

Memorandum

CS Memorandum No. 1377

To: Distribution

From: Wayne Gilles, CS Safety and Security Certification 

Date: March 1, 2013

Reference: Project No. M544.1, Contract No. CS-149, Final Design
Task No. 1.15-02 Safety and Security Certification

Subject: Package 1256 STS Construction Specification Conformance Checklist, Revision 0a

Enclosed please find the draft Package 1256 STS Construction Specification Conformance Checklist, Revision 0a, for your review and comment. Please provide comments by **March 22, 2013**.

Attachments:

Package 1256 STS Construction Specification Conformance Checklist, Revision 0a
Comment Review Form
No Comment Review Form

Cc: CS File No. M544.1.5. 0940.b

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Report
Contract CS-149

CONSTRUCTION PHASE
CN 1300
Construction Specification
Conformance Checklist

Package STS-1256
Revision 0a
March 1, 2013

Prepared for:

SFMTA

CITY AND COUNTY OF SAN FRANCISCO
MUNICIPAL TRANSPORTATION AGENCY
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Central Subway Partnership

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Contract CS-149
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Construction Specification Conformance Checklist
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1.0 CONSTRUCTION SPECIFICATION CONFORMANCE

The purpose of the Construction Specification Conformance Checklists is to establish a formal process to verify that the as-built facilities, systems, and equipment incorporate the safety and security-related requirements in the Technical Specifications, including approved changes since the final design. Each safety and security requirement contained in the Checklists requires evidence that demonstrates its achievement.

1.1. CONSTRUCTION CONTRACT PACKAGES

The SFMTA is constructing the CSP under Contract (CN) 1300 and includes the construction of three underground stations at Chinatown, Union Square/Market Street and Yerba Buena/Moscone areas with one surface station at Fourth and Brannan Street in addition to the construction of the systems and track through the tunnels and in the stations. CN 1300 is comprised of four contract packages:

- Union Square/Market Street Station (UMS-1253) package
- Chinatown Station (CTS-1254R) package
- Moscone Station (YBM-1255) package
- Trackwork, Systems, and Surface Station (STS-1256) package

CN 1252 – Tunneling is a separate contract. Each construction package/contract has a corresponding Construction Specification Conformance Checklist.

1.2 SAFETY/SECURITY CERTIFICATION STEPS

In general terms, the safety and security certification process for construction specification conformance consists of three steps:

1. Create a list of safety and security technical specification requirements
2. Verify compliance with the requirements
3. Document the review and approval process.

Step 1 – Create a list of safety and security requirements. The first step of the process is to identify the safety and security requirements in STS-1256 checklist. The STS-1256 Construction Specification Conformance Checklist is located in Section 2.0. The Safety and Security Certification Review Committee (SSCRC) will review and approve the baseline STS-1256 checklist after any comments are resolved. Requirements may be added to the document as the project progresses, design changes, and/or further identification of safety and security items. Changes to the baseline STS-1256 checklist will be brought to the SSCRC for review and approval.

Step 2 –Verify compliance with the requirements. This step consists of using the conformance checklist to conduct the appropriate reviews to verify that the safety and security related requirements are incorporated into the end products. Methods to accomplish this include: document reviews, contract deliverables, audits, inspections, photographs, and testing. As requirements are verified, the appropriate requirements are completed, stating the method of verification, the date, and the name of the

individual performing the verification. The responsible party verifies and signs off on each line item in the checklist. When complete, the responsible party submits the verified checklist to the SSCRC for review and acceptance.

Additionally, the conformance process is audited and reviewed by the SFMTA Safety Division and the CSP Safety and Security Certification Manager. The audit/review process consists of selecting a sample of items from the checklists to review compliance documentation and to evaluate the effectiveness of the conformance process.

Step 3 – Document the Review and Approval Process. Documentation is essential to provide evidence of the various reviews, analyses, tests, inspections, training, and hazard resolution activities performed to ensure the safety and security of the system. Once all the items on the conformance checklists are executed, validated and reviewed, the responsible party completes and signs the associated Certificate of Conformance, and submits it to the SSCRC for review and acceptance. If the SSCRC approves the document, the construction conformance checklist and associated Certificate of Conformance is routed for final signature and approval. It is then transmitted to Document Control for scanning and placement into document control.

2.0 STS-1256 CONSTRUCTION SPECIFICATION CONFORMANCE CHECKLIST

This section contains the STS-1256 Construction Specification Conformance Checklist and describes terms and explanation of items in the checklist format:

1. **Item No.:** Refers to sequential number of safety and security requirement
2. **Spec Section Title:** Refers to specification section title that safety and security requirement is located.
3. **Safety Requirement:** Refers to specific safety and security requirement.
4. **Specification Reference, Sec and Para:** Refers to specification section number and paragraph that safety and security requirement is located.
5. **Status:** Refers to the status of the verification process.
 - A – Approved
 - DA – Disapproved
 - NA – Not Applicable
 - UI – Under Investigation
 - O – Other
6. **Method of Verification:** Refers to method used by the responsible engineer to verify that the as-built facilities, systems, and equipment incorporate the safety and security-related requirement. Typically methods used include:
 - Document reviews
 - Contract deliverables
 - Audits
 - Inspections
 - Photographs
 - Test results.
7. **Title of Verification Document:** Refers to title, revision, and date of document used to verify requirement.
8. **Approval Document File No.:** Refers to date and specific approval document reference for the verification method.
9. **File Verified, By and Date:** Refers to printed name of individual who verifies that the documents referenced in columns 6, 7, and 8 are accurate and correct for verifying the safety and security requirement in column 3, and date that the files are verified.
10. **Verification Signature:** Refers to the signature of the individual who verifies the documents in column 9.

Contract:	Stations, Surface, Track, and Systems	SFMTA	SFMTA CENTRAL SUBWAY PROJECT		Approved By:		
Contract #:	CN1300		SAFETY AND SECURITY CERTIFICATION PROGRAM		Revision: 0a	Date: March 1, 2013	Page 2-2
Package:	STS-1256		Specification Conformance Checklist				

Item No.	Spec Section Title	Safety Requirement	Specification Reference		EVIDENCE						
			Sec	Para	Status	Method of Verification	Title of Verification Document	Approval Document File No.	File Verified		Verification Signature
				By	Date						
1.	Concrete Finishes	Nonslip Finish: Conform to ACI 301. Provide "nonslip finish" for interior pedestrian ramps, walkways, subway cross-passage floors, and other floor areas where indicated.	033500	3.01.C.5							
2.	Concrete Topping	Topping slabs shall receive a "troweled finish" or fine "broom finish" in combination with a "nonslip finish," as selected by the Engineer from Contractor-prepared mock-ups, with "flat" tolerance, as specified in ACI 117, as specified in ACI 117 and per Section 03 35 00, Concrete Finishing..	035300	3.04.C.1							
3.	Metal Fabrications	Product Data: For the following: 1. Nonslip aggregates and nonslip-aggregate surface finishes.	055000	1.04.A							
4.	Pipe and Tube Railings	Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated: 1. Handrails and Top Rails of Guards: a. Uniform load of 50 lbf/ ft. applied in any direction. b. Concentrated load of 200 lbf applied in any direction. c. Uniform and concentrated loads need not be assumed to act concurrently.	055213	1.03.C							
5.	Joint Protection	Fire-Resistant Sealant: Sealants used at penetrations of fire-rated walls and ceiling assemblies shall be UL listed as meeting UL 1479.	079200	2.01.A.5							
6.	Blast Resistant Metal Doors and Frames	Reports and Certificates: 1. Submit certificates of inspection as required for fire-rated doors.	081200	1.04.D.1							

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7.	Blast Resistant Metal Doors and Frames	Fire-Rated Doors and Frames: Installation of doors and frames, including hardware and operational characteristics, shall be in accordance with NFPA Standard No. 80, as applicable. Verify that doors and frames are labeled as indicated.	081200	3.01.F							
8.	Access Doors and Panels	Lock: Spring-loaded stainless steel latch with interior handle and removable exterior wrench. Provide two interior slide bolts on inactive leaf of pair of doors. Lock to be operable from below at all times.	083100	2.05.E							
9.	Access Doors and Panels	Safety Chain: Provide safety chain on inactive side of pair of open doors.	083100	2.05.H							
10.	Point-Supported Glazing With Steel Back-Up System (Surface Station Canopy)	Certificates or test reports demonstrating components and methods have been successfully tested by an independent laboratory in the United States certifying that the proposed system has been tested and as defined by Performance Requirements.	084413	1.05.A.6							
11.	Point-Supported Glazing With Steel Back-Up System (Surface Station Canopy)	Safety glazing: Comply with Consumer Product Safety Commission 16 CFR 1201, ANSI Z97.1, and other applicable safety requirements. Each piece of safety glazing shall be permanently labeled with appropriate marking.	084413	1.06.E							
12.	Glass Windscreens	Glass Scratch-Resistant Film: 3M Scotchgard Anti-Graffiti film, as specified in Section 08 80 00, GLAZING, or approved equal.	089900	2.04.E							

