-end equipment associated with the OCC shall include but not be limited to servers, switching system, workstations with microphones, and all associated control and management software.

1. The PA/VMS system field equipment shall include but not be limited to PA zone and VMS controllers, VMS displays, power amplifiers, speakers, microphones, monitoring system, racks/cabinets, microphones, and ancillary communications equipment as specified herein.

2. The stations and locations to be equipped with these systems are the following:

3. This Contract is for the installation of a Passenger Information System consisting of a PA system and LCD VMS to include controllers, amplifiers, mixers, speakers, and signage devices for the Honolulu Rail Transit System.

4. The Honolulu Rail Transit System will consist of 21 Rail Stations and one OCC with a backup Center, for 24 Sites/Locations and 60 rail cars.

5. The PA/VMS system shall be ADA-compliant and interface to the Honolulu Rail Transit system Fiber Optic Communications Network (FOCN) for communications between the station sites, the Rail Cars, OCC, Maintenance Control Center, FACP, and Supervisory Control and Data Acquisition (SCADA) system.

6. The Locations where PA/VMS systems are to be installed are as follows:

East Kapolei	Kalihi
UH West Oahu	Kapalama
Hoopili	Iwilei
West Loch	Chinatown
Waipahu Transit Center	Downtown
Leeward Community College	Civic Center
Pearl Highlands	Kakaako
Pearlridge	Ala Moana
Aloha Stadium	Pearl Harbor Naval Base
International Airport	Lagoon Drive
Middle Street Transit Center	MSF/OCC Building/Yard/OCC Backup Center
60 Rail Cars	Park and Ride Lots

7. Other locations where work shall be performed including the Maintenance & Storage Facility (MSF) Building are:
   a. OCC Equipment Room
   b. OCC Operations Room
   c. OCC Communication Room
   d. Maintenance Center
   e. Passenger Information
   f. OCC Backup Center

8. The Work involves but is not limited to the items bellow:
   a. Furnish and install a complete functional turnkey PA/VMS system in accordance with these Specification and all related Honolulu Rail Transit system specification and design criteria.
   b. The system shall have all the features requested herein unless waived by the City and shall operate at all stations and Rail Cars in accordance with herein and to the complete satisfaction of the City.
   c. Site inspections will be required by the Contractor to ensure a detailed understanding of the stations and the Work to be performed.
      1) Detail PA/VMS system design review
      2) Delivery of components and equipment material
      3) Installation of a turnkey PA/VMS system
      4) Optimization, acceptance testing, and commissioning
      5) System documentation, training, and warranty

9. The following diagrams and drawings have been provided for reference in developing the Honolulu Rail Transit PA/VMS system:
   a. Conceptual Honolulu rail Transit PA/VMS Network Block Diagram
   b. Recommended location of VMS drawings for each station and the OCC
   c. Recommended location of VMS drawings in Rail Car

10. Supply and install a complete functional turnkey system that will be ADA-compliant in accordance with the following ADA Guidelines:
    a. Public Address Systems: Where public address systems convey audible information to the public, the same or equivalent information shall be provided in a visual format.
    b. The Audible information must be synchronized with the variable visual message system.
    c. Character Height: Minimum *character* height shall comply with the values in Table 27 80 00 - 1 (ADA Table 703.5.5). Viewing distance shall be measured as the horizontal distance between the *character* and an obstruction preventing further approach towards the sign. *Character* height shall be based on the uppercase letter "I".

Table 27 80 00 - 1 ADA Table 703.5.5 Visual Character Height

Height to Finish Floor or Ground From Baseline of Character	Horizontal Viewing Distance	Minimum Character Height
40 inches (101 than or equal to 70 inches 5 mm) to less (1,780 mm)	less than 72 inches (1,830 mm)	5/8 inch (16 mm)
	72 inches (1,830 mm) and greater	5/8 inch (16 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 72 inches (1,830 mm)
Greater than 70 inches (1,780 mm) to less than or equal to 120 inches (3,050 mm)	less than 180 inches (4,570 mm)	2 inches (51 mm)
	180 inches (4,570 mm) and greater	2 inches (51 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 80 inches (4,570 mm)
greater than 120 inches(3,050 mm)	Less than 21 feet (6,400 mm)	3 inches (75 mm)
	21 feet (6,400 mm) and greater	3 inches(75 mm), plus 1/8 inch (3.2 mm) per foot (305 mm) of viewing distance above 21 feet (6,400mm)

    d. The VMS assembly and structure shall fit esthetically in the Honolulu Rail Transit environment and shall provide easy access to the VMS for maintenance purposes.
    e. Provide drawings and cut sheets of the assemblies and structures for approval by the City.
    f. The VMS assembly and structure shall be capable of supporting static signs attached to the VMS and shall incorporate electrical and mechanical hooks to attached future static signs assembly should the City so directs.

11. Contractor Obligations:
    a. Provide a fully operational PA and VMS system in accordance with the scope of work.
    b. The Contractor's obligations shall include, but not be limited to, the responsibilities in the following list and those required to meet the requirements described herein.
    c. All required surveys of control locations and stations.
    d. All required permissions (permits). The Contractor is responsible to obtain permits well in advance of the need.
    e. Liability for loss of operation and repair for any system that is disrupted during the installation of components of this project.
        1) All hardware, software, and firmware required satisfying the requirements of herein.
        2) Definitive Design Review, Final Design Review, including project scheduling, periodic project meetings, design review meetings, required technical meetings, conference calls, and periodic project reports documenting progress during the Contract period.
        3) Quality Assurance/Quality Control plan, schedule, documentation, Quality Assurance and Quality Control.
        4) Providing required statement of work to the electrical contractor for the running of power, communications and other wiring as required for PA and VMS system equipment.
        5) Integration of all Contractor-provided hardware and software into a complete functioning PA and VMS system.
        6) Complete documentation covering all hardware, software, and firmware.
        7) Provide power distribution system and required hardware.
        8) Interfacing with other field equipment.
        9) Shipment and delivery of all Contractor-provided equipment.
        10) Installation of all Contractor-provided equipment.
        11) Factory acceptance testing of all functional capabilities of the Contractor-provided hardware and software.
        12) Start-up and field acceptance testing of all Contractor-provided equipment and functions.
        13) Hardware, firmware, and software maintenance of Contractor-provided equipment through field acceptance by the City.
        14) Hardware and software maintenance support and replacement parts throughout the warranty period.
        15) Training of the City maintenance and operating personnel.
        16) Technical assistance to the City during the Contract and warranty periods.
        17) Availability of spare parts, service, and expansion parts in accordance with the Contract Document and General Condition requirements.
        18) Special test equipment required for troubleshooting and maintaining Contractor-provided equipment.
        19) Compliance with all laws, ordinances, rules, and regulations of the City and governmental authorities having jurisdiction over the project.

20) The drawings depict what is believed to be a feasible approach of performing the required work. Bear the ultimate responsibility of determining constructability and providing a feasible solution to perform the work to obtain a fully functional HHCTCP PA and VMS systems. Assume responsibility for the design, engineering, documentation, fabrication, procurement, software, implementation, testing, training, delivery, installation, start-up, and warranty of all components of the PA and VMS system to be installed.

21) The City has set forth performance criteria throughout this solicitation. Deliver a product that meets the requirements of herein including addenda and revisions, the Contractor's Technical Offer, and negotiated clarifications entered into with the City.

22) All Work under this procurement may be subject to Independent Verification and Validation (IV&V) to the satisfaction of the City. The cost of any such IV&V shall be the responsibility of the City should this right be exercised. In the event that IV&V determines that a Contract requirement has not been fulfilled after such time that the Contractor has invoiced for such work, remedy the situation to the satisfaction of the City at no cost to the City. The details for IV&V are described in theses Specifications.

12. Placement of VMS shall be located at a minimum height of 10 feet from the bottom of the sign to the platform top surface to avoid vandalism. If lower than 10 feet, a protective case shall be provided.

13. All outdoor VMS and mounting hardware shall not fail under high winds. The LCD signs shall meet the AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals" for wind loads specifications.

14. All VMS shall be capable of operating in their environment without failure due to the environmental conditions. The environmental conditions requirements are described in detail herein.

15. Provide a mechanism to control the VMS. Control for the VMS shall be supported:
    a. Locally at the sign by using a diagnostic/control port connection
    b. From the Station Controller and/or server
    c. From the Honolulu Rail Transit system control center

16. An inventory of spare parts of 10 percent shall be provided for components that are prone to failure (have Mean Time Between Failure (MTBF) < 10 years). A manufacturers list of recommended spare parts shall be provided based on components having a high mortality rate.

17. The VMS shall be connected by Ethernet to the Station Controller via the Station Local Area Network.

18. The VMS shall be Internet Protocol (IP) addressable.

19. Power conditioning and regulation shall be provided for all signs. All power connections shall be from the local UPS.

20. The VMS sizes will vary with location within the station. The largest sign will contain four lines of text. The smallest will contain two lines of text. Four lines of

text shall be installed in the transfer, AFC, and Station Manager (SM) areas. Propose VMS size for engineering review.

21. The VMS shall be resistant to moisture and shall be supplied with watertight seals for all accesses. They shall not fail structurally or operationally for at least 10 years.

22. VMS shall have easy access to the electronics for maintenance. Access into the signs shall be by removal of only one or two latching devices. Signs shall have VMS panels that are easily replaceable without requiring removal of the whole sign.

23. VMS shall use non-glare finish.

24. VMS shall be visible and legible during the day or night from equal distance with equivalent brightness and clarity. The VMS shall automatically adjust the brightness for various conditions.

25. The VMS shall support alphanumeric characters.

26. The VMS shall support an acknowledgment response to the Station Controller to verify proper transmission.

27. The VMS system shall have self-diagnostics. The stations components shall detect failures of operation. The VMS system components at the station shall provide a status of operational availability back to the Station Controller, and the Station Controller back to the operation center or Central Control Computer/Sever at the center.

28. If any remote device fails entirely and cannot report an alarm, the workstations at all Control Centers shall have the capability to detect the failure and report the problem electronically.

29. VMS shall generate an alarm for defective and/or failed LCD VMS.

30. The VMS shall support system diagnostics modes that can be initiated locally or from a control computer at central.

31. The VMS shall be capable of displaying the current time and date if enabled. This time/date shall be kept synchronized to the Honolulu Rail Transit system central control and master clock. This display will always be shown unless overridden by control.

32. VMS Display Modes: It shall be possible to display messages using multiple line modes:
    a. Single-line mode: Characters shall be a minimum height of 6 inches and a single line of text shall be displayed.
    b. Two-line or split screen mode: Characters shall be a minimum height of 3 inches and two lines of text shall be displayed, one over the other.

33. The VMS shall be capable of VMS features as commanded to do. These features include display characters capable of the following:
    a. Flashing
    b. Sparkle
    c. Scrolling

d. Roll Up/Down

e. Bolding

f. Varying degrees of brightness for automatic or manual dimming

g. Split mode display operation (dividing the display into multiple fields)

34. Display messages shall be entered in text from or selected from a menu of prepared messages at the PA and VMS system workstation keyboard. Each VMS shall be individually addressable. The capability to select a group of VMSs shall be possible from the workstation by choosing station names and platforms (Westbound/Eastbound) from a menu list.

35. ADA Compliance: All VMS shall be ADA-compliant in accordance with ADA STANDARDS for accessible Design (49 CFR Part 37).

D. PA/VMS Head End Server:

1. The PA/VMS head end server shall provide PA/VMS functionality and control to the OCC workstations. The redundant fault tolerant head end servers shall be located within the HHCTCP OCC Communications Equipment Room and shall include a database for the prerecorded audio/visual files. The PA/VMS system database shall be maintained on redundant storage units.

2. The PA/VMS head end servers shall provide a polling function to all workstations, PA zone controllers, and VMS controllers to provide for system supervisory and acknowledgement of all messages, thus providing positive feedback to the system users of sent messages. Sent messages that have failed to transmit shall also be acknowledged.

3. The PA/VMS head end servers shall have the ability to log all local or remote messages presented to the passengers. The log shall be generated and recorded at the head end servers and shall be made available to any PA/VMS workstation.

4. All messages logged at the PA/VMS server shall be remotely retrievable from any workstation. Included in the system log shall be the date, time, location, message identifier, message type, and other message information. The log shall be read-only with system administrator permission. Capacity to hold 31 days logging shall be provided. Archival storage of the log files must be provided.

5. Each PA/VMS workstation shall be capable of generating a report of all log messages. The log shall include the zone, the detection of use of the microphone and all audio/visual messages attributes. The actual audio/visual files are not required but the message identifier shall be required. All reports generated for the log files shall be in ASCII format and shall be exportable as word files or as comma separated ASCII files.

6. Sign groups should also include capability to address all signs by a single selection, or logical groups of signs (airport to downtown or vice versa) again by a single keystroke. System should have capability to program future groups of signs for easy, immediate access.

7. The PA/VMS head end servers shall have the ability to import database information on a dynamic update basis using commercial access applications, such as dial up and Virtual Private Network (VPN) circuits.

8. The PA/VMS head end servers shall provide diagnostics information to all workstations upon request or automatically when a failure is detected. Provide the ability for an authorized user to perform PA test functions including but not limited to test tones, white noise generator, and analyzing / setting audio and line levels.

9. The PA/VMS system shall automatically alert an authorized user, with system administration permissions, as to a failure(s) to display signage information at a specific destination, or the failure to play audio (of any type) within a given zone. Diagnostic information available to the system administrator shall include test patterns, memory configuration, alarms, faults, relay logic, and VMS defect detection.

10. PA/VMS system workstations shall be capable of detecting and displaying system and equipment faults. The faults include but are not limited to the following:
    a. Sign communications failure (non-responsive unit)
    b. Sign electronics service required
    c. Sign electronics self-diagnostics failure
    d. PA/VMS system server communications failure with PA zone controller, VMS controllers, and all public address and display components
    e. Failure of workstation to communicate with the database and/or the server
    f. Software/operating system faults
    g. Failure to play audio portion of a message
    h. Amplifier failures
    i. Speaker failures
    j. Sign Failures

E. PA/VMS System Software:

1. The Contractor-furnished software shall adhere to guidelines specified in the IEEE Software Engineering Standards with regard to software requirements specifications, quality assurance, configuration management, test documentation, and reviews and audits, in addition to the guidelines in the IEEE Software Engineering Standards.

2. Provide software that provides the capability to the City to change any display configuration field and/or option without requiring vendor assistance.

3. Pay for upgrades and/or software version upgrade required to control and/or configure the system, including maintenance cost until CONTRACT CLOSEOUT.

4. All software updates shall be properly submitted for review and approval by the City before utilization. Any updated versions of the system and component software shall be backwards compatible with the other system and component software.

5. All software, configuration data, and memory data shall be updated electronically. Component exchanging shall not be permitted. All software updates and data files on distributed equipment (servers, workstations) shall be downloadable and configurable via network connection.

6. The software shall provide the version number on demand. The PA/VMS software shall control the PA system elements and all sign displays.

7. All system and component software, including but not limited to signs, PA Systems, station control units, PA/VMS workstations, and servers, shall be a tested, released version only. No software shall be permitted in any part of the system that is not a controlled, released version. All like equipment shall have the same versions of software. All software components shall be submitted and turned over at completion of the Work.

8. The software shall include a Graphical User Interface (GUI) that shall display all PA/VMS functions on all the user workstations. Provide interface equipment as required to allow for the GUI functionality between the PA/VMS servers and workstations.

9. Upon loss of power, PA/VMS servers and workstations shall automatically reboot when power is restored. Upon power up or reset, the software shall display all version numbers, date, time, communications configuration data, and status data. All software restarts shall be recorded to the message log with date, time and all possible device status.

F. PA/VMS Workstations:

1. The PA/VMS workstation shall provide the ability for authorized operators to enter the following selections and associated parameters with regard to the playing, recording and displaying of ad-hoc audio/visual messages:
    a. One or more PA zones and associated signs, groups of zones, or all zones that shall play the ad-hoc audio/visual message.
    b. The starting time and date to play the ad-hoc audio/visual message. If no starting time is specified, the default shall be the current time and date, i.e. the message is played immediately.
    c. The length of the time during which an ad-hoc message is to be played.
    d. The repeat interval between each successive time the message is played.
    e. For example, the PA/VMS operator may enter that the ad-hoc audio/visual message is to be played on 07/04/2009 starting at 10:45 AM, play for 6 hours, and repeated every 5 minutes.
    f. The PA/VMS server and workstations shall provide the ability for authorized operators to make prerecorded or live audio announcements to selected PA zones.
    g. Live announcements shall be defined as those that can be heard at selected PA zones simultaneously while an authorized PA/VMS operator speaks into any PA/VMS microphone at the OCC, Station Manager Booth, and FACP.
    h. There shall be no perceptible delay, i.e. less than 50 milliseconds, between an operator pressing the push-to-talk and speaking into any PA/VMS microphone, and the audio being heard on the selected PA zone speakers.

2. The system shall be designed to have workstations located at the OCC to control and monitor the prerecorded as well as live audio/visual messages.

3. The PA/VMS shall provide for prerecorded audio/visual messages in the form of audio/visual files (text, WAV, MP3, MPEG, et al) generated at the head end servers. Any prerecorded audio message that is transmitted to PA speakers shall be accompanied by visual signage displaying similar message contents.

4. Authorized operators shall have the ability at any PA/VMS workstation to change the messages on any VMS. The operator shall have the ability to review the ad-hoc message prior to broadcasting over the system.

5. The PA/VMS shall provide the ability for authorized operators to create, edit, and maintain a schedule whereby audio/visual messages are automatically played at configurable zones at pre-determined times by minute, hour, day, month, and year.

6. The PA/VMS system shall accept and implement commands to play, stop, repeat, delete, and view the status of audio/visual messages and schedules.

7. The PA/VMS shall provide the ability for authorized operators to make ad-hoc recorded audio/visual messages.

8. The PA/VMS shall provide the ability to play ad-hoc prerecorded audio/visual messages at selected zones immediately and within seconds after being entered by the operator.

9. Coordinate with the City to prepare and create a library of prerecorded voice and visual text messages. Messages may be provided in the English and other native languages as required by the City. Voice talent and studio time, if needed, shall be provided by the Contractor.

10. Pre-recorded messages may be distributed on PA zone controllers at individual Train Control & Communication Room (TCCR) rooms and/or resident on the redundant system servers centrally located in OCC communication rooms.

G. PA/VMS Field Equipment:

1. All PA zone and VMS controllers shall communicate with the PA/VMS servers via the Communications Transmission System /FOCN interface cards and/or switches.

2. Work with the City System Maintenance group to configure the interface cards/switches and perform the necessary addressing throughout Honolulu Rail Transit system for all PA/VMS head end servers, workstations, PA zone controllers, and VMS controllers.

3. Sign message organization shall show appropriate display information, current time, and service messages.

4. The PA/VMS system shall broadcast speech over all speakers in selected zones. Feedback control shall be applied where necessary to prevent acoustic coupling.

5. Speech Intelligibility Performance Requirement.

H. Average Performance Level:

1. Ensure that the PA/VMS as a whole provides a Speech Transmission Index (STI) averaging 0.60 over at least 90 percent of the target coverage areas on a per zone basis.

2. Note that this average level of speech intelligibility corresponds to an AI of 0.67, and is equal to 0.78 on the Common Intelligibility Scale (CIS).

I. Minimum Performance Level:

1. Ensure that the PA/VMS as a whole meets or exceeds the NFPA 72 standard for minimum intelligibility.

2. Ensure that the PA/VMS as a whole provides a minimum STI of 0.50 over 100 percent of the target coverage areas on a per zone basis.

3. Note that this level of speech intelligibility corresponds to an AI of 0.50, and is equal to 0.70 on the CIS.

J. Testing and Remediation of Performance Requirements:

1. Submit a test procedure for approval before testing and conduct a Speech Intelligibility Performance testing.

2. Be responsible for the remediation of all areas not meeting the intelligibility requirements as stated by this document.

3. Remedies for low intelligibility shall include but not be limited to:
   a. Adjusting the strength of the signal (i.e. increasing the signal to noise ratio) provided by PA/VMS elements
   b. Adjusting speaker and other PA component power settings
   c. Adding more speakers
   d. Adjusting the alignment of the center axis of speakers

4. PA/VMS operator workstations shall have the ability to change the visual portion of a message on any sign. Only the system administrator and authorized password holders shall have the capability to edit the database.

5. Be responsible for providing all wiring, cabling, conduits, and connections necessary for a complete and fully operational PA/VMS system.

K. Environmental Requirements – Temperature:

1. TCCRs Equipment: The Communications Room equipment shall be designed, fabricated, and environmentally tested to operate in the temperature range between -4 degrees Fahrenheit and 131 degrees Fahrenheit with a relative humidity range of 5 percent to 95 percent, non-condensing over the entire operating temperature range.

2. Exterior Equipment: Exterior equipment such as externally mounted CIS, speakers, conduits and electrical contacts shall be designed, fabricated, and environmentally tested to operate in the temperature range between -4 degrees and 131 degrees Fahrenheit with a relative humidity range of 5 percent to 95 percent, non-condensing.

3. Interior Equipment: Interior equipment to be installed shall be designed and certified by the manufacturer to operate in a range of between 5 degrees Fahrenheit and 89.6 degrees Fahrenheit with a relative humidity of 20 percent to 80 percent, non-condensing. Make clear in the technical proposal any additional heating or air-conditioning that may be required.

L. Equipment Storage and Start-up:

1. All Exterior and Communications Room products shall be designed to avoid damage due to thermal shock from operations or start-up during low temperature conditions.

2. All equipment shall be designed for dry storage in temperatures that range from -4 degrees to 131 degrees Fahrenheit.

3. All PA/VMS equipment shall comply with the following environmental requirements.

4. Displays and VMS assemblies consisting of electronic sign components and sign case enclosure shall operate with no discernable degradation while operating within the parameters identified herein

5. Communications Room assemblies consisting of PA zone controller, VMS controller, PA pre-amplifier/mixer, PA power amplifier, and ambient noise system (ANS) shall operate without performance degradation while operating within the parameters identified herein

6. Interior equipment consisting of PA/VMS server, PA/VMS workstations, and all other components required to support the PA/VMS shall operate without performance degradation while operating within the parameters identified herein.

7. All other components of the PA/VMS shall operate with no discernable degradation between 32 degrees Fahrenheit and 104 degrees Fahrenheit, 5 to 95 percent relative humidity, non-condensing.

M. Weather and Elements:

1. All exterior equipment and any other potentially exposed units shall be designed and tested to operate continuously and reliably in varying conditions of humidity, rain, salt, dust, cleaning detergents, water spray, roadway chemicals, exhaust emissions, and other contaminants found in the transportation areas.

2. This means that appropriate rain/corrosion tightness testing shall be conducted for all transit equipment. All exterior components shall be designed and finished to resist adverse effects from solar radiation.

N. Electromagnetic and Electrostatic Susceptibility:

1. System equipment shall not be adversely affected by radiated or conducted electromagnetic or electrostatic interference from trains or fixed site and other electric/electronic equipment on or near public transit areas. Certain tests for electromagnetic interference and electrostatic discharge susceptibility are required. These testing conditions shall include but not be limited to trains within the station, fixed site, cellular telephones, portable, mobile radio interference, incidental (spurious) radiation, ignition noise, lighting fixture (static) interference, electrical power system transients, vehicular systems interference, and electrostatic discharge (air or contact).

2. Investigate all environmental factors that may affect equipment operations both before and after installation of the equipment, including shock and vibration. Environmental deficiencies uncovered during installation testing, on-line demonstration, or final tests may be cause for additional design adjustments and additional environmental testing by the Contractor. The City shall retain the exclusive right to judge the environmental acceptability of the components before final acceptance.

O. Electrical Power: All components shall be certified via testing to operate with normal outputs when the input voltage varies as much as plus/minus 10 percent.

P. Shock and Vibration:

1. All exterior and interior equipment, when in their fully assembled configuration, shall not be damaged nor shall experience any operational performance degradation during train operation into the station due to shock and/or vibration.

2. Vibration isolation for station cabinets shall be provided to protect electronic components within the cabinets from long-term low frequency events resulting from continual train operations through the stations.

3. Coordinate with electronic equipment and cabinet manufacturers to determine proper vibration isolation hardware to meet the manufacturer's electronic equipment environmental test specifications.

Q. In all places where this Section states a requirement as "the Contractor shall supply the ability" or "the Contractor shall provide the capability" it shall be interpreted to mean that the Contractor is required to deliver the PA/VMS with the described required function fully implemented, integrated, and functioning as part of the delivered system unless expressly stated otherwise. It shall not mean that the specified functionality can theoretically and/or potentially be added to the PA/VMS at a later date via the addition or modification of software and/or hardware that is not provided as part of the base, delivered System.

R. VMS System Specifications:

1. The major items listed below shall conform to the operational and performance requirements of herein. Incidental items not specifically mentioned but required for a complete and operational system shall be furnished and installed by the Contractor at no additional cost to the City.

2. VMS Requirements:

a. Requirements are based on the ADAAG and shall be used in conjunction with the technical specifications for the display signs to ensure compliance with the ADA.

1) ADA-Compliant Systems: Where public address systems convey audible information to the public, the same or equivalent information shall be provided in a visual format.

2) The Audible information must be synchronized with the LCD variable VMS.

b. Each VMS shall possess the following display specifications:

1) Character Proportion: Letters and numbers on signs width-to-height ratio shall be programmable between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10.

2) Character Height: Characters and numbers on signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case X. Lower case characters are permitted. The ADA standard is a minimum of 3 inches for any sign mounted over 80 inches high. There should be no display of transit information of less than 3 inches at any time.

3) Character Display Color: Selectable.
4) Color Capability LCD system: Selectable.
5) Viewing Angle: Minimum 30 degrees.
6) Minimum Milli-Candela (MCD) per pixel: 2000.
7) The LCD Sign shall be readable in direct sunlight.
8) Minimum Display Brightness: 11,000 candela per square meter.
9) LENS: Polycarbonate, red, 3 mm. thick, anti-glare.
10) Life Expectancy per LCD: 100,000 Hours.

3. VMS Service Access: Each enclosure shall be equipped with a keyed power switch that is capable of rebooting power to the backplate(s). The switch shall be made accessible through the bottom of the enclosure.

4. Each VMS shall have an electrical disconnect provided within line of sight of sign to allow isolation of each ungrounded conductor in accordance with the NEC.

5. The VMS shall have the capability of storing and the capability of displaying and broadcasting emergency messages.

6. VMS Fonts: Narrow, Bold, Wide, ADA compliant aspect ratios.

7. Contrast: Characters and symbols shall contrast with their background (i.e. light characters on a dark background).

8. Metallic Finish: All metallic housing components and fasteners are corrosion-resistant.

9. Waterproof Equipment: Listed and labeled for duty outdoors or in damp locations. All entrance and egress points on the VMS shall be waterproof type. The VMS design shall take into account maintenance access requirements when selecting waterproofing. The waterproofing shall meet all applicable to the NEMA 4X standard.

10. VMS Self Diagnostics: Each VMS display shall be capable of self diagnosis and communicating its operational status to the VMS control system. The proper execution of commands sent from the control system shall be verifiable, with the capability of dispatching service calls in the event of error messages. In the event that the VMS loses communications with the server at the respective control center or the Station Controller, the display sign shall reboot automatically; if the failure persists, the sign shall stop displaying information (all Signs off).

11. VMS Environmental Design: The proposed VMS equipment shall be designed and manufactured to withstand a harsh transit environment including the effects of weather conditions on outdoor deployed equipment. HHCTCP’s environmental requirements are listed in this Specification

12. Display Capability: Programmable alphanumeric and graphic.

13. Clock: Built-in time and day for display and shall be synchronized to the system Master Time Base.

14. Power Requirements: 120 Volts AC (VAC).

15. Head Room: Walks, halls, corridors, passageways, aisles, or other circulation spaces shall have 80 inches minimum clear head room. If vertical clearance of an area adjoining an accessible route is reduced to less than 80 inches (nominal dimension), a barrier to warn blind or visually impaired persons shall be provided.

16. Each VMS shall have the following enclosure requirements:

    a. Easy access for maintenance. The electronics shall be accessible by removing a few screws (secure type) and swing mount door.

    b. Paint to match station color scheme. The paint shall be baked on type and shall last at least 10 years.

    c. All enclosure hardware shall take the extreme vibration environment into account.

    d. The enclosure shall be mounted to reduce vibration on the VMS.

S. PA/VMS Head End Servers: Provide redundant PA/VMS head end servers. The PA/VMS head end servers shall consist of rack-mount processors with the following minimum requirements:

1. The server shall provide facilities for selective remote control of platform speaker announcements. The server shall have access to any sign display and PA zone speakers in the system.

2. The server shall provide the ability to address individual VMS display, groups of VMS displays, individual PA Zones, or groups of PA zones. A continuous display of control status shall be provided on the control console indicating when a device is free for selection, successfully addressed or malfunctioning.

3. The system shall be capable of storing at a minimum up to 1,000 text and voice messages plus spare capacity. Text messages shall be up to 80 characters and shall have limits based on the human factors limitations of the corresponding displays. The voice messages shall be nominally 30 seconds in duration (approximately 2.6 MB of data for each digitized audio message). Provide the ability for an authorized user with system administration level permission to create, modify and delete text and voice messages via on-line configuration tool provided as part of the PA/VMS GUI. Provide the ability for PA/VMS system administrator to develop scripts to automatically purge text and voice messages that have not been accessed for user defined days.

4. All PA/VMS servers shall include time synchronization software that shall use the full implementation of the Network Time Protocol to receive time updates, via the communications network, from a master timeserver.

5. The control servers shall be connected to the FOCN and broadcasts over the network shall use an accepted multicasting standard like Internet Group Multicast Protocol (IGMP) when more than one device will receive the same information.

T. PA/VMS Workstation Equipment:

1. The Central Processing Unit (CPU) should include at minimum:

    a. CPU: Dual Central Processor, Intel Core 2 Quad Processor, FSB 1333 MHz

    b. OS: Windows® 2000/XP/Vista pre-installed

    c. 8 GB RAM

d. 12 MB L2 Cache
e. 24-inch LCD monitor
f. Dot Pitch: 0.27 mm
g. Contrast: 600:1
h. Resolution: 1600 x 1200
i. Brightness: 250 cd/m2
j. 250 GB hard disk

2. Audio Card:
   a. Line In x 1
   b. Line Out x 1
   c. Microphone in x 1
   d. Headphone x 1
   e. PS/2 keyboard, optical 2-button scroll mouse

3. Removable Storage: DVD-RW

4. Furnished Operating System shall be the most recent version of Windows or UNIX available.

5. Microphones: Microphones shall be noise-canceling, dynamic type, with a gooseneck type mounting configuration.
   a. Impedance: 150 ohms
   b. Frequency Response: 100 to 6,000 Hz
   c. Sensitivity: E.I.A. minus 90 Decibel (dB)
   d. Output: -60 dB with reference 0 dB

6. Workstation Speakers:
   a. One speaker shall be installed in the console and each shall be a 3-inch square speaker with a single rotary master volume control.
   b. The two speakers should be no closer than 24 inches between the centers of the speakers. Each speaker should be capable of handling 8 watts Root Mean Square (RMS) power, have a total harmonic distortion of less than 2 percent and a frequency response of 150 to 12 kHz plus or minus 5 dB. Sensitivity shall be 85dB 1 watt at 1 meter.

7. PA Zone Controller: Provide a PA Station controller for each TCCR. Station controllers shall be an industrial grade rack-mount computer with the following minimum requirements:
   a. CPU: Dual Central Processor, Intel Core 2 Quad Processor, FSB 1333 MHz
   b. OS: Windows® 2000/XP/Vista pre-installed
   c. Memory: 4/2 GB SRAM (8GB SRAM)
   d. Cache: 12 MB L2
   e. Internal Disk: 250 GB HDD x 1
   f. Network: Gigabit port (10/100/1000) x 2
   g. Interfaces: Serial x 2, Parallel x 1, USB 2.0 x 2, Wi-Fi
   h. PCI: 64-bit/66 MHz x 2 slots

i. Drive Bays: DVD/ CD-ROM 48X or Faster

j. Audio: (LINE-Out and MIC-In) x 2

k. Dimensions: 1U (1.7 x 19.0 x 18.0 inch H x W x D)

l. Power: 90 – 260 VAC

m. Environmental: 0 to 60 degrees Celsius (32 to 140 degrees Fahrenheit)

8. The PA Controller: Shall include a sound card that shall meet, at a minimum, the following specifications:

   a. Audio Controller: 16-bit Sound

   b. Line Output Level: 0 dB, maximum

   c. Gain: 20 dB maximum (adjustable)

   d. Output Impedance: Balanced 600 ohms

9. VMS Controller:

   a. Provide a VMS controller for each display. The VMS controller shall consist of a CPU embedded in or mounted with each display. The VMS controller shall operate in conjunction with the display software running on the PA/VMS head end servers to provide a distributed, network-based display system.

   b. Contractor may propose an alternate design whereby VMS controllers are rack-mounted and installed in TCCRs.

   c. VMS controllers installed in TCCRs shall deliver the information content to the display panels via a standard RGB (VGA, XGA).

   d. VMS controllers shall be a computer with the following minimum requirements:

      1) CPU: Dual Central Processor, Intel Core 2 Quad Processor, FSB 1333 MHz

      2) OS: Windows® 2000/XP/Vista pre-installed

      3) Memory: 4/2 GB SRAM (8GB SRAM)

      4) Cache: 12 MB L2

      5) Internal Disk: 250 GB HDD x 1

      6) Network: Gigabit port (10/100/1000) x 2, RJ-45 x 2

      7) Interfaces: Serial x 2, USB2.0/1.1 x 2

      8) PCI: 64-bit/66 MHz x 2 slots

      9) Drive Bays: DVD-ROM

      10) Dimensions: 1U (1.7 x 19.0 x 18.0 inch H x W x D)

      11) Power: 90 – 260 VAC

      12) Environmental: 0 to 60 degrees Celsius (32 to 140 degrees Fahrenheit)

10. Amplification Equipment:

   a. All amplifiers shall be protected in a 1:1, 1:2, 1:3, and 1:4 configuration depending on the quantity of amplifiers to be installed at each station. Other alternate protection configuration will be considered.

   b. Provide and install one or more audio control/mixers in each communications equipment room/closet as follows:

   c. Install sufficient quantity of amplifier/mixers in each TCCR to provide one audio output channel for each PA zone, plus one spare backup unit. For example, if the number of PA zones handled from a given TCCR is 4, then a total of 5 audio output channels are required.

d. The audio control/mixer shall be a processor digital signal-processing unit and shall have automatic mixing capability.

e. The audio control/mixer shall have a minimum of six inputs and four outputs. Any of the audio control/mixer shall be capable of any combination of routing and mixing from any input to output.

f. Each input shall provide signal processing features including delay, input gate, automatic leveling, filters, input compression, and auto mixing. Auto mixing functions shall include priority ducking. Each of the inputs shall be capable of being assigned an individual priority level.

g. Each output shall provide signal processing features including signal delay, filters, and ambient noise leveling.

h. The audio control/mixer shall include a supervisory port remote communication to PA/VMS head-end servers. Include all software necessary for an authorized PA/VMS system administrator to remotely monitor, configure, and control all amplifier/mixers from the OCC.

i. The audio control/mixer shall conform, at a minimum, to the following specifications:

   1) Input Gain Range: +20dB to –12 dB
   2) Max Input Level: +32dB (line) or +7dB (mic)
   3) Input Impedance: 20 K-ohms balanced, 10 K-ohms unbalanced
   4) Frequency Response: 20 to 20 kHz plus or minus 0.5 dB
   5) Dynamic Range: > 100dB (A-weighted), 20 to 20 kHz
   6) Digital Sampling: 24-bit, 48 kHz
   7) Output Impedance: 100 ohms balanced, 50 ohms unbalanced
   8) Crosstalk: > 80dB at 10 kHz
   9) Distortion: < 0.05 percent THD at between 20-20 kHz
   10) Power Input: 120 VAC, 50/60 Hz

11. Power Amplifiers:

a. Provide and install one or more power amplifiers in each TCCR.

b. Install sufficient quantity of power amplifiers in each communications TCCR to provide one audio output channel for each PA zone, plus one spare. For example, if the number of PA zones handled from a given TCCR is 4, then a total of 5 audio output channels are required. If each power amplifier contains 2 audio output channels, install a total of 3 power amplifiers in that TCCR.

c. The power amplifiers for the PA/VMS system shall conform at a minimum to the following specifications:

   1) Power level: Power amplifiers shall have sufficient power to provide the audio levels specified, as measured at ear level throughout each PA zone. Amplifiers shall be capable of providing a minimum of 300-watts (RMS) output power per channel.

      a) Distortion: < 0.1 percent THD between 20 to20 kHz full rated out
      b) Frequency Response: 20 to 20 kHz plus or minus 0.25 dB
      c) Input Impedance: 10K-ohm balanced, 5 K-ohm unbalanced

d) Output Loads Independence: 4 ohms, 8 ohms, 70.7 V selectable

e) Load Voltage: 70.7 V

f) Output Regulation: 1.5 dB from 0 to full load

g) Signal-To-Noise Ratio: 104 dB, A-weighted, below rated output

h) Power Input: 120 VAC, 50/60 Hz

12. Output Protection: The amplifier output shall include multiple automatic protection circuits to guard against overheating (i.e. thermal limiting), shorted outputs, mismatched loads, over/under voltage, and internal faults.

13. Indicators: The power amplifier shall include VMS indicators for power, overload, thermal, clip, and fault for each output channel.

14. Ambient Noise System:

    a. The ANS shall expand the output channel gain to compensate for a sensed elevated noise level on the platforms.

    b. The ambient level shall be received via ambient sensing microphones.

    c. The ANS shall allow the amplifier/mixer to maintain optimum signal to noise, sound pressure levels, and intelligibility, for each PA zone with varying background noise.

    d. The ANS shall have control parameters that shall be remotely configurable by an authorized PA/VMS system administrator at the OCC. ANS control parameters shall include, but not be limited to, the following:

    e. On/Off – Enables or disables ANS.

    f. Sense Input: Sets the sense input (i.e. ANS microphone) that shall be the source of the ambient level that will do the adjustment.

    g. Sense Threshold: Sets a level for the ambient sensor input threshold. The ANS expansion shall be inhibited for input levels below this threshold. The control range shall be from -80 dB to +20 dB in 0.5 dB steps.

    h. Max Added Gain: Sets the maximum increase in gain through the ANS. The control range shall be from 0 dB to +20 dB in 0.5 dB steps.

    i. Expansion Ratio – Determines how much the gain of the output channel will increase for every increase in the ambient signal level above the Threshold setting. The control range shall be from 0.1:1 to 5:1.

    j. Attack Time: Sets the time required for the Auto-Leveler to expand its gain by 20 dB. The control range shall be from 0.1 to 60 seconds in 0.1-second steps.

    k. Release Time: Sets the time required for the Auto-Leveler to compress its gain by 20 dB. The control range shall be from 0.1 to 60 seconds in 0.1-second steps.

15. ANS Microphones:

    a. Provide and install a minimum of one ambient sensing microphone for each PA zone.

    b. The ANS microphones shall be wall or ceiling mounted. The mounting hardware shall be vandal-resistant.

    c. The ANS microphones shall have the following minimum requirements:

        1) Element Type: Electret Condenser

        2) Frequency Response: 80 Hz to 20 kHz

3) Polar Pattern: Hemispherical
4) Impedance: 75 ohms
5) Sensitivity: 1.4 V/Pa

U. Electromagnetic and Electrostatic Susceptibility:

1. System equipment shall not be adversely affected by radiated or conducted electromagnetic or electrostatic interference from trains or fixed site and other electric/electronic equipment on or near public transit areas. Certain tests for electromagnetic interference and electrostatic discharge susceptibility are required. These testing conditions shall include but not be limited to trains within the station, fixed site, cellular telephones, portable, mobile radio interference, incidental (spurious) radiation, ignition noise, lighting fixture (static) interference, electrical power system transients, vehicular systems interference, and electrostatic discharge (air or contact).

2. Investigate all environmental factors that may affect equipment operations both before and after installation of the equipment, including shock and vibration. Environmental deficiencies uncovered during installation testing, on-line demonstration, or final tests may be cause for additional design adjustments and additional environmental testing by the Contractor. The City shall retain the exclusive right to judge the environmental acceptability of the components before final acceptance.

V. Priority Functions:

1. The operation of the PA/VMS shall be managed at all times by a priority function. The PA/VMS shall use priorities to manage users and message sources, allowing the higher priority sources to have precedence over and to preempt lower priority ones in order to make an announcement.

2. The PA/VMS system shall use priorities to prevent simultaneous system usage, i.e. more than one message playing in the same zone at the same time. As a default, user shall be assigned by the Contractor in the following order, where 1 = highest, as shown in Table 27 80 00 - 2. User access and message priority is easily editable, by authorized personnel in the City Transportation Department, utilizing an on-line configuration tool provided as part of the PA/VMS GUI.

3. Messages from lower priority sources that are pre-empted by higher priority sources are not recorded or placed onto a queue.

4. A user of equal priority level is denied access to a particular PA/VMS unit (i.e. PA zones and/or signs) until such time as the current user has finished with their message including both the audio portion and any associated text displayed.

Table 27 80 00 - 2 PA/VMS System Announcement Priority Levels

1	FACP – live via audio channel
2	PA/VMS Operator – live via Station Manager Booth microphone
3	PA/VMS Operator – live ad-hoc message via OCC console microphone
4	PA/VMS Operator – canned prerecorded selected via OCC workstation
5	PA/VMS Server – scheduled prerecorded message from database such as train arrival
6	Future, Auto Generated FACP announcements
7	Future, spare

W. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and implementation of the Passenger Information System.

2.02 SPEAKER EQUIPMENT

A. Indoor Ceiling Speakers:

1. The ceiling flush-mounted speaker shall include a speaker, transformer, housing, round grille, and all associated mounting hardware.

2. All speaker components shall be electrical and acoustically matched for a frequency response of 50 Hz to 15 kHz. The speaker assembly shall be UL 1480-listed.

3. The speaker shall be cone-type 4-inch diameter. The speaker shall have a ceramic magnet and a dampened high-compliance cone.

4. The speaker enclosure shall be constructed of cold-rolled steel, undercoated, and be finished in textures black epoxy. The maximum dimensions for the speaker enclosure shall be 7 inches in diameter by 7 inches deep.

5. The grille shall be constructed from steel, finished in semi-gloss white enamel. The maximum dimensions for the speaker grille shall be 8 inches in diameter by 0.25 inches deep.

6. Indoor Ceiling Speakers shall meet the following requirements:
   a. Power Rating: 10 Watts
   b. Voltage: 70.7 V
   c. Transformer Taps: 1, 2, 4, 8 Watts
   d. Frequency Response: 50 to 15 kHz plus or minus 1.0 dB
   e. Sound Pressure Level: 94 dB, 1 Watt at 1 Meter
   f. Dispersion: 135º

B. Horn Loudspeakers:

1. The horn loudspeaker where used shall have rated output of 30 watts. It shall consist of a loudspeaker and a single driver positioned on a common mounting frame.

2. Dimensions of the horn loudspeakers shall be approximately 10 inches long by 9 inches in diameter.

3. The horn loudspeaker shall be constructed from steel, finished in gray baked epoxy.

4. The horn loudspeakers shall meet the following requirements:
   a. Power Rating: 30 Watts
   b. Voltage: 70.7 V
   c. Transformer Taps: 1.8, 3.7, 7.5, 15, 30 Watts
   d. Frequency Response: 400 to 12 kHz (Nominal)
   e. Sound Pressure Level: 101 dB, 1 Watt at 1 Meter
   f. Dispersion: 175º

C. Bi-Directional Horn:

1. The bi-directional horn where used shall be at shall have rated output of 30 watts. It shall consist of two horn speakers and a single driver positioned on a common mounting frame.

2. Dimensions of the bi-directional horn shall be approximately 16 inches long by 10 inches in diameter.

3. The bi-directional horn shall be constructed from steel, finished in gray baked epoxy.

4. All bi-directional horns shall be installed and mounted as shown in RFP Plans.

5. Bi-directional horns shall be constructed to resist impact and harsh rail tunnel environmental conditions.

6. The bi-directional horn shall meet the following requirements:
   a. Power Rating: 30 Watts
   b. Voltage: 70.7 V
   c. Transformer Taps: 1.8, 3.7, 7.5, 15, 30 Watts
   d. Frequency Response: 400 to 12 kHz (Nominal)
   e. Sound Pressure Level: 101 dB, 1 Watt at 1 Meter
   f. Dispersion: 175º

2.03 EQUIPMENT CABINETS

A. All equipment shall be located in new equipment cabinets unless otherwise specified.

B. Each cabinet shall be furnished with shock mountings to prevent vibration damage to the equipment. Provide all hardware for securing it within the preformed crevice or ceiling. Architecturally-approved edge finishing shall be provided to cover any gap between the display and the edge of the crevice.

C. Each PA/VMS cabinet shall include a 120 VAC multi-outlet strip with main disconnect, wired to a UPS located at each station and the MSF.

2.04 CABLING AND CONNECTIONS

A. Use the electrical service panel at each station. If required, provide a separate service sub-panel. The equipment shall be wired such that 20-amp (maximum) circuit breakers are used. Provide drawings for all sub-panels and panels. All wiring to all devices shall be grounded via wiring, not the conduits. Produce wiring diagrams showing the circuit breaker numbers, wire gauges, wire paths and connections. All panels shall be located in new, locked, weatherproof, and vandal proof cabinets. All locks shall be key type.

B. Provide PA/VMS system-wiring materials as follows:

1. Signal control and data cables.

2. Signal control and data cables shall be 22 or 24 American Wire Gauge (AWG), stranded, twisted pair, 300 V, and shielded cable.

3. All cables shall have tinned copper conductors.

4. All microphone cable shall be 2 TP, 16 AWG shielded.

C. Speaker Cable:

1. The speaker cable shall be suitable for 70.7 V public address systems and shall be a minimum of four conductor 16 AWG stranded cable.

2. The insulation of the speaker cable shall be no smoke, low halogen.

3. The cable pairs shall be two twists per linear foot, minimum. Ripcord shall be applied under jacket and follow the color-coding. The outer jacket shall be riser rated gray PVC 9 (inside wire).

4. The cable shall be UL listed MPR/CMR, TIA/EIA 568A, NEMA WC63.1a and designed to meet UL 1666 Flame Test.

5. Variations of the above listed cable may be used after review and approval by the City.

6. Furnish any additional equipment, hardware, accessories, terminal blocks, cabinets, conduits, raceway, cable trays, cables, and wire required for mechanical and electrical installation of the PA/VMS system.

7. Cables installed in underground duct-banks shall have a corrugated metallic cable shield with an appropriate sheath.

2.05 MAINTENANCE AND TESTING EQUIPMENT

A. A production unit of each major component shall be provided for maintenance, testing, and training purposes. The equipment to be provided shall include but not be limited to:

1. Two platform departure displays

2. Two connection boards

3. One PA zone and VMS controller

B. Provide special test software for system diagnostics and analysis. This software shall be included in the PA/VMS system software and shall include resident diagnostic functions that provide an authorized user, with system administration permissions, and the ability to monitor and analyze data transactions.

C. Spare Equipment:

1. Submit a list of spare parts to the City for approval. Provide spare equipment as required by the Contract spare equipment requirements.

2. Only use this spare equipment to meet schedule and spare equipment must be replaced by Contractor. Use of spare equipment shall only occur after the City review, and after testing and determining that equipment is not operational.

3. Provide equipment test reports to the City for all equipment tested.

PART 3 – EXECUTION

3.01 PREPARATION

A. Transmit submittals and deliverables required by herein.

B. Furnish products as indicated.

C. Inspect the work site to ensure there are suitable conditions to receive the work of this Section. Report noted discrepancies to the City prior to commencing the Work.

3.02 SITE INSPECTIONS

A. It is strongly recommended that the Contractor shall perform inspections of all stations where work shall be performed to determine:

B. Location of VMS, speakers, ambient noise sensors, and station controller.

C. Audio amplifier and power requirements.

D. Existence and suitability of conduits, in particular those that communicate to platforms across the tracks.

3.03 INSTALLATION

A. VMS shall be ceiling or beam-mounted. If rigid mountings are used, these shall absorb vibration and shocks.

B. PA speakers and VMS enclosures shall be of approved colors for the station by the City.

C. PA speakers shall be mounted in or near the locations specified in the drawings. Under no circumstances shall the VMS equipment be installed below the specified minimum height. All external mounting hardware shall be stainless steel or made of a City-approved corrosion resistant material.

D. Pole-mounted speakers shall have all-purpose mounting brackets that allow tilting the speaker toward the platform to adjust the sound distribution pattern.

E. Use conduits for all PA speakers and VMS cables. Where the proposed conduits cannot be reused the Contract shall propose an alternative conduit route to the City. For locations that require the installation of alternative underground conduits, work diligently with the City to request any permits that may be required for the installation of the conduits.

F. All wiring for the VMS equipment shall be new and it shall be labeled accordingly.

G. Install the required connectors, attenuators, baluns, audio isolation transformers, and inter-rack wiring between the various equipment and make all necessary connections, interfaces and cross-connections required for complete installations. All inter-rack wiring between the various components shall be shielded.

H. All electrical installations shall meet the specification requirements, NFPA 70: NEC, and all applicable city, county and/or state regulations.

I. Where the Contractor's work disturbs station aesthetics, the Contractor shall be responsible for returning any affected space to its pre-installation condition.

J. All connections shall be provided for all equipment wiring via rack-mounted interface terminal panel, connect interface carrier wiring to the proper wiring-frame terminals and, after testing both the PA/VMS system and carrier installations, complete the cross-connects on the wiring frame to the assigned carrier terminals.

3.04 GROUNDING

A. System Grounds: Ensure that the equipment is appropriately grounded. Attach to the existing ground and establish grounding where none exists.

B. Secondary system grounding conductors shall be provided from all racks, audio consoles, and non-grounded audio equipment in each area to the primary system grounding point for the area. Each of these grounding conductors shall have a maximum of 0.1 ohms total resistance.

C. The AC neutral conductor shall not be used for a system ground.

D. Verify the integrity of all grounding systems.

3.05 PA/VMS FIELD EQUIPMENT INSTALLATION

A. Install all PA speakers in or near locations indicated in the drawings for best acoustics within the audible range. The proper polarity of the speakers shall be maintained throughout the installation of each zone. Speakers of different types within the same zone shall be tapped accordingly.

B. Following completion of the installation of all equipment at a site, inspect all equipment wiring to verify that all mechanical connections are made and properly secured, all hardware is installed in its proper location, and all wiring is properly terminated. This inspection includes conductor and shield continuity and isolation verification of all installation wiring.

C. The PA/VMS workstations shall have the ability to remotely obtain control equipment diagnostic and maintenance information regarding the Passenger Information System, public address systems, and PA/VMS server. The system shall be designed such that the ability to retrieve diagnostics and maintenance information is dependent on the access rights of the individual operator using the PA/VMS workstation.

D. All PA/VMS components shall be time-synchronized from the master timeserver, as described elsewhere herein.

3.06 TESTING REQUIREMENTS

A. Prepare and submit a Test Plan that describes how the PA/VMS shall be verified to meet all requirements set forth in the Design Plans to the satisfaction of the City. Provide test, inspection and documented test results to the City sufficient to verify design and nameplate ratings, ensure proper performance, safety and reliability, and demonstrate compliance with the Contract Documents. Provide the Test Plan, for review and approval by the City, 30 days before the testing will begin.

B. Installation Testing: Test the rack-mounted PA/VMS equipment under power following approval of the installation inspection by the City. Installation testing shall demonstrate the full functional and control capability of the equipment.

C. System Testing: Test the PA/VMS system once installation is complete and the City has reviewed the inspection certification. System testing shall address at minimum:

1. Functional testing of each equipment item installed.

2. Coordination between audio and visual messages.

3. That all messages are displayed on the appropriate signs.

4. Bandwidth allocation on local or City networks is not exceeded during peak operation.

5. Demonstration of priority functions.

6. Demonstrations of all system control functions are available as specified from all control locations.

7. Provide a conformance certification that the system tests meet these Specification requirements. The City shall be allowed to witness the system tests.

D. Site Acceptance Testing:

1. Site acceptance testing (SAT) of the complete PA/VMS system shall follow completion of all contracted installation and system testing, including Control Center-based system tests. SAT shall consist of exercising the overall PA/VMS from a workstation to verify all interlocks, indications, and priority definitions including all interface levels to and from the Communication Transport System (CTS). The tests shall be witnessed by the City. Levels and distortion readings shall be taken at random locations defined by the City representative on the scene at the time of testing.

2. Test the equipment after installation to determine if it operates only when it is addressed. All VMS controls shall be exercised from the workstation to verify the correct operation of the system software.

3. Test when powering up the database schedule to bring the PA/VMS to its normal status. Test that the system will also operate locally when the output audio and push-to-talk activation is made from an external microphone and pre-amplifier wired to the

microphone input port. An operational test of the PA/VMS priority shall be made to demonstrate control priorities.

4. SAT shall be performed over a continuous 1,000-hour period without an error, and witnessed by the City. In the event of a failure, the City, in its sole discretion, reserves the right to suspend, reset, or continue running the SAT period. In the event the SAT period is suspended or reset, the SAT period shall not resume until such time that it can be clearly demonstrated that the failure triggering such reset or suspension is resolved to the satisfaction of the City.

5. All environmental testing in accordance with herein shall require written test procedures prepared by the Contractor and reviewed by the City. All environmental test procedures shall be submitted by the Contractor for review and approval by the City before the testing.

6. Provide test support upon request by the City to assist in additional testing of the PA/VMS system or equipment after its acceptance by the City.

7. Following successful completion of a 1,000-hour SAT and Construction Acceptance, a Warranty Period shall commence.

8. Be responsible for obtaining technical assistance from the equipment manufacturers and/or suppliers in cases where programming, operational adjustment difficulties are encountered.

9. Be responsible for updating training to maintenance personnel on communications equipment if new or unusual problems/repairs are discovered during the Warranty Period.

10. Be responsible for correcting problems attributable to poor workmanship and/or equipment.

11. All equipment supplied shall conform to the Environmental Requirements listed in Table 27 80 00 – 3.

Table 27 80 00 - 3. Environmental Requirements

	Equipment Room Equipment	Exterior Equipment	Interior Equipment	MIL-STD-810(F) Test Reference
Temperature	-13 to 145.4 degrees Fahrenheit	-13 to 145.4 degrees Fahrenheit	5 to 89.6 degrees Fahrenheit	501.3, II, A2 502.3, II, C1 Interior: Design Only
Humidity	5% to 95% (Note 1)	5% to 95% (Note 1)	20% to 80% Interior: Design Only	507.3, I
Rain & Tightness	Drip	Blowing No Rain		506.3, I, Blowing Rain 506.3, II, Drip
Corrosion & Contaminants	Yes	Yes	No	509.3, I, Salt Fog-Ag Screen 510.3, Blowing Dust
Voltage Input	+/-10%	+/-10%	+/-10%	Local Test
RF/Elec. Noise Interference	Yes	Yes	Yes	ANSI/IEC 801-2 Draft Interior: Design Only
Shock (20g)	11msec	11msec	No	516.4, I, Cat 1, Basic X-port 514.4, I, Cat 10, Min Integ 514.4, III, Cat 3, Loose Trans
Dry Storage Variations	-13 to 145.4 degrees Fahrenheit	-13 to 145.4 degrees Fahrenheit	-13 to 145.4 degrees Fahrenheit	501.3, I, A2 All: Design Only

Note 1: Non-condensing

3.07 ENVIRONMENTAL TEST PROCEDURES

A. The environmental requirements described in herein shall be in effect for all components unless specifically excluded by other specification sheets of this procurement document.

B. Environmental Requirements Deliverables:

1. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

2. Shop Drawings: Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

   a. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in Hawaii, who is responsible for their preparation

   b. Design Calculations: Calculate requirements for selecting seismic restraints

   c. Detail fabrication, including anchorages and attachments to structure and to supported cable trays

   d. Field quality-control reports

e. Operation and maintenance data

3.08 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within two working days of notification of the need for maintenance and support.

3.09 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: The City shall have the option of purchasing directly from the appropriate Original Equipment Manufacturer(s) (OEMs) of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5 day / 8 hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided, on site, within 24 hours of notification and on any of five weekly working days. The quotation shall include the provision of a monthly Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for all major components repair service, where each failed component is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective component and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed component unit at the Contractor's premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on a hourly basis

2. Engineering support, defined as work performed by employees not paid on a hourly basis

3. Software Maintenance support

3.10 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all software until successful completion of the 1-year warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for software shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the Contractor, on site, as a minimum, within one working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year warranty no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within this project. The City shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. Additionally, the City shall be placed, at no charge to the City, on any appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period. Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.11 TRAINING

A. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

END OF SECTION

SECTION 27 90 00

OPERATIONS CONTROL CENTER AND ANCILLARY EQUIPMENT

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Operations Control Center (OCC) Section specifies the performance requirements for the OCC facilities to be implemented by the Contractor for the Honolulu High-Capacity Transit Corridor Project (HHCTCP) system. The OCC will monitor and control all aspects of the Honolulu Rail Transit system, including Train monitoring and control functions that may be required to support the reliable operation of the transit services.

B. Section Includes:

1. Installation Requirements
2. Installation
3. Specific Installation Requirements
4. Completion of Installations
5. Contractor Installation Responsibilities
6. Maintenance during Installation, Testing, and Warranty
7. Hardware Maintenance after Warranty
8. Software Maintenance during Installation, Testing, and Warranty
9. Software Licenses
10. On-Line Demonstration Testing
11. Training

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communication Transmission System
3. Section 27 30 01 – Telephone System
4. Section 27 60 00 – SCADA System
5. Section 27 70 00 – Wireless Communications System
6. Section 27 80 00 – Passenger Information System
7. Section 27 90 01 – CCTV System

8. Section 28 13 00 – Access Control

9. Section 28 36 00 – Seismic Detection

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement of payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements, or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

The governing version of the listed documents shall be the latest as adopted and administered by the City. Included in References are standards and codes deemed pertinent to the final design of the system defined herein.

A. Americans with Disabilities Act (ADA):

1. 28 CFR Part 35 Title II Technical Assistance Manual
2. 28 CFR Part 36 Title III Standards of Accessible Design
3. 49 CFR Part 37 Transport Services for Individuals with Disabilities

B. American National Standards Institute (ANSI):

1. ANSI X3.135 Standard Database Language SQL
2. ANSI X3.124 GKS Standard
3. ANSI NCITS/J16 Standards for Programming Language C++
4. ANSI Z1.4-1993 Sampling Procedures and Tables for Inspection by Attributes
5. ANSI/ICEA S-87-640 Standard for Outside Plant Communications Cable
6. ANSI/ICEA S-80-576 Communications Wire and Cable for Wiring of Premises
7. ANSI/ICEA S-83-596 Standard for Fiber Optic Premises Distribution Cable
8. ANSI/HFES 100 Human Factors Engineering Requirements for Visual Display Terminal (VDT) Work Stations, latest version
9. ANSI/IEEE C37.90.2 Standard for Tolerance of Radiated Electromagnetic Frequency Interference (RFI)

C. Department of Defense (DOD):

1. 472F Human Engineering
2. MIL STD-781 Reliability, Test Methods, Plans, and Environments for Engineering, Development, Qualification and Production
3. MIL STD-1472E Human Engineering

4. MIL STD-2167A — Data Item Description Specification
5. MIL 810C, D, & E — Radio Equipment Temperature, Shock, Vibration, and Moisture

D. Electronic Industries Association (EIA):

1. EIA 603 — Radio Transmitters
2. EIA 204-D — Radio Receivers
3. EIA 329-A, 1 — Radio Antennas
4. EIA RS-316 — Radio Electrical Performance
5. EIA-310-D — Cabinets, Racks, Panels, and Associated Equipment

E. Electro Magnetic Compatibility (EMC):

1. EMC Emission — EN55022 Class A
2. EMC Immunity — EN50082-1

F. Federal Communications Commission (FCC):

1. CFR 47, Part 90 — Private Land Mobile Radio
2. CFR 47, Part 15 — Class A

G. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE 200 — Reference Designations for Electrical and Electronics Part and Equipment
2. IEEE 730 — Standard for Software Quality Assurance Plans
3. IEEE 828 — Standard for Software Configuration Management Plans
4. IEEE 829 — Standard for Software Test Documentation
5. IEEE 830 — Recommended Practice for Software Requirements Specifications
6. IEEE 1003.1 — Portable Operating System Interface for Computer Environments
7. IEEE 1016 — Recommended Practice for Software Design Descriptions
8. IEEE 1028 — Software Reviews and Audits
9. IEEE 1058.1 — Standard for Software Project Management Plans
10. IEEE 1012 — Software Validation & Verification Plan
11. IEEE 1471 — Software Engineering Standards Collection
12. IEEE 802 — Overview and Architecture
13. IEEE 802.1b — LAN/MAN Management

14. IEEE 802.1d Media Access Control
15. IEEE 802.1f Common Definitions and Procedures
16. IEEE 802.1g Remote Media Access Control Bridging
17. IEEE 802.1q Virtual Bridged Local Area Networks
18. IEEE 802.1p Quality of Service/Class of Service Protocol for Traffic Prioritization
19. IEEE 802.3 CSMA/CD Access Method and Physical Layer Specification
20. IEEE 802.3ae 10 Gigabit Ethernet
21. IEEE 802.3u Fast Ethernet
22. IEEE 802.11 a/b/g/n Wireless Local Area Networks

H. International Telecommunications Union (ITU):

1. H.261 ITU-T Video Coding
2. E. ITU-T G.652.D Standard for single-mode fiber

I. Internet Engineering Task Force (IETF):

1. TCP/IP Protocol suite, latest version

J. Metro Ethernet Forum (MEF):

1. Carrier Ethernet Specifications (MEF 1 thru 19)

K. National Fire Protection Associations (NFPA):

1. NFPA 72 National Fire Alarm Code
2. NFPA 130 Standard for Fixed Guideway Transit and Passenger Rail Systems
3. NFPA 70 National Electrical Code

L. NENA technical standards for 9-1-1 telephone services.

M. Telcordia (Bellcore):

1. Network Equipment-Building System (NEBS) LEVEL 3 requirements
2. TR-TSY-000020 Generic Requirement for Optical Fiber and Optical Cables
3. GR-63-CORE Earthquake Environment (Zone 1) and Office Vibration Environment
4. GR-771 Generic Requirement for Fiber Optic Splice Closures

N. Telecommunications Industry Association (TIA):

1. Project 25 102 series Digital Wireless Radio Communications

2. TIA/EIA 568-B — Commercial Building Telecommunications Cabling Standard

3. TIA/EIA 569 — Commercial Building Standard for Telecommunications Pathways and Spaces

O. Unless specifically noted otherwise herein, the latest edition of the code, ordinance, regulation, and standard that is in effect at the time the final design is initiated shall be used, to the extent that it does not conflict with the governing code as cited in the Design Criteria. Where more than one cited code, standard, or criterion is applicable, the most restrictive shall govern to the extent that it does not conflict with the governing code. If a new edition or amendment to a code, ordinance, regulation, or standard is issued before the design is completed, the design shall conform to the new requirements to the extent practical or required by the governmental agency enforcing the changed code, ordinance, regulation, or standard changed.