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13.	Tiling	Performance Requirements, Static Coefficient of Friction: 1. For tile installed on walkway surfaces, stairways and stair landings, provide products with the following values as determined by testing identical products in accordance with ASTM C1028: a. Level Surfaces: Minimum 0.6.	093000	2.02.B							
14.	Tactile Hazard Warning Tile	Slip Resistance of Tile when tested by ASTM C1028 the combined wet/dry static coefficient of friction not to be less than 0.80.	096250	1.04.A.1							
15.	Tactile Hazard Warning Tile	Americans with Disabilities Act (ADA): Provide tactile warning surfaces which comply with the detectable warnings on walking surfaces section of the Americans with Disabilities Act (Title 49 CFR Transportation, Part 37, Appendix A, ADA Accessibility Guidelines for Buildings and Facilities, Section 4.29; and CCR Title 24, Part 12, Chapter 12 – 11A and B).	096250	1.04.C							
16.	Tactile Hazard Warning Tile	Fire Resistance: When tested to ASTM E84 flame spread shall be less than 25.	096250	1.04.D.1 0							
17.	Tactile Hazard Warning Tile	Colors shall be yellow conforming to Federal Color No. 33538, and black, conforming to Federal Color No. 37038. Colors shall be homogeneous throughout the tile.	096250	1.04.H							

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									By	Date	
18.	Anti-Graffiti Coating	For Surface, Track and Systems package (STS-1256), the work shall consist of preparing and applying anti-graffiti coating to the following: 1. All exposed surface station platform concrete surfaces, except walking surfaces. 2. All exposed surface station signage face surfaces.	098600	1.01.B							
19.	Anti-Graffiti Coating	Submit the manufacturer's product data and technical information for graffiti removal that is compatible with anti-graffiti coating.	098600	1.03.D							
20.	Signage	Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details. All shop drawings shall be prepared and delivered so as to be in compliance with Section 01 33 00, Submittal Procedures. 1. Provide message list for each sign, including large-scale details of wording and lettering.	101400	1.05.C.1							
21.	Signage	Apply anti-graffiti coating over all tunnel signage and publicly accessible station signage face surfaces.	101400	2.09.C							
22.	Display Cases	Glass Scratch-resistant film: 3M Scotchgard Anti-Graffiti film, as specified in Section 08 80 00, GLAZING, or approved equal	104100	2.05.F							

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23.	System Assurance	The Contractor shall develop a Systems Assurance Plan (SAP) that clearly identifies and reflects its approach to incorporating reliability and maintainability into final design and construction of the Project.	207100	1.02.A								
24.	System Assurance	Reliability Analysis (RA) for each system with calculated predictions of Mean Time Between Failures (MTBF) and Availability.	207100	1.03.A.2								
25.	System Assurance	Preventative Maintenance Plan: The Contractor shall develop and submit a detailed Preventative Maintenance (PM) plan based upon the maintenance concepts and maintainability requirements established in the SAP. The PM plan shall include all servicing, inspections, scheduled overhaul, or any task required on a scheduled basis.	207100	3.03.C								
26.	Identification For Plumbing And Fire Suppression System	San Francisco Fire Department (SFFD) Documentation: Submit draft and SFFD documentation, including drawings and maps, to the Engineer. Contractor shall submit shop drawings identifying the hose valve signage and sectional control valve signage information for the entire tunnel alignment and three underground stations; and other labeling/ identification documentation as required by the SFFD. A copy of the draft submittal shall be reviewed and approved by the Engineer prior to the submittal to the SFFD.	204013	1.03.E								

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27.	Identification For Plumbing And Fire Suppression System	Control Valve Drawing/Map: Provide a legible, laminated drawing/map along with an isometric piping drawing of the location of all control valves, along with indication of what they control, shall be provided on the wall at a location approved by the SFFD. The drawing/map and isometric drawings shall be reviewed and approved by the SFFD.	204013	2.01.G							
28.	Fire-Suppression Standpipes	Certified Test Reports: Submit certified test reports of aboveground and underground piping as indicated in NFPA 13.	211200	1.04.C							
29.	Fire-Suppression Standpipes	Operation and Maintenance Data: Submit operation and maintenance data for the equipment and system provided, in accordance with Section 01 79 00, Training Programs and Operations & Maintenance Manuals.	211200	1.04.F							
30.	Fire-Suppression Standpipes	San Francisco Fire Department (SFFD): Separate Shop Drawings of the drywetted standpipe system shall be submitted to the SFFD for approval. A copy of the submittal shall be reviewed and approved by the Engineer prior to submittal to the SFFD. Approval shall be obtained before beginning installation work. The Contractor shall submit a copy of the SFFD approved shop drawings for the Engineer's information.	211200	1.04.I							

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31.	Fire-Suppression Standpipes	Seismic restraints, anchorages and reinforcements shall be provided for equipment and piping in accordance with the California Building Code, NFPA 13 and Appendix A, NFPA 14 and San Francisco code standards and regulations. Equipment and piping shall be anchored to withstand forces generated by earthquake movement.	211200	2.06.B.1							
32.	Fire-Suppression Standpipes	The Contractor shall perform all tests in the presence of the Engineer and shall furnish all items used in testing. The Contractor shall give 48-hour notice prior to test. The Engineer will review certificates and test reports, and will inspect the standpipe system to verify conformance with NFPA 14. Test shall be witness by authority having jurisdiction.	211200	3.04.C							
33.	Facility Storm Drainage	Test Reports: Submit certified test results and certificates of compliance as necessary to verify conformance with specified requirements.	221400	1.04.F							
34.	Sump Pumps	Submit maintenance and operating data in accordance with Section 01 79 00, Training Programs and Operations & Maintenance Manuals.	221429	1.04.D							

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35.	Sump Pumps	The cross passage sump pumps shall be equipped with a time relay set at 30 minutes (unless directed by the Engineer) that will transmit a Supervisory Control and Data Acquisition (SCADA) signal to SFMTA Operations Control Center (OCC) and Transportation Management Center (TMC) if one of the pumps runs continuously over 30 minutes. Provide SCADA outputs for the following (1) high water alarm; (2) high-high water alarm; (3) pump #1 failure to operate; (4) pump #2 failure to operate; and (5) four spares.	221429	2.04.K							
36.	Sump Pumps	Refer to Section 01 79 00, Training Programs and O&M Manuals, for training of SFMTA maintenance personnel requirements.	221429	3.02.A							
37.	Sump Pumps	Field test shall demonstrate work quality, operation, and performance. Each test attribute shall be completed in the order listed below to the satisfaction of the Engineer. Submit a written record indicating that the items listed have been completed.	221429	3.03.D							
38.	Air Replenishment System	O&M Data: Submit operation and maintenance data for the equipment and system provided, in accordance with Section 01 79 00, Training Programs and O&M Manuals. Include recommended spare parts list.	221601	1.04.F							
39.	Air Replenishment System	San Francisco Fire Department (SFFD): Separate Shop Drawings of the air replenishment system shall be submitted to the SFFD for approval.	221601	1.04.G							

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40.	Air Replenishment System	Provide and install the following system component to each cabinet: 1. One isolation valve located between the air discharge line to the next air substation and the downstream line to the air base station supply or the air substation below to the next substation above the air base station. 2. The fill hoses and isolation valves shall be installed between the air bottle connection line and the fresh air supply. For STS-1256 only, air replenishment system contractor shall coordinate the required piping and control panel with the fixed fragmentation console equipment installation at the x-passage. 3. Excess bleed valves shall be located between the air bottle fill hose and the next air substation. 4. Each fill station shall contain two fill hoses/fittings that are provided with a pressure regulating valve to equalize pressure between two bottles. The filling of two bottles shall be controlled by a single control valve between the air supply and air bottle. The SCBA fill hoses shall be designed with two RIC UAC female fittings as well as two routine filling fittings. A protective cap shall be provided for each hose. 5. Cylinder Filling Hose. The cabinet shall provide a means for storing the hose to prevent kinking. When the hose is coiled, brackets shall be installed so that the hose bend radius is maintained at 4 in or greater. Each filing hose shall be a min length of 6 feet.	221601	2.05.D								
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41.	Air Replenishment System	Pressure Monitoring Switch and Door Switch: An electric low pressure monitoring switch shall be installed in the piping system to monitor the air pressure as indicated in the Contract Drawings. A door switch shall be installed at exterior fire department connection panel to monitor the opening of the panel door. The pressure switch and door switch shall both be connected to the building's fire alarm system via a monitor module. The pressure switch and door switch shall transmit a supervisory signal to the station fire alarm control panel provided under Section 28 31 11 – Digital, Addressable Fire Alarm System, respectively, when the pressure of the breathing air system is less than 3,000 psig at 70 degrees F, plus or minus 100 psig, or when the exterior fire connection panel door is opened.	221601	2.06.G							
42.	Air Replenishment System	Fire department connection panels shall be clearly labeled "FIREFIGHTER'S AIR SYSTEM" in letters 2 inches in height with a 3/8-inch brush stroke;	221601	3.03.B							
43.	Air Replenishment System	System will be inspected and tested in accordance with San Francisco Fire Department Bulletin 5.07 for compliance with these Specifications.	221601	3.04.A							