1.04 SUBMITTALS

A. General: Refer to General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. The OCC and a Backup OCC fully equipped, developed, installed, and tested as defined herein.

C. At least ten fully equipped, developed, installed, and tested OCC workstations plus back-up units, including all supporting documentation, as defined herein.

1. The proposed workstations are as follows:
   a. Four for OCC Dispatch Controllers
   b. One for OCC Equipment Room
   c. Two for OCC Security
   d. One for Maintenance Group
   e. Two for Backup OCC

D. Fully developed, installed, and tested OCC software, to include a graphical user interface and required hardware, for all workstations in the OCC, including all software keys, protocols, licenses, and supporting documentation.

E. Fully equipped, developed, and tested OCC database, populated with all data necessary to meet the functionality specified in this Section, including all supporting documentation.

F. Complete "As-Built" final hardware drawings and system/software architecture diagrams. The As-Built diagrams shall include a complete material list of all utilized hardware and software components, wiring diagrams and termination diagrams in hard copy and in electronic format. Text documents shall be in Microsoft Word.

G. Electronic files of all drawings. The submitted drawings shall be in AutoCAD (City latest version) format in accordance with City CAD standards. All blocks developed by the Vendor shall be prepared in accordance with City CAD Manual and shall be approved by the City. CAD files converted from other CAD packages are not acceptable. It shall be acceptable for the electronic files to be supplied on CD-ROM, as approved by the City. It shall be the responsibility of the Vendor to ensure that all the supplied electronic CAD files are free from viruses.

H. Hardcopy and electronic files of all Software Materials.

I. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

J. Shop Drawings: Show fabrication and installation details of cable trays, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1. Seismic-Restraint Details: Signed and sealed by a qualified professional engineer, licensed in Hawaii, who is responsible for their preparation.

2. Design Calculations: Calculate requirements for selecting seismic restraints.

3. Detail fabrication, including anchorages and attachments to structure and to supported cable trays.

4. Field quality control reports.

5. Operation and maintenance data.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test , install, integrate and commission the subsystems of the Operations Control Center and Equipment room to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Conditions for Quality Assurance requirements and procedures.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Quality Control:

1. Qualifications: The Work shall be performed by a professional Audio/Visual System contractor who shall provide references upon request to verify that they have experience and abilities with installation of similar systems of this size and complexity.

2. Be an authorized system integrator of the manufacturer’s equipment offered. The Contractor/subcontractor shall have manufacturer’s training and be certified and factory authorized in the installation of all PA/VMS equipment.

E. Quality of Materials:

1. All materials and equipment supplied by the Contractor shall be new and meet or exceed the latest published Specification of the manufacturers.

2. Reliability Maintainability Availability Criteria:

a. The systems shall be reliable, and shall provide full functionality in all operational and environmental conditions encountered in the Honolulu Rail Transit stations and the OCC.

b. Systems shall have a Mean Time Between Failure (MTBF) of greater than or equal to 100,000 Hours.

c. Systems shall have a Mean Time To Repair of less than or equal to 2 hours.

d. All main items of systems equipment shall employ a modular construction, and will be designed for field serviceability.

F. Warranty Statement:

1. Provide a statement of warranty on the entire system and on the individual components of the equipment. The system warranty terms and conditions must be as approved by the City. During the warranty period, provide all replacement equipment, material, and labor at no cost to the City.

2. Provide a two-hour response time for service calls during the installation and warranty period.

G. Alternate Equipment:

1. Where necessary, provide recommendations for alternative equipment that would enhance the performance and reliability and reduce complexity of the system. Provide cost comparisons for such proposed modifications to the City.

2. Examine herein and take responsibility to complete the installation and ensure that performance requirements are met. This applies to alternate equipment and non-alternate equipment.

3. Submit the following to the City for review and approval:

a. PA/VMS System Layout Drawings.

b. Functional Site Block Diagram.

c. System Integration Plan.

d. System Test Procedures.

e. PA/VMS Installation Plan shall include:

f. System Wiring Plan.

g. List of Materials - list proposed manufacturers with model or catalog numbers, identifying the materials and equipment proposed.

h. Shop Drawings.

i. Product Data Sheets and Specifications.

j. System Power and Heat Load Calculations.

k. System Test Reports in accordance with Article 3.06 herein.

l. Submit samples of any materials for review when requested by the City. Samples shall be sent to the site and stored by the Contractor.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. System Design Criteria:

1. The OCC facility shall be secured. Access to the OCC facility shall be controlled on a 24-hour basis to prevent unauthorized entry. In addition, provision shall be included for a police or security guard room in the OCC facility.

2. The OCC shall be designed to accommodate group visits, without causing undue distraction to operations or allowing unauthorized access to secure areas.

3. System expansion and upgrade shall be considered as part of the design of the OCC. Rooms shall be sized to allow for maintenance and replacement of equipment.

4. The Backup OCC facility shall meet all relevant requirements provided herein, including but not limited to construction, acoustics, lighting, finishes, environmental control (heating, ventilation, and air conditioning (HVAC)), fittings, and equipment.

5. . Identify limitations, if any, with regard to the expansion of the OCC to accommodate rail system extensions identified in the Draft Environmental Impact Statement.

6. Ensure that the OCC facilities will be accessible to people with disabilities in accordance with the Americans with Disabilities Act (ADA) guidelines.

7. The control room layout shall be designed to a high ergonomic standard. As a minimum, design shall comply with USA Standard Codes for similar facilities. The layout and/or ergonomic design of all operating desks, control equipment, overview video and data wall display systems, and other peripherals within the control room shall be determined by the workload analysis and an appropriate work environment analysis and ergonomic study undertaken by the Contractor.

8. Computer generated color renderings for the control room shall be submitted to the City for review and authorization during each phase of the design.

9. The scope of the design and Specification shall cover but not be limited to the following:
    a. Ergonomics
    b. Acoustics
    c. Lighting
    d. Finishes
    e. Color scheme
    f. Environmental control
    g. Room layout and furniture
    h. Raised floors
    i. Workstation design
    j. Overview video and data wall display and technology
    k. Security

10. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that an unobstructed section of wall-space shall be provided in the control room for the video and data wall display. The wall display shall be located to provide a good ergonomic room design and blend in with the control room environment. The video and data wall display shall be visible from all operator workstations and will provide an overview of the Transportation Master Plan. A video projection, Liquid Cristal Display (LCD) or Light Emitting Diode (LED) solution may be considered for the video and data wall display. In addition, a separate wall space shall be allocated for a bank of closed circuit television (CCTV) monitors, to support system-wide surveillance.

11. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that the control room is acoustically acceptable for the OCC application. If not, the control room shall be acoustically treated to reduce noise transmission. Window treatments shall be provided by the Core Systems Contractor if natural light glare control is required.

12. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that a raised anti-static computer floor is provided for the control room, with suitable supports to safely carry the weight of the room's contents.

13. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that a suspended ceiling-suspended anti-glare lighting shall be provided in the OCC room with recessed anti-glare lighting suitable for use with Video Display Unit (VDU).

14. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that separate climate control units for the OCC control rooms and equipment rooms are provided, as required, by the equipment manufacturers.

B. OCC Equipment Room:

1. An equipment room will be provided to house the OCC equipment. The equipment to be provided by the Core Systems Contractor and installed in this room shall include, but not be limited, to the following:
    a. Systemwide systems
    b. Furniture as required for workstations and equipment
    c. An Remote Terminal Unit (RTU) control function system to provide a control interface to the OCC building services
    d. Electrical shielding as required by the design

2. Include the layout of the equipment in the equipment room, as part of the OCC room plan.

C. Not Used

D. Not Used

E. Functional Requirements:

1. In addition to the OCC, the Contractor is to provide a Backup OCC, to be used in the event that the OCC is not available.

2. The Backup OCC shall contain all required functionality to support operation of the Honolulu Rail Transit system, such as:
    a. Train Control (ATC)
    b. Traction Power
    c. SCADA
    d. Fire Management
    e. Passenger Information Systems
    f. Telephone Systems
    g. Mobile Radio Systems (EDACS)
    h. CCTV / Security

3. All specification and performance requirement for the OCC set herein shall apply in respect to the Backup OCC, save where expressly stated otherwise.

4. The OCC shall be a functional element of the Maintenance Storage Facility (MSF) constructed under separate contract for use by operations and security personnel and related equipment. Refer to Design Criteria Chapter 18 – Maintenance and Storage Facilities, for the design criteria for this facility. The OCC shall be located on the third floor of the Operations facility as indicated on the plans. Provide a Backup OCC with all of the operational and functional features here described; location has been determined to be at the Joint Traffic Management Center (JTMC) in the City of Honolulu.

5. The communications systems designer shall utilize the space provided by the MSF Design-Build contractor to design and coordinate all elements defined in this Specification. The following elements shall be provided at the OCC to provide a complete and functional OCC as follows:
    a. Operations and security personnel workstations or console furniture that integrates Supervisory Control and Data Acquisition (SCADA), CCTV, Public Address and Variable Message Sign (PA/VMS), Fire Alarm & Emergency Evacuation announcements, radio, telephone/emergency telephone, and administrative computer equipment.
    b. Operations overview display system.
    c. Communications systems equipment room raceway, electrical distribution cable management, equipment racks, and related hardware.
    d. MSF/Yard PA system.
    e. MSF/Yard CCTV system.
    f. Intrusion and Access Control System (IACS).
    g. Raised computer floor, millwork, raceway, electrical distribution equipment, cable management, and related hardware.
    h. An equipment room for communication systems will be provided by the MSF Contractor. This space shall be utilized by the communications systems designer to house centralized communications equipment, application servers to support OCC and systemwide functions. Generally, this room is intended to include but not limited to the following type of equipment.
        1) Video and voice storage
        2) Applications servers (e.g. SCADA, PA/VMS, CCTV, MSF/Yard PA)
        3) Network equipment

4) Wireless/radio equipment

F. OCC Overview: The OCC shall consist of a central operations room accommodating the following:

1. A multi-layered data wall display for depicting the Honolulu Rail Transit Metropolitan area of operation, streets, and mapping.

2. Multi-function workstations fitted with two or more monitors; keyboard and cursor positioning device; multifunction telephone set; and radio control panel. Access to any function, system, or part of a system from a workstation for either operation or maintenance purposes, shall be strictly limited to authorized persons.

3. A bank of CCTV monitors for providing simultaneous monitoring of an appropriate number of locations, including on-board Rail Cars CCTV video.

4. Control superintendent’s podium with a multifunction workstation.

5. Not Used.

6. Not Used.

7. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that equipment room(s) housing the train control and communications equipment, OCC systems computers/servers and communications equipment, and the associated engineering management/maintenance terminals and support facilities. Provide access control to vital and commercial central computers.

8. Secure rooms and/or locations for CCTV Monitoring , Access Control System (ACS) pass production and network management operations.

9. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that equipment room(s) for housing all power supply equipment and controls are in accordance with the NEC, such as UPS, and stand-by generator for the operation of the OCC’s power facilities.

10. Administration support rooms and amenities provided under the MSF Design Build Contract.

G. OCC Networks and Network Interfaces:

1. Design a suitable and secured Local Area Network (LAN), (e.g. switched fast Ethernet) to meet the requirements of the OCC. This LAN shall be equipped with appropriate interfaces to the OCC operating room facilities, redundant interface to the communication backbone network and interfaces with the central computers of the systems necessary to supervise the Honolulu Rail Transit system and ensure its performance and safety, including the following systems:

   a. Signaling and train control system
   b. Station management systems’ SCADA system
   c. Power SCADA system
   d. Telephone system
   e. Radio communication system
   f. Emergency services radio system

g. Emergency (E-TEL) and Passenger Information Phones (P-TEL) systems
h. CCTV system
i. Station and Vehicle PA system
j. Station and Vehicle Variable Message System (VMS)
k. Security systems
l. Master clock system
m. TVM central control computer
n. City computers
o. Train Tracker system
p. Fire Alarm System
q. IACS
r. MSF/Yard PA system
s. CATV

2. The LANs at the OCC and the Yard Tower shall also be provided with suitable interfaces with the Yard Control Center network, to enable the coordinated transfer of trains between the Yard and the revenue lines.

3. A similar LAN shall be designed to support all functions of the Backup OCC.

H. Equipment Room Provisions: Engineer’s workstations shall be provided in the equipment room(s) for the management and maintenance of the OCC systems and those systems operated from the OCC. Recorders and printers shall be connected to each system to record operations and failures for historical records, failure trend analysis, and re-creation of all events.

I. OCC Operations Plan: As part of the Operating Plan in accordance with Design Criteria Chapter 2 – Operations, develop an OCC/Backup OCC Operations Plan that shall enable the safe, secure, and reliable operation of planned passenger services and management of unplanned events.

J. OCC Functions: The key functions of the OCC shall be as follows:

1. Monitor and regulate passenger train service in accordance with the timetable and institute recovery programs or manual intervention when required.

2. Manage works train operation, as required.

3. Manage planned and unplanned incidents (special event trains, people, rolling stock, fixed engineering).

4. Manage emergency and security incidents and coordinate with the appropriate services.

5. Coordinate Rolling Stock entry and exit with revenue service and during non-revenue hours.

6. Coordinate with station and other line staff in the safety interest of safety within the system.

7. Monitor Stations and Train Stops.

8. Monitor and regulate Yard operations as a back up to Yard Control Tower.

9. Coordinate fault and corrective works for the Honolulu Rail Transit system.

10. Manage track access and possessions.

11. Provide train service information to passengers and public.

12. Management of the maintenance equipment (M&E) for the Station and guideway environmental safety systems and monitoring of the associated engineering.

13. Monitoring and management of the Honolulu Rail Transit portion of the High Voltage (HV) electric power supply and traction system.

14. Accommodate programs for development, maintenance, and diagnostics.

K. OCC Facilities:

1. All central control computers of the system-wide equipment supervising the Honolulu Rail Transit system, signaling, traffic, power and control, communications, and TVM shall be located at the MSF and networked to the OCC operator facilities identified herein.

2. The TVM, ACS, Communications Transmission System, Fiber Optic Cabling Network (FOCN), and LAN systems central computers and their associated workstations shall be located in secure rooms at the OCC to facilitate management of the systems.

L. Back-Up Operation Control Center:

1. The Backup OCC shall be located at the JTMC building. The primary function of the Backup OCC shall be to ensure the continued operation of the Honolulu Rail Transit and associated traffic within the system, including all interfaces with the MSF/OCC, in the event that the OCC becomes unavailable. The secondary function of the Backup OCC shall be to provide training and software testing facilities.

2. The Backup OCC facility shall consist of a control room or an adequate workstation area for a minimum of two workstations and an equipment room at the JTMC building.

3. The Backup OCC workstations shall be multifunctional and provide the same functionality as the main OCC workstations.

4. If the OCC becomes unavailable for any reason, the Backup OCC shall take over the responsibility for safety and rescue issues within 15 minutes. For operation and supervision of the Honolulu Rail Transit system, the Backup OCC shall take over within 3 hours. For the events of this nature, the City may use qualified people from the OCC skilled staff. The Backup OCC may commence control of Honolulu Rail Transit system only after the OCC Control Superintendent releases the control priority interlock. If the interlock is not operational, release shall be possible from the Backup OCC by a Master engineering override using executive level security access code.

M. OCC: A room within the proposed O & S building shall be provided. Detailed floor plans and a suggested console layout shall be provided to the Contractor after Contract award.

Submit a Preliminary OCC Layout Plan at the time of Definitive Design Review (DDR), and a Final OCC Layout Plan at the time of Interim Design Review. For proposal purposes, the following work description shall be used. The proposed room measures approximately 39 feet by 33 feet, with a ceiling height of 10 feet. The room floor will be fitted with raised computer decking, with a raised plinth for the Supervisor positions. HVAC is provided within the entire building, and adequate AC power (with UPS back up) is available. Within this facility, the following shall be provided:

1. Raised computer flooring will be provided over the entire area. An area approximately 78 feet wide and 33 feet long will be installed with a floor height of approximately 12 inches. The first area is for the equipment room. The adjacent area is for four Operator consoles and three Supervisor consoles.

2. Provide and install four Operator consoles. The Operator consoles shall be functionally identical, and each of the consoles shall be configurable into either an Operator or a Supervisor console, essentially with the only difference being the level of access allowed.

3. Supply a multi-layered data wall display for depicting the Metropolitan area of operation, streets, and mapping in the OCC interfaced to the consoles and workstations.

4. The size and height of the displays shall be determined by studying the site and taking into account all the ergonomics of the system and local. A minimum of six 50-inch flat panel LCD configuration will be considered.

5. Supply two operator consoles for the CCTV operation similar in design to the operation and control consoles except only two monitors will be provided per workstation.

6. Provide and install wall mounted displays for the CCTV operations and monitoring. The size and height of the displays shall be determined by studying the site and taking into account all the ergonomics of the system and local. A minimum of six 50-inch flat panel LCD configuration will be considered.

7. The consoles shall be of modular design with individual equipment modules built into the consoles such that each workstation component shall be easily accessible for service. Each of the consoles shall include four displays, as follows:
   a. The four displays shall be mounted in a side-by-side arrangement integral to the console and capable of being raised vertically and tilted.
   b. Each display shall be a minimum of 23-inch flat-panel configuration.
   c. Each display shall be configurable for split-screen operation, where up to four smaller images may be displayed on each display screen.
   d. An accessible drawer or drawers shall be provided for forms, file folders, and other supplies.
   e. The consoles shall be wheelchair accessible with clearances below the work surface of at least 26 inches vertically and 32 inches horizontally. At least 15 inches of horizontal clearance shall be provided between the knees of an operator seated at the console and any vertical obstruction in front of the seated operator. All edges and corners of the consoles shall be rounded. Visible surfaces shall have a matte finish to reduce glare.

f. The console design shall permit the height and tilt of the keyboard supporting structure to be adjusted independent to the console work surface, with a maximum tilt adjustment of 20 degrees from the horizontal. The keyboard supporting structure shall be sized to accommodate the keyboard, a mouse and mouse pad, and a wrist rest/support pad.

g. Each console shall be provided with a minimum of four unused 20-amp 110-VAC grounded outlets. All workstation wiring and cabling shall be neatly tied and bundled, and concealed as much as possible.

h. Each console shall be provided with a heavy-duty operator chair, designed for use in a 24-hour/day environment by different personnel. The chair shall be fully adjustable, and the seat shall adjust pneumatically from 16-1/2 inches to 20-1/2 inches. The back shall have an adjustable lumbar support, a back angle adjustment, a seat tilt mechanism, and adjustable sloped arms. The base of the chair shall be configured with at least five spokes, each with a swivel caster.

i. Each Dispatcher/Supervisor Workstation shall be provided with a wireless mouse and keyboard.

j. The console shall be equivalent in form, fit, and function to the “Response” Sit-Stand consoles available from Evans Consoles, Inc., of 1616-27 Avenue North East, Calgary, AB, Canada T2E 8W4. The Evans WEB site may be found at <www.evansonline.com>

k. Install the consoles at the OCC, in accordance with a layout and installation plan to be developed in conjunction with the City.

l. Provide and install a video wall display unit consisting of four 50-inch Digital Light Processor monitors. The monitors shall be equivalent in form, fit, and function to the 50-inch front access display cube model VS-50XLF20U available from Mitsubishi Digital Electronics America, Inc., 9351 Jeronimo Road, Irvine CA 92618. The Mitsubishi WEB site may be found at www.mitsubishi-megaview.com. Provide appropriate controlling devices such that any image visible on any operator console can be duplicated on the large-screen display. Install the display at the OCC, in accordance with a lay-out and installation plan to be developed in conjunction with the City.

m. Provide and install a color laser jet printer capable of producing high quality color photograph images, in accordance with a lay-out and installation plan to be developed in conjunction with the City. The color printer shall be equivalent in form, fit, and function to the HP Model 5550N.

n. Provide and install a LAN and associated equipment server configured to provide an interface between the consoles and the Central Office Facility.

o. The City will provide a dedicated circuit breaker for each of the four consoles, and the video wall display unit in accordance with the voltage and current requirements to be specified by the Contractor. Provide and install the necessary power cables and connections in accordance with a lay-out and installation plan to be developed in conjunction with the City.

p. The requirements of the ADA shall apply to the design of the OCC and its component furniture, equipment, and accessories.

q. Raised computer flooring will be provided over the entire area, with a floor height of approximately 12 inches.

r. Design, procure, and install all that necessary central office equipment required to serve the functionality of the CCTV surveillance system. The actual equipment descriptions, specifications, and installation details shall be in accordance with a lay-out and installation plan to be developed in conjunction with the City

s. The MSF camera sites have been selected on a preliminary basis. After the Contract has been awarded, conduct an in-depth review of the MSF and design and provide a CCTV surveillance system with the appropriate number and placement of cameras.

t. The MSF PA sites have been selected on a preliminary basis. After the Contract has been awarded, conduct an in-depth review of the MSF and design and provide a PA system with the appropriate number and placement of speakers per PA specifications provided in Section 27 80 00 – Passenger Information System.

u. At the OCC, the GigE communication system will send images from the cameras to one 21-inch segmented display monitor (to be provided under this Contract and delivered to the City at the OCC). The City will mount this display within existing furniture at the OCC.

v. Provide the interface cables and devices to provide a connection between the station equipment and the switch or switches that provide connectivity to the Honolulu Rail Transit GigE system.

w. The actual equipment descriptions, specifications, and installation mounts and details shall be in accordance with a Layout and Installation Plan to be developed in conjunction with the City.

N. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the Operations Control Center, Backup OCC and Ancillary Equipment.

2.02 EQUIPMENT

A. The OCC furniture, consoles, and workstations shall be designed with an appropriate life expectancy to avoid the need for reconfiguration during the system life cycle.

1. All materials and components used shall have a proven record of successful use in the transit industry, and be in use with other transportation operators.

2. The equipment, materials, and cables shall be selected and designed to operate safely, reliably and efficiently in the environment for the Design Life. The design shall facilitate easy maintenance without disrupting services, including hot backup or fault tolerance.

3. Standardization of equipment and inter-changeability of components performing similar functions shall be provided to every extent possible. Operator workstations in the control room shall be capable of carrying out the functions of other workstations to ensure maximum back up in the case of special events or emergencies.

4. All system interfaces shall use recognized standard protocols. Submit all interface protocols to the City for review.

5. All system clocks shall be synchronized to the master clock.

B. Environmental Conditions:

1. The Core Systems Contractor shall coordinate with the MSF Design Build Contractor to ensure that HVAC provided in the OCCwill provide adequate environmental control such that the equipment does not exceed maximum recommended operating temperatures.

2. The equipment shall be designed to be compatible with the electromagnetic environment. It shall be able to withstand any shocks and vibrations that may be caused by foreseeable factors such as road works, earthquakes, heavy road and air traffic, and according to the climatic report of the State of Hawaii.

C. General: All equipment and components provided to comply with herein shall be manufactured of the grade and quality of materials that comply with all Standards and Codes listed herein, including IP rating, that are appropriate for the type and location of service for which it is intended, and for the design life specified in the RFP Plans.

D. Control Room Principal Equipment: Control room principal equipment shall consist of the following:

1. Video and data wall display

2. Operator workstations fitted out to meet the requirements defined herein

3. Bank of CCTV monitors

E. Equipment Room Principal Equipment:

1. Equipment room principal equipment shall consist of the following:
    a. Central computers and engineers workstations for:
        1) Data wall processor
        2) Signaling and train control system
        3) Control and communications systems (FOCN, radio, telephone, power and station management system, SCADA, PA, CCTV, fire detection and alarm, VMS, and clock system)

2. Power Supply Room Principal Equipment: Power supply room principal equipment shall consist of the following:
    a. Distribution panels provided under the MSF Design-Build contract
    b. UPS
    c. Alarm / monitoring functions

F. Secure Room's Principal Equipment: Secure room's principal equipment shall consist of the following:

1. Central computers and engineers workstations for:
    a. TVM
    b. ACS
    c. LAN
    d. FOCN

2. With the exception of the data wall display and number of workstations, similar equipment shall be in the Backup OCC. Instead of a wall display, the Backup OCC workstations may be equipped with multiple monitors.

G. Local Area Networks at OCC and Backup OCC: The LAN shall be of sufficient capacity data transfer speed to provide efficient operation. It shall be designed to provide fast service to the workstations enabled for different OCC functions using high-speed dedicated servers. Duplicated LAN's shall be provided with a combined minimum availability of 99.999 percent. Interfaces with other networks, workstations, printers, and other devices shall employ standard protocols.

H. Workstations/Interoperation:

1. Control room workstations shall be designed so that any single workstation may take over the functions of another. All the systems shall be integrated operationally. The integration level shall be total so that each display can access, monitor, and control relevant to the Honolulu Rail Transit systems. The integration shall provide redundancy of Man Machine Interface and a direct connection of the system with the video and data wall display as a minimum.

2. The designs of the desks and chairs to be used with the different types of workstations shall be included in the room program to be submitted to the City for their review, during the Final Design submission deliverables.

I. Video and Data Wall Display:

1. A programmable multi-layered video and data wall system shall be provided in the OCC room. It may be based on a video projection scheme, if this approach is found to be the optimum solution. This display shall include the Honolulu Rail Transit track layout, the traffic light system, road, streets, and lanes and will contain the following information, as a minimum:
   a. Honolulu area corridor mapping and Honolulu Rail Transit system alignment
   b. Honolulu Rail Transit system track layout with a mimic of the signaling system route setting and information, real time train location with description, and alarms
   c. HV power supply and traction system status and alarms
   d. CCTV display of public locations at the stations, parking lots, and equipment rooms, as required
   e. E-TEL point alarms
   f. Static data
   g. Communications layout display with status and alarms
   h. Event log display

2. Provide a system that is sized to be clearly visible and legible from any operator position. The system shall be of ergonomic design, based on the Contractor's ergonomic study and be consistent with the VDU graphic displays in orientation, symbols, color scheme, and layout. Submit the above for approval of the City.

3. The images from adjacent displays shall blend seamlessly with each other with no loss of information.

4. The video and data display system shall have a MTBF greater than 30,000 hours of operation.

5. The display presentation for the overview display system shall be easily configurable and modified and be able to support resolutions of 1,280 x 1024 pixels or greater.

The display technology proposed shall also be able to display computer graphics from the VDU and accept video signals from the CCTV system to allow real time video images to be displayed on the wall display system.

6. The video and data wall shall be dynamically updated so that they display the latest available data.

7. The system shall provide facilities for setting the brightness and contrast to provide a uniform display over the whole data wall.

8. The choice of the wall display system technology shall be subject to the review of the City.

J. MSF/Yard PA system: The MSF/yard PA system shall be fully integrated. The audio messages from all sources shall be delivered to designated speaker zones within MSF building, MOW, Storage Facility and yard zones. Message sources include, but are not limited to, the following:

1. MSF/Yard PA system shall be compatible with the PA system specified in Section 27 80 00 – Passenger Information System. The systems shall share resources where applicable (i.e. database etc.)

2. Manually selected prerecorded messages stored within a database.

3. Scheduled prerecorded messages stored within a database.

4. Ad-hoc prerecorded messages stored within a database.

5. Live announcements made directly from the Tower and/or Administration offices microphones (i.e. at console workstations).

6. Announcements made directly from Fire Alarm Control Panels (FACP) microphones.

7. Announcements made directly from two spare microphones interfaces, to be provided in the system.

8. The system should have the capability of expanding seamlessly to include the capability to trigger prerecorded message externally.

K. Printers:

1. The OCC and other operations facilities as required shall be provided with the following printers:
   a. Event log line printers for the logging of information
   b. Laser page printers for generation of reports
   c. Color page printers for generation of graphical displays from the VDUs
   d. The backup OCC shall be equipped with one multifunctional printer

2. In addition, propose, recommend, and provide additional printers, if required to support operations. The printers shall support both English and up to as many as five other language scripts defined by the City.

3. The color hard copy page printers shall enable high quality color prints to be made of the contents of a VDU screen. They shall be connected to the OCC network, so that

a screen print can be made from any operator workstation. Line printers are typically dedicated to specific systems such as SCADA/fire alarm system.

L. Not Used.

M. Spare Capacity: The equipment at the OCC and the Backup OCC shall be designed with spare capacity, to allow for expansion capability as identified in the EIS without degradation of system performance.