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44.	Air Replenishment System	During the system final test, after the system is pressurized with air from a certified compressor, two air samples shall be taken from the lowest and highest air filling panels, and submitted to an accredited testing laboratory that meets the requirements for air filling specified in Chapter 4 of NFPA 1989. Copies of laboratory testing report shall be provided to the Engineer and the district fire inspector prior to the issuance of the Certification of the Final Completion for station. Contractor shall submit a copy of the Certification of Final Completion to the Engineer.	221601	3.04.D							
45.	Jet Fans	Certified test results signed by fan manufacturer shall be submitted to Engineer for approval within 30 days after the completion of each test. No equipment shall be released for shipment until certified test data is accepted by the Engineer. Copies of accepted test procedures, raw data measured results, calculations and all data derived from tests shall be included in the report.	238220	1.06.A.4							
46.	Jet Fans	Submit certificate of compliance that the design and fabrication of various components of the jet fan assemblies meet the requirements of this Contract.	238220	1.06.C.1							
47.	Jet Fans	Submit certificate of compliance or test data showing that the jet fan assemblies meet the requirement of operation at the elevated temperature specified herein.	238220	1.06.C.2							
48.	Jet Fans	Operation and Maintenance Manuals:	238220	1.06.E							

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49.	Jet Fans	Furnish final alarm and trip set points and time delays that need to be programmed into the Motor Control Center PLC and Control's Station RTU's (CS-1 and CS-2), the Vibration Monitoring Units and Winding Temperature Monitor(s).	238220	1.06.F							
50.	Jet Fans	Emergency Mode: The Contractor shall demonstrate that the operator at the workstation can put the jet fans serving the portal tunnel in the emergency mode. During the emergency mode test, the contractor shall simulate a Motor Protective Relay fault at the MCC for each of the jet fans in turn and verify that the jet fan continue to run.	238220	3.05.G.3							
51.	Jet Fans	Emergency Standby Mode: The Contractor shall demonstrate all functions and operations detailed for this mode. The Contractor shall demonstrate that the operator workstation can perform local control, and monitoring including data logging, graphic displays, fault conditions, and alarming of ventilation system in any mode of operation.	238220	3.05.G.5							
52.	Jet Fans	B. Training shall be divided as follows: 1. One (1) eight hour day of instruction for operators. 2. One (1) eight hour day DDC maintenance training. 3. One (1) eight hour day fan and fan monitoring instrumentation maintenance training. C. Each training class shall consist of up to fifteen (15) individuals.	238220	3.06.B & C							

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53.	Low-Voltage Electrical Power Conductors and Cables	Conductors in conduits or raceways shall be permitted to be embedded in concrete or run in concrete or run in concrete electrical duct banks, but they shall not be installed exposed or surfaced-mounted in air plenums unless cables are listed fire-resistive cable having a minimum 1-hour fire-resistive rating in accordance with ANSI/UL 2196 and shall be installed per the listing requirements.	260519	3.03.K							
54.	Low-Voltage Electrical Power Conductors and Cables	Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to firestopping material used.	260519	3.06.A							
55.	Low-Voltage Electrical Power Conductors and Cables	Test Reports: Prepare a written report to record the following: 1. Test procedures used. 2. Test results that comply with requirements. 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.	260519	3.07.C							
56.	Wiring for Roadway Lighting and Traffic Signals	Perform insulation resistance tests of all low voltage cables and wires in accordance with NETA Section 7.3.2.2 requirements.	260520	3.07.D							
57.	Wiring for Roadway Lighting and Traffic Signals	Test grounded equipment enclosures, raceways, conduits, exposed expansion joints, trench ducts, and trolley poles for continuity to the ground rod system.	260520	3.07.F							

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58.	Wiring for Roadway Lighting and Traffic Signals	Perform system grounding and equipment grounding inspection and testing in accordance with NETA Standards.	260520	3.07.G							
59.	Grounding and Bonding for Electrical Systems	Perform the following tests and inspections and prepare test reports: 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements. 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.	260526	3.04.A							
60.	Grounding and Bonding for Electrical Systems	Report measured ground resistances that exceed the following values: 1. Power and Lighting Equipment or System with Capacity 500 kVA and less: 10 ohms. 2. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms. 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms. 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohm(s). 5. Substations and Pad-Mounted Equipment: 5 ohms.	260526	3.04.B							
61.	Raceway and Boxes for Electrical Systems	Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.	260533	3.04.A							

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62.	Junctions and Pullboxes	Fire/Police pull station pull boxes shall be type 3. All pull boxes covers shall be three-piece and inscribed with "PUBLIC SAFETY". Letters shall be 1 inch high and made with 1/4-inch wide strokes. Letters inscribed on concrete lids covers shall be made with 1/8-inch (minimum) deep imprints. Legends in steel covers shall be made with weld bead letters.	260535	2.01.G							
63.	Electrical Testing and Commissioning	Perform commissioning work in accordance with Power Check Lists and equipment manufacturer's standard procedures and check lists, including but not limited to: 1. Verify test readings, such as: a. Cable DC Hipot. b. Ground fault protection. c. Ground resistance. d. Frequency. e. Transformer heating. f. Circuit breaker tripping. 2. Verify calibration of meters: a. Kwhr meters. b. Voltmeters. c. Ampermeters. d. Frequency meters. e. Circuit Breakers. 3. Verify operation of electronic power monitors.	260800	3.05.B							

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64.	Electrical Testing and Commissioning	Functional Performance Test: Demonstrate operation of power distribution system per specifications including the following: 1. Activate system by connection to utility power. 2. Demonstrate draw out operation of circuit breakers. 3. Verify voltages and amperes at meters on switchgear. 4. Verify voltages and amperes at switchboards, motor control centers, panelboards, and transformers primary and secondary. 5. Verify voltages and amperes at mechanical motors and other major pieces of equipment.	260800	3.06.C							
65.	Electrical Testing and Commissioning	Functional Performance Test: Demonstrate operation of fire alarm system per specifications including the following: 1. Alarm initiating devices including pull stations, ceiling smoke detectors, duct smoke detectors, heat detectors, and sprinkler alarm switches. 2. Air handling unit redirect upon alarm. 3. Elevators upon alarm. 4. Verify tie-in and proper system operation with any off-site system monitoring. 5. Fire alarm system annunciator panel. 6. Alarm devices, visual and audible. 7. Central processing unit alphanumeric display and printer. 8. Verify system function upon loss of power.	260800	3.08.C							

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66.	Motor-Control Center	Operation and maintenance data.	262419	1.02.E							
67.	Motor-Control Center	A training program plan for training SFMTA personnel and O&M manuals in accordance with the requirements of Section 01 79 00, Training Programs and Operations & maintenance Manuals.	262419	1.02.G							
68.	Motor-Control Center	Perform the following field tests and inspections and prepare test reports: 1. Perform each electrical test and visual and mechanical inspection, except for optional tests, stated in NETA ATS "Motor Control Centers." Certify compliance with test parameters.	262419	3.06.B							
69.	Static Uninterruptible Power Supply	A training program plan for training SFMTA personnel and O&M manuals shall be in accordance with the requirements of Section 01 79 00, Training Programs and Operations & Maintenance Manuals..	263353	1.05.B.5							
70.	Static Uninterruptible Power Supply	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.	263353	3.02.E							

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71.	Static Uninterruptible Power Supply	Doors or accesses into rooms, buildings or areas containing stationary lead-acid battery systems shall be provided with approved signs. The signs shall state that the room contains lead-acid battery systems, that the battery room contains energized electrical circuits, and that the battery electrolyte solutions are corrosive liquids.	263353	3.03.A							
72.	Lighting	Test Reports: Submit certified test reports of factory and field tests performed, in accordance with applicable referenced standards and Specification requirements.	265000	1.03.C							
73.	Facilities SCADA System	Training on the new SCADA system shall be in accordance with Section 01 79 00, Training Programs and Operations and maintenance Manuals.	272105	1.05.A							
74.	Facilities SCADA System	O&M manuals in accordance with Section 01 79 00, Training Programs and Operations & Maintenance Manuals. This includes User, Maintenance, Installation, Configuration and Spare Parts Manuals for PC software and hardware provided as part of the Facilities SCADA system. These manuals shall be provided on CDs in the PDF format. Complete documentation of any specialty modules, including documentation on kits for building modules and on engineering resources for third-party developers, shall also be provided.	272105	10.C.10							

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75.	Facilities SCADA System	Conformance of Facilities SCADA System equipment with the Metro Subway Facilities SCADA System shall be demonstrated for the following: 1. Log-in: Users shall log in before any change to any object attribute that has been constrained is allowed.	272105	2.15.B								
76.	Facilities SCADA System	Field testing shall include verification of the following: 1. The PLCs correctly connect to, operate and monitor all the appropriate field devices 2. The equipment has operable ports for interfacing to the Systems Network. 3. The PLC failure diagnostics, local logic programming, input sensitivities, and other configurable elements.	272105	3.08.B								
77.	Facilities SCADA System	In performing these [system integration] tests, the SCADA Integrator shall cooperate with SFMTA and the third parties involved in the system elements compromising the integrated Facilities SCADA System. The testing will include a verification of the interfaces between: 1. The PLC systems and the field devices 2. The PLC systems and the Systems Network 3. The PLCs and the Metro Subway Facilities SCADA head-ends 4. The Ethernet-ready field devices and the Metro Subway Facilities SCADA head-ends	272105	3.09.C								

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78.	Facilities SCADA System	As part of the systems integration testing, the following additional items shall be verified: 1. All I/O points shall be verified as part of the systems integration testing. 2. Switchover of the PLCs and SCADA head-ends to verify configuration is maintained in redundant elements 3. Operator workstation HMI depicting Central Subway screens and monitor and control points 4. Contractor shall coordinate with the Engineer and designated SFMTA personnel for preservation of Historian data logging of all system data.	272105	3.09.D							
79.	700 MHZ and 800 MHZ Radio Systems	The contractor shall, on a date or dates agreed to by the Engineer, execute training sessions with CCSF personnel at which the final system and channel card programming and level setting will take place.	273210	3.03.A							
80.	700 MHZ and 800 MHZ Radio Systems	At CTS and YBM, for each channel, an RF signal placed at the input to the cable connected to the outside antenna at a level of -90 dBm must produce a signal on the same frequency at output of the cross-band coupler connected to the BDA providing signals to the Station and Tunnels at a level of +30 dBm.	273210	3.03.B.1							

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81.	700 MHZ and 800 MHZ Radio Systems	At UMS, for each channel, an RF signal placed at the input to the cable connected to the outside antenna at CTS or YBM at a level of -90 dBm must produce a signal on the same frequency at output of the cross-band coupler connected to the BDA providing signals to the Station and Tunnels at a level of +30 dBm.	273210	3.03.B.2							
82.	700 MHZ and 800 MHZ Radio Systems	At YBM, CTS and UMS an RF signal placed at the input to the cross-band coupler connected to the BDA from the Station and Tunnels at a level of - 90 dBm must produce a signal on the same frequency at the connector to the outside antennas at YBM and CTS at a level of +30 dBm.	273210	3.03.B.3							
83.	700 MHZ and 800 MHZ Radio Systems	Using a spectrum analyzer, check the signal levels on the 700/800 MHz systems at all locations throughout YBM, CTS and UMS and the tunnels to make sure that the minimum signal level on all channels is no lower than - 90 dBm.	273210	3.03.B.4							
84.	700 MHZ and 800 MHZ Radio Systems	Using portable radios, make signal quality checks on the 700/800 MHz systems to insure that the signal quality is DAQ4 or better in both directions. Check for 'delay-interference' at each of the three station entrances, and reduce power, substitute or remove equipment to minimize the area affected.	273210	3.03.B.5							
85.	Platform Display System	Training shall be in accordance with Section 01 79 00, TRAINING PROGRAMS AND OPERATIONS AND MAINTENANCE MANUALS.	274216	1.03.A							

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86.	Platform Display System	O&M manuals in accordance with the requirements of Section 01 79 00, TRAINING PROGRAMS AND OPERATIONS MANUALS.	274216	1.07.C.1 0							
87.	Platform Display System	Functional and Performance Tests: Perform tests to verify conformance of system to functional and message requirements.	274216	3.04.D							
88.	CCTV System	A 4-day classroom training on the CCTV system shall be given by Contractor's personnel in accordance with Section 01 79 00, Training Programs and Operations & Maintenance Manuals.	282005	1.05.A							
89.	CCTV System	The Contractor shall submit the following to the Engineer for approval: 6. O&M manuals in accordance with the requirements of Section 01 79 00, Training Programs and Operations & Maintenance Manuals.	282005	1.06.A.6							
90.	CCTV System	The Contractor shall submit the following to the Engineer for approval: 10. Shop Drawings d. Show the placement of all cameras on floor plan drawings, including the routing of conduit, the number of conductors in each conduit, mounting type and mounting heights. e. Show the intended coverage area for each camera, and the associate lens settings.	282005	1.06.A.1 0							

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91.	CCTV System	The Contractor shall submit the following to the Engineer for approval: 11. Test Results: Record and submit the readings for the various specified tests. Test results shall be a comprehensive profile of the cable indicating it's compliance with the CAT6 standards.	282005	1.06.A.1 1							
92.	CCTV System	The system shall: 8. Provide individual loss of video alarm to the monitoring video workstation at TMC.	282005	1.07.B.8							
93.	CCTV System	Fixed and Pan-Tilt-Zoom cameras shall be installed at various locations throughout the station to ensure adequate coverage of the following regions such as but not limited to: 1. The inbound and outbound sides of the subway station platforms and 4 th and Brannan platform station and the track areas adjacent thereto.. 2. All equipment cabinets including Ticket Vending Machines (TVMs). 3. Elevator and escalator locations. 4. Emergency stairways. 5. Paid and non-paid public areas. 6. Platform ramp areas.	282005	1.07.D							

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94.	CCTV System	Video shall be recorded locally on network storage managers (NSM) located at the subway station communication rooms for the subway station CCTV cameras and tunnel CCTV cameras and at the 4th and Brannan communication cabinet for the 4th and Brannan platform CCTV cameras. When an alarm is detected from the Alarm Interface Unit (ALM), the video from the camera associated with the alarm shall be tagged as alarm video. The dwell time during alarm condition shall be programmable to a desired duration.	282005	1.07.E							
95.	CCTV System	All cameras shall have camera sabotage behavior video analytics which detects camera vandalism and reports the alarm condition. The video management solution shall be able to accept these and other video analytic alarms from the IP cameras and manage them accordingly.	282005	1.07.G							
96.	CCTV System	The alarm conditions which shall result in camera call up are the following: 1. Camera vandalism. (Identify the individual camera, maximum of fifteen cameras per platform.) 2. Equipment cabinet intrusion. 3. TVM door intrusion.	282005	1.07.I							

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97.	CCTV System	A. Indoor/Outdoor Fixed Dome IP Camera 1. General h. Camera shall have tamper resistant hardware and have an impact resistance rating of IK10++ per EN62262 (5OJ).	282005	2.01.A.1 .i							
98.	CCTV System	C. Fixed Indoor/Outdoor Megapixel Dome IP Camera 1. General h. Camera shall have tamper resistant hardware and have an impact resistance rating of IK10++ per EN62262 (5OJ).	282005	2.01.C.1 .i							
99.	CCTV System	A. Network Video Recorder Systems 1. General Requirements b. All systems shall be capable of access and control from central control workstations located at remote locations. 1) Contractor shall connect CCTV system to SFMTA enterprise network.	282005	2.04.A.1 b.1)							
100.	CCTV System	VIDEO ANALYTICS SERVER, NETWORK STORAGE MANAGER A. Rack mount NSM(s) in equipment cabinet in the main communication room.	282005	3.02.A							
101.	CCTV System	VIDEO ANALYTICS SERVER, NETWORK STORAGE MANAGER D. Power from UPS backed source.	282005	3.02.D							
102.	CCTV System	A complete operational test for all the equipment shall be performed by the Contractor once the CCTV system is completely installed.	282005	3.05.B							

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103.	CCTV System	Contractor shall coordinate with the Engineer to perform remote testing of the CCTV system at TMC and Lenox OCC. Refer to Section 34 01 24, Operations Control Center.	282005	3.05.C							
104.	Tactile Warning Surfaces	Shop drawings: Submit shop drawings showing plans of tile placement including joints, all materials to be used, and an outline of installation procedures.	321726	1.03.C							
105.	Tactile Warning Surfaces	Color: Yellow conforming to Federal Standard 595B Table IV, Color No. 33538. Color shall be homogeneous throughout the tile.	321726	2.01.B							
106.	Tactile Warning Surfacing	The field area shall consist of a non-slip surface with a minimum static coefficient of friction of 0.80, wet and dry.	321726	2.01.D							
107.	Operations Control Center	Submit cutover plan to include cutover of Central Subway systems at the SFMTA centers in accordance with Section 01 80 00, FACILITY TESTING, START-UP AND COMMISSIONING.	340124	1.04.C							
108.	Operations Control Center	O&M manuals and a training program plan in accordance with the requirements of Section 01 79 00, TRAINING PROGRAMS AND OPERATIONS AND MAINTENANCE MANUALS.	340124	1.04.C.4							

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109.	Operations Control Center	Perform systems integration of PA/PDS, FSS, ATCS, IHMI, Enterprise Network, Systems Network, A/V Management at the SFMTA Control Centers for transit operations and security monitoring functions as required by Section 01 80 00, FACILITY TESTING, START-UP AND COMMISSIONING.	340124	3.04.A							
110.	Operations Control Center	PA/PDS work shall include providing SFMTA Control Centers with the ability to make visual and audible announcements at the new CSP stations for providing the public with information, including information and directions during an emergency.	340124	3.07.A							
111.	Operations Control Center	Primary system control and management shall be at the planned TMC with a secondary system control and management at the Lenox OCC.	340124	3.07.B							
112.	Operations Control Center	The PDS shall be integrated with the PA system to provide coordinated message delivery to the passenger stations both audibly and visually for all types of messages including train arrival/departure, announcements, and directing patron response to emergencies.	340124	3.07.C							
113.	Operations Control Center	Software upgrades for the PA/PDS shall include incorporation of pre-defined zones for the new CSP stations as determined by station wiring. Include zones for broadcast which can be individually selected or selected in any combination including all zones in each station.	340124	3.07.F							