N. Expansion Capability:

1. Expansion capability typically takes the form of spare rack space, back-plane wiring, and/or interface connectors. Where equipment is of a modular nature, which can have its capacity increased by addition of discrete elements, spaces and connections shall be provided for future expansion.

2. Where equipment cannot have its capacity increased, then the initial installation shall be sized with capacity to suit the future expansion of the system. Include a provision for 50 percent expansion above the initial requirement.

O. Performance Criteria:

1. Design and construct the OCC and Backup OCC functions to ensure that the Quality Criteria specified herein are met.

2. The systems assurance plan for OCC and Backup OCC systems shall be in accordance with requirements detailed herein and in related sections.

3. Define the necessary vital systems for safe secure operation of the Honolulu Rail Transit system.

P. Availability and Reliability: OCC and Backup OCC systems shall be designed for a minimum operational life of 15 years, based on the equipment being in continuous use, with a minimum availability of 99.99 percent.

Q. Response Times: Submit the following performance parameters of the proposed system to the City for their review:

1. Update time interval of digital status and analogue/metering values at the operator workstation from a change of status in the field.

2. Control response time measured from the time of activation at the workstation to equipment operation in the field, and the notification at the same workstation on the status of the control action.

3. The conditions and methods of measurements for which the parameters are valid shall be clearly defined.

R. Electromagnetic Compatibility: For EMC requirements refer to the related standards and codes listed in Article 1.03 herein.

S. Software: For software assurance, refer to the related standards and codes.

T. Testing and Commissioning: The Testing and Commissioning Plan for the OCC and the Backup OCC shall be in accordance with the appropriate Standards and Codes.

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Install all equipment furnished under this Contract. Provide on-site field engineering to supervise, and technicians to perform the installation. All Work shall be performed in a manner adapted to local conditions and best calculated to promote quality installation, to secure safety to life, person, and property, to assure a safe and continuous operation of the City, and to reduce to a minimum interference with the public and with other contractors in or about the property. Provide preliminary documentation at DDR on installation practices, tests, and quality control procedures of each component of the CCTV Surveillance system. Provide final documentation on the results of the application of these installation practices, tests, and quality control procedures after completion of the installation at each City facility.

3.02 INSTALLATION

A. Monitors, wall mounted LCDs and related equipment shall only be installed in accordance with installation plans that have been previously approved by the City. Provide all mounting hardware, cables, plugs, and accessories. Installation shall not commence until appropriate installation plans have been reviewed and approved by the City.

1. Site availability for equipment installation: The City will make its best endeavors to have sites available for installation, however the City shall not be held responsible for any necessary or untoward unavailability of sites.

2. Installation Planning: The Monitors, wall mounted LCD installations shall be planned such that the minimum of disruption of service shall occur to City operations. The installation plan shall consist of four steps: development of an installation plan and schedule, a description and plans of the work to be accomplished, approval by the City, and accomplishment of the equipment installation.

3. Develop the detailed Site Installation Plan(s), schedule, and installation drawings for each facility. These plans shall be submitted to the City at least 30 days prior to the commencement of any installation.

4. The City shall grant approval to each Site Installation Plan within 10 working days of receipt of each Plan.

5. Installation work shall not commence at any site until and unless specific written notice has been received of the City approval of each specific Site Installation Plan.

6. Each installation shall be accomplished in accordance with the relevant Site Installation Plan. Any deviations or changes to each relevant Site Installation Plan shall be coordinated with the City and agreed to by the City in writing.

3.03 SPECIFIC INSTALLATION REQUIREMENTS

A. Equipment installations shall be done in a professional and workmanlike manner and in accordance with all applicable codes and good engineering practices.

1. All components and related equipment shall be connected by means of CAT-5e/CAT-6 cable, with power being supplied integral to the CAT-5 cable. At those

sites where cable lengths preclude the use of CAT cable, obtain specific approval from the City, in writing, allowing the deviation.

2. All equipment racks and cabinets, and individual equipment shall be grounded. In this connection, the Contractor is to take special note of the presence of high ground currents near the energized rail tracks, and take appropriate steps to avoid ground loops and consequent equipment damage.

3. All main equipment racks shall be connected to suitable breaker panels to be provided by the City. All electrical wiring and connections shall be properly made and installed, and properly terminated.

4. All equipment installed in the equipment room is to be isolated and braced in at least 2 different directions to meet seismic and bolted with a minimum of 3/8 inches or larger anchors (Still required to have a seismic PE sign off on meeting the seismic requirements of bolt your particular racks.) with nylon washers and sleeves to maintain isolation from the building floor/rebar. Isolation mat between the footprint of the rack and the floor will be required to maintain isolation.

5. There should be cable tray in the room with 6 OT ground cable throughout the cable tray. The cable tray should be up to Honolulu seismic standards. The cable tray should be continuously bonded and grounded to the ground bus bar in the room. This would help each system contractor installing equipment to splice to the 6 OT in the cable tray. Typically, the cable tray is isolated. Utilization of dog ears with isolation grommet and at a minimum of 3/8 inches strut or larger in two different direction anchoring the top of the racks to maintain seismic (Still required to have a seismic PE sign off on meeting the seismic requirements of bolt your particular racks.) and electrical isolation. Multiple cabinets of the same system can be bolted together to make a large more stable footprint but the corners at the top still would need dog ears with isolation grommets to meet seismic and isolation requirements.

6. All System Printers, workstations (SCADA, CTS, FOCN, MDS, CTS, PA/VMS, Radio, Wireless, etc.) and the Central Processor Workstations shall be synchronized to the Master Time Base (MTB) so that the alarm indications on the screen and the print out would match.

7. PA bezels and OCC/Ancillary Equipment/Backup OCC/Yard/Shop enclosures and consoles and workstation consoles will be the approved color for that location if the colors are different of each location to match the aesthetics of that particular station.

8. All CCTV/Intrusion/ACS/PA cable shall be physically protected and supported and shall be installed in a manner to prevent vandalism i.e. flex/conduit when installed in a public area.

9. As necessary, provide drawings that indicate the locations of each component of the CCTV surveillance system, location of wiring runs, conduit and interconnect points, and other pertinent details. Loose wiring or wiring not properly contained in a trough, conduit, or raceway shall not be acceptable.

10. Conduct the installation of equipment such as to ensure the minimum of disruption to City operations. In the event that equipment down time is required, it shall be accomplished at the time of the midnight shift, and the City shall be given at least 48-hours notice of the time and duration of the proposed down time. In no circumstances shall any City equipment be placed out of service without prior written

permission from the City. Work shall be coordinated with the appropriate City entity.

11. The Contractor is encouraged to propose installation methods that will simplify the installation process.

3.04 COMPLETION OF INSTALLATIONS

A. Provide an “as-built” checklist for each individual City site that lists all components removed, installed, or modified at each site. For each component, model, type numbers, and serial numbers shall be provided as appropriate. The checklist should also show completion of tests and appropriate acceptance signature blocks. The satisfactory accomplishment of this checklist shall be an inherent part of the Contractor Quality Control process. Where appropriate, City acceptance signatures should also be included. The date of acceptance of the completed “as-built” checklist by the City for a particular site shall act as the date of commencement of beneficial use of that site. These provisions shall flow down to any installation subcontractor.

3.05 CONTRACTOR INSTALLATION RESPONSIBILITIES

A. Install all equipment, systems, and parts thereof. Damage caused by the Contractor shall be immediately reported to City, and damage so caused shall be repaired by the Contractor at the expense of the Contractor. If the Contractor fails to repair the damage within 30 days of its occurrence, City may undertake the repair and withhold such moneys from any balance due and/or seek reimbursement to cover the repair costs.

B. After installation or modification, ensure that the site is clean and free from trash, metal shavings, grease marks, and water leaks.

C. Database responsibility: Undertake the responsibility for installing, correcting, and updating the provided software and databases provided by the Contractor. Work closely with the City and other database users or providers to determine the scope and extent of any correctional or update work required to ensure complete and seamless integration between these other databases and the provided system.

D. Installation of data, computer software, and files: Load all data, computer software, and other information into the system. As appropriate, City will provide files in existing formats for the use of the Contractor, including files current at the time of cut-over.

E. Software system set-up: Initially set up the system and for entering and loading all required data into the system, including but not limited to the following:

1. Defining the hardware and software configuration:
    a. Defining the user functional partitions
    b. Defining the data required for all data bases
    c. Defining the routing of event and incident reports
    d. Defining the priorities of event and incident actions
    e. Setting the initial values for all user-adjustable parameters
    f. Setting the initial values for thresholds
    g. Entering all communication interface parameters
    h. Downloading all aid, help, and procedure files

F. Install or modify all equipment, systems, and parts thereof in accordance with the requirement of a complete turnkey system installation. The Contractor is fully responsible for installing a completely operational system at the Contract price. Provide all labor, materials, parts, cables, required signs, software, documentation, instructions, warranty, and maintenance in accordance with the intent of herein.

3.06 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Maintain and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within two working days of notification of the need for maintenance and support.

3.07 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: City shall have the option of purchasing directly from the appropriate Original Equipment Manufacturer(s) (OEMs) of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5 day / 8 hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and shall request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for all major components repair service, where each failed component is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective component and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed component unit at the Contractor's premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on a hourly basis

2. Engineering support, defined as work performed by employees not paid on a hourly basis

3. Software Maintenance support

3.08 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Maintain and support of all software until successful completion of the Standard warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for software shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the Contractor, on site, as a minimum, within 1 working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year warranty, no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within the Work. The City shall be placed on the Contractor’s mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. In addition, the City shall be placed, at no charge to the City, on any appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period.

Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.09 SOFTWARE LICENSES

A. Routine use of software: Issue to the City a non-transferable, non-exclusive license to use the supplied software and training video(s) on a restricted rights basis. A copy of this Software License shall be furnished together with the response to this Statement of Work (SOW). It is understood that this Software License shall apply to executable code only, and that the source code for Software shall not be provided except as by the following paragraph.

B. Software escrow: In the response to this SOW, agree to deposit application software source code, written by the Contractor, in a third party escrow account. This action will enable the City to continue basic operation and maintenance of such software in the event that the Contractor fails to continue support for the software and does not provide for such support by a third party. In such event, the City agrees to maintain the confidentiality of the source code. The Contractor shall maintain the escrowed software to assure that the escrowed version incorporates any Contractor's updates to the software. The Contractor shall annually certify to the City that the escrow version of the software is current with all appropriate updates. This annual certification shall commence upon Final Acceptance and shall be provided each January for a period of 10 years.

C. Acceptance Testing:

1. This SOW requires the completion of all work to the satisfaction of the City. Carry out all tests required to demonstrate compliance with this SOW and that the CCTV Surveillance system is fully operational in all respects. As required, provide an overall Acceptance Test Procedure (ATP) at the time of DDR, and individual ATP for individual components of the system at least 30 days prior to the test date(s). After City approval, these individual ATP tests shall be conducted and the results documented. Once the entire CCTV surveillance system is installed and operational, On-Line Demonstration Testing shall be conducted. After the completion of all tests, and the delivery of all Contract deliverables, Final Acceptance shall occur.

2. Technical Documentation Requirements: Provide the following technical documents:

   a. Preliminary documents: the following information is to be presented no later than 60 days of notice to proceed (NTP).

   b. Block Diagrams: Drawings showing major system components for each installation site, with site layout details as appropriate and proposed location of all Contractor provided equipment in the various equipment rooms.

   c. Product Data: Manufacturer's catalog cuts, material specifications, installation instructions, and other pertinent product data.

3.10 ON-LINE DEMONSTRATION TESTING

A. Testing Requirements: On-Line Demonstration Testing shall provide definitive proof that the CCTV surveillance system is providing the surveillance services at the accuracy and quality requested herein, and that the installed system is capable of meeting the long-term reliability and performance requirements of herein. As a minimum, conduct the following tests:

1. Visibility of on-screen displays of images, and overlaid status or alarm symbols. Verification of change of status indications on these symbols

2. Capabilities to set and reset system parameters

3. System well-being monitoring, malfunction alarms, and associated displays and alarms

4. Verification of all reporting and data-collection functions

5. Quality of images reproduced by color printer

6. Such other tests as the City perceive as being important to demonstrate the successful installation of the system, and that the system is ready, in all respects, for operation

B. Testing Organization and Timing: Provide a written description of the methods, procedures, and anticipated time and City facility and personnel requirements for the accomplishment of the On Line Demonstration Tests, at least 60 days prior to the planned start of the tests. Coordinate with the City for the accomplishment of tests, provision of test objects or personnel, City personnel to witness the tests, and the date or dates and timing for the accomplishment of the tests. All test reports shall be submitted within 10 days of completion of the test(s).

C. Final Acceptance Test Report:

1. Occurrence of Final Acceptance Test: Final Acceptance Test shall occur upon completion of the following:
   a. Completion of Preliminary Acceptance Tests by the Contractor
   b. Completion of Preliminary On-Line Demonstration Testing
   c. Completion of all remedial work required because of the discrepancies or faults discovered during the Preliminary Acceptance Tests and On-Line Demonstration Testing
   d. Completion of Final On-Line Demonstration Testing

D. The Final Acceptance Test Report shall consist of a document, signed by the City, certifying that all the steps outlined above have been completed acceptably, and that:

1. All milestone completion dates have been met

2. All deliverables are complete and have been approved

3. All source code, object code, and data files are complete

4. The City has received all written documentation, drawings, technical and other manuals, and all other deliverables within this procurement

5. All training has been completed

6. All applicable software licenses have been issued and delivered to the City

7. All applicable warranties and guarantees have been delivered to the City

8. Hardware and software maintenance agreements have been concluded with the City

3.11 TRAINING

A. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

END OF SECTION

SECTION 27 90 01

CCTV SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section includes a Closed Circuit Television (CCTV) surveillance system that will provide effective surveillance of all Honolulu High-Capacity Transit Corridor Project (HHCTCP) properties, Maintenance and Storage Facility (MSF), ancillary buildings and yard, train stations, platforms, parking lots, and vehicles. The CCTV surveillance system will be based on existing proven technology and the use of freely available Commercial Off-The-Shelf (COTS) equipment. The procured system will be capable of easy and cost-effective growth toward a seamless future system expansion.

B. Section Includes:

1. Installation Requirements
2. Installation
3. Specific Installation Requirements
4. Completion of Installations
5. Installation of Central Office and PMF Equipment
6. Contractor Installation Responsibilities
7. Warranty
8. Hardware Maintenance during Installation, Testing, and Warranty
9. Hardware Maintenance after Warranty
10. Software Maintenance during Installation, Testing, and Warranty
11. Software Licenses
12. List of Installation Milestones Including Project Schedule
13. On-Line Demonstration Testing
14. Documentation and Training

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communication Transmission System
3. Section 27 30 01 – Telephone System
4. Section 27 60 00 – SCADA System
5. Section 27 70 00 – Wireless Communications System

6. Section 27 80 00 – Passenger Information System

7. Section 27 90 00 – Operations Control Center Ancillary Equipment

8. Section 27 90 02 – Station Local Area Network (SLAN)

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. The governing version of the listed documents shall be the latest as adopted and administered by the City and County of Honolulu. Included in the following References are additional standards and codes deemed pertinent to the final design of the system defined herein.

B. Reference Source A: This technical recommended practice has taken input from the following publications:

1. APTA CCTV placement standard for transit applications; APTA S-FS 002-07 (June 07)

2. BSI EN 50132-7 CCTV Surveillance Systems for Use in Security Applications Guidelines

3. CCTV Systems –Operational requirement analysis – Merseyside Police (UK)

4. Digital Imaging procedure – UK PSDB (March 2002)

5. IEEE 1473, T, L and E (2002) (E will be introduced as of Dec 07)

6. ISO/IEC/JTC1/SC29 WG11 Coding of Moving Pictures and Audio

7. National code of practice for CCTV systems for mass passenger transport sector for counter terrorism (2006) – Council of Australia Governments

8. SWGIT document on recommended guidelines for the use of cameras and recording systems in law enforcement applications Version 2.1 2004.07.22

1.04 DEFINITIONS

A. B Frames: In older standard designs (such as MPEG-2); B pictures are never used as references for the prediction of other pictures. As a result, a lower quality encoding (resulting in the use of fewer bits than would otherwise be the case) can be used for such B pictures because the loss of detail will not harm the prediction quality for subsequent pictures. In older standard designs (such as MPEG-2), use exactly two previously-decoded pictures as references during decoding, and require one of those pictures to precede the B picture in display order and the other one to follow it. Typically require fewer bits for encoding than either I or P pictures.

B. CIF: Pixel resolution of a video image.

1. CIF: PAL video is 352X288 pixels; NTSC video is 352X240 pixels.

2. 2CIF: PAL video is 704X288 Pixels; NTSC video is 704X240 pixels

3. 4CIF: PAL video is 704X576 pixels; NTSC video is 704X480 pixels

C. Cat5: Category 5 cable includes four twisted pairs in a single cable jacket. This use of balanced lines helps preserve a high signal-to-noise ratio despite interference from both external sources and other pairs (this latter form of interference is called crosstalk). It is most commonly used for 100 Mbit/s networks, such as 100BASE-TX Ethernet.

D. Codec: A codec is a device or program capable of performing encoding and decoding on a digital data stream or signal. The word codec may be a combination of the following: ‘Compressor-De-compressor’, ‘Coder-Decoder’, or ‘Compression/Decompression algorithm’.

E. Field: In interlaced video only, in which a frame consists of two fields, the "top field," which is the odd numbered rows, and the "bottom field," which is the even numbered rows. The two fields are displayed alternately. This is called interlaced video. Two successive fields are called a frame.

F. FOV: The ‘field of view’ is the area of a scene, observed by a camera and lens combination and measured both horizontally and vertically, that can be seen through the camera. Differing lenses can be configured for wide angle FOV or Narrow FOV depending on requirements and is measured as a ratio of the min and max ranges of the FOV in either degrees (angular) or mm’s (linear).

G. Frames: In film, video production, animation, and related fields, a frame is one of the many still images that compose the complete moving picture.

H. I Frames: I-frames are used for random access and are used as references for the decoding of other pictures. Intra refresh periods of a half-second are common on such applications as digital television broadcast and DVD storage.

I. P Frame: In older standard designs (such as MPEG-2, use only one previously-decoded picture as a reference during decoding, and require that picture to also precede the P picture in display order. In H.264, can use multiple previously-decoded pictures as references during decoding, and can have any arbitrary display-order relationship relative to the picture(s) used for its prediction. Typically require fewer bits for encoding than I pictures.

J. PKI: Public Key Infrastructure, A framework for creating a secure method for exchanging information based on public key cryptography. The foundation of a PKI is the certificate authority, which issues digital certificates that authenticate the identity of organizations and individuals over a public system such as the Internet.

K. Pixel: A pixel (short for picture element, using the common abbreviation "pix" for "picture") is a single point in a graphic image.

L. Rotakin: CCTV Video Target developed by UK Police Scientific Development Board for testing CCTV system level performance and resolution capabilities, including playback and recordings, end to end. Also known as Rota test.

1.05 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Shop Drawings: Submit Shop drawings for CCTV each surveyed site, containing the following information:

1. Schematic flow diagram of system showing location of each CCTV camera and accessories.

2. Label each control device with setting or adjustable range of control.

3. Wiring diagrams indicating all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

4. Logic diagrams showing sequence of events and their relationship.

5. Provide details of faces of control panels, including controls, instruments, and labeling.

6. Include sequence of operation.

C. Product Data: Submit manufacturer's technical product data for each control device furnished, with certificates of compliance, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

D. Samples: Submit sample of each type of furnished CCTV camera.

E. Operation and Maintenance Data: Submit manufacturer's operating and maintenance instructions for all items of equipment.

1.06 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test, install and commission the CCTV System to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Condition for Quality Assurance requirements and procedures.

C. Field Quality Control:

1. Tests and Inspections:
   a. Comply with manufacturer's written instructions.
   b. Inspect interiors of enclosures, including the following:
      1) Integrity of mechanical and electrical connections
      2) Component type and labeling verification
      3) Ratings of installed components
   c. Inspect cameras and accessories according to requirements in International Electrical Testing Association Acceptance Testing Specifications.
   d. Test manual and automatic operational features and system protective and alarm functions.

2. The CCTV system will be considered defective if it does not pass tests and inspections.

3. Record of Tests and Inspections: Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

4. Prepare test and inspection reports.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. System Design Criteria:

1. The CCTV system shall consist of cameras, displays, application servers, video storage, and related equipment and software shall be provided systemwide at facilities specified. The system design shall consist of the following functional elements:

2. High availability application servers, database servers, and related software for viewing, control, and administration of all cameras.

3. Fixed and PTZ cameras for operations and security purposes.

4. Video storage, retrieval, and archiving equipment.

5. Train to wayside interface for car-born cameras to support real-time on-demand video routed to the OCC.

6. Two exterior cameras on car, one in the front of the car and one in the rear for real time wayside and track monitoring from the OCC.

7. Car-born camera recording equipment and storage with immediate retrieval capability at the OCC.

8. Monitors located at the OCC, all station manager booths, and the capability of a third remote location to be utilized by law enforcement.

9. Wall-mounted video display bank at the OCC such that each station video can be displayed in a pre-determined polled manner in a manner that satisfies the operational requirements of the City.

10. Activation of an E-TEL telephone in the station, a T-TEL in the train and/or an Intrusion Detector system shall trigger an alarm and automatic selection of the camera with the best view of the area. This image shall be displayed in a user selectable view.

11. A COS shall be provisioned on the CTS network to support low-jitter, low-latency network parameters required for video services.

12. System shall be designed to provide a minimum resolution of 4 CIF at 15 fps from all cameras.

13. System shall be IP based and use the MPEG 4 protocol, H264 will also acceptable for transmission on the CTS network.

B. Cameras:

1. Resolution: As required to support Safety and Security Design guidelines.

2. Shall all be solid-state, state-of-the-art and produce a noise free picture with no geometric, pixilation, or other distortions.

3. Shall provide a usable video signal over the entire specified range with a minimum scene illumination of 0.010 foot-candles.

4. Shall be housed in a corrosion-resistant, vandal resistant environmental enclosure with flexion inhibiting shatterproof glass and a polycarbonate viewing port. Enclosures shall be weather-proofed when installed in an exposed environment.

C. Passenger Stations Fixed Camera Locations:

1. Placed to view all areas of all platforms.

2. Placed to view platform emergency exits.

3. Placed to view all stairs and escalators.

4. Placed to view elevator cabs and doors.

5. Placed on all pedestrian bridges.

6. Placed to view street/concourse level areas such as: Ticket Vending Machines, Passenger Assistance Telephones, and Fare Gates.

7. Placed to view interior of all access controlled doors.

8. Placed to view rail/platform area such as: To provide an alarm should train rail/platform train right of way be obstructed.

9. Placed in accordance with Design Criteria Chapter 25 - System Safety and Security.

D. Parking Facility Pan Tilt Zoom (PTZ) Camera Locations:

1. Placed to view park and ride lots and passenger drop-off points. The minimum quantity shall be two cameras.

2. Placed to view transit centers.

3. Placed to view all levels of parking garages, elevators, and stair cases emergency telephones.

4. Placed in accordance with Design Criteria Chapter 25 – System Safety and Security.

E. MSF/Yard Camera Locations:

1. PTZ cameras to view all areas of the yard and perimeter.

2. Fixed cameras placed to view entrances and exits to all buildings, all access controlled doors.

3. Placed in accordance with Design Criteria Chapter 25 – System Safety and Security.

4. Access-Controlled Rooms along the right-of-way (ROW).

5. CCTV views should be provided at all access controlled rooms in the ROW and in stations when key pad/card reader is activated or when doors are forced open.

F. Train Cameras are to be provided by the vehicle provider. Refer to Design Criteria Chapter 12 – Revenue Vehicle, for additional detail.

G. Placed to view public areas of the rail car.

H. Place to view all rail car exits.

I. Placed to view all T-TEL.

J. Placed to view track in front of a moving consist such as to provide an alarm should tracks be obstructed. The System should record operational data and technical information including but not limited to the following:

1. Rail Track Images
2. Grade crossing Images
3. Rail Car speed
4. Direction
5. Audible warnings
6. Power control (emergency) status

K. Train to wayside interface:

1. Shall include equipment to support real-time remote viewing of car-born cameras from the OCC.
2. The Mobile Data System (MDS) shall be used as the wireless link for this interface.
3. Shall support remote real-time viewing triggered by the activation of car-born T-TELs and emergency stop activations.
4. Upon a Push-to-Call activation, an alarm message shall be sent to CCTV consoles at the OCC. Upon acknowledgment of alarm, the system shall present the image from the camera with the best view of the area near the activated T-TEL.

L. Each CCTV workstation shall include at a minimum the following:

1. Three high resolution flat screen type displays. Minimum size shall be 21 inches diagonal
2. High availability computer workstation
3. Keyboard and mouse

M. The collection and transmission of camera video for passenger monitoring shall include equipment to digitally record and store information at the OCC.

N. Camera video archival, retrieval, and storage equipment shall be designed for high availability with a 2 of N RAID (where N can be any integer value representing the number of memory-array devices) hot swappable hard drive system sized to store video for 31 days without archiving.

O. Security and surveillance requirements:

1. Deterrence of acts of crime and/or terrorism: This requirement is to be satisfied by monitoring of sensitive areas such as platforms, concourses, elevators, staircases, and power stations. These cameras are to provide direct alerts in the case of boundary intrusion, or a left object on a platform. In the event of an incident alert occurring, all incidents are recorded permanently.

2. Protection of City customers: This requirement calls for the installation of CCTV cameras to provide surveillance of areas such as station concourse areas, staircases and elevator access, parking lots and access paths, and platforms such that City customers can gain greater security on entering or using City property. This requirement includes monitoring of station platforms and concourses, elevator and escalator monitoring, and ticket and vending machines. Generally, these are fixed point cameras, recording all passers by. These recordings are archived for later retrieval and perpetrator identification, as desired.

3. Protection of City property from unauthorized access: This requirement entails the installation of surveillance cameras at areas where unauthorized personnel may attempt to gain access to City property, and then engage in robbery or vandalism of City property. Accordingly, CCTV cameras are installed at sites such as access gates to provide spot coverage, at watch points on peripheral fences to provide linear coverage, and with wide-angle cameras at critical areas such as rail yards. In addition to these outside cameras, CCTV cameras are mounted at storage room doors such that entry by unauthorized City personnel can be monitored. Both fixed and moveable PTZ cameras are installed, permanently recording all passers by.

4. Comprehensive and authenticated incident recording: This requirement calls for the provision of a high quality camera image recording system. All camera images are recorded all the time. Depending upon the presence or absence of an incident, or some other factor, camera images are either deleted after a period of time, or sent to local or remote archival storage for later forensic or other use.

5. Seamless integration to State and Federal agencies: This requirements calls for the provision of a CCTV surveillance system that is capable of high speed interconnections to agencies and users outside the City. The existing effective firewall and protocol requirements shall be met. Further information will be provided during the Definitive Design Review (DDR).

P. Functional Requirements:

1. The City requires a multi-site CCTV surveillance system. The system is required to provide effective surveillance over multiple City properties, with six overall requirements to be satisfied:
   a. Deterrence of acts of crime and/or terrorism
   b. Protection of City customers
   c. Protection of City property from unauthorized access
   d. Comprehensive and authenticated incident recording
   e. Interfacing with Fire and Intrusion Alarm System
   f. Seamless integration to state and federal agencies

2. The CCTV surveillance system procured under this RFP shall provide the City with effective CCTV surveillance at 21 Honolulu Rail Transit stations, platforms, elevators, escalators, concourses, ticket barriers, outside entrances, parking lots, and the MSF yard and buildings.

3. The sites to be surveyed are as follows:

East Kapolei	Kalihi
UH West Oahu	Kapalama
Hoopili	Iwilei
West Loch	Chinatown
Waipahu Transit Center	Downtown
Leeward Community College	Civic Center
Pearl Highlands	Kakaako
Pearlridge	Ala Moana
Aloha Stadium	Pearl Harbor Naval Base
International Airport	Lagoon Drive
Middle Street Transit Center	MSF/Yard/OCC Building/Back-up OCC
60 Rail Cars	Park and Ride Lots

4. A Central Office Facility (COF) at the OCC is to be installed within the O&S building; it is to contain operator and supervisor consoles with display screens and all necessary communication interfaces. The CMF shall also contain the necessary COF electronic data storage, system control, and communications equipment.

5. Communication capabilities and interfaces shall be based on IPs, to allow interconnection of the City CCTV surveillance system with similar CCTV surveillance systems at other facilities, such as other local, state, and federal surveillance systems.

6. The CCTV surveillance system procurement shall include:
   a. System design optimization, including camera site surveys and coverage designs
   b. Procurement of all necessary systems and components
   c. Installation of CCTV components at all Honolulu Rail Transit designated locations
   d. Testing and Acceptance testing of all installed components and systems
   e. Training of City operational, maintenance, system administration, and system management staff
   f. Provision of acceptable warranty terms

7. The CCTV surveillance system shall be provided as a single prime Contractor turnkey project.

Q. Operational Requirements:

1. Communications requirements: The system shall utilize the fiber optic Gigabit capability of the Metropolitan Area Network (MAN). This system will be designed

and installed throughout the Honolulu Rail Transit stations and to other facilities such as parking lots, maintenance yards, and interfaced via a high capacity wireless system to the rail cars. The system is designed as a ring system, with multiple cross modes and connectivity. Network security protocols shall be incorporated into the system and all connected systems and system components are required to undergo extensive security checks to ensure that the system is impervious to outside attack.

2. Storage and search requirements: The CCTV surveillance storage system shall make use of readily available RAID or similar low-cost storage components and shall have the capacity to store all CCTV system data for 31 days. Image search and find systems shall be based on the use of a relational data base using commonly available software programs, such as Microsoft SQL.

3. Interface requirements: Customer interfaces shall follow TCP/IP protocols, using standard COTS servers for connectivity.

4. Administrative Interface requirements: User support connectivity requirements, internal (to the City) system interfaces, operating system, and other features pertinent to the CCTV surveillance system environment shall be made available to the Contractor after Contract award. The central computer system shall have the capability to handle all data communications functions in accordance with:
   a. All external computer communications functions shall meet City security protocols, and must be tested and certified by the City information technology department and/or designated representative prior to activation with the City communication network.
   b. The central computer shall interface, via a LAN connection, to the City MAN network. The hub, bridge, and/or routing architecture shall interface with the City computer network. However, the City will be responsible at all sites for supplying the actual device (switch) that connects the hub to the City network.