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114.	Operations Control Center	The Control Centers shall receive a signal when any individual station PA is making an announcement.	340124	3.07.H								
115.	Operations Control Center	All message traffic, whether text, bit-mapped graphics, or audio files, shall be stored on the server for future reference in a format approved by the Engineer. The server shall be able to store at least 90 days (user configurable) of such traffic before offline archiving is required. Archived messages shall contain all details of the message including time, user, location, and duration. Archived messages shall be auditable by replaying audio on a PC with speakers and redisplaying text and graphics on its screen.	340124	3.07.N.6								
116.	Operations Control Center	Provide a TelNet connection streaming ATCS data from the redundant Central Subway Location Servers (SLS).	340124	3.07.O.1								
117.	Operations Control Center	Testing: Perform operational tests and speech intelligibility tests for the PA system at each station to verify the system meets the requirements of these Specifications and the requirements of the individual Central Subway station Contract Documents.	340124	3.07.V								
118.	Operations Control Center	CCTV and access control monitoring work shall include integration of CSP CCTV and access control systems, including intrusion detection, to provide monitoring of these systems at the TMC and Lenox OCC.	340124	3.09.C								

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119.	Operations Control Center	Training: Provide a total of 8 hours of system training to operator(s) designated by Owner for general AV system operation, including the use of all control systems.	340124	3.12.Q							
120.	Operations Control Center	Incorporate Central Subway video feeds including PTZ control functions for line management use into the IHMI system. All functions and features of the IHMI system shall be provided for the Central Subway CCTV system.	340124	3.13.C							
121.	Operations Control Center	Provide monitoring for all Central Subway escalator and elevator alarms to 700 Pennsylvania Avenue using the existing SFMTA notification system, Lift-Net. System shall monitor all activities including but not limited to status, alarms, and log events that occur.	340124	3.14.A							
122.	Operations Control Center	The system shall be capable where desired of allowing approved individuals under multi-level password control to access all system features via the local area network, internet or via modem over the public telephone network.	340124	3.14.G							
123.	Operations Control Center	The remote monitoring system shall be capable of displaying the status of: 1. Operating Mode. 2. Location. 3. Direction. 4. Faults. 5. Alarms. 6. Maintainer On Site (MOS). 7. Historical Data. 8. Producing Escalator Report.	340124	3.14.I							

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124.	Operations Control Center	Program the Lift-Net Alert program at 700 Pennsylvania Ave to include alert monitoring for Central Subway station elevators and escalators. Include alerts for faults and events currently received by Market Street Subway stations. These shall include, but not be limited to, the following alarms and faults from field monitoring devices: 1. Emergency Stop. 2. Skirt Obstruction. 3. Reversal Stop. 4. Broken Step Chain. 5. Broken Drive Chain. 6. Comb Impact. 7. Step Upthrust. 8. Handrail Speed Monitoring. 9. Missing Step. 10. Step Level. 11. Defective Roller. 12. Main Drive Shaft Brake.	340124	3.14.L						
125.	Operations Control Center	Provide comprehensive training for the designated SFMTA representatives for the operation, maintenance, and troubleshooting of new or modified systems. Provide two copies of configuration data file for control systems.	340124	3.15.C						

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126.	Construction on Existing Tracks	All new special trackwork and new running rail constructed in accordance with this Section shall be pre-coated with an insulated coating or fitted with a rubber boot in accordance with the requirements of Section 34 11 20, EMBEDDED TRACKWORK ELECTRICAL ISOLATION. This includes the bottoms of castings and rails that would otherwise have contact with concrete	341101	2.01.A							
127.	Construction on Existing Tracks	Signaling including track circuits and switch and lock movements shall be restored and tested to verify readiness for service.	341101	3.09.C							
128.	Construction on Existing Tracks	SFMTA will provide test vehicles on site for testing of the trackwork and OCS work. SFMTA staff will operate the test vehicles. The testing will consist of the passage of the vehicles over the tracks as many times as required to the satisfaction of the Engineer.	341101	3.10.D							
129.	Basic Trackwork Materials and Methods	Track-tunnel alignment verification report.	341110	1.05.B							

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130.	Basic Trackwork Materials and Methods	Restraining rail shall be constructed in embedded track where shown on the Contract drawings and as specified herein 1. Restraining rail shall be constructed adjacent to tee rail sections on curves with track centerline radii of 300 feet or less and where shown on the Contract Drawings. 2. Restraining rail shall be machined from 115 RE tee running rail and shall be as shown on the Contract Drawings. 3. Restraining rails at each side of a restraining rail joint shall not be less than 10 feet long. 4. Restraining rail shall be shop curved in accordance with shop curving requirements for running rail. 5. Top of installed restraining rail shall be above the top of running rail as shown on the Contract Drawings.	341110	2.04.A							

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131.	Basic Trackwork Materials and Methods	Restraining rail shall be constructed in embedded track where shown on the Contract drawings and as specified herein 6. 4-inch separator blocks for the restraining rail shall be evenly spaced between every other rail fastening assembly. 10-inch end blocks shall be at every restraining rail joint and at each end of restraining rail. a. Separator and end blocks, and shims, shall conform to ASTM A36. b. Separator and end blocks shall conform to the dimensions and bolt hole locations as shown on the Contract Drawings. c. Separator and end block shims shall be fabricated to a configuration to match the separator and end blocks, and as shown on the Contract Drawings. Shims shall be provided to adjust flangeway width as shown on the Contract Drawings. 7. Restraining rail shall extend a minimum of 10 feet beyond the end of the curve except where located in between special trackwork elements.	341110	2.04.A							

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132.	Basic Trackwork Materials and Methods	Insulated joints shall be of the epoxy-bonded type. Insulated joints shall be insulated by use of 3/8 inch thick pressure end posts. Insulated joints shall be provided in restraining rail where the running rail contains insulated joints. Insulation materials shall be high impact resistance with a dielectric breakdown strength of 500 volts per mil. Insulated joints components shall include bars, end posts, bushings, washers, pin bolts, collars, and adhesives as recommended by the manufacturer.	341110	2.09.B							
133.	Basic Trackwork Materials and Methods	[Allowable Variations] Guardrail and restraining rail height: Plus 1/8 inch), minus 0 inch.	341110	3.03.F							
134.	Basic Trackwork Materials and Methods	The Contractor shall check the insulated joints for magnetism. In the event that the joints exhibit magnetism, the ends of the rails shall be end hardened by a method approved by the Engineer.	341110	3.07.C							
135.	Basic Trackwork Materials and Methods	Vehicle Testing of Trackwork: At a time mutually agreed upon by the Contractor and the Engineer, the Contractor shall receive SFMTA's Test Car at the project site. City personnel will operate test vehicle on the track. The track and overhead work shall be adjusted by Contractor to assure successful completion of eight full uninterrupted test runs on each track when vehicle is traveling at operating speeds.	341110	3.11.H							

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136.	Rail	Product Data: Submit the following product data for rail: 3. Rail Ultrasonic Test Report	341114	1.05.B.3							
137.	Rail	Submit Certificate of Compliance that the rail furnished meets all requirements included in this Contract Specifications Section.	341114	1.05.C							
138.	Rail	Restraining rail on track with centerline radius of less than 300 feet shall be head hardened.	341114	2.02.D							
139.	Rail	Rail shall be ultrasonically tested at the factory to verify that there are no internal rail flaws.	341114	3.03.A							
140.	Rail	The Contractor shall engage an independent internal rail flaw detection service, approved by the Engineer for the following: 1. Installed rail shall be ultrasonically tested by the independent rail flaw detection service to confirm that no internal rail flaws have developed after leaving the rail manufacturing plant.	341114	3.04.A.1							
141.	Flash Butt Rail Welding	Submit detailed description of testing program and procedures to be performed by Inspection and Testing Agency (ITA).	341116	1.05.B							
142.	Flash Butt Rail Welding	Visually and dimensionally inspect each weld to determine conformance with the alignment and finishing tolerances in AREMA Manual, Chapter 4, Section 3.12, Specifications for Fabrication of Continuous Welded Rail.	341116	3.07.B							

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143.	Flash Butt Rail Welding	ITA shall magnetic particle test each weld by the coil method (longitudinal magnetization) using the dry powder method in accordance with ASTM E709.	341116	3.07.C							
144.	Flash Butt Rail Welding	Ultrasonically test each weld for defects in accordance with ASTM E164. Use testing equipment capable of detecting a 3/64-inch discontinuity, 6-1/2 inches below top of rail. Perform ultrasonic testing after rail has been destressed.	341116	3.07.D							
145.	Flash Butt Rail Welding	Inspect each weld using a three-foot straightedge along the centerline of the rail and 0.625 inch below top of rail on the gauge side of the rail head. Center the straightedge over the weld; the gap between the straightedge and the rail shall comply with, the requirements of AREMA Manual, Chapter 4. Section 3.12, Specifications for Fabrication of Continuous Welded Rail	341116	3.07.E							
146.	Thermite Rail Welding	Submit detailed description of testing program and procedures to be performed by Inspection and Testing Agency (ITA).	341117	1.05.B							
147.	Thermite Rail Welding	Ultrasonic testing shall be performed after the weld has been ground and finished to specified tolerances. Ultrasonic testing shall be performed in accordance with ASTM E164. Equipment used shall be capable of detecting a 3/64-inch discontinuity, 6-1/2 inches below the top of rail.	341117	3.10.F.1							