5. Electromagnetic and Electrostatic Susceptibility:
   a. System equipment shall not be adversely affected by radiated or conducted electromagnetic or electrostatic interference from trains or fixed site and other electric/electronic equipment on or near public transit areas. Certain tests for electromagnetic interference and electrostatic discharge susceptibility are required. These testing conditions shall include but not be limited to trains within the station, fixed site, cellular telephones, portable, mobile radio interference, incidental (spurious) radiation, ignition noise, lighting fixture (static) interference, electrical power system transients, vehicular systems interference, and electrostatic discharge (air or contact).
   b. Investigate all environmental factors that may affect equipment operations both before and after installation of the equipment, including shock and vibration. Environmental deficiencies uncovered during installation testing, on-line demonstration, or final tests may be cause for additional design adjustments and additional environmental testing by the Contractor. The City shall retain the exclusive right to judge the environmental acceptability of the components before final acceptance.
   c. All power sources to the system and components shall be wired from the local Uninterruptable Power Supply (UPS) system.

R. Incident Monitoring and Recording: This requirement is to be satisfied by the installation of both short-term incident recording, and long-term archival storage of incident images in accordance with the following:

1. The video from each operating camera may need to be transmitted to the central City CMF. At the CMF, dedicated monitoring personnel will be able to view video from all the stations cameras, wherever located. In addition, the CMF users have control (that is, priority control) of the PTZ function on cameras equipped with PTZ.

2. Routine recordings of cameras providing protection to City customers and City property may be made at a reduced frame rate, typically five to ten fps. Incident recordings from deterrent cameras may be made at a faster frame rate of 20-30 fps. Determine the most satisfactory frame rates, camera resolutions, and compression techniques that best result in the most efficient communications and storage systems. The result of this determination shall be provided to the City in the response to this Statement of Work (SOW).

3. All incident recordings are automatically transmitted to a central site for immediate examination and long-term archival storage. Each individual image shall be indexed and catalogued.

4. All video images shall be "water-marked" to prove authenticity.

5. The Contractor may elect to use either a centralized or a distributed storage system. In either case, calculate the anticipated loading of the GigE link and the anticipated size of the resultant central storage system and any distributed storage system. The result of this calculation shall be provided to the City in the response to this SOW.

6. A brief description of the proposed storage system shall be provided to the City in the response to this SOW, together with a description of the image entry and retrieval capabilities. The proposed storage system shall be of sufficient capacity to handle the image storage requirements proposed for the sites detailed in this SOW, plus 50 percent spare capacity. In addition, later expansion of the storage capacity to 200 percent of the installed capacity shall be straightforward, with no major replacement of any component equipment provided under this SOW. A description of the expansion capabilities of the proposed storage system shall be provided to the City in the response to this SOW.

7. The entire set of City video images shall be available to City users with access to the City Intranet. Appropriate access authority codes and access limitations will be made available to the Contractor after Contract award.

S. Image Search, Retrieval, and Forensic Analysis: The system shall provide a means of rapidly identifying salient characteristics of a particular image (for instance, the color of a hat) recorded by any camera in the system. The system shall be capable of rapidly searching through the entire set of images recorded throughout the entire CCTV surveillance system to determine whether the same salient characteristic is visible on other images from other cameras. Time constraints and salient characteristics for the search shall be set by the operator.

T. Seamless Integration to State and Federal Agencies: The CCTV surveillance system shall provide full integration of the City security system, to all other Hawaiian State Agencies, such as the Hawaii Emergency Management Agency. The concept is that the City CCTV surveillance system, as represented by video images, is available to properly authorized state or federal agencies. The corollary is that authorized City personnel also have seamless access to video images from interconnected state or federal agencies. In effect, the City security system shall be an intrinsic part of the state and federal security system.

U. Security Requirements:

1. The City CCTV surveillance system shall be fully secure. The following description is of the minimal security requirements; the Contractor may propose additional security features.

2. The system shall use password authentication to enable only authorized users access to the system, and the stored video images therein. As the City incident records may be subject to depositions and other legal actions, access to the records may need to be limited to a "need to know" basis, whereas other video recordings, such as routine monitoring of the number of cars entering a parking lot on a given day or period, may not be on a "need to know" basis. These different procedures shall be developed, written, and promulgated as part of the documentation of the Work.

3. The entire City CCTV security system is subject to the requirements of the Homeland Security Act, and dissemination of the actual characteristics and capabilities of the system should be avoided to the greatest extent possible. Detailed information should be made available only on a "need to know" basis.

V. Essential Design Parameters:

1. Precise camera capabilities and specifications shall be selected by the Contractor, based on site requirements, satisfaction of performance requirements, sensitivity, resolution, image size, coverage, and a comprehensive system design.

2. Storage device or storage system capabilities and specifications shall be selected by the Contractor, based on site requirements, satisfaction of performance requirements, storage size, access speed, and a comprehensive system design.

3. The CCTV surveillance system shall be capable of intruder detection and alarm by means of remotely adjustable guard boundaries and determination of object size or color. When applied to specific doors or areas, it shall be possible to program the intruder alarms to be energized either by a routine such as night time hours only, or weekend days only, or by specific on/off command from the system operators.

4. The CCTV surveillance system shall be capable of left object detection by means of remotely adjustable protected area size and object size or color. When applied to specific areas, it shall be possible to program the left object alarms to be energized either by a routine such as night time hours only, or weekend days only, or by specific on/off command from the system operators. The left object system shall be a system that has been deployed and used in a similar environment to the City platforms.

5. The proposed system shall be capable of rapid selection of pertinent characteristics of an object within any camera image from a particular site. The system shall then allow the operator to select other sites and determine whether, within a pre-set period, the same identified object appears.

6. The cameras within the system are typically aimed at specific points and/or boundaries. In addition, fixed camera settings for details such as magnification

(fixed zoom), aperture, color balance, and focus points shall be established for each individual camera. The responsibility for these actions should not be open to City personnel, but should be limited to authorized City personnel. These procedures shall be developed, written, and promulgated as part of the documentation of the Work.

7. Submit a Definitive Design Review (DDR) document for approval by the City. If the City deems necessary, arrange for, and accompany, a visit by the City to existing operational sites, selected by the Contractor, to review actual performance of working systems. Procurement of system components, as selected by the Contractor, shall not proceed until the City has formally approved the DDR document.

8. The sources of the expert software used in the system that will be provided should be clearly identified in the SOW, together with limitations or extra costs involved in later expansion or modification, and third party license requirements. If the City deems necessary, arrange and accompany the City to an existing operational system, selected by the Contractor, to review actual performance of a working software system.

9. The City CCTV security system, when fully implemented will contain between 800 and 1,500 cameras. To effectively manage and control this large number of cameras, an integrated System Management, Performance Monitoring, and Camera Control system is required. A full description of the Management, Monitoring, and Control features of the proposed system shall be provided in the response to this RFP. This Management, Monitoring, and Control system shall, as a minimum, provide the following:
    a. Assign access authorization codes at various levels such as operator, supervisor, and system administrator users of the system.
    b. Add, remove, and dispose facilities, cameras, and network arrangements to the overall management scheme.
    c. Set individual camera controls, such as frame rate, focus, and zoom settings.
    d. Establish Intruder Alarm boundaries for appropriate cameras.
    e. Allow camera images to be sent to third party software programs, such as advanced object detection programs.
    f. Monitor camera performance and provide an alert if a “blank screen” is observed.

W. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the CCTV System.

2.02 MATERIALS

A. The CCTV surveillance system is to be installed at the CMF and on the Honolulu Rail Transit stations, platforms, access points, concourses, parking lots, and other locations as determined necessary at each location by the City. Access to City transit facilities is controlled, and appropriate Safety and Security regulations and practices apply. Conform to the requirements of Design Criteria Chapter 25 – System Safety and Security.

B. Design: Design the entire CCTV surveillance system in accordance with the requirements of this RFP. Participate in a DDR and a FDR. Survey each installation location and develop an Installation Plan in accordance with the requirements herein.

C. CMF: A room within the proposed MSF/OCC building shall be provided. Detailed floor plans and a suggested console layout shall be provided to the Contractor after Contract award. Submit a Preliminary CMF Layout Plan at the time of PDR, and a Final CMF Layout Plan at the time of FDR. For proposal purposes, the following work description shall be used. The room floor has been fitted with raised computer decking, with a raised plinth for the Supervisor positions. HVAC is provided within the entire building, and adequate AC power (with UPS back-up) is available. Within this facility, the following shall be provided:

1. Raised computer flooring will be installed over the entire area. The first area is for three Operator consoles, and the second area is for one Supervisor console.

2. Provide and install four Operator consoles. The Operator consoles shall be functionally identical, and each of the consoles shall be configurable into either an Operator or a Supervisor console, essentially with the only difference being the level of access allowed. Three consoles shall be mounted on the lower floor level, and one on the upper floor level.

3. The consoles shall be of modular design with individual equipment modules built into the consoles such that each workstation component shall be easily accessible for service. Each of the consoles shall include four displays, as follows:
   a. The four displays shall be mounted in a side-by-side arrangement integral to the console and capable of being raised vertically and tilted.
   b. Each display shall be a 23-inch flat-panel configuration.
   c. Each display shall be configurable for split-screen operation, where up to four smaller images may de displayed on each display screen.
   d. An accessible drawer or drawers shall be provided for forms, file folders, and other supplies.
   e. The consoles shall be wheelchair accessible with clearances below the work surface of at least 26 inches vertically and 32 inches horizontally. At least 15 inches of horizontal clearance shall be provided between the knees of an operator seated at the console and vertical obstructions in front of the seated operator. All edges and corners of the consoles shall be rounded. Visible surfaces shall have a matte finish to reduce glare.
   f. The console design shall permit the height and tilt of the keyboard supporting structure to be adjusted independent to the console work surface, with a maximum tilt adjustment of 20 degrees from the horizontal. The keyboard supporting structure shall be sized to accommodate the keyboard, a mouse and mouse pad, and a wrist rest/support pad.
   g. Each console shall be provided with a minimum of four unused 20-amp 110-VAC grounded outlets. All workstation wiring and cabling shall be neatly tied and bundled, and concealed as much as possible.
   h. Each console shall be provided with a heavy-duty operator chair, designed for use in a 24-hour/day environment by different personnel. The chair shall be fully adjustable, and the seat shall adjust pneumatically from 16-1/2 inches to 20-1/2 inches. The back shall have an adjustable lumbar support, a back angle adjustment, a seat tilt mechanism, and adjustable sloped arms. The base of the chair shall be configured with at least five spokes, each with a swivel caster.
   i. Each Dispatcher/Supervisor Workstation shall be provided with a wireless mouse and keyboard.

j. The console shall be equivalent in form, fit, and function to the “Response” Sit-Stand consoles available from Evans Consoles, Inc., of 1616-27 Avenue North East, Calgary, AB, Canada T2E 8W4. The Evans WEB site may be found at <www.evansonline.com>

k. Install the consoles at the CMF, in accordance with a lay-out and installation plan to be developed in conjunction with the City.

l. Provide and install a video wall display unit consisting of four 50-inch Digital Light Processor monitors. The monitors shall be equivalent in form, fit, and function to the 50-inch front access display cube model VS-50XLF20U available from Mitsubishi Digital Electronics America, Inc., 9351 Jeronimo Road, Irvine CA 92618. The Mitsubishi WEB site may be found at www.mitsubishi-megaview.com. Provide appropriate controlling devices such that images visible on operator consoles can be duplicated on the large-screen display. Install the display at the CMF, in accordance with a lay-out and installation plan to be developed in conjunction with the City.

m. Provide and install a color laser jet printer capable of producing high quality color photograph images, in accordance with a lay-out and installation plan to be developed in conjunction with the City. The color printer shall be equivalent in form, fit, and function to the HP Model 5550N.

n. Provide and install a LAN and associated equipment server configured to provide an interface between the consoles and the COF.

o. The City will provide a dedicated circuit breaker for each of the four consoles, and the video wall display unit in accordance with the voltage and current requirements to be specified by the Contractor. Provide and install the necessary power cables and connections in accordance with a lay-out and installation plan to be developed in conjunction with the City.

p. The requirements of the Americans with Disability Act (ADA) shall apply to the design of the CMF and its component furniture, equipment, and accessories.

q. COF: A room adjacent to the CMF shall be provided. Detailed floor plans shall be provided to the Contractor after Contract award. Submit a Preliminary Central Office Plan at the time of DDR and a Final Central Office Plan at the time of FDR. For proposal purposes, the following work description shall be used. The proposed room measures approximately 30 feet by 7 feet, with a ceiling height of 9 feet. The room is inside the building, and there are no windows. One access door is provided, a door leading to the CMF. A dedicated HVAC unit is provided within the room, and adequate AC power (with UPS back-up) is available.

r. Raised computer flooring will be installed over the entire area, with a floor height of no less than 3 inches.

s. Design, procure, and install all necessary central office equipment required to serve the functionality of the CCTV surveillance system. The actual equipment descriptions, specifications, and installation details shall be in accordance with a lay-out and installation plan to be developed in conjunction with the City.

t. One System Administrator workstation shall be supplied fitted with a 23-inch screen. This workstation shall be mounted on a desk to be supplied by the City.

u. Design, procure, and install the interface cables and devices to provide a connection between the Central Office Equipment and the switch or switches (provided by the City) that provide connectivity to the City GigE system.

1) At each of the Honolulu Rail Transit stations, camera sites have been selected on a preliminary basis. After the Contract has been awarded, conduct an in-depth review of each station and design and provide a CCTV surveillance system with the appropriate number and placement of cameras at each station.

v. At the station platforms, the cameras shall be located and oriented to provide:

1) Effective surveillance of the entire platform area.

2) Left object detection at those platform areas that the City designates to be protected. These selected areas may vary from station to station. The City would prefer that all platform cameras have a left object capability, such that the areas protected may be varied from time to time.

3) Intruder detection at those platform areas that the City designates to be protected. These selected areas may vary from station to station. The City would prefer that all platform cameras have an Intruder Detection capability, such that the areas protected may be varied from time to time. At each platform, a specific area that will always be protected will be the entrance gates to the tunnel portals. Intruder detection over the actual tracks (that is, a fallen passenger) would be desirable.

4) At the OCC, the GigE communication system will send images from the new cameras to one new 24-inch segmented display monitor (to be provided under this Contract and delivered to the City at the CMF). The City will mount this display within existing furniture at the OCC.

5) Provide the interface cables and devices to provide a connection between the station equipment and the switch or switches (provided by the City) that provide connectivity to the City GigE system.

6) The actual equipment descriptions, specifications, and installation mounts and details shall be in accordance with a Layout and Installation Plan to be developed in conjunction with the City.

7) The system shall be synchronized to the Master Time Base (MTB).

PART 3 – EXECUTION

3.01 INSTALLATION REQUIREMENTS

A. Install all equipment furnished under this Contract. Provide on-site field engineering to supervise and technicians to perform the installation. All Work shall be performed in a manner adapted to local conditions and best calculated to promote quality installation; to secure safety to life, person, and property; to assure a safe and continuous operation of the City; and to reduce to a minimum interference with the public and with other contractors in or about the property. Provide preliminary documentation at DDR on installation practices, tests, and quality control procedures of each component of the CCTV surveillance system. Provide final documentation on the results of the application of these installation practices, tests, and quality control procedures after completion of the installation at each City facility.

B. Equipment Deliverables:

1. Delivery point: The component equipment deliverables of the CCTV surveillance system shall be shipped, carriage, insurance and freight pre-paid (CIF) destination, to City premises.

2. Insurance on all deliverables shall be maintained until the deliverables have been safely and appropriately delivered to City and title has passed to City.

3. The City will assume no responsibility for the safe-keeping of deliverables not delivered inside City premises. The Contractor may, at its option, provide a secure trailer for the temporary storage of equipment deliverables. City will endeavor to locate the trailer on City property as close to the installation site as possible, but City will assume no responsibility for safe storage of deliverables inside the trailer.

3.02 INSTALLATION

A. Cameras and related equipment shall only be installed in accordance with installation plans that have been previously approved by the City. Provide all mounting hardware, cables, plugs, and accessories. Installation shall not commence until appropriate installation plans have been reviewed and approved by the City.

1. Site availability for equipment installation: The City will make its best endeavors to have sites available for installation; however, the City shall not be held responsible for necessary or untoward unavailability of sites.

2. Installation Planning: The camera installations shall be planned such that the minimum of disruption of service shall occur to City operations. The installation plan shall consist of four steps: 1) development of an installation plan and schedule, 2) a description and plans of the work to be accomplished, 3) approval by the City, and 4) accomplishment of the equipment installation.

3. Review the station sites to establish equipment requirements, cable paths and layouts, mounting details, modification requirements, and other requirements such that all necessary information is gathered for each camera installation site.

4. Develop the detailed Site Installation Plan(s), schedule, and installation drawings for each facility. These plans shall be submitted to the City at least 30 days prior to the commencement of any installation.

5. The City shall grant approval to each Site Installation Plan within 10 working days of receipt of each Plan.

6. Installation work shall not commence at any site until and unless specific written notice has been received of the City approval of each specific Site Installation Plan.

7. Each installation shall be accomplished in accordance with the relevant Site Installation Plan. Deviations or changes to each relevant Site Installation Plan shall be coordinated with the City and agreed to by the City in writing.

3.03 SPECIFIC INSTALLATION REQUIREMENTS

A. Equipment installations shall be done in a professional and workmanlike manner and in accordance with all applicable codes and good engineering practices.

1. All cameras and related equipment shall be connected by means of CAT-5e cable, with camera power being supplied integral to the CAT-5e cable. At those sites where cable lengths preclude the use of CAT-5e cable, obtain specific approval from the City, in writing, allowing the deviation.

2. All equipment racks, cabinets, and individual equipment shall be grounded. In this connection, the Contractor is to take special note of the presence of high ground currents near energized rail tracks, and take appropriate steps to avoid ground loops and consequent equipment damage.

3. All main equipment racks shall be connected to suitable breaker panels to be provided by the City. All electrical wiring and connections shall be properly made, installed, and terminated.

4. As necessary, provide drawings that indicate the locations of each component of the CCTV surveillance system, location of wiring runs, conduit and interconnect points, and other pertinent details. Loose wiring or wiring not properly contained in a trough, conduit, or raceway shall not be acceptable.

5. Conduct the installation of equipment such as to ensure the minimum of disruption to City operations. In the event that equipment down time is required, it shall be accomplished at the time of the midnight shift, and the City shall be given at least 48 hours notice of the time and duration of the propose down-time. In no circumstances shall City equipment be placed out of service without prior written permission from the City. Work shall be coordinated with the appropriate City entity.

6. The Contractor is encouraged to propose installation methods that will simplify the installation process.

3.04 COMPLETION OF INSTALLATIONS

A. Provide an "as-built" check list for each individual City site that lists all components removed, installed, or modified at each site. For each component, model, type numbers, and serial numbers shall be provided as appropriate. The check list should also show completion of tests, and appropriate acceptance signature blocks. The satisfactory accomplishment of this check list shall be an inherent part of the Contractor Quality Control process. Where appropriate, City acceptance signatures should also be included. The date of acceptance of the completed “as-built” check list by the City for a particular site shall act as the date of commencement of beneficial use of that site. These provisions shall flow down to any installation subcontractor.

3.05 INSTALLATION OF CENTRAL OFFICE AND PMF EQUIPMENT

A. Develop proposed detailed equipment layout diagrams for the Central Office and Central Monitoring Facilities at the MSF. The plan shall be presented for review and approval by the City.

B. Develop a proposed Installation, Transition, and Cut-Over Plan, describing and illustrating the steps that shall be taken to install the new Host Computer and peripheral equipment in the COF. The plan shall be presented for review and approval by the City.

C. Develop a proposed Console layout, floor plan, and elevations for a PMF room, if required. The plan shall be presented for review and approval by the City.

D. Provide an "as-built" check list for the Central Office and Monitoring Facility equipment. The list shall include details of all component equipment removed, installed, or modified. For each component equipment, the model, type numbers, and serial numbers shall be provided, as appropriate. The check list should also show completion of tests and appropriate acceptance signature blocks. The satisfactory accomplishment of this check list shall be an inherent part of the Contractor's Quality Control process. The date of acceptance of the completed "as-built" check list by the City shall act as the date of commencement of beneficial use of the equipment.

3.06 CONTRACTOR INSTALLATION RESPONSIBILITIES

A. Repair of damage: Install all equipment, systems, and parts thereof. Damage caused by the Contractor shall be immediately reported to City, and damage so caused shall be repaired by the Contractor at the expense of the Contractor. If the Contractor fails to repair the damage within 30 days of its occurrence, the City may undertake the repair and withhold such moneys from the balance due and/or seek reimbursement to cover the repair costs.

B. After installation or modification, ensure that the site is clean and free from trash, metal shavings and grease marks, and water leaks.

C. Database responsibility: Undertake the responsibility for installing, correcting, and updating the provided software and databases provided by the Contractor. Work closely with the City and other database users or providers, to determine the scope and extent of correctional or update work required to ensure complete and seamless integration between these other data bases and the provided system.

D. Installation of data, computer software, and files: Responsible for loading all data, computer software, and other information into the system. As appropriate, the City will provide files in existing formats for the use of the Contractor, including files current at the time of cut-over.

E. Software system set-up: Responsible for initially setting up the system and for entering and loading all required data into the system, including but not limited to the following:

1. Defining the hardware and software configuration:
   a. Defining the user functional partitions
   b. Defining the data required for all data bases
   c. Defining the routing of event and incident reports
   d. Defining the priorities of event and incident actions
   e. Setting the initial values for all user-adjustable parameters
   f. Setting the initial values for thresholds
   g. Entering all communication interface parameters
   h. Downloading all aid, help, and procedure files

2. Responsible for the installation or modification of all equipment, systems, and parts thereof in accordance with the requirement of a complete turn-key system installation. The Contractor is fully responsible for installing a completely operational system at the Contract price. Provide all labor, materials, parts, cables, required signs, software, documentation, instructions, warranty, and maintenance in accordance with the intent of herein.

3.07 WARRANTY

A. General: The rights and remedies of the City under this Article are not intended to be exclusive and shall not preclude the exercise of other rights or remedies provided for in this Scope of Work, subsequent Contracts, or by law or otherwise.

B. Warranty: Warrant that all goods supplied, systems, equipment, designs, and work covered by this Scope of Work and subsequent Contract shall be satisfactory for its intended purpose, shall conform to and perform as called for in the Contract requirements specifications and shall be free from all defects and faulty materials and workmanship. Goods supplied, systems, equipment, designs, or work found to be defective within the time specified below shall be repaired, remedied, or replaced, hereinafter called "corrective work", by the Contractor, free of all charges including transportation.

C. The warranty period for all Contractor-provided goods supplied, systems, and equipment except spare parts, shall be in accordance with the Technical Provisions of this Contract.

D. In the event that it is necessary to place spare parts into operation or service prior to the completion of the warranty period, the Contractor covenants and agrees to furnish and deliver, free to the City, a replacement part to the City spare part inventory.

3.08 HARDWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the Work, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within two working days of notification of the need for maintenance and support.

3.09 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: The City shall have the option of purchasing directly from the appropriate OEMs of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5-day / 8-hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and shall request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided on site within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly

Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for a camera repair service, where each failed camera is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective camera and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed camera unit at the Contractor's premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of warranties or maintenance contracts. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on an hourly basis

2. Engineering support, defined as work performed by employees not paid on an hourly basis

3. Software Maintenance support

3.10 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all software until successful completion of the 1-year warranty period.

B. During the Installation and Testing phases of the Work, maintenance and support for software shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the Contractor, on site, as a minimum, within one working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year warranty no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support for work requested by the City outside the scope of warranties or maintenance contracts. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within this Work. The City shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. In addition, the City shall be placed, at no charge to the City, on appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period. Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.11 SOFTWARE LICENSES

A. Routine use of software: Issue to the City a non-transferable, non-exclusive license to use the supplied software and training video(s) on a restricted rights basis. A copy of this Software License shall be furnished together with the response to this SOW. It is understood that this Software License shall apply to executable code only, and that the source code for Software shall not be provided, except as by the following paragraph.

B. Software escrow: In the response to this SOW, agree to deposit application software source code, written by the Contractor, in a third party escrow account. This action will enable the City to continue basic operation and maintenance of such software in the event that the Contractor fails to continue support for the software and does not provide for such support by a third party. In such event, the City agrees to maintain the confidentiality of the source code. Maintain the installed and accepted version of the software and installed updates and upgrades obtained by the City, and refresh the software in escrow at least every 6 months for a period of 10 years from the date of final system Acceptance.

C. Acceptance Testing:

1. This SOW requires the completion of all work to the satisfaction of the City. Carry out all those tests required to demonstrate compliance with this SOW and that the CCTV surveillance system is fully operational in all respects. As required, provide an overall Acceptance Test Plan at the time of FDR and individual ATPs for individual components of the system at least 30 days prior to the test date(s). After City approval, these individual ATP tests shall be conducted and the results documented. Once the entire CCTV surveillance system is installed and operational, On-Line Demonstration Testing shall be conducted. After the completion of all tests, and the delivery of all Contract deliverables, Final Acceptance shall occur.

2. Technical Documentation Requirements: Provide the following technical documents:
   a. Preliminary documentation.
   b. Block Diagrams: Drawings showing major system components for each installation site, with site layout details as appropriate and proposed location of all Contractor provided equipment in the various equipment rooms.
   c. Product Data: Manufacturer’s catalog cuts, material specifications, installation instructions, and other pertinent product data.

3.12 LIST OF INSTALLATION MILESTONES INCLUDING PROJECT SCHEDULE

A. A preliminary structured schedule showing accomplishment of the station equipment installations, systems/subsystems tests, actions, personnel, and transitions required to initiate operation of the new system. This plan shall indicate the expected time of day and duration of service interruptions, if any. The preliminary station installation schedule shall be submitted for City approval.

B. A preliminary structured schedule showing accomplishment of the central Office and Monitoring Facility and associated computer room equipment installations, systems and subsystems tests, actions, personnel, and transitions required to cut-over to the new system and host computer equipment. The preliminary schedule shall indicate the expected time of day and duration of service interruptions.

C. As the Work develops, the following detailed documents are to be presented within 30 days after completion of the completed tasks and sub-tasks:

   1. Equipment Layout drawings, both plan and elevation that shows new equipment layout including all modified existing racks and furniture.

   2. Installation and mounting detail drawings, as appropriate.

   3. Functional and Cable Block Diagrams including a bill of materials.

   4. Power Cable routing drawings including cable interconnects, associated circuit breaker boxes and assigned circuit breakers, cable trays, conduits, mounting hardware, and grounding details.

   5. Manufacturer’s Manuals that define equipment operation, contain schematic diagrams as appropriate, and define maintenance and alignment procedures for the Contractor provided equipment.

   6. Completed system block diagram(s).

D. Final Acceptance Tests: Prior to the commencement of the Final Acceptance Tests, the following information shall have been provided:

   1. A document thoroughly describing software, if provided, for system configuration or re-configuration. This material shall be presented in the System Administrator and Data Administrator manuals.

   2. As-built drawings and documentation for all systems/sub-systems provided under this Contract.

   3. Product Data: In response to this RFP, provide data-sheets, brochures, catalog cuts, or similar information that describes all equipment proposed to be provided under

this Contract. In the event that, due to particular manufacturer's equipment or model changes or improvements, new data sheets or brochures or similar information are available during the course of the Contract, submit this new information to the City prior to the Final Acceptance Tests.

4. Qualifications: Provide documentation showing compliance with the Quality Assurance requirements of this RFP.

5. Certification: Provide the manufacturer's certifications for all system/sub-systems to be furnished under this Contract.

6. Spare Parts Data: Provide a list of Recommended Spare Parts in accordance with herein.

7. Test and Final Acceptance: Provide documentation for all system/sub-system test and final acceptance reports.

E. Testing Requirements: Conduct those tests that verify and document the CCTV surveillance system performance and compliance with this SOW. Submit an ATP for approval by the City 30 days prior to the commencement of Acceptance Testing. Acceptance Testing shall contain component, subsystem, and system tests to verify that the overall CCTV surveillance system will meet the design requirements. Coordinate acceptance testing with City personnel in order to minimize operational impact upon normal daily activities. Perform preliminary Acceptance Tests and preliminary On-Line Demonstration Tests in order to ensure that discrepancies are not discovered during the Final Acceptance Tests.

F. Test Compliance Document: Provide a Test Compliance Document clearly noting each particular test to be accomplished in a format such that appropriate City personnel who witness the tests may signify that each individual test has been successfully completed. Pass/fail criteria shall be established on each particular test, and space shall be provided for comments on non-compliant test results. The Test Compliance Document for each particular test shall be furnished to the City for approval no later than 60 days prior to the commencement of the particular test. However, no particular test shall be commenced until written approval of the particular test has been received from the City. The completed and witnessed Test Compliance Document shall be furnished to the City as part of the Final ATP.

G. Test Results: Provide the City with written test results documentation no later than 5 working days after the completion of each test or tests.

H. Non-compliant test results shall be repeated until the City is satisfied that all test parameters have been correctly met and accepted by the City.

3.13 ON-LINE DEMONSTRATION TESTING

A. Testing Requirements: On-Line Demonstration Testing shall provide definitive proof that the CCTV surveillance system is providing the surveillance services at the accuracy and quality requested herein and that the installed system is capable of meeting the long-term reliability and performance requirements of herein. As a minimum, the following tests shall be conducted:

1. Camera resolution and performance under various lighting considerations and day and night conditions, as appropriate.

2. Camera performance in relation to Pan, Tilt, and Zoom speed, and accuracy in returning to preset positions (for cameras so fitted).

3. Camera performance in relation to adjustable fps and different compression ratios.

4. System performance in relation to setting of intrusion alarm boundaries and detection of intrusion within these boundaries.

5. System performance in relation to setting of left-object reaction time, left object detection at various distances and sizes.

6. System performance in relation to object identification and system-wide search capabilities.

7. Quality of images reproduced by color printer.

8. Quality of images multicast to remote sites.

9. Visibility of on-screen displays of images, and overlaid status or alarm symbols. Verification of change of status indications on these symbols.

10. Capabilities to set and reset system parameters.

11. System well-being monitoring, malfunction alarms, and associated displays and alarms.

12. Verification of all reporting and data-collection functions.

13. Such other tests as the City perceive as being important to demonstrate the successful installation of the system, and that the system is ready, in all respects, for operation.

B. Testing Organization and Timing: Provide a written description of the methods, procedures and anticipated time and City facility and personnel requirements for the accomplishment of the On Line Demonstration Tests, at least 60 days prior to the planned start of the tests. Coordinate with the City for the accomplishment of tests, provision of test objects or personnel, City personnel to witness the tests, and the date or dates and timing for the accomplishment of the tests. All test reports shall be submitted within 10 days of completion of the test(s).

C. Occurrence of Final Acceptance Test: Final Acceptance Test shall occur upon completion of the following:

1. Completion of Preliminary Acceptance Tests by the Contractor.

2. Completion of Preliminary On-Line Demonstration Testing.

3. Completion of all remedial work required because of the discrepancies or faults discovered during the Preliminary Acceptance Tests and On-Line Demonstration Testing.

4. Completion of Final On-Line Demonstration Testing.

D. The Final Acceptance Test Report shall consist of a document, signed by the City, certifying that all the steps outlined above have been completed acceptably, and that:

1. All milestone completion dates have been met.

2. All deliverables are complete and have been approved.
3. All source code, object code, and data files are complete.
4. The City has received all written documentation, drawings, technical and other manuals, and all other deliverables within this procurement.
5. All training has been completed.
6. All applicable software licenses have been issued and delivered to the City.
7. All applicable warranties and guarantees have been delivered to the City.
8. Hardware and software maintenance agreements have been concluded with the City.

3.14 DOCUMENTATION AND TRAINING

A. Manuals shall be provided in accordance with the following:

1. Manufacturer’s standard manuals will be acceptable, subject to the approval of the City. Each manual must contain specific identification of products by model and part and number supplied under this Contract. A detailed list of manuals to be provided shall be submitted at DDR.
2. Documentation shall be provided for all system software, utilities, compilers, assemblers, linkers, editors, maintenance software, and other packages used to develop, debug and load software, with the exception of COTS products.
3. Revisions to manuals shall be reflected in a revision index that is part of each handbook or manual and is revised according to a revision control method approved by the City. Revisions shall be made for all design changes, retrofits, and errors.
4. Maintenance and Repair Manuals: These manuals shall provide sufficient information, including schematics, layout drawings, test and alignment procedures, inter-cabling diagrams, and parts lists, to permit quick and efficient maintenance and repair of the equipment by a qualified technician.
5. Manual Types and Quantity: Supply complete documentation of the entire system provided. Quantities will be defined by the City, as required. In addition to hard copy versions of the manuals, the contractor shall provide CD-R copies in Microsoft Word 2003 and/or higher format of every manual supplied.

B. Training: Provide a program to train City personnel in all aspects of the operation and maintenance of the systems and equipment provided, as follows:

1. Design the program such that the City may assume control and accomplishment of the training.
2. All training course program materials, including training manuals and audio/video tapes or disks, shall become the property of the City and for use by the City for internal training purposes.

C. Training Program: Develop a detailed training program plan to be submitted to the City for approval as follows:

1. Provide an overview description of instructor and student materials and schedules necessary to provide system operations and maintenance courses for operations personnel and maintenance technicians. The schedule is contained in the plan and shall address the availability of operations and maintenance manuals and shall show all training program milestones for the development of training materials and manuals for the schedule of classes.

2. Instructor Material: Develop course outlines, lesson plans, classroom notes, video recordings, films, slides, printed materials, and mock-ups or models. Course outlines for each class shall be submitted 60 days prior to the beginning of training classes and lesson plans shall be submitted no later than 30 days prior to the beginning of training classes. Final course material shall be delivered to the City no later than 10 days prior to the commencement of the training.

3. Student Materials: The primary source of instructional material shall be applicable operations and maintenance manuals. In addition, develop notebooks, drawings, and procedures to supplement these manuals to ensure that all learning objectives are met in an orderly and timely manner.

4. Facilities: Space for classroom lectures and practical training on equipment will be furnished at City facilities. Provide projectors, screens, easels, testing equipment, and other training aids, as needed.

5. Spare parts furnished under this Contract may be used as training aids and for demonstration of practical exercises for adjusting, testing, disassembly, and assembly of equipment. However, ensure that spare parts are repackaged and returned to storage in acceptable condition for installation.

6. Installed equipment, such as operator positions, may be used to demonstrate the practical function and operation of the system.

D. Training Courses: Table 27 90 01-1 lists the required training courses.

Table 27 90 01-1

Course Title	Description	Recipients, class size/sessions/hours
Management	High level system overview	City senior personnel 5/2/4
Operator	Operations (train the trainer)	Operators, City training staff. 5/4/4 or as required (see Note 1)
System Administrator	Host administration, statistics and data capabilities	System Administrator 2/2/8
Maintenance	Technician training	Technicians 4/2/8
Data Administration	Reporting capabilities	Department Managers, Planners 5/2/8
Report Generation	Management report generation	Planning staff 4/2/8

(Note 1): The operator training should be based on a course assuming that the operators know nothing about the operation of the CCTV surveillance system.

E. Spare parts shall consist of the following:

1. Spare parts for equipment supplied by the manufacturer of the camera equipment

2. Spare parts for equipment supplied by the manufacturer of the computer and storage equipment

3. Other spare parts for equipment supplied by other manufacturers

F. Parts List: Provide a complete Parts Cross Reference List of all parts and components used in the equipment delivered in accordance with this Contract. This list shall include as a minimum, equipment manufacturers part number and part name, and as appropriate the part number of the OEM part or component, in addition the part unit price. This information shall be furnished prior to Final Acceptance of the system.

G. Initial Spare Parts: In response to this RFP, provide a list and quotation for an Initial Spare Parts Kit sufficient to maintain the system in operation during the initial operations of the system. Among this spare parts list and quotation shall be:

1. Five standard camera units

2. Five PTZ camera units

3. Two replaceable data storage elements

4. Two replaceable lamps for video wall equipment

H. Recommended Parts: In addition to the deliverable equipment and initial spare parts required to fully implement the system, identify all recommended on-site spare parts required to fully support the entire system over the long term and after the warranty period. This information shall be furnished prior to Final Acceptance of the system. The City reserves the right to purchase any, all, or none of the identified replacement parts at the published spare parts price list as current at the time of placing the spare parts order.

I. Parts Availability: The availability of replacement parts shall be guaranteed for a period of 10 years from the time of CCTV surveillance system acceptance. A written statement confirming this required availability of spare parts shall be provided no later than 30 days after NTP.

1. Test Equipment: Identify all recommended items of test equipment and maintenance items required to fully support the system after the warranty period. The list shall include bench and field maintenance test sets or other measurement or alignment equipment. In the event that any of this equipment is required as an essential initial part of the system and equipment provided, details and pricing for such equipment shall be provided. The City reserves the right to purchase any, all, or none of the test equipment and maintenance items identified.

J. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

K. Self-training materials shall be available for the software user interface.

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SECTION 27 90 02

STATION LOCAL AREA NETWORK (SLAN)

PART 1 – GENERAL

1.01 SUMMARY

A. Description:

1. This Section includes Specifications for engineering, furnishing, and installing a complete integrated Station Local Area Network (SLAN) at all Honolulu High-Capacity Transit Corridor Project (HHCTCP) stations and facilities. The SLAN will provide the following:
    a. Serve as the communication backbone for each Honolulu Rail Transit station providing data transfer among station subsystems, such as Supervisory Control and Data Acquisition (SCADA), closed circuit television (CCTV), Public Address and Variable Message Sign (PA/VMS), Access Control, Seismic Detection, Telephone systems, Fare Vending Machines, Fire and Intrusion Alarm system, and other station specific subsystems.
    b. Connect to the City's Communications Transport System (CTS) or Metro Area Network (MAN) for communications and control requirements with the Operations Control Center (OCC), other stations, and facilities.
    c. Use "industrial grade" Ethernet as a common communication protocol over a state of the art Fiber Optic Cable (FOC) plant connected in a ring topology, thus substantially reducing cabling and conduit requirements.
    d. Provide significant unused "dark fiber" accessible throughout each station for future expansion and repair.

B. Section Includes:

1. General
2. Station and Facility Site Surveys
3. Installation
4. Tests, Acceptance, and Training
5. Site by Site Installation, Test, and Acceptance of SLAN
6. Hardware Maintenance During Installation, Testing, and Warranty
7. Hardware Maintenance After Warranty
8. Software Maintenance During Installation, Testing, and Warranty
9. Training

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications System

3. Section 27 30 01 – Telephone Systems
4. Section 27 60 00 – SCADA System
5. Section 27 70 00 – Wireless Communications Systems
6. Section 27 80 00 – Passenger Information System
7. Section 27 90 00 – Operations Control Center Ancillary Equipment
8. Section 27 90 01 – CCTV System
9. Section 28 13 00 – Access Control
10. Section 28 36 00 – Seismic Detection

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. The governing version of the listed documents shall be the latest as adopted and administered by the City and County of Honolulu. Included in the following References are additional standards and codes deemed pertinent to the final design of the system defined herein.

1. Applicable NFPA Codes and Standards
2. EIA-455-82A
3. EIA/TIA-526-14 or OFSTP 14, Method B
4. Fiber optic termination Loss tests in accordance with Fiber Optic Test Procedures (FOTP)-171
5. NEC (National Electrical Code) paragraph 770
6. TIA/EIA-568B, FDDI, Gigabit Ethernet and ATM applications

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. Submit fiber optic/Cat 5 cabling system data, including but not limited to, specification sheets, shop drawings, Manufacturer’s Product Data Sheets, and related data.

C. Submit detailed installation documents indicating splicing details, distribution panel layouts, shop drawings, and related details.

D. Indicate actual device placements, number and type of cables between devices, fiber optic bend radius and mounting details, destination and termination point ID numbers, cable route ID numbers, slack and cable storage points, and site and building floor plans showing conduit size and routing.

E. Point-to-point Wiring Diagrams: Indicate terminal-to-terminal connection between system components, type of connections, and other information necessary to make final terminations.

F. All cable submittals shall include the following information from the Manufacturer:

1. Current Catalog Cut Sheet
2. Manufacturer’s installation instructions
3. Manufacturer’s Production Cable Configuration Drawing(s)
4. Manufacturer’s confirmation letter listing the Optical Fiber Manufacturer (glass), which shall be utilized for the manufacture of said OSP Cable/s
5. Letter of certification warranting compliance with Telcordia GR-20-CORE
6. The Manufacturer’s REA Listing Letter that demonstrates a minimum of 2 years continuous listing
7. Letter of certification warranting compliance with TIA/EIA-472, Generic Specification of Fiber Optic Cables

G. Cable Schedule:

1. Shall provide but not be limited to the following:
   a. Number of cables
   b. Number of terminations
   c. Conduit Type or ID number
   d. Source cable ID
   e. Terminating cable ID
   f. Cable routing path or segment ID
2. Total cable distance:
   a. Cable routing allowance
   b. Excess cable allowance (slack)
   c. Actual cable distance between all termination points
3. Copies of the Cable Schedule submittal shall also be submitted to the Communications Transmission System (CTS) contractor for use in computing optical link budgets for that system.

H. Cable Loss Budget:

1. Perform and furnish fiber optic link budget calculations based at 1310 nanometers (nm) and 1550 nm wavelength factory tested loss for the cable.
2. State all engineering metrics and assumptions used in computing the optical loss budgets.

3. Measurements and calculation shall be provided but not be limited to the following
    a. Fiber optic cable loss per foot
    b. Routing Distance of fiber optic cable
    c. Connector and splice loss assumptions
    d. Total expected loss due to distance
    e. Loss to other factors such as dispersion and other optical cable impairments
    f. Total System Losses
    g. Planned Optical System Loss Margin

4. Results of above shall be provided to the CTS subcontractor for use in determining the CTS optical link budget and for any simulations that depend on these parameters.

I. Final Test Report using Optical Time Domain Reflectometer (OTDR):

1. Submit the results of testing the installed fiber optic plant by using an OTDR.

2. Submission shall consist of the following:
    a. Main Technical Report consisting of an explanation of all events shown on the traces, an interpretation of each event and an explanation of how they correlate with equipment, splices, connectors, and patch panels in the test path.
    b. The starting and end points of the Fiber Under Test (FUT) shall be clearly identified in the Final Test Report.
    c. Technician signoff sheet attesting to the time, date, and identity of the person doing the testing as well as the equipment used, serial number, and date attesting to the last calibration of the instrument.
    d. A pass/fail summary of all tests including a record of measured values versus required values.
    e. An Appendix to the main report with the original copies of the OTDR traces for bi-directional tests of all optical stands in the system along with event numbers for each trace and with the FUT starting and end points clearly marked on the trace.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test, install and commission the Station Local Area Network System to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Conditions requirements for quality assurance requirements and procedures.

C. Testing of devices and subsystems, and calibration of testing equipment shall be performed in accordance with the requirements herein, applicable codes and standards, and industry best practices as specified elsewhere.

D. Installation of new equipment shall be performed as required herein, following the manufacturer’s instructions and recommendations, industry best practices, applicable codes and standards as specified elsewhere.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Description and General Requirements: Work in this Section shall include (at a minimum) the following:

1. Engineer, furnish, install, and test a complete FOC plant at each station and ancillary facility including conduits, fiber optic cable, termination panels, cable management trays, and other fiber cable plant accessories. Power cabling and emergency power requirements for networked SLAN nodes.

2. Engineer, furnish, install, and test "industrial grade" and "non-industrial grade" Ethernet switches (as environmentally appropriate), a non-industrial grade Layer 3 switch at each Train Communications and Control Room (TCCR), media converters, and protocol translators as required in each of the stations and ancillary facilities.

3. Engineer and integrate existing MAN/LAN systems to SLAN.

4. Provide as-built documentation, training, spares, and test equipment for all SLAN systems at all stations and facilities.

5. The SLAN shall consist of "industrial grade" and "non-industrial" grade (as environmentally appropriate) Ethernet switches connected in a ring topology with single mode fiber optic cable. The SLAN shall also provide a ring of unused "dark fiber" within the same fiber optic cable. At all SLAN nodes, half of the unused "dark fiber" shall be connectorized at patch panels and half shall remain unconnectorized.

6. The SLAN subsystems shall consist of:
   a. A FOC plant with conduits, FOC, power cables, termination panels, cable management trays, cable slack enclosures (CSEs), and other FOC accessories
   b. Networking equipment such as Layer 2 and Layer 3 switches
   c. Station subsystem connections to SLAN
   d. SLAN to MAN (GigE Ethernet) Interface

7. SLAN Locations:
   a. SLAN access nodes consist of SLAN LAN nodes, SLAN dark fiber nodes, and SLAN MAN nodes.
   b. Within a Honolulu Rail Transit station or facility, SLAN LAN nodes shall be available at all Programmable Logic Controller (PLC,) on all station levels, Train Control & Communication Room (TCCR), and Station Manager booth locations. As a minimum, they shall consist of an Ethernet switch (industrial or non-industrial), fiber optic patch panels and cords, CSEs, and cable management trays in a dedicated key-locked enclosure or cabinet.
   c. SLAN dark fiber nodes shall be made available via fiber optic termination panels at all SLAN LAN nodes, CCTV and PA/VMS nodes, and in the public areas listed below:
      1) Halls, hallways
      2) Public areas, concourse areas
      3) Ancillary level hallways
      4) Any hallways having access to public areas

d. SLAN dark fiber nodes can be considered for communications between PLCs and remote input/output modules, communications panel, TCCR communications, and other special City-approved communication needs. All SLAN dark fiber nodes shall be installed in a dedicated key-locked enclosure or cabinet.

8. SLAN MAN nodes shall be located at the TCCR of each station. It shall consist of one Layer 3 Ethernet switch. The TCCR shall be considered as the interface point for MAN (GigE Ethernet) to SLAN.

9. Determine locations and quantity of SLAN nodes based on pre-proposal survey, indicative drawings, and as-built drawings of all stations and all ancillary facilities.

B. The SLAN shall be implemented in all of the 21 Honolulu Rail Transit stations, OCC and ancillary buildings, including the Maintenance and Storage Facility (MSF) and Traction Power Substations (TPSS). SLAN locations shall be as follows:

1. Honolulu Rail Transit Stations and Locations:

East Kapolei	Kalihi
UH West Oahu	Kapalama
Hoopili	Iwilei
West Loch	Chinatown
Waipahu Transit Center	Downtown
Leeward Community College	Civic Center
Pearl Highlands	Kakaako
Pearlridge	Ala Moana
Aloha Stadium	Pearl Harbor Naval Base
International Airport	Lagoon Drive
Middle Street Transit Center	MSF/OCC Building/BOCC & other Facilities.
MSF Yard and Facilities	Park and Ride Lots

2. Ancillary Facilities: Additional sites may be added to the above list at pre-proposal or at Contract time or during City input.

C. The SLAN shall also provide connectivity through fiber drops (spurs) and Ethernet switches to the TPSS locations and parking lots CCTV nodes. All fiber drops (spurs) shall be redundant and fed from adjacent stations.

D. The SLAN shall also cover the following specific rooms at all stations: TCCR and Station Manager booth.

E. The existing elevator, escalator shall use a dedicated communications network for command and control; however, it shall interface with the SLAN at the TCCR through the Layer 3 Switch.

F. SLAN Networking Equipment:

1. The SLAN networking equipment (Layer 2 and 3 switches and other networking equipment) shall consist of “industrial grade” and “non-industrial grade” switches

with Ethernet protocol, built for harsh and industrial environments and office environments, and with enhanced networking capability. Features shall include security, remote manageability, Quality of Service (QoS), bandwidth reservation, port restrictions, and high availability. Provide a standard (or non-rugged) Layer 3 Ethernet switch with security and remote manageability options for the TCCR.

2. The switches shall be located at SLAN nodes and be connected to the fiber optic ring network using fiber optic termination panels. Station subsystems shall connect to the SLAN via these switches.

3. The SLAN switches shall have self-healing capability. A single FOC cut shall not cause communication failure for any SLAN nodes. Single equipment (Layer 2 Switch) failure shall only render that node inoperable. The switch routing algorithms at all Layer 2 Switches shall re-establish SLAN communications to all operable nodes within 5 seconds of a cable cut or a nodal failure.

4. In the selection of networking equipment, minimize the use of discrete media converters, protocol converters, and translators. Utilization of networking equipment shall be optimized. The use of routers shall be minimized by using a Layer 3 switch, where applicable.

5. Connections from the fiber nodes to all subsystems (e.g. CCTV, PIS, TEL, SCADA) shall be in a star topology and hall be via Ethernet cable to Cat 5e or higher depending on the application bandwidth requirements. Power Over Ethernet (PoE) solutions shall be acceptable provided the application is warranted.

G. Power Cabling to City Provided Station UPS: Provide AC power, emergency power, and power circuit hardware to all SLAN electronics.

H. Fiber Optic Cable Plant – Fiber Optic Cable:

1. Provide FOC as the underlying media to construct the ring network at each station. Each segment of the ring shall terminate at a FOC termination panel. The termination panel shall provide access to Layer 2 Switches and dark fiber terminations.

2. The FOC strands shall be single mode and glass material.

I. The FOC shall be a dry, tight buffer type. It shall have fire retardant, rodent protection and water repellent characteristics as specified herein.

J. The FOC shall have fiber count not less than 24 strands. Each buffer tube shall not have more than 12 fiber count.

K. The FOC shall have a strength member made up of Kevlar™ yarn.

L. The FOC shall be “armored” with two weather-resistant black polyethylene (PE) jackets with a single steel armor in between the two PE jackets. The extra jacket shall provide additional crush and impact resistance. The Contractor may propose functionally equivalent FOC provided it is suitable for the intended purpose, cost effective, and approved by the City.

M. To avoid fiber breaks, all fiber terminations shall be enclosed on cable splice trays. At all times, fiber strand exposure shall be minimized and protective hardware or covers used.

N. Fiber Optic Cable Plant – Routing:

1. Within a station, FOC shall be routed in a ring fashion connecting all nodes within the station. To the maximum extent practicable, two adjacent FOC segments should not share the same conduits. Additional conduit layout just to meet this requirement shall not be required. Review the conduit layout with Engineer and the City at input time and confirm that sharing of conduit is minimized.

2. For ancillary facilities, a fiber optic drop (spur) shall be used (not a ring).

3. The cable shall be routed such that the cable entering the room and the cable leaving the room shall be as far apart as possible.

4. The FOC shall run continuously between rooms or between equipment such that the cable used will be a one-piece unit and not in pieces (i.e. no intermediate splices to be used).

5. Engineer, route, and install all cables, such as power cables, communication cables, and FOCs required to make the SLAN operational.

6. FOC and power cables shall be routed to ancillary locations inside and outside the station such as, parking lots and TPSS. These locations shall have a fully operational SLAN.

7. If the information provided in the indicative drawings is not sufficient to decide cable laying for each room, determine cable layout requirements for each station during the engineering phase after Contract award.

O. Fiber Optic Cable Plant – Termination Panels and Cable Management Trays:

1. All used fiber strands (for SLAN ring) and 50 percent of the dark fiber strands shall be field terminated using pre-fabricated (or factory manufactured) Standard Connector or Siemon Connector (SC) connector type pigtail assemblies, fusion-spliced to the strands of the incoming cable. The connectors shall be mounted on bulkheads, installed in the patch panels, with Physical Contact (PC) polish style ceramic connectors. The remaining FOC strands shall be bundled and kept in the splice trays.

2. Cable management trays splice drawers and splice trays shall be provided, as required, for easy fiber management of in use fibers, connectorized dark fibers, and unconnectorized dark fibers.

3. To the maximum extent possible, the termination equipment shall be shared by allowing two FOC segments in the same terminating equipment. However, the fiber optic termination panels, splice drawers, and splice trays shall have sufficient future capacity for all strands should the City decide to connectorize the remaining dark fibers.

P. Fiber Optic Cable Plant – Splices:

1. Fusion type splicing shall be used. The number of splices shall be minimized.

2. Fusion splicing shall have minimum splice loss in accordance with industry standards. All field splices shall have attenuation of no more than 0.1 decibel (dB).

3. For core alignment, High Resolution Direct Core Monitoring method of splicing shall be used.

4. Heats shrink/pin type sleeve protector shall be used to protect the splices.

Q. Fiber Optic Cable Plant – Slack Enclosures:

1. At each end of FOC segments, 20 feet of cable slack (service loop) shall be left within minimum bend radius limits. Slack shall be enclosed in a CSE.

2. Provide a slack enclosure for service loops.

R. Fiber Optic Cable Plant – Communication and Power Conduits:

1. Provide power, fiber optic, and communication conduits for SLAN use.

2. During the Contractor’s station and facility site surveys, conduit engineering, layout, and routing shall also be determined. The survey findings report on conduits shall be submitted to the City for approval at Definitive Design review (DDR).

S. Interface of Station Subsystems to SLAN:

1. The interface between the SLAN and Station subsystems shall be at Ethernet switches located at SLAN LAN nodes. The interface between the GigE Ethernet (MAN) and SLAN shall use one Layer 3 non-industrial grade switch.

2. Refer to applicable Sections for interface details on required interfaces for these systems. Provide the necessary Ethernet interfaces e.g. Ethernet cards in order to connect station and facility subsystems to SLAN.

T. Honolulu Rail Transit Metro Area Network (MAN) Integration and Security:

1. Provide all the required communication equipment, such as switches and Ethernet cards, as necessary to communicate with MAN (GigE Ethernet) located in the TCCR. Refer to applicable Sections for additional information and requirements. Switch in the TCCR shall not be required to be industrial grade.

2. At most TCCRs, one Layer 3 switch shall be installed as indicated in the “SLAN Conceptual – Drawing”.

3. Provide all equipment needed for this project.

4. Restrict direct or indirect SLAN -MAN interfaces to City’s private GigE Ethernet network only. No other MAN interface to SLAN shall be permitted e.g. public internet or dial-up.

5. Coordinate the work plan for MAN-SLAN integration with the City.

U. Cat/Ethernet Cable Plant Requirements shall follow the list bellow but is not limited to these guidelines:

1. Ethernet cable runs shall not exceed distances of 100 meters above their rated speed length.

2. Mix cables of different cable types are unacceptable. As long as the minimum cable category supports the maximum speed of your network.

3. All Ethernet cables shall be backward compatible with prior ethernet standards.

4. All Ethernet cables shall be manufactured to length and assembled by a reputable company in the industry.

5. All Ethernet cables shall be of the catch connector type.

6. All Ethernet cables shall be a Cat. 5e cable or higher anything less is unacceptable.

7. Ethernet cable in network shall be rated no less than the maximum speed of the network.

8. Cat cables shall be tag with identifiers.

9. Cables shall be labeled to as "patch" or "cross over" cable.

V. Safety and System RMA (Reliability, Maintainability, and Availability):

1. The SLAN engineering shall adhere to best practices of system safety and RMA as outlined in the Design Criteria Chapter 24 – System Assurance and Chapter 25 – System Safety and Security. Specifically:
   a. Eliminate critical and catastrophic hazards
   b. Provide high degree of reliability
   c. Minimize downtime during maintenance and malfunctions as specified

2. In addition to complying with Quality Assurance, develop as part of a robust safety and RMA plan, the following detailed plans as further specified below:
   a. FIAT Plan – Field Installation Acceptance Test (FIAT) Plan
   b. RMA Study – Reliability, Maintainability, and Availability Study
   c. 30DOT Plan – SLAN Thirty Days Operational Test Plan

3. General Reliability, Maintainability, and Availability Requirements:
   a. Submit in the technical proposal a detailed study of RMA for the proposed SLAN system. Spare parts, model types, SLAN architecture, cable routing diversity, quantities, and other applicable engineering parameters shall be taken into account in this study.
   b. Identify critical risk areas for SLAN, submit a risk assessment report, and include findings and recommendations in the RMA study. The report shall address risk areas such as conduit breaks, fiber cuts, switch failure, power outages, and other equipment failures, such as but not limited to fiber termination panel failures, slack enclosure failures, and cable management tray failures.
   c. Assume for the purposes of RMA calculations the following parameters for City furnished equipments: reliability of “1” and availability of 100 percent if reliability data is difficult to estimate or obtain, otherwise an MTTR of 2 hours and MTBF of 25 years shall be assumed.
   d. At Final Engineering Review, re-compute the RMA analysis based on final engineering. Real figures for MTTR and MTBF for City furnished equipment shall be used where available.
   e. As part of FIAT for SLAN and prior to cutover of SLAN at a station or facility, conduct a SLAN 30DOT that verifies overall system RMA requirements for that

station or facility. The FIAT shall be engineered such that a simulated load of at least 66 percent above the nominal bandwidth of the SLAN network is applied continuously for the testing period. Provide a calculation justifying the simulated load used during SLAN FIAT. Industry standard test equipment shall be used to simulate the load. Demonstrate that during the entire SLAN FIAT less than 0.1 percent of total Ethernet frames encountered errors i.e. dropped packets, collisions, etc.

W. SLAN Cabinets / Enclosures:

1. SLAN equipment at each node (within a station) shall be housed in secured cabinets / enclosures.

2. In addition to these requirements, meet the requirements specified herein.

3. SLAN Dark Fiber nodes shall require one cabinet or enclosure to house the optical-termination hardware

4. SLAN LAN nodes shall require two cabinets or enclosures, one for the optical-termination hardware and the other for the electronics.

5. SLAN MAN nodes shall require one enclosure or cabinet.

X. Ancillary Facility Connectivity: The City will allow the Contractor to use the FOC installed by others, for providing connectivity to the following ancillary facilities:

1. TPSS

2. Parking Lots

3. Others as defined by the City

Y. Interfacing and Working with Others on Related Projects:

1. Parallel City operational activities and other Contract work will be ongoing and require co-ordination during this Contract effort. Currently known activities that may require coordination are:
   a. TPSS upgrade
   b. CCTV implementation
   c. SCADA
   d. Telephone Systems
   e. Public Information System including PA and Signage
   f. Other ongoing activities to be listed

2. Other systems outside the scope of this work may require use of SLAN communications facilities prior to 30DOT of SLAN. This shall not void warranty. Any support for such activities to be provided by the Contractor shall be approved by the City.

Z. Guidance to Contractors:

1. Indicative drawings in the attachments are provided to the Contractor as guidance only. Develop his engineering drawings from site surveys, system engineering, and final engineering reviews approved by the City.

2. The Contractor can propose alternative technologies and architectures in his technical proposal than outlined herein as long as benefits are clearly presented.

AA. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the Station Local Network system.

2.02 MATERIALS SLAN NETWORKING EQUIPMENT

A. Specifications for Industrial Grade and Non-Industrial Grade Switches:

1. Provide full specifications and characteristics for the proposed SLAN switches at PDR for City approval. Minimum specifications and characteristics are provided below. Non-industrial grade switches shall meet the functional requirements listed herein, but need not meet mechanical and environmental requirements.

2. Capacity - 12 ports and 24 ports modularity shall be provided. The Contractor may propose alternative modularity if cost effective, to the City.

3. Exhibit high reliability compared to office Ethernet products.

4. Redundant power inputs to prevent single power failure.

5. Support for ring topology to provide a redundant backup path.

6. The ability to withstand extreme storage temperature conditions, such as from -40 degrees Fahrenheit to 185 degrees Fahrenheit. Humidity 5 percent to 95 percent (non-condensing).

7. Environmental requirements:
   a. Non-controlled environment: Active devices that will be in non-controlled environments shall meet the environmental requirements.
   b. Controlled Environments: Active devices shall be industrial grade and capable of operating in temperatures of 32 degrees to 140 degrees Fahrenheit and shall function continuously in the relative humidity range of 10 percent to 95 percent non-condensing.

8. Certification by industry regulatory agencies.

9. The ability to withstand shock, drop, and vibration conditions.

10. Line-swap fast recovery that responds when devices change their port position.

11. Standards - IEEE802.3, 802.3u, 802.3x, 802.1D, 802.1W, 802.1Q, 802.1p.

12. Protocols - IGMP V1/V2/V3 device, GVRP, SNMP V1/V2c/V3, DHCP Server/ Client, BootP, TFTP, SNTP, SMTP, RARP, and EDS-SNMP OPC Server Pro (optional).

13. MIB - MIB-II, Ethernet-Like MIB, P-BRIDGE MIB, Q-BRIDGE MIB, Bridge MIB, RSTP MIB.

14. Flow Control - IEEE802.3x flow control, back pressure flow control.

15. Interface - RJ45 Ports, 10/100 BaseT auto negotiation speed, Full duplex mode, and auto MDI/MDI-X connection.

16. Fiber Ports – At least two 1000 BaseFX ports (SC connector).

B. Non-Industrial Grade Layer 3 Switch Specifications:

1. 24 ports with Gigabit Ethernet capacity

2. Support stackable feature

3. Support for ring topology to provide a redundant backup path

4. 2 Gigabit single mode fiber optic links compatible with Layer 2 fiber optic switch ports. (SC connector)

5. Flow Control - IEEE802.3x flow control, back pressure flow control

6. IP-based management access filtering using Telnet, HTTP, and SNMP (Version1/2/3)

7. Dynamic VLAN trunking and multicasting feature with IGMP Version 3 support

8. Supports Rapid Spanning Tree Protocol (IEEE 802. 1W)

9. QoS based on layer 2/3/4 information

10. Line-swap fast recovery that responds when devices change their port position

11. Remote management using Telnet, SNMP (Version1/2/3), Web GUI Network Manager

2.03 FIBER OPTIC CABLE SPECIFICATIONS

A. Cable size shall be 24 fibers with 4 buffer tubes of 6 fibers each or 6 buffer tubes of 4 fibers each. Additionally the FOC shall be rated for interior and exterior installations and shall meet or exceed the following specifications:

1. Tight-buffered tube 62.5/125um (core/cladding) single mode.

2. TIA/EIA-568B color-coding for FOC.

3. A central strength member of Kevlar™ yarn, capable of supporting a short-term tensile load of 400 pounds without stretching.

4. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long-term load).

5. Capable of a minimum crush resistance of 850 lb. /in.

6. FOC shall have impact resistance not less than 2,000 impacts with 1.6 Nm.

7. Single armored FOC shall be double jacketed. Outer jacket shall have a wall width 1.5 mm or more. Inner jacket with wall width 0.75 mm or more.

8. Rodent resistant, fungus-resistant, water-resistant immersed in standing water and ultra violet-resistant for outdoor use.

B. The loss specification for the single mode optical fibers shall be in accordance with the latest applicable EIA/TIA standard.

1. The FOC shall meet the Mechanical and Environmental conditions as specified by the latest EIA/TIA 455-82A.

C. Color Coding:

1. Fiber Optic: Each fiber in a tube shall be distinguishable from other fibers in the same tube by means of color-coding ink. Coating material shall be stable over the cable's operating temperature range. The coloring shall not be susceptible to migration and shall not affect the transmission characteristics of the optical fibers. The color coding, at the time of ordering the FOC, shall meet the conditions as mentioned in the most recent version of TIA/EIA.

2. Buffer Tube: At the time of ordering the FOC, each tube shall be colored completely and consistently in accordance with the present version of specifications in TIA/EIA-568.

2.04 FIBER OPTIC TERMINATION EQUIPMENT - FIBER DISTRIBUTION PANEL

A. Each node of the SLAN shall provide access to active, terminated, and dark fibers through FOC distribution panels, cable management trays, and splice drawers. Minimum requirements are provided below:

1. Termination capacity: 24 fibers/24 connectors for each end of FOC segment, total 48 fibers/48 connectors. Operational termination capacity shall be enough to terminate 50 percent of two adjacent FOC segments into the same termination panel.

2. Mounting: 19-inch vertical rack mounted.

3. Major Components: Termination / Patch Enclosure, Splice Enclosure, Splice Trays.

B. Termination / Patch Enclosure:

1. 12 adapter panels with SC connectors (6 connectors per panel)

2. 24 type SC factory manufactured pigtail assemblies

3. Minimum bend radius: engineering shall ensure that bend radius of fiber stored is more than 2 inches

4. Access: Each tray with hinged access doors

5. Patch cords: 8 patch cords per termination/patch enclosure

C. Splice Enclosure:

1. Splice enclosure shall have capacity to house 24 splices in trays

2. 12 fibers per splice tray

3. Splice tray type: Fusion

D. Accessories: Provide necessary components for rack mounting.

2.05 FIBER OPTIC TERMINATION EQUIPMENT - CABLE SLACK ENCLOSURE

A. Provide CSEs at both cable entry/exit points of a SLAN node. Wall or surface-mounted type, aluminum construction, with ample space and brackets for coiled slack of up to 20 feet shall be provided. Bending radius of FOC in CSE shall exceed minimum bending radius of FOC.

B. Knockouts and cable grommets at the bottom and top of enclosure of ample size to allow entrance of FOC.

2.06 FIBER OPTIC TERMINATION / PATCH ENCLOSURE PLACEMENT

A. Termination/patch enclosure shall be placed immediately above the splice enclosure to minimize pigtail exposure.

B. Minimum bend radius: The termination/patch enclosure design shall ensure that bend radius of fiber stored meets fiber specifications.

C. Front type access shall be provided to the termination/patch enclosure.

D. Termination/patch enclosures shall be wall mounted or rack mounted as appropriate and as approved by the City.

2.07 FIBER OPTIC TERMINATION EQUIPMENT – ACCESSORIES

A. Connector **-** The optical connector chosen shall be SC single mode ceramic with a PC polish, and splices shall deliver a maximum allowable insertion loss of 0.75 dB at either 850 or 1,300 nm, and a maximum allowable return loss of 26 dB for data / 55dB for video minimum guarantee for all terminated optical fiber. Loss is tested in accordance with FOTP-171, single cable reference.

B. Pigtails **-** Constructed of the same quality optical material as FOCs supplied under this Contract.

1. Core and cladding of pigtails identical in dimensions to that of FOC fibers.

2. Equipped with SC connectors.

C. Fiber Optic Patchcords – Flexible and durable single mode patch cords with SC connectors at both ends.

D. Fusion Splicer(s) – Two core alignment fusion splicers shall be shared among all stations. The fusion splicer shall be functionally equivalent to a Sumitomo Type-25M Fusion Splicer Kit.

2.08 FIBER OPTIC CABLE RELATED EQUIPMENT - OPTICAL POWER METER AND LIGHT SOURCE UNIT

A. Two rugged portable test equipment shall be provided and shared among all stations and facilities. A new recent model, not older than 2 years, from a manufacturer who has supplied OTDRs and OLTS for at least 5 years. These Specifications shall be functionally equivalent to EXFO FTB-400 universal test device or approved equivalent. Additional requirements shall be as stated herein.

B. The portable device shall support following features:

1. Minimum of 4 dedicated slots for OTDR and GigE testing
2. Supports multiple (at minimum of 500) OTDR and Loss testing (OLTS) combinations
3. Supports testing for Dense Wavelength Division Multiplexing and Optical Spectrum Analysis
4. Packet blazer testing for Ethernet based service
5. Simultaneous acquisitions and data post-processing
6. Saving test reports to a file on the system
7. Printing: Capability to print OTDR reports
8. RFC-2544 compliant for network performance testing

C. Hardware requirements:

1. 12 inch TFT active color touch screen with pixel resolution of 800X600 for user interface
2. Integrated power supply
3. Windows 2000/ Xp based system
4. Memory (RAM): 512 megabytes

D. Accessories:

1. Hard transit case
2. Bare fiber adapter
3. Fiber optic patch cable, 10 meter ST to SC cable

E. Operational characteristics:

1. Wavelength: 850 nm, 1,300 nm, 1,310 nm and 1,550 nm
2. Dynamic Range: From 21 dB to 35 dB
3. Accuracy: plus or minus 0.01 percent of distance or plus or minus 1.65 feet, whichever is better
4. Optical Connections: SC or bare fiber
5. Safety: Unit shall meet Class 1 laser product safety classification under radiation control for Health and Safety Act of 1968

2.09 FIBER OPTIC CABLE RELATED EQUIPMENT - LIGHT SOURCE UNIT

A. Provide two pairs Optical Light Source Units compatible to use with EXFO FTB-400. These units shall be shared among all stations and ancillary facilities.

B. Alternatively, the minimum requirements for a Light Source are provided below.

1. Power: 120 VAC/internal battery

2. Packaging hand-held

3. Operating Temperature: 32 degrees Fahrenheit to 113 degrees Fahrenheit

4. Accessories:
   a. AC adapter
   b. Carrying case: Rugged case suitable for transit field use with storage for Optical Light Source Units

C. Optical Light Source:

1. Output power: -20 dB m @ 850 nm, >-20 dB m @ 1,300 nm, >-38 dB m @ 1,300 nm and –10 dB m @ 1,550 nm

2. Output stability: Less than plus or minus 0.1 dB/hour at 77 degrees Fahrenheit

3. Wavelengths: 850 nm, 1,300 nm, 1,550 nm

4. Optical connectors: Bare fiber, FC/PC, ST, SC

2.10 FIBER OPTIC CABLE RELATED EQUIPMENT

A. Emergency Restoration Kit (ERK)

B. Furnish one complete ERK to be shared by all stations and facilities

C. The ERK shall have the following minimum item:

1. 300-foot reeled length of FOC conforming to theses Specifications.

D. Two Fusion Splicers

E. Two high-precision cleavers conforming to the following:

1. Hand-held

2. End angles after cut (typical): Within 0.5 degrees of perpendicular

F. Four Splice Enclosures conforming to the following:

1. Splice Type: fusion splicing.

2. Enclosure shall include splice containment trays and hardware.

3. Access: Provide end caps and re-enterable type encapsulating compound. End caps shall have cable ports admitting cable up to 1 inch in diameter. Encapsulant shall be a non-toxic, fungus-resistant, polyurethane-based material.

4. Two tool kits: Include cable stripping tools, fiber cleaning compounds and additional accessories required for the completion of fusion splices.

5. Two instruction manuals and all necessary additional items required for temporarily bypassing a damaged section of cable.

6. Provide ERK transit case for the secure transport of the above items under severe field conditions.

2.11 ANCILLARY EQUIPMENT

A. All other equipment necessary to make the system fully operational, but not mentioned in this Section such as cable ladders, steel frames, racks, electrical cables, screws, fiber optic patch cords, and connectors shall also be installed, furnished, and tested by the Contractor at no extra cost to the City.

B. All ancillary components must be designed to operate in the manner that is intended by the manufacturer. If for any reason the Contractor needs to deviate from the application or specifications a device was intended for, the Contractor must provide an approval from the manufacturer indicating such modification is allowed and would not cause any problems to itself or the system. Submit this proposal to City at City INPUT. In addition, all parts and devices shall be industry certified and comply with all the regulations of the communications and electrical industries as well as federal, state, and local governmental institutions.

2.12 CABLE SAMPLE

A. Provide 2-foot sample specimens of each type of fiber cable used in the SLAN to the City for approval.

B. These sample specimens shall remain the property of the City.

PART 3 – EXECUTION

3.01 GENERAL

A. The execution phase of SLAN shall consist of the following sub-phases:

1. Station and facility site surveys
2. Preparation and conduct of City INPUT
3. Preparation and conduct of PDRs for SLAN hardware and functionality
4. Preparation and conduct of FDRs for SLAN hardware and functionality
5. Factory Acceptance Test (FAT) of SLAN FOC and networking hardware
6. Site by site installation, test, and acceptance of SLAN
   a. Site by site staging and installation of SLAN FOC plant, networking hardware, and integration into existing MAN (GigE Ethernet) at each station and facility
   b. Site by site testing and acceptance of SLAN subsystem at each station and facility, including execution of SLAN FIAT and 30DOT
   c. Provide as-built documentation, training, and spares for all SLAN systems

B. Codes, Standards, and Regulations – Work under this Section shall be performed according to all appropriate city, state, and federal codes, standards, and regulations.

C. Test plans and reports as identified earlier, shall be required during factory, system and availability testing phases. These shall be submitted to the City for review and approval.

City reserves the right to include more tests in the test plan. The test plan and results shall be submitted as FDR.

D. Acceptance of RFP Plans by the City or closing of a phase shall not preclude the Contractor from updating such documentation to reflect any direct or incidental changes. Submit updated documentation at 30DOT.

3.02 STATION AND FACILITY SITE SURVEYS

A. Perform station and facility site surveys as part of determining and confirming exact engineering requirements for all subsystems required in this Contract. In particular, for SLAN, engineering requirements for layout of equipment, exact locations of all components, power cabling, conduit routing, cable routing, FOC, cable management trays, slack enclosures, equipment enclosures, and necessary quantities of all components comprising SLAN shall be determined at station and facility site surveys.

3.03 INSTALLATION

A. Installation of all fiber optic plant shall conform to NEC Article 770.

B. Staging for the installation of SLAN components - Perform staging for all SLAN components according to the SLAN Staging Plan. This includes pre assembly of SLAN hardware and interconnections.

C. During Honolulu Rail Transit Revenue hours, Train Traffic Management capabilities shall not be reduced or eliminated. These functions shall be available under one system.

D. Shop drawings for SLAN installations shall be produced prior to the installation.

E. Perform a physical audit and inventory of the equipment to be delivered prior to shipping and installation.

F. Furnish all the needed AC Power circuits, terminations, and power strips for the use of the SLAN.

G. Install all SLAN systems at each station and extension locations as specified elsewhere in this Section. This shall include at a minimum:

1. Installation of SLAN fiber optic plant, power, and other communication cables
2. Providing conduits for all the cable installed

H. All cable installation shall be done in accordance with the applicable electrical and the fire codes including NFPA 72 and NFPA 130.

I. All cables, devices, ports, and wire shall be labeled using the same format as the labels on the shop and as-built drawings. Labels on cables and wire shall be descriptive to indicate location of the terminations, subsystem identification, and port number (if applicable), as specified herein.

3.04 TESTS, ACCEPTANCE, AND TRAINING

A. At a minimum, perform the following tests on the SLAN system:

1. Factory Acceptance Test (FAT): Perform FATs for all subsystems specified in this Contract including SLAN. Propose a configuration at the Contractor's facility that simulates, as practicable, live operation of all subsystems. The FAT shall include at a minimum, procedures, execution, and detailed test reports - all witnessed by Engineers. The tests to be performed under FAT, as a minimum shall include the following:

    a. Validation: Perform tests using OTDR equipment to find the any discontinuity in the fiber cable, normalized attenuation, total attenuation, and splice loss. The optical power shall be used to Measure power and wavelength of the light sent into the FOC, splices, and connectors. All the tests recommended by the manufacturer and other tests specified herein shall be performed.

    b. Integrated FAT: The integrated FAT tests shall be carried out for the fiber optic plant, splices, switches, and other SLAN equipment. Integrated FAT shall include the use of a lab setup for SLAN. Other subsystems, such as the SCADA shall use this lab setup for SLAN communications.

2. SLAN FIAT: This test shall be performed at a system level and the individual component level. All hardware devices shall be tested after being deployed or re-deployed to the premises where they will operate. The specific tests to be performed under the FIAT are:

    a. Performing OTDR tests for splice loss, fiber optic loss, fiber breaks, and light scattering in the fiber optic plant

    b. Tests to check for loss and discontinuities within the fiber cable using optical power meter

    c. Network component and connectivity testing for every SLAN node to every other SLAN node

    d. Testing of all ports on a switch and patch panel interfaces on each SLAN node

    e. Reporting status of all bugs and discrepancies found during the testing phase

3. SLAN 30DOT: The 30DOT shall be performed after the FIAT has been completed and approved by the City. This test is performed at system or subsystem level only and at every time new components are integrated into the SLAN. The tests to be performed are:

    a. Testing each SLAN node with other SLAN nodes and with the Master PLC, Slave PLC, Switches, GigE ETHERNET, and any other components connected to the SLAN. Every component, system, and subsystem shall be verified for connectivity and communications.

    b. All the reported bugs, discrepancies, and functional deficiencies identified shall be documented and rectified prior to 30DOT completion for SLAN.

B. Execute tests of all SLAN equipment at each station and each ancillary facility.

C. All optical plant testing shall be in accordance with the latest EIA/TIA 455 standard.

D. Perform 30DOT in accordance with the test plans.

E. Provide as-built documentation, training and spares for all SLAN subsystems and components as specified herein.

F. Develop and provide training courses for the SLAN components addressing operators, facilities, etc. in accordance with the Training Plan. All courses shall be made available to all the shifts concerned with a particular course.

G. All training details shall be contained in the Training Plan as conformed during the FDR.

H. All training courses shall be available to the City at least 2 weeks prior, but not more than a month in advance of the course material becoming relevant or implemented.

I. All SLAN training shall take into account General Conditions requirements and unique environment. This means that the course material shall use City terminology, and all the examples shall be within the context of the Honolulu Rail Transit System. Generic examples shall not be allowed.

J. Offer “Beta” presentations to a selected City audience to review and evaluate each course content prior any course offering. These presentations shall occur at least 30 days prior the actual course offering.

3.05 SITE BY SITE INSTALLATION, TEST, AND ACCEPTANCE OF SLAN

A. In accordance with the Migration Plan, execute the site-by-site installation, test, and acceptance of the FOC plant at each station and facility. This shall include at a minimum:

1. Installation of conduits

2. Installation, testing, and acceptance of FOC plant

B. Execute site-by-site installation, test, and acceptance of networking equipment at each station and facility.

C. Execute integration and test of existing MAN (GigE Ethernet) / LAN subsystems to SLAN including site by site end to end testing with OCC and Backup Operational Center.

D. Provide as-built documentation and spares for all SLAN subsystems.

E. Schedule and conduct training along with other subsystems.

3.06 HARDWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Responsible for maintenance and support of all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within two working days of notification of the need for maintenance and support.

3.07 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: City shall have the option of purchasing directly from the appropriate OEMs of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5-day / 8-hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and shall request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided on site within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for all major components repair service, where each failed component is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective component and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed component unit at the Contractor’s premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of warranties or maintenance contracts. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on an hourly basis

2. Engineering support, defined as work performed by employees not paid on an hourly basis

3. Software Maintenance support

3.08 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. The Contractor shall be responsible for maintenance and support of all software until successful completion of the 1-year warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for software shall be available from the Contractor, on site, within one hour, and 24 hours per day, seven days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the

Contractor, on site, as a minimum, within one working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year warranty no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support for work requested by the City outside the scope of warranties or maintenance contracts. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within this project. The City shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. In addition, the City shall be placed, at no charge to the City, on appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period. Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.09 TRAINING

A. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

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SECTION 27 90 03

MAINTENANCE MANAGEMENT INFORMATION SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section includes a Maintenance Management Information System (MMIS) designed as an integral software application for the planning, control, maintenance, and performance analysis of the entire Honolulu Rail Transit system. The MMIS is located in the Maintenance Control Center. The MMIS will be designed as an asset register, a planning system, and a data and analysis system. The MMIS will permit the following tasks:

1. Financial control, through proper knowledge of costs and use of resources, allowing appropriate trade off decisions
2. Technical results, through efficient tracking of technical information
3. Efficient scheduling and organization of activities
4. Quality through compliance with ISO traceability requirements and delivery of current technical information to maintenance personnel
5. Improvement results through proper global indicators allowing detection of trends and continuously improving maintenance performance
6. Identification of Endemic Design or Manufacturing Defects
7. Equipment availability and reliability improvement

B. Section Includes:

1. General
2. Operational Requirements
3. Maintenance During Installation, Testing, and Warranty
4. Hardware Maintenance After Warranty
5. Software Maintenance During Installation, Testing, and Warranty
6. Training

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement of payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements, or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

A. The governing version of the listed documents shall be the latest as adopted and administered by the City. Included in the following References are additional standards and codes deemed pertinent to the final design of the system defined herein.

B. Federal Communications Commission (FCC):

1. 47 CFR 15 Radio Frequency Devices

C. International Standards IEC 61968-4:

1. As used in the International Electrotechnical Commission (IEC) 61968 series, a Data Memory System (DMS) consists of various distributed application components for the utility to manage electrical distribution networks. These capabilities include monitoring and control of equipment for power delivery, management processes to ensure system reliability, voltage management, demand-side management, outage management, work management, automated mapping, and facilities management. Standards interfaces are defined for each class of applications identified in the Interface Reference Model (IRM), which is described in IEC 61968-1.

2. This Part of IEC 61968 contains the Clauses shown in Table 27 90 03-1.

Table 27 90 03-1 – Document Overview for IEC 61968-4

Clause	Title	Purpose
1	Scope	The scope and purpose of the document are described.
2	Normative references	Documents that contain provisions, which through reference in this text, constitute provisions of this International Standard.
3	Reference and information models	Description of the relevant parts of the interface reference model, static information model, and message type naming convention.
4	Records and asset management message types	Message types related to the exchange of information for network data sets, assets, and asset catalogues.

D. National Electrical Manufacturers Associations (NEMA):

1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)

E. National Institute of Standards and Technology (NIST)/Federal Information Processing Standard (FIPS) Publication:

1. FIPS-201 Personal Identity Verification of Federal Employees and Contractors

2. FIPS-140-2 Security Requirements for Cryptographic Modules

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. System descriptive information.

C. Product data sheets.

D. Shop Drawings: Indicating actual device placements, number and type of wires and cables between devices, equipment mounting details, power requirements, data circuit requirements, point numbers, equipment addresses, and site and building floor plans showing conduit size and routing.

E. Point-to-point wiring diagrams: Indicating terminal-to-terminal connection between system components, type of connections, and other information necessary to make final terminations.

F. Manufacturer’s installation instructions.

G. Standby battery calculations: Provide standby current requirements, quantity and type of batteries proposed, and calculated standby time under normal and worst-case operating conditions.

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test, install and commission the MMIS to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Refer to General Conditions for Quality Assurance requirements and procedures.

C. Quality Assurance Program: The manufacture, test and installation of the MMIS communication interfaces to the CTS shall conform to the requirements of the approved Quality Assurance Program and the Quality Assurance provisions of this Contract.

D. The Contractor must employ factory-trained service personnel with a minimum of 5 years experience in MMIS related equipment and operations.

1.06 DESIGN CRITERIA

A. Asset Register: The purpose of the asset register is to have a current record of all assets and the modification and maintenance status of each significant item, component, or system. The asset register will also be used as a basis for optimizing whole-life costs. Begin providing asset register information as specific assets become identifiable. Asset register information shall be included in each monthly report by the Contractor.

B. Planning Systems: As a minimum, planning systems will:

1. Devise Transit rosters

2. Devise staff rosters

3. Plan train paths, including special trains and station stops
4. Plan technical incident control

C. Plan maintenance activities including:

1. System configuration tracking
2. Maintenance and new work planning, scheduling and control
3. Resource management
4. Materials management
5. Cost and budgetary control
6. Record and Display in real time all subsystems alarms and failures

D. Data and Analysis Systems: Data and analysis systems shall be available to provide statistical information over different user-defined time frames (e.g. daily, weekly, monthly, yearly) concerning, but not limited to the following:

1. Numbers of trains running daily
2. Total daily mileage of each vehicle
3. Availability of vehicles
4. Defects record
5. Reliability of equipment
6. Punctuality of services with analysis of cause of delays
7. Interface with Technical Documentation

E. Propose, design, and install, a complete and functional MMIS.

F. MMIS remote units shall be installed in the following locations:

East Kapolei	Kalihi
UH West Oahu	Kapalama
Hoopili	Iwilei
West Loch	Chinatown
Waipahu Transit Center	Downtown
Leeward Community College	Civic Center
Pearl Highlands	Kakaako
Pearlridge	Ala Moana
Aloha Stadium	Pearl Harbor Naval Base
International Airport	Lagoon Drive
Middle Street Transit Center	MSF/OCC/BOCC Building
60 Rail Cars	Park-and-Ride Lots

G. General System Functions:

1. Programming shall be provided for the purposes of setting up of people, cards, and access rights from a single workstation regardless of the number of remote units in the system. It shall also be possible for this to be performed from several workstations simultaneously. It shall also be possible to program individual remote units by using a local programmer, either for commissioning and diagnostics purposes or for reprogramming the remote units the event of failure of some other part of the system (e.g. personal computer-(PC) to-remote terminal unit (RTU) communications).

2. Identification or authentication shall be achieved by providing each person with a unique ID/Password. At the time of presenting the ID/Password, additional confirmation may be required showing that the correct person is accessing the system. This confirmation may be in the form of a personal identification number or biometric template.

3. Decision making or authorization:

   a. The decision to grant access to the MMIS software shall be taken by the central database at the OCC.

   b. The decision to raise an alarm on the occurrence of a specified event will also be taken by the central data base at the OCC.

4. Reporting: Reports will be available both on demand and automatically. On-demand reports will include personnel identification and location, event data (including date and time) and system configuration data. A separate report for input-to-relay mapping will be available. Automatic reports will be restricted to specifically selected events, and as such are alarms intended for immediate notification. Selected events will include attempted entry by unauthorized persons after specified periods.

5. Software: The software shall be resident in the main and back-up servers at the Maintenance Control Center. The system shall be capable of interfacing to all the above identified locations. The City may decide to have a back-up Maintenance Control Center and the system shall be capable of interfacing transparently to this site with all the features available to the system at the Main site.

PART 2 – PRODUCTS

2.01 GENERAL REQUIREMENTS: FEATURE + ASSET MANAGEMENT + MAINTENANCE MANAGEMENT

A. The Computerized Maintenance Management Software (CMMS) system shall be user friendly and be easily installed and operated.

B. Provide the following basic functions:

1. Asset Manager

2. Inventory and Expense Manager

2.02 ASSET MANAGER

A. Preventive Maintenance: Maximize system resources, reduce downtime, and increase efficiency. The MMIS shall help identify potential breakdowns and prevent equipment failure-impacting system and subsystem operation. The system will automatically create work orders when preventive maintenance is due and document activities making it easier to analyze trends and spot recurrent problems.

B. Scheduling: Monitor maintenance by odometer, hours, days, calendar dates, and days of the week. It shall also monitor everything that needs routine maintenance (e.g. all Communications equipment, CCTV cameras, Telephone systems, PA/VMS systems, Access Control Units, Intrusion Detectors).

C. Repair Histories: Produce complete repair histories for each system and subsystem, including parts and labor. Review repair costs in a variety of ways - geographic location, department, type, ID number.

D. Power Consumption: Detect early signs of equipment and system power variation. Monitor performance based on power consumption. Kilowatt hours reports can be printed to help pinpoint and prevent potential problems.

E. Tool Tracking: Employee tools assignment, tool/equipment check-out and return time to depot. The date and time of assignment and return information is also tracked.

F. Work Orders: Create work orders for routine maintenance, eliminating manual input. For unscheduled maintenance, provide easy work description and parts entry system. Classify work orders by the type of work performed. Once completed, the inventory, history, and budget files are updated automatically.

G. Sub Assets: Track maintenance and service schedules on equipments and other components of major assets.

H. Asset Depreciation: Track depreciation of major assets using the Straight Line Depreciation method.

I. Warranty Tracking: Track the warranty information on all systems and subsystems equipment, tools and vehicles. Know when assets are still covered under warranty, length of term, and more.

2.03 INVENTORY PLUS EXPENSE MANAGER

A. Parts Inventory: Tracks all of the information need for inventory.

B. Track Inventory status and eliminate costly stock outs or surpluses with the reorder and overage functions.

C. Report in detailed list of all purchases.

D. Automatically generate purchase order with the quantity needed to bring stock back to the normal stocking level.

E. Alternate Parts: produce approved alternate parts lists that can be used in systems and subsystems when out of a specific part.

F. Expense Tracking: Analyze projected budget versus actually, showing variances on a monthly basis with Expense Tracking for all account and maintenance expenses. If needed, group budgets for reporting purposes.

G. Purchase Orders: MMIS shall quickly and automatically generated purchase orders when inventory items are low. Giving the option and flexibility to generate, change, delete, and print purchase orders. Purchase orders automatically update inventory quantities, as well as expenses.

H. Components:

1. All equipment and components provided shall be new and the manufacturer's current model.

2. All equipment and components shall be UL listed and installed in compliance with manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, and physical sizes, before beginning system installation.

3. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of control panels, card readers, and sensors.

4. The user interface at the administrator and terminal workstations shall be a mouse driven graphical user interface allowing the user to open and work on multiple windows simultaneously.

I. Power Supply: Power for the system shall be derived from the Uninterruptable Power Supply system.

2.04 SOFTWARE

A. General:

1. The software provided as part of the system shall be capable of being utilized on one or more workstations simultaneously.

2. The software shall be suitable for use on Windows operating systems.

3. The primary functions of the software shall be to:
   a. Permit setting up of RTU
   b. Permit programming of people, cards, and access rights
   c. Provide on-demand reporting of events and system data
   d. Provide automatic notification of selected "alarm" events

B. Database:

1. There shall be a single database, of a suitably secure and reliable technology. It shall be possible to implement the database and all necessary client software on a single computer (subject to performance and capacity considerations).

2. Automated database back-up tools shall be provided that can back up the database each day to a different computer. Provide the ability to limit the maximum size of the database, by limiting event storage.

3. Where multiple workstations are required, they shall connect to the database server utilizing Transmission Control Protocol/Internet Protocol (TCP/IP) over local area network or wide area network. Each workstation shall be capable of running RTU communications client software as well as user-interface client software.

C. Communications: It shall be possible to use multiple PCs as communication servers, such that the PC – although polling RTUs continuously creates minimal TCP/IP traffic by communicating with the database only when there are events reported by the RTU or commands to send to the RTU.

D. User Interface: The user interface shall be primarily graphical and shall comply with the Microsoft Windows 2000/XP design principles.

E. Equipment Set-up:

1. The software shall permit full setting up of all parameters relating to RTUs. These parameters shall be downloaded to the RTUs to allow the RTUs to function autonomously.

2. Unless specified otherwise, all of the features listed herein shall be capable of being implemented via the software.

F. Reporting: Any report that can be generated by the software shall be capable of being viewed on screen, sent to a printer or saved to a file in a variety of formats including but not restricted to RTF, CSV, HTML, and PDF formats.

2.05 HARDWARE REQUIREMENTS AND CAPABILITIES

A. Administrator Workstation and Terminal Workstations: The workstations shall be IBM or IBM compatible computers with suitable capacity for the designed purpose. These workstations shall be shipped factory configured with all software preloaded and tested. All computer hardware replacement components shall be available off the shelf. This workstation shall have the following minimum characteristics:

1. Intel Zeon processor central processing unit (CPU)) with a clock speed of 3.0 GHz or greater

2. 2.0 GB random-access memory

3. 52X CD-RW drive

4. DVD-RW drive

5. 250 gigabytes minimum small computer system interface hard disk

6. 21-inch flat-panel monitor

7. 256 MB video card

8. Standard 101- type keyboard and mouse

9. Two network interface controllers (10/100/1000 Base-T Ethernet port) or equivalent

10. Two USB ports

B. System Printers: System Printer shall be laser units.

2.06 ELECTROMAGNETIC COMPATIBILITY

A. The MMIS shall comply with all electromagnetic compatibility regulations regarding electromagnetic compatibility within the HHCT system environment and with other systems installed within the same locations.

PART 3 – EXECUTION

3.01 GENERAL

A. Installation:

1. Design and operation of the system shall conform to the referenced codes, regulations, and standards, as applicable.

2. All equipment shall be permanently attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.

3. Install wire and conduit in accordance with manufacturer's recommendations and applicable codes and standards.

4. Furnish and install clamps or other cable-restraining hardware in areas where support is required for cables entering or leaving conduit.

5. Furnish filling compound for cables entering or leaving conduit. The filling compound shall be applied in conformance with manufacturer's instructions.