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148.	Special Trackwork	Rail shall be ultrasonically tested for internal defects in accordance with the AREMA Manual. Twenty-five percent of all castings shall be radiographically tested. All manganese steel castings shall be radiographically tested for internal defects. Radiographic testing shall be in conformance with the AREMA Specifications.	341123	1.04.A							
149.	Special Trackwork	Submit six copies of shop drawings for each special trackwork item. Shop drawings shall include all details related to the fabrication and installation of each item including: 4. Guard rails	341123	1.06.E.4							
150.	Special Trackwork	Rail, guard rail, flangeway liner, joint bars and other items to be installed in curves with a centerline radius of 300 ft or less shall be shop curved to conform to the radii of the track in which they will be installed as specified in Section 34 11 10, BASIC TRACKWORK MATERIALS AND METHODS.	341123	2.01.D.1 5							
151.	Special Trackwork	Guard rails shall be one piece manganese steel, 7-tie length, per AREMA Portfolio, Plan No. 510.	341123	2.01.E.5							

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152.	Rail Fasteners	A report of test results of each test shall be submitted to the Engineer which includes test name, identity of test sample, original data calculations, test procedure references, test equipment identification, test personnel, time and date of test, specified requirements, actual test results, nonconformances if any, and interpretation of the results. The format for the test report shall be arranged so that the data is presented in an orderly manner.	341136	1.03.I.1							
153.	Track Appurtenances and Accessories	Design Calculations: Submit six copies of design calculations for bumping posts showing stopping distance.	341193	1.05.B							
154.	Track Appurtenances and Accessories	Crossing panels shall be electrically insulated from the running rails and DF fasteners.	341193	2.02.F							
155.	Track Appurtenances and Accessories	Install bumping posts in accordance with the manufacturer's instructions at the locations as shown on the Contract Drawings.	341193	3.02.A							
156.	Track Appurtenances and Accessories	A representative of the manufacturer shall be present at the field test. Owner will provide a test vehicle conforming to the consist described in subpart 2.01C. The train will be operated by SFMTA at the prescribed speed into one of the bumping posts. The stopping distance will be measured.	341193	3.05.A.1							

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157.	Sectionalizing Breaker	Operations & Maintenance Manuals: The Contractor shall submit for approval eight copies of a proposed O&M manual for the sectionalizing breakers.	342119. 19	1.06.G							
158.	Sectionalizing Breaker	Each breaker shall be mounted within a padlockable, painted, NEMA type 3R, vented, drained stainless steel enclosure. All breaker enclosures shall be of sturdy construction; all doors shall have vertical hinges and three point latches. Steel components shall be hot-dip galvanized after fabrication. All hardware, including hinge pins, shall be stainless steel. All doors shall open 180 degrees for internal access. The Contractor shall furnish and install sturdy Schlage padlocks on access doors. Keying of the locks shall be master keyed to the existing master keying system.	342119. 19	2.01.A							
159.	Sectionalizing Breaker	Personnel Protection: A shutter shall be provided in each breaker compartment which shall automatically operate to completely cover the stationary portion of the primary disconnecting device when the circuit breaker is withdrawn, or the disconnecting devices shall be designed so that they shall be protected from personnel or foreign material accidentally contacting or getting within unsafe clearances of any current carrying portion of the stationary disconnecting device member.	342119. 19	2.01.F.2							

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160.	Sectionalizing Breaker	Compartment Doors: Each circuit breaker compartment shall have concealed hinged steel doors (front and rear), not furnished as part of the breaker, with a suitable handle and three-point bolt latch (lockable) for holding the door in a securely closed position. Each door shall be provided with a door stop to hold the door in the open position. The doors shall be formed of sheet steel and properly reinforced against distortion by suitable flanges and stiffening members. The hinges shall be heavy-duty stainless steel. The front door shall be electrically interlocked to trip the breaker when the door is opened. A mechanical interlock to prevent opening the front door unless the breaker is tripped shall be provided.	342119.19	2.01.F.3							

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161.	Sectionalizing Breaker	Circuit Breaker Positions: Provisions shall be made for an operator to move the breaker to "connected," "test" and "disconnected" positions via automatic disconnect or umbilical cord. In the "connected" position, both the primary disconnecting devices and the secondary disconnecting devices shall be in full contact and the breaker shall be positioned for normal operation. In the "test" position, the primary disconnecting devices shall be disconnected with shutters fully closed and the secondary disconnecting devices shall be in full contact. In the "disconnected" position, both the primary and secondary disconnecting devices shall be opened and separated by a safe distance. Mechanical interlocks shall be provided to prevent moving a closed circuit breaker in or out of the "connected" position. An indicator shall be provided to show the location of the circuit breaker in "connected," "test" or "disconnected" positions.	342119.19	2.01.F.5							
162.	Sectionalizing Breaker	Means shall be provided to permit padlocking the DC breaker to not allow the movement of the breaker from the "test" or "disconnected" position to the "connected" position or vice versa.	342119.19	2.01.F.5.a							

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163.	Sectionalizing Breaker	The removable assembly shall be provided with a fully interlocked, manually-operated racking mechanism to move the circuit breaker between the DISCONNECTED, TEST, and CONNECTED positions. A position indicator shall be provided which shall be clearly visible from a point 1.5 m in front of the panel. It shall be possible to rack the breaker between these 3 positions without opening the door of the breaker compartment.	342119.19	2.02.A.7.b							
164.	Sectionalizing Breaker	Control Switch: A control switch and breaker position indicating lights shall be provided on each breaker unit. Position indicating lights shall be red for CLOSED position and green for OPEN position. The control switch shall be able to close and trip the breaker electrically while the breaker is in the "TEST" position with the selector switch in either "LOCAL" or "REMOTE" position, and initiate the control sequence for closing and tripping the breaker while the breaker is in the "CONNECTED" position with the 43S selector switch in the "LOCAL" position.	342119.19	2.02.A.9.c							
165.	Sectionalizing Breaker	Electronic high speed Overcurrent Trip (Device No. 76): Each feeder circuit breaker shall be provided with direct-acting series and/or solid state, bi-directional overcurrent trip device(s). This device shall provide the primary overcurrent protection for the circuit.	342119.19	2.02.D.2							

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166.	Sectionalizing Breaker	Device No. 64, Enclosure Ground Relay: A high-resistance ground relay shall be connected between the DC switchgear enclosures and station grounds. The relay shall be provided with a NO contact to initiate annunciation upon metal enclosure grounding or contact with the negative circuit, or malfunction of the ground relaying network. The relay shall also be furnished with a NO contact to initiate tripping of the unit lockout relay if any part of the metal enclosure becomes energized in the event of a fault.	342119.19	2.02.D.3							
167.	Sectionalizing Breaker	Contractor shall install two weather resistant 7 inch x 10 inch OSHA format warning signs within the enclosure, in a prominent location: "DANGER – BREAKER MAY OPEN AUTOMATICALLY". On the outside of the front door of the enclosure, the Contractor shall install a weather resistant, metal 7 inch x 10 inch OSHA format warning sign, attached by rivets or approved equal "DANGER – HIGH VOLTAGE – IN EMERGENCY NOTIFY 554-9204".	342119.19	2.02.AA							

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168.	Sectionalizing Breaker	Remote Terminal Unit The backup battery shall be 120VDC maintenance-free battery. It shall be normally charged from 125VDC power. It shall last for 8 hours upon loss of 615VDC power on both sides of the sectionalizing breaker. It shall be located off the cabinet floor in the auxiliary equipment compartment and located to be viewable for inspection and accessible for maintenance and cleaning.	342119.19	2.03.J.1							
169.	Sectionalizing Breaker	After satisfactory completion of the factory acceptance test, the Engineer will authorize shipping of the equipment. Equipment shall not be shipped until all required tests and inspections have been made and certified copies of the test reports have been accepted in writing by the City.	342119.19	3.05.G.2.a							
170.	Sectionalizing Breaker	The following training shall be provided to MUNI personnel: 1. Database training for user programming, 3 people for a week. 2. System administrator training for master station operation, 3 people for 3 days. 3. Operator's training for RTU operation: 1 day. 4. RTU programming and trouble-shooting: 3 days.	342119.19	3.07.A							

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171.	Traction Power Cables	<u>Tunnel, Subway Stations</u> 750 kcmil cables shall have a 2.4 kV rating; shall be compressed stranded copper conductors with an extruded conductor shield conductor with class B stranding; unshielded, with type EPR insulation, low smoke, non-halogen outer jacket; and shall be rated 90 degrees C for normal operating conditions in dry or wet conditions. The cables shall have a minimum insulation and jacket thickness of 155 and 125 mils, respectively; shall meet the requirements of NEMA WC-71, UL-1072, ASTM B3 and B8.	342200	2.01.A							
172.	Traction Power Cables	<u>Tunnel, Subway Stations</u> 500 kcmil cables shall have a 2.4 kV rating; shall be compressed stranded copper conductors with an extruded conductor shield conductor with class B stranding; unshielded, with type EPR insulation, low smoke, non-halogen outer jacket; and shall be rated 90 degrees C for normal operating conditions in dry or wet conditions. The cables shall have a minimum insulation and jacket thickness of 140 and 110 mils, respectively; shall meet the requirements of NEMA WC-71, UL-1072, ATM B3 and B8.	342200	2.01.B							

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173.	Traction Power Cables	<u>Surface</u> 750 kcmil cables shall have a 2.4 kV rating; shall be uncoated copper, singleconductor with class B stranding; unshielded, with type XLP insulation, PVC jacket; and shall be rated 90 degrees C for normal operating conditions in dry or wet conditions. The cables shall have a minimum insulation and jacket thickness of 155 and 125 mils, respectively; shall meet the requirements of NEMA WC-71 and UL-1072.	342200	2.02.A							
174.	Traction Power Cables	<u>Surface</u> 500 kcmil cables shall have a 2.4 kV rating; shall be uncoated copper, singleconductor with class B stranding; unshielded, with type XLP insulation, PVC jacket; and shall be rated 90 degrees C for normal operating conditions in dry or wet conditions. The cables shall have a minimum insulation and jacket thickness of 140 and 110 mils, respectively; shall meet the requirements of NEMA WC-71 and UL-1072.	342200	2.02.B							
175.	Traction Power Cables	The tape shall be non-corrosive to metallic cable sheaths and compatible with synthetic cable jackets. It shall be self-extinguishing and shall not support combustion. The tape shall not deteriorate when subjected to water, salt water, gases, and sewage.	342200	2.05.A							

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176.	Traction Power Cables	The Contractor shall install non-asbestos fireproofing tape and blanketing for feeder cables in all manholes, as indicated on the Contract Drawings, and in accordance with manufacturer's instructions.	342200	3.05.A							
177.	Traction Power Cables	Negative return circuit insulation resistance to ground shall be tested with a 1,000 VDC megger. The insulation resistance for the tested cable shall exceed 50 megohms.	342200	3.08.B.8							
178.	Traction Power Cables	Riser Cables: Riser cable insulation resistance to ground shall be tested with a 1,000 VDC megger. The insulation resistance for the tested cable shall exceed 50 megohms.	342200	3.08.C							
179.	Traction Power Testing and Training	Equipment components shall be tested for functionality prior to incorporating into its respective system. The Contractor shall submit Certificates of Compliance as proof that the components meet the requirements of this Contract. The Contractor shall certify all components' functionality prior to proceeding to the Subsystem and System Tests.	342300. 19	3.02.A							

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180.	Traction Power Testing and Training	After acceptance of the start-up tests, the Contractor shall proceed with the subsystem tests in conformance with the Schedule and Work Plan. The Contractor shall demonstrate to the City proper and complete operation of all installed subsystems. The Contractor shall not perform final system hookup and testing unless they are fully prepared to immediately address and correct system problems and malfunctions, especially when existing SFMTA systems and facilities are impacted.	342300.19	3.03.A							
181.	Traction Power Testing and Training	After acceptance of the system components and subsystems, the Contractor shall proceed with the overall system test in conformance with the Schedule and Test Plans. The Contractor shall demonstrate to the City proper and complete operation of all installed systems. The Contractor shall not perform final system hookup and testing unless they are fully prepared to immediately address and correct system problems and malfunctions, especially when existing SFMTA systems and facilities are impacted.	342300.19	3.04.C							

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182.	Traction Power Testing and Training	The Contractor shall provide a program to educate, train, and teach personnel in all details of all equipment to the component level as required to enable SFMTA to operate, service, and maintain the equipment satisfactorily. The training program shall be implemented immediately prior to commissioning.	342300.19	3.05.B.1							
183.	Traction Power SCADA Equipment	Submittals 17. RTU terminal layout drawings with all control, status, and alarm points indicated. 20. Certified test reports of completed testing and confirmation of all RTU I/O points for Washington Substation at Chinatown Station, Gap Breaker Station at Union Square/Market Street Station, Folsom Substation	342310	1.06.A							
184.	Traction Power SCADA Equipment	Operations & Maintenance Manuals: The Contractor shall submit for approval eight (8) copies of a proposed O&M manual for the sectionalizing breakers and video display wall system.	342310	1.06.E							
185.	Traction Power SCADA Equipment	The security required for critical control activity shall be provided so that each point operates on a select-before-operate control message sequence. Two levels of computer controlled diagnostic checks shall be designed into the binary output subsystem to protect against false operations. If an error is detected at any stage of the binary output process, the sequence shall be halted, and error shall be reported to the existing Master Station.	342310	2.01.F.4.b							

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186.	Traction Power SCADA Equipment	A Local/Remote switch shall also be provided on the RTU to block remote operation of all controlled devices, providing a safe environment for service personnel. When the switch is placed in the local mode, an alarm may be sent to the existing Master Station and all electrical and software operations of control outputs shall be blocked. All other data acquisition functions shall remain fully operational.	342310	2.01.F.4.c							
187.	Traction Power SCADA Equipment	Suitable ground braid shall electrically connect all moving enclosure parts (i.e., door, swing rack) to the cabinet. An enclosure grounding lug capable of accommodating a #4/0 AWG stranded grounding cable shall be provided in each enclosure.	342310	2.01.L.1.c							
188.	Traction Power SCADA Equipment	A minimum 90-minute backup power for the video display wall system via UPS power supplies	342310	2.10.A.3.d							
189.	Traction Power SCADA Equipment	The Contractor shall perform the following tests: 1. Factory Acceptance Test 2. Commissioning Test 3. System Availability Test	342310	3.06.A							

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190.	Traction Power SCADA Equipment	Training shall be provided as two separate classes: 1. Class 1 will provide Administration training over a period of one week (Monday through Friday) for a single shift: 45 hours total. 2. Class 2 will provide NTU and Operator training over a period of one week (Monday through Friday) for 2 shifts as defined by SFMTA: 50 hours total.	342310	3.08.A							
191.	Traction Power Poles	Contractor shall submit the following items for approval prior to ordering and fabrication: 5. Test data and results of pole deflection test.	342313	1.05.A							
192.	Traction Power Poles	Pole deflection testing shall be required for all pole types. Tests shall be conducted on not more than 5 percent of the poles in any lot of twenty or more and only one pole in any lot under twenty. A lot is defined as the number of poles of any one type covered by the Contract.	342313	2.04.A							
193.	Traction Power Poles	Each steel trolley pole shall be grounded.	342313	3.01.M							
194.	Overhead Cable Suspension	The Contractor shall submit Operation and Maintenance Manual, including preventive maintenance schedule for section insulators, new hardware to MUNI system, and other items as requested by the Engineer.	342316	1.05.A.6							

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195.	Overhead Cable Suspension	(STS-1256 only) Provide a minimum of 12 hours of on-site training to MUNI maintenance personnel in maintaining and trouble-shooting section insulator, switch control assemblies, new hardware to MUNI system, steady arm, elastic arm, catenary hanger, and other items as requested by the Engineer. The training shall include, at the minimum, the following: equipment familiarization, description and functional characteristics of equipment and components, preventive maintenance service intervals and schedules, maintenance procedures, component removal and reinstallation, diagnosis and problem solving (troubleshooting).	342316	2.06.A							
196.	Overhead Cable Suspension	Unless otherwise noted, the height of the messenger wire shall be at 14 feet-1 inch plus or minus 1 inch above the rail in the tunnel at 60 degrees F. (Applicable only to STS-1256)	342316	3.03.B							
197.	Overhead Cable Suspension	After installation of the OCS, megger all insulators. Replace insulators that are found defective.	342316	3.03.D.5							
198.	Overhead Testing and Acceptance	Contractor shall submit to the Engineer the following for review and approval: 1. Test Program Plan 2. Test Procedures 3. Test Reports	342316. 16	1.03.A							

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199.	Overhead Testing and Acceptance	Clearance Envelope Testing (Applicable only to STS-1256): 1. Verify clearances of pantograph from the newly installed OCS components. 2. Perform initial testing with a rail mounted height and stagger gauges, having the same profile as the vehicle pantograph to verify clearance between the pantograph and the OCS components such as heels of steady arms, elastic arms, and trolley wire clamps. The Contractor shall correct all deficiencies to the satisfaction of the Engineer.	342316.16	3.03.C								

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200.	Overhead Testing and Acceptance	The vehicle shall operate through the OCS when completed in each lane or track and at speeds directed by the Engineer. The OCS shall be checked for smooth operation especially at crossings, switches and section insulators. A successful test is when two runs in each lane or track by the test vehicle traveling at operating speeds, with the pantograph positions at "A" and "B", are achieved without interruption through all possible movements and directions used by MUNI Operating Division, or at the discretion of the Engineer. A successful run is where: a. All electric and selectric switch operations, including signal indications and resets, function as designed. b. Pantograph traverses through special work, section breaks and section insulators smoothly without bouncing or arcing. (Applicable only to STS-1256) c. Pantograph tracks smoothly and within 9 inches of the pantograph centerline. (Applicable only to STS-1256) d. No dewirement of historic car or trolley coach collector pole occurs through any special work such as switches, crossings, curves or through tangent trolley wire.	342316.16	3.03.D								

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201.	Overhead Testing and Acceptance	Final OCS Testing: 1. The test vehicle shall operate through the entire limits of the Contract for final testing. A successful test is when two runs in each lane or track by the test vehicle traveling at operating speeds are achieved without interruption, or at the discretion of the Engineer.	342316.16	3.03.E						
202.	Traffic Signals	Testing and warranty information for LED vehicle modules shall be submitted as follows: Manufacturer's testing data shall be submitted to DPT Traffic Engineer at SF DPT, 1 South Van Ness Avenue, 7th Floor, SF CA 94103-5417, not Caltrans (overrides Caltrans LED specification sections 9.4.2.1 and 9.4.2.2).	344113	2.01.A.8.a						

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203.	Traffic Signals	No vehicle signal heads will be considered pre-accepted by the City. Some signal heads manufactured by PEEK (TCT), Traffic Parts, Inc, and McCain Traffic Supply have demonstrated the ability to meet the City's specifications in the past. It is the Contractor's responsibility to demonstrate that each traffic signal head meets or exceeds the City's requirements as set forth in this Section. In order for a manufacturer other than those specified above to be considered for acceptance, a working sample must be submitted to the City's Traffic Signal Division for a minimum of 1 year for installation and field testing prior to being allowed for use on any of the traffic signals within the City.	344113	2.01.A.1 1						
204.	Traffic Signals	Louvers shall be Directional Louvers in accordance with Caltrans Standard Plan ES-4C. Visors for signal faces shall be aluminum.	344113	2.02.A						
205.	Traffic Signals	Pedestrian signals shall conform to Section 86-4.06 "Pedestrian Signal Faces" of 2006 CTSS and shall be Type A, Hand/Walking Man, Symbol (http://www.dot.ca.gov/hq/esc/oe/specifications/std_specs/2006_StdSpecs/2006_StdSpecs.pdf). Pedestrian signal housing including the door shall be dye castaluminum.	344113	2.03.A						

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206.	Traffic Signals	Testing and warranty information for countdown pedestrian signal LED modules shall be processed as follows: 1. Test units and manufacturer's testing data shall be submitted to DPT Traffic Engineer at SF DPT, 1 South Van Ness Avenue, 7th Floor, SF CA 94103-5417, not Caltrans (overrides Caltrans LED specification sections 4.4.2.1 and 4.4.2.2).	344113	2.03.D.1								
207.	Surface Signaling System General Requirements	Six (6) certified copies of each Test Report shall be submitted to the Engineer and to the Contractor Quality Control System Manager for acceptance within five (5) working days after completion of each test. Test Reports must contain all the data obtained during tests, and analysis of the data and conclusions relating to the test pass/fail criteria outlined in the test procedure. A test that fails must be repeated and all corrective actions taken to pass the re-test must be outlined in a new test procedure.	344213	1.03.N								

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208.	Surface Signaling System General Requirements	O & M Manuals: At least 30 days prior to operational testing of the installed system, the Operation and Maintenance manual for the Track Switch Control System shall be provided. The O&M manual shall be written to provide all necessary information to train technicians to service, troubleshoot, repair and modify the system and shall include as-built layout plans, wiring and schematic diagrams, customized cover and introduction, and shall reference and include standard manuals for VTS, VPI, track switch controller, switch operators, etc.	344213	1.03.P							
209.	Surface Signaling System General Requirements	Lesson Plan: The Lesson Plan shall be submitted 30 days prior to training, detailed lesson plans shall be submitted for approval. The lesson plans shall be designed to allow Muni to duplicate the training without any information other than the O&M manuals and shall include duplicates of any training aids used.	344213	1.03.R							

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210.	Surface Signaling System Wayside Equipment	O & M Manuals: At least 60 days prior to operational testing of the installed system, the final Operation and Maintenance manuals for the Track Switch Control System shall be provided. The O&M manual shall be written to provide all necessary information to train technicians to service, troubleshoot, repair and modify the system and shall include as-built layout plans, wiring and schematic diagrams, customized cover and introduction, and shall reference and include standard manuals for VTS, VPI, track switch controller, switch operators, etc.	344215	1.02.A.7							
211.	Surface Signaling System Wayside Equipment	Cabinets shall have double doors, front and back. Cabinet doors shall be hinged type, provided with hooks and clips to hold the door at either the 90 degrees or 180 degree position, and shall be completely removable when open. Door handles shall be designed to accept padlocks to lock the doors. One padlock shall be provided for each pair of doors. All the padlocks supplied under this contract shall be keyed alike to match existing Muni Railway keying system (FALCON brand).	344215	2.01.D							
212.	Surface Signaling System Wayside Equipment	Track circuit shall be single rail, shunt type track circuits. A shunt of 0.20 ohms at any point between the rails of any track circuit shall cause that track circuit to indicate occupancy. Loss of shunt protection shall be provided at all times.	344215	2.04.A							

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213.	Surface Signaling System Wayside Equipment	The Contractor shall provide foundation and grounding arrangements for cabinet. Track Switch Controller cabinet shall be set in Dow Corning 791 Silicone Sealant and bolted to foundations.	344215	3.01.B							
214.	Surface Signaling System Wayside Equipment	LRT signals shall be positioned and oriented for best visibility to provide Operators with non-conflicting visual feedback.	344215	3.03.A							
215.	Surface Signaling System Wayside Equipment	Provide VTS detection loops at locations as shown on the Drawings. Each loop antenna shall be installed between the rails. Loops shall be installed in a figure-of- 8-pattern and shall have a width of 30 inches and a length of 20 feet, except as noted. The centerline of the loop shall be within 1/2 inch of the centerline of the track, except as noted. The loop shall be symmetrical, with less than 1 inch difference in length between each lobe and 1 inch difference in width between each lobe of a loop.	344215	3.04.B							
216.	Vital Interlocking Logic Controllers	Complete predicted Reliability and Maintainability (R&M) calculations. Actual performance data for a like system for which reliability records have been maintained for a period of not less than five years may be used to support or substantiate the submitted predicted R&M calculations.	344219	1.03.A.9							

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217.	Vital Interlocking Logic Controllers	Provide a VMIS that is immune to levels of internal and external electrostatic and electromagnetic conducted or radiated interference including SFMTA's radio system equipment and commercial broadcast frequencies such as used for television, radio, CB etc., that may have transmitters or other equipment operating in close proximity to SFMTA's right-of-way. Levels of EMI generated shall not adversely impact nor be impacted by existing SFMTA's electrical environmental conditions. Applicable FCC requirements shall apply.	344219	2.01.A							
218.	Vital Interlocking Logic Controllers	The VMIS shall de-energize all outputs and affect a systems shutdown in the event that any output fails to correspond to the requested state or through the sensing of a critical systems error. In such an event, it shall be ensured that the home signals will display stop aspect.	344219	2.02.B.1							
219.	Vital Interlocking Logic Controllers	Power for the VMIS shall be supplied from two sources. These sources shall be kept separate from each other. One power source shall be provided for input and output functions and the other for processor logic functions. The processor system source shall be 12 volts DC ungrounded signal battery system.	344219	2.03.A							
220.	Vital Interlocking Logic Controllers	Training for the development system shall be included as well as approved Training Manuals.	344219	2.06.E							

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221.	Vital Interlocking Logic Controllers	All functions required for VMIS integrity evaluation, error logging, hardwire interface, timing, data communications, application logic execution, and the application of power to the vital controller shall be fully interleaved and executed by the Executive Firmware. Failure to pass any of the VMIS integrity tests shall cause the VMIS to cease all data communications and remove power, in a completely fail-safe manner, from the hardwire outputs.	344219	2.08.D							
222.	Vital Interlocking Logic Controllers	The application firmware shall be keyed to the vital controller hardware rendering it impossible for any application dependent firmware to be executed in any vital controller other than the intended vital controller.	344219	2.09.B							
223.	Vital Interlocking Logic Controllers	The vital processor units shall be provided with double break vital output printed circuit boards, double break vital input printed circuit boards and double break vital lamp driver printed circuit boards as specified herein.	344219	2.10.E							
224.	Vital Interlocking Logic Controllers	Data between vital microprocessors and other vital microprocessors shall be of a vital nature. Each VMIS shall be provided with vital communication ports.	344219	2.14.A							

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225.	Vital Interlocking Logic Controllers	Vital event recording shall be performed by a dedicated event recorder in each VMIS based on the following requirements: All vital and non-vital functions in the VMIS applications software, as well as all external vital relays shall be recorded.	344219	2.15.A.4								
226.	Vital Interlocking Logic Controllers	Deliver complete copies of all maintenance manuals for the installed VMIS, including specialty component/module documentation, complete with troubleshooting procedures and detailed parts lists. These manuals shall consist of two types, manufacturer generic and application specific. Both types shall be written so that a qualified technician is enabled by the reading thereof to maintain, repair, test and adjust the equipment. The application specific manuals shall include a complete description of the VMIS operation, installation, alignment and adjustment procedures, and troubleshooting tables/logic charts to assist in locating malfunctions and locating failed components.	344219	2.16.E								
227.	Vital Interlocking Logic Controllers	The VMIS and all subsystems shall be tested in accordance with the approved factory test procedure.	344219	3.04.B								

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228.	Vital Interlocking Logic Controllers	The final system acceptance (in-service) test shall be deemed passed only if and when: 1. The system acceptance test has been successfully completed and no problems remain and all modifications, as a result of testing, are made final. 2. The Authority has successfully operated the unit for a period of not less than 30 consecutive days during which time a series of tasks and verification procedures have been performed as determined by the Engineer to be sufficient to enable the Engineer to determine that the unit operates in accordance with its functional specifications and its design specifications. 3. Throughout the period specified in the above item, the unit has not failed and no problems have been discovered.	344219	3.04.I							
229.	ATCS Safety	An ATCS "system" software analysis if the proposed "system" software is materially different from that installed on the existing SFMTA