6. Cable entrance openings in equipment enclosures and junction boxes shall be sealed with compression-type fittings or pliable sealing compound after cable is in place. Sealing compound shall be used to seal area around cable where it emerges from the end of a conduit or junction boxes.

B. The system shall be programmed with the information supplied. The system must be fully working with all system parameters. It is the Contractor's responsibility to ensure that all the necessary information is obtained before commissioning the system.

C. Terminations:

1. Wire or cable terminated on terminal equipment that is moveable (such as terminal blocks mounted on swivels) shall be routed to the terminal equipment such that, when the terminal equipment is rotated or moved, the wire or cable twists instead of bending.

2. Cable terminations shall have permanent cable tags identifying the cable number, the number of copper pairs in the cable, the distant end (where the cable goes) and the route that it takes.

3.02 OPERATIONAL REQUIREMENTS

A. General: MMIS shall provide online status and history to authorized users for virtually all program data. The major features shall be:

1. Data maintained online by users

2. Reports built on demand from current data
3. Comprehensive view of all asset types
4. Condition and locations of all assets
5. Work processes
6. Optimum planning, control, audit and compliance capability
7. Critical information about assets resources
8. Asset configuration and physical and logical relationship to other resources
9. Access to data limited by username and password
10. Data available via Intranet at virtually any location
11. Links provide access to data supported by other websites
12. Integrated with Electronic Data Interchange systems
13. Allows segregation of data between project and programs
14. Data access and privileges tailored using roles and usernames

B. Some of the major features of the MMIS tool set shall be:

1. Centralized maintenance–all upgrades are done on server
2. Uses standard http port 80 or port 443
3. Windows XP, 2003 or UNIX can be used for application server or database
4. Uses standard ORACLE security and roles and/or equivalent Operating System
5. All business rules are enforced on database
6. Easy data import/export and backup using full file import/export

C. The MMIS should be designed to answer questions such as:

1. How many units are being inducted on a particular contract per month?
2. What does the trend line look like?
3. What were the top 10 defective parts last month?
4. What were the top 30 defective parts last year?
5. How long does it take on average to close a work order for a particular part?
6. What percentage of defects reported last year was related to vendor workmanship?
7. What assets need Engineering Change Proposal (ECP) “xyz” incorporated?
8. What is the mean time between failure (MTBF) for a particular system and subsystem Line replacement unit (LRU)?
9. Is MTBF getting better or worse?

3.03 MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Maintain and support all equipment provided until successful completion of the warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for all equipment shall be available from the Contractor, on site, within 1 hour, and 24 hours per day, 7 days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all equipment shall be available from the Contractor, on site, within two working days of notification of the need for maintenance and support.

3.04 HARDWARE MAINTENANCE AFTER WARRANTY

A. Computer equipment: City shall have the option of purchasing directly from the appropriate Original Equipment Manufacturer(s) (OEMs) of computers and associated peripheral equipment on-call maintenance services in accordance with the various levels of service offered by such OEMs, such as a 4-hour response (5 day / 8 hour) capability. Prior to the expiration of the warranty, have the equipment certified as being acceptable by the OEMs for the OEMs contract maintenance services, and shall request the OEMs to provide written quotation(s) to the City for the provision of such services. An undertaking to perform this action shall be provided to the City no later than 30 days prior to Final Acceptance.

B. Other equipment: As an option in the Price Proposal, provide an itemized written quotation for the supply of maintenance and support of all Contractor-provided equipment, based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include a statement to the effect that maintenance support will be provided, on site, within 24 hours of notification and on any of five weekly working days. The quotation shall include the provision of a monthly Maintenance Report. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all or some of the equipment provided, following the expiration of the warranty.

C. As an option in the Price Proposal, provide the rates for all major components repair service, where each failed component is returned to the Contractor by the City at the expense of the City, and the Contractor repairs the defective component and returns the repaired unit to the City at the expense of the Contractor. This offer must contain a guaranteed return time, for example 30 days after receipt of the failed component unit at the Contractor's premises.

D. As an option in the Price Proposal, provide the hourly rates for on-call technician and engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses:

1. Technician services, defined as work performed by employees paid on a hourly basis
2. Engineering support, defined as work performed by employees not paid on a hourly basis
3. Software Maintenance support

3.05 SOFTWARE MAINTENANCE DURING INSTALLATION, TESTING, AND WARRANTY

A. Maintain and support all software until successful completion of the 1-year warranty period.

B. During the Installation and Testing phases of the project, maintenance and support for software shall be available from the Contractor, on site, within one hour, and 24 hours per day, seven days per week.

C. After the first date of placing the system into operation, and until the expiration of the warranty period, maintenance and support for all software shall be available from the Contractor, on site, as a minimum, within one working day of notification of the need for maintenance and support.

D. Software Maintenance after Warranty: Describe the facilities available for on-call software support and maintenance services after the expiration of the1-year Warranty no later than 30 days prior to Final Acceptance.

E. As an option in the Price Proposal, provide the pricing for a software support option based on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The option shall be based on a response time such that software maintenance support will be provided, on site, within 24 hours of notification and on any of 5 weekly working days. The quotation shall include the provision of a monthly Maintenance Report.

F. The pricing should be on an annual basis commencing upon the date of expiration of the warranty, and for 2 years thereafter. The quotation shall include the provision of a completed Fault Report form for each fault incident. The City shall have the option of entering into one or more of these 1-year maintenance contracts for the maintenance and support of all the software provided by the Contractor, following the expiration of the warranty.

G. As an option in the Price Proposal, provide the hourly rates for on-call software engineering support, for work requested by the City outside the scope of any warranty or maintenance contract. The quotation shall include the provision of Activity Reports. Rates should be inclusive, including travel time and travel expenses.

H. Software Change Notification Service: The City shall be informed of alterations, modifications, and up-dates for all software provided within this project. The City shall be placed on the Contractor's mailing list to receive announcements of the discovery, documentation and solution of software problems as well as other improvements, up-dates, new software releases, and other improvements that could be made to the system provided to the City. This service shall commence at the time of Contract Award, and shall continue for 10 years. In addition, the City shall be placed, at no charge to the City, on any appropriate subscription lists for software subcontractors (for example, Microsoft) change notification service from the time of Contract Award through the warranty period. Prior to the expiration of the warranty period, the City shall be supplied with instructions on how to obtain renewable option(s) for extended subscription(s) beyond the warranty period.

3.06 TRAINING

A. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer’s own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

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SECTION 27 90 06

NETWORK TIMING SYSTEM

PART 1 – GENERAL

1.01 SUMMARY

A. Description: This Section specifies the design, furnishing, and installation and testing of a complete Network Timing (NT) System. The System is based on a Global Positioning System (GPS)-based timekeeping system to provide system wide timing and synchronization for Train Control, Closed Circuit Television (CCTV), and Supervisory Control and Data Acquisition (SCADA) message time stamping.

1. The NT will be used to provide timing and synchronization to support the following system-wide functions:
    a. Time stamping the dispatching and receiving of SCADA control, status, and alarm messages
    b. Time stamping CCTV video images for law enforcement purposes
    c. Time stamping control points and restricted area access requests for security purposes
    d. Time stamp fire alarm control and supervisory systems
    e. File server and database synchronization
    f. Facilitate email sorting and network data delivery
    g. Implement time-of-day switching and routing controls
    h. Provide a common time reference to synchronizing different data systems
    i. Provide interface to external Time Division Multiplexing (TDM) communications systems such as E-9-1-1-trunks and DS1 lines
    j. Provide time co-ordination for system-wide incident investigation (e.g. computer malfunctions, security attacks)

2. Local System Timing is provided by means of Network Time Protocol (NTP) protocol access to a main Primary Reference Source (PRS) network timeserver and by Synchronization Supply Unit (SSU) located at each Passenger Station, Traction Power Substations, and Train Control House requiring precise and synchronized network timing.

B. Section Includes:

1. System Testing
2. Electromagnetic Compatibility (EMC)
3. Installation Requirements
4. Training

C. Related Sections:

1. Section 27 13 01 – Fiber Optic Cabling Network
2. Section 27 20 01 – Communications Transmission System

3. Section 27 30 01 – Telephone Systems

4. Section 27 60 00 – SCADA System

5. Section 27 70 00 – Wireless Communications

6. Section 27 80 00 – Passenger Information System

7. Section 27 90 00 – Operations Control Center Ancillary Equipment

8. Section 27 90 01 – CCTV System

1.02 PRICE AND PAYMENT PROCEDURES

A. General: Separate measurement or payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of work in the General Conditions requirements or incidental to the Work.

1.03 CODES, STANDARDS, AND RECOMMENDED PRACTICES

Unless a specific date or version of a code or standard has been cited herein, the latest version in effect on the date of the Request for Proposals shall be used.

A. American National Standards Institute (ANSI):

1. ANSI/T1.101-1987 “Synchronization Interface Standards for Digital Networks”

2. ANSI C62.41 ANSI/IEEE Standard C62.41: IEEE Standard 587, Guide on Surge Voltages in AC Power Circuits Rated up to 600V

B. Electronic Industries Association (EIA):

1. EIA 204-D Radio Receivers

2. EIA 329-A, 1 Radio Antennas

3. EIA RS-316 Radio Electrical Performance

C. Federal Communications Commission (FCC)

D. GR-1089-CORE: Electromagnetic Compatibility and Electrical Safety Electrical Safety

E. Institute of Electrical and Electronics Engineers (IEEE):

1. IEEE 802.3 Ethernet-based LAN Standard

F. International Electrotechnical Commission (IEC):

1. IEC 60096 Radio-frequency Cables

2. IEC 61000 Electromagnetic Compatibility (EMC)

3. IEC 801 Parts 2, 3, and 4 for Electronic Static Discharge (ESD), radiated RF immunity and power line bursts

G. International Telecommunication Union Standardization (ITU-T):

1. ITU-T G.704 — Synchronous Frame Structures Used at 1544, 6312, 2048, 8448 and 44 736 kbit/s Hierarchical Levels - Series G: Transmission Systems and Media, Digital Systems and Networks Digital Transmission Systems - Terminal Equipments - General

2. ITU-T G.811/G.812 — "Timing Characteristics of Primary Reference Clocks"

H. Internet Engineering Technical Forum (IETF):

1. RFC 1305 — Network Time Protocol Version V3

I. National Electrical Manufacturers Association (NEMA):

1. IEC 60529 — Ingress Protection (IP) 66

2. NEMA ICS 6-1993 — Industrial Controls and Systems Enclosures

3. NEMA Type 1 — General Purpose Enclosures

4. NEMA Type 4 — Watertight and Dust tight-Indoor and Outdoor Enclosures

1.04 SUBMITTALS

A. General: Refer to the General Conditions for Submittal Procedures, and for Shop Drawings, Product Data, and Samples requirements and procedures.

B. QA Program: The manufacture, test and installation of the communication cable shall conform to the requirements of Technical Provisions TP-02, “Verification, Testing, and Acceptance.”

C. Submit results of network delay calculations from both Active Network Time Servers (ANTS) and Standby Network Time Servers (SNTS) out to the farthest reaches of the Communications Transmission Network (CTS) for purposes of accurately calculating, verifying, and implementing bi-directional network delays in implementing a universal system time for all network elements requiring it.

1. Network delay data shall be collected, recorded, and utilized to provision the NT system and compensate for timing differences at different network locations due switching and propagation delay.

2. The data shall be used to account for and correct for timing differences introduced by network delay to assure all network devices are equally synchronized to the PRS.

D. Submit manufacturer tests and antenna patterns for the GPS antenna to measure symmetrical properties and how well antennas track high and low elevation satellites at different azimuths.

E. Employ factory-trained service personnel with a minimum of 5 years experience in servicing radio frequency (RF) related equipment.

F. Comply with the following requirements:

1. RF and GPS cabling requirements

2. Antenna grounding for GPS systems

3. Lightning protection standards for elevated antenna structures

4. Manufacturer's recommendations and applicable codes and standards for radio systems operating in the GPS RF band

1.05 QUALITY ASSURANCE

A. QA Program: The manufacture and/or contractor shall, test, install and commission the Network Timing System to conform to the requirements of the General Conditions of this Contract and to all applicable codes, standards and recommended practices referred to in Article 1.03 herein.

B. Comply with Technical Provisions TP-02, “Verification, Testing, and Acceptance” and the performance requirement detailed herein.

C. Perform failover testing to simulate GPS receiver switchover from active to standby and back to active. Network time shall continue to be accurate to 1 millisecond in all areas of the network after GPS failover and restoration process has been simulated.

D. Perform tests to assure and document all system slave clocks meet the 2 week holdover time to remain within 1.0 millisecond of PRS time when master clock (Stratum 1) time is lost.

1.06 OPERATIONAL REQUIREMENTS

A. Each application server on the network supporting the following subsystems that need access to precise network time using the NTS shall employ Network Time Protocol (NTP):

1. Main SCADA Server
2. Main CCTV Server
3. Main and backup VoIP Call Manager
4. Access Control and Intrusion Detection Server
5. Fire alarm control and supervisory systems
6. OCC Main and Remote Network Server (e.g. database, email, file management)
7. Train Control Application Server
8. Provide interface to external TDM communications systems such as E-9-1-1-trunks and any outside DS1 lines
9. Passenger Information Server
10. Maintenance Yard Switching and Power Control System Server

B. To obtain precise network time, each application server shall use UDP Port 123 and be able to simultaneously monitor the IP addresses for the ANTS and the SNTS.

1. In the event of an ANTS, the NTP protocol shall query the SNTS to obtain the precise network time.

C. Network time shall be precise to a level one millisecond from the Stratum 1 Primary Time Source.

1.07 NETWORK SYNCHRONIZATION HEIRARCHY

A. For purposes of this Contract, a Stratum1 Timing shall be defined as a completely autonomous source of timing, which has no other input, other than a yearly calibration. The usual source of Stratum 1 timing is an atomic standard (Cesium Beam or Hydrogen Maser) or reference oscillator (OCXO).

1. The minimum adjustable range and maximum drift shall be defined as a fractional frequency offset (f/f) of 1x10E-11 or less.

2. At this minimum accuracy, a properly calibrated Stratum1 source shall provide bit-stream timing that will not slip relative to an absolute or perfect standard more than once every 4 to 5 months.

B. The PRS, as defined in ANSI/T1.101 for the NT system described herein, shall be a Stratum1 clock employing direct control from a Coordinate Universal Time (UTC) service provided by the satellites of GPS.

1. GPS system receivers shall be provisioned to provide UTC reference by means of radio access to at least four simultaneously reachable GPS satellites.

2. Timeservers may incorporate the GPS receiver as part of the server or implement as two separate devices.

3. The accuracy of the GPS time service shall meet the Statum1 G.811/G.812 standards set forth in Article 1.03 herein.

C. For purposes of this Contract, a Stratum 2 Timing shall be defined as a clock system requires a minimum adjustment (tracking) range of 1.6 x E10-8.

1. The drift of a Stratum 2 with no input reference shall be less than 1.6 x 10-8 in one year. The short-term drift of the system shall be less than 1 x 10-10 in 24 hours.

2. This shall conform to a drift of no more than 1 x 10E-10 each 24 hours, or a frame slip rate of no more than 1 slip in 7 days when the Stratum 2 clock system is in the holdover mode.

3. Statum2 timing may be provided by either Rubidium Standard clock or a Double Oven Crystal Oscillator Controlled (OCXO) type.

D. Stratum 3, Stratum 4 or Stratus 4E clocks shall not be used as the source of timing for other clocks in the NT system.

1.08 ALARMS

A. Provide capability of transmitting alarm conditions as Ethernet data frames over the CTN.

B. Provide 10/100BaseT or 100BaseFx interfaces. Provide ability to insert or replace network timing and synchronization modules and cards without disrupting network timing.

C. Interfaces to report the following alarms:

1. Low GPS receive signal

2. Loss of four GPS satellite acquisition

3. Failure of Internal Clock

4. Frame slippage of more than 1 frame per 7-day period

5. Stratum 2 clock or oscillator exceeding Holdover Stability margin

6. Active NTP Server and/or Backup NTP Server loss of power (separate major alarms for each and a critical alarm for both)

1.09 RELIABAILITY

A. Reliability shall be achieved using two separate GPS receiver/antenna units feeding two separate network timeservers at two different locations (e.g. equipment and spatial diversity).

1. The system's GP receivers may be integrated into the Network Time Server platform or be a standalone unit.

2. One location (main) shall be at the Maintenance and Storage Facility (MSF) Operations and Control Center (OCC) and shall be designated ANTS.
    a. The PNTS shall be supplied by 48 VDC from the OCC UPS system.
    b. DC-to-DC conversion shall be supplied to meet 48 VDC equipment requirements

3. The second location shall be at a passenger station to be determined in the final design and shall be designated as the SNTS.
    a. The SNTS shall be supplied by 48 VDC from the Passenger Station UPS system.
    b. DC-to-DC conversion shall be supplied to meet 48 VDC equipment requirements
    c. Locate the SNTS at the Remote OCC when such a facility is so designated.

4. Network protocols shall support the requirement that any application servers on the NT system be able to derive PRS time from either ANTS or the SNTS.

5. At passenger stations, the SNTS shall be located in the Train Control and Communications Room.

6. To provide the required redundancy the servers that manage the individual subsystems shall employ a version of NTP that allows each subsystem point to and obtain timing from the SNTS's IP address when the ANTS fails.

7. The antenna for the SNTS shall be located on the station structure and equivalent to the one provided for the ANTS consistent with the local building structure and proper RF design for GPS systems.

B. Both Network Time Servers shall be compliant with NTP RFC 1305(v3). Be compliant with SSM specifications in accordance with T1X1.3 TR33, ANSI T1.101-1997, ITU-T G.704, and Telcordia GR-253-CORE.

C. Network Time Server shall have a Mean Time Between Failure of 25 years (approximately 220,000 hours).

D. Holdover Stability Margin: System clock shall maintain Stratm1 level accuracy without access to Stratum1 PRS for at least two weeks after losing GPS signal or reference to the Primary Standard Reference Time.

1.10 NETWORK TIME PROTOCOL (NTS) INTERFACES

A. NTP, as defined in Article 1.03 herein, shall be the standard used for network interfacing to the NTS Network Time Server. Simple Network Time Protocol (SNTP) shall not be used as a substitute for NTP.

B. All NTS access to Network Time Server shall implement UTP Port 123 for the reception of uniform network time. No other communications network service shall share UTP Port 123 nor shall this port be used for another service except disseminating synchronized network time for the NT system.

1.11 RADIO FREQUENCY GPS ANTENNA FOR NETWORK SYNCHRONIZATION SYSTEM

A. NTS GPS Antenna Cabling and Connectors:

1. Antenna coax shall exhibit loss of no more than 1.0 dB per 100 feet at 1.0 GHz or 1.5 dB per 100 feet at 2.4 GHz or quality such as to ensure proper signal levels from at least four satellites are available.

2. Antenna RF cabling shall be installed and dressed in such a manner as not to expose cable to damage from prolonged transit vehicle operations and in such a way to not exceed manufacturer’s cable bend radius.

3. RF connectors shall all be Type N and installed in such a manner to withstand without degradation in RF performance from weather and mechanical vibration.

4. Supply all mounting hardware, brackets, tie-downs, and supports necessary for installation.

5. Supply RF signal, power and grounding cable, and optical fiber terminations and their associated connectors.

B. Antenna System Grounding:

1. All wayside wireless nodes and antenna shall have proper grounding consistent with established and acceptable RF standards for equipment operating in the L1 1575.42 MHz or L2 1227.60 MHz GPS band.

2. Designed ground to optimize antenna RF patterns and coverage at the GSP RF bands of operation.

3. Grounding shall be by means of the guideway vertical structure. Each trackside wireless node shall have its own grounding cable and ground rod or net which shall be independent of the stray current ground grid on the guideway deck or the traction power ground system.

4. Communication signal and RF grounds shall present an ohmic resistance of 5 ohms less when measured using standard ground resistance procedures.

5. Conform to all NEC requirements.

C. Lightning Arrestors:

1. Provision each antenna in the wireless system with a lightning arrestor.

2. Meet or exceed IEEE requirement to trigger a path to ground in less than 8 microseconds.

3. Frequency response of lightning arrestors shall be compatible with the Li and/or L2 GPS bands.

4. Impedance of the arrestor shall match the antenna subsystem (e.g. 50 ohms).

5. Arrestor connector type shall match the ones on the RF system being used.

6. Insertion loss shall be 0.1 dB or less.

D. NTSS GPS Antenna Operation and Survivability:

1. Remain operational at wind speeds of up to 100 mph.

2. Survivable at wind speeds of up to 150 mph.

1.12 NETWORK TIME SERVER (NTS)

A. The NTS shall be the master source of time for all communications systems and related devices. The system shall be designed to utilize a highly precise and accurate timing signal from a GPS-based radio system (either as an internal card in the NTS or a separate GPS unit external to the NTS), convert it to time-of-day and date using the NTP, store, provide and coordinate requests for precise system time from any element in the communications network requiring network synchronized time.

1. The distribution network shall be designed with specific interfaces as required for each communications subsystem (e.g. CCTV, SCADA, PA/VMB, Communication-Based Train Control, Passenger Station clocks) to use NTP to initial queries for system time from the NTS.

2. The NT system shall be the source of PRS time as defined by ANSI/T1.101 standard and shall be referenced to the Universal Coordinated Time (UTC) worldwide time standard.

B. The master time base shall be designed to provide a reliable synchronous system-wide time stamp accurate to within one millisecond of a second for all network devices and corrected for all network locations.

C. The NTS shall consist of:

1. Two different and physically separated network time servers, one being designated the Active NTP server and the other as the Standby NTP server, which shall operate in hot standby mode with the Active.

2. Two different and physically separated GPS receivers each with its own GPS antenna, cabling, and ground system.

3. A backup oven controlled oscillator (OCXO) or Intelligent Clock Module using an internal Rubidium-Stratum (2E) clock able to provide PRS time for up to two weeks in the event of a loss of the synchronizing GPS signal.

4. Network Time Displays supporting NTP at the passenger stations on the platform synchronized to the PRS timekeeper.

5. Network Time Displays supporting NTP at the TC&C and OCC room synchronized to the PRS timekeeper.

6. Digital Time Displays supporting NTP at the Remote OCC and Train Yard Control Room.

D. Basic Requirements Compliance:

1. Maintain synchronization of 1 pulse per second output disciplined to the UTC second and accurate to within 1ms

2. Free run time drift < 1ms/day

3. Holder over time at the required standard for at least two weeks

4. Provide on demand ASCII time string output

5. Provide time zone and daylight savings time adjustment

6. Indicates locked/synchronized and unlocked/unsynchronized

7. Alarm dry contact closure upon power time synchronization loss or loss of GPS reference source

8. System alarm notification to be provided if and when systems switch from active GPS receiver to standby GPS receiver

1.13 SYNCHRONIZATION SUPPLY UNIT

A. Supplies local precise frequency or a one second pulse reference to UTC to PLCs that provide I/O device time stamps.

B. Contain local oscillator (slave clock) that meets Holder Over stability of at least 2 weeks such that it can provide PRS time in the absence of GPS synchronization or reference to the central ANTS.

C. Provide alarms to SCADA network.

D. Interface with the switched Ethernet fiber optic CTS and obtain NTP timing data from either the ANTS or the Backup Network Time Server.

1.14 NETWORK TIME DISPLAYS

A. Local time clocks at Passenger Stations and the OCC will be provided by Section 27 80 00 – Passenger Information System.

B. The Passenger Information System shall use the ANTS at the OCC or the SNTS to provide precise and accurate reference clock source for display.

1.15 INTERFACES

A. NTSS and LAN Interface: At the MSF, the ANTS shall interface as a wired LAN node on the OCC Local Area Network (LAN).

B. Fiber Optic Interfaces:

1. All optical splices made as part of the NT system as specified herein shall be of the fusion type. Mechanical splices are expressly forbidden under this Contract.

C. Communications Port:

1. Ethernet, 10 Base-T supporting TCP/IP-based applications

D. Management Interfaces:

1. Support simple fault, visual and contact closures

2. Support embedded interactive ASCII

3. Support embedded SNMP for NTSS network management purposes

E. Software and firmware upgrades shall be installable via remote Ethernet-based login.

F. Conform to the requirements and specifications listed by reference in Article 1.01C herein, for the design and impletion of the Network Timing System.

1.16 EVENT LOGGING

A. Capable of storing up to 1,000 events including system faults, user interventions, control messages, and alarms.

B. Events shall be time stamped to an interval of at least 1 millisecond.

PART 2 – PRODUCTS

2.01 NETWORK TIME SERVER

A. Capable of accepting GPS timing signals from a GPS radio receiver and providing network time of day and date information using NTP.

B. Hold Over Clock: Purpose of the Holdover Clock shall be to maintain network timing and synchronization signals within system specifications in the event of failure to receive adequate signal strength the from the GPS network links to the Stratum1 clock.

1. Either enhanced Rubidium (Type II) or Enhanced Quartz (Type I)

C. Holdover time shall be defined as the time the independently operating clock shall keep Stratum1 time without reference to the external GPS synchronization signal (e.g. in the event of GPS antenna and receiver failure for up to two weeks time and still operate within 1 millisecond of the PRS timing source).

2.02 SYNCHRONIZATION SUPPLY UNIT

A. Functional Requirements. The SSU shall:

1. Supply local precise reference frequency or a UTC one second pulse depending on PLC/I/O device requirements at the Traction Power Substation and Gap Breaker Station.

2. Provide local oscillator which meets holder over stability of at least two 2 weeks such that it can continue to provide PRS standard time and date information to the nearest millisecond in the absence of Network Time Server or GPS synchronization.

3. Ability to provide alarms to SCADA network via existing CTS fiber optic backbone.

B. Locate in the Communications Interface Cabinet (CIC) cabinet in TPSS and GBS to provide local precise system timing pulses or frequency references to the Traction Power master PLC.

C. Provide a precise frequency reference or a UTC one second pulse:

1. Coordinate with the time synchronization control protocol for the Traction Power PLU and ETS breakers.

D. In Traction Power Substations and Gap Breaker Stations, Train Control Huts shall be located in the CIC.

E. Connectivity shall be from the SSU to the I/O or PLC device needing external synchronization through dedicated hard-wired copper connection from the communications part of the CIC where the PLU I/O equipment is located.

F. Power Requirements:

1. 24 VDC or 48 DVC

2. DC-DC converted required for operation on existing 115 VDC battery supply at Traction Power Substations

2.03 GPS RECEIVER UNIT

A. GPS receiver shall use the Civilian GPS L1 frequency band of 1575.42 MHz or other suitable available GPS signals in the UHF radio band. The receiver shall be capable of receiving processing and applying GPS ephemeris and almanac data by which the Network Data Server may retrieve the necessary master timing signal to synchronize its primary reference Stratum1 Time Server clock.

B. Shall be a dual unit to be used with the Network SSU. The SUU shall accept the GPS timing signals from the dual GPS Receiver Unit

C. It is desirable that the GPS Receiver Unit be integrated into the Network Timing Server or the Master Synchronization Supply Unit by use of a commercial grade surface mount dual antenna GPS receiver. Such as receiver shall have the following characteristics:

1. GPS satellite tracking sensitivity: at least -158 dBm

2. Assisted (i.e. hot) acquisition sensitivity: at least -154 dBm

3. Unassisted (i.e. cold) acquisition sensitivity (with ephemeris decoded): at least -143 dBm

4. Timing Accuracy: plus or minus 25 nanoseconds with granularity of 5 nanoseconds or better.

5. Support two standard GPS antenna using MCX type antenna connectors

6. Support NMEA 0183 GPS talk protocols and interface if necessary with NMEA 0183 GPS compliant third party software

7. Operating temperature to 104 degrees Fahrenheit

8. Support multichannel operation to permit all GPS satellites in view to be tracked

9. Feature fast-acquisition signal hardware, real-time clock and onboard high precision crystal

10. Support design that prevents position jumps caused by individual satellite blockage

D. GPS Receivers for Network Synchronization purposes can also be stand-alone commercial off-the-shelf units as long as they provide the proper interfaces and signal types and levels required by the Network Time Server or Synchronization Supply Units.

1. The functional and performance requirements listed in Article 2.03A herein, shall also apply to the stand-alone receivers.

2. Any GPS receiver units not board-integrated into the Network Time Server or the Synchronization Supply Unit shall be capable of being rack mounted in a standard 19 inch communications rack and be operated with either 110 VAC or 48 VDC UPS-backed power and suitable RF grounding connectivity.

2.04 GPS ANTENNA

A. Design and install antenna to achieve line-of-sight (LOS) reception simultaneously from at least four different GPS overhead satellites.

1. LOS reception shall be defined as reception such that there are no significant Fresnel zone infringements of the radio signal from satellite to receiving antenna.

B. Both antenna for active and standby GPS receiver shall be supplied from the same manufacturer and be identical in make, model and performance characteristics to ensure consistent phase response over all azimuths and look angles.

C. Antenna shall exhibit good phase center stability and repeatability so that measurements for different satellites at different azimuths and elevation angles will be consistent with one another.

D. Recommended type shall be Trimble Zephyr, Zephyr Geodetic or equivalent.

E. Antenna shall exhibit good ground plane stability at GPS frequencies bands of interest.

F. GPS antenna shall exhibit good phase center stability so that measurements for different satellites at different azimuths and elevation angles will be consistent.

PART 3 – EXECUTION

3.01 SYSTEM TESTING

A. Notification of NT system testing: The City reserves the right to be notified before any major NT system testing in sufficient time to have a representative present for the tests. The City shall have unrestricted access to all results of system tests.

3.02 ELECTROMAGNETIC COMPATIBILITY (EMC)

A. Radio consoles shall comply with IEC 801 Parts 2, 3, and 4 for electronic static discharge (ESD), radiated RF immunity and power line bursts.

B. Trackside Wireless Access Nodes shall be able to withstand all noise from 750-volt 4000 amp third rail train operations including gap/arcs at crossovers due to interruption of third rail power.

3.03 INSTALLATION REQUIREMENTS

A. System shall be designed, furnished, installed, and tested in a manner that certifies that the system is being deployed in the configuration for which it was authorized under FCC Part 15 CFR and uses only those antenna for which the system is designed to operate

B. Equipment including wireless node transceivers, switching, fiber optic terminating, and patch panels, antennas, cabling, and power and batteries (if required) shall be installed in such a manner that future troubleshooting, maintenance, and configuration of equipment, including antenna, can be accomplished without personnel having access to the elevated guideway or without the interruption of revenue service operations.

3.04 TRAINING

A. The City will determine the number of staff members that will receive training on the operation and configuration of the system. The training shall be conducted by the manufacturer's own training staff or by other certified training staff.

B. Self-training materials shall be available for the software user interface.

END OF SECTION

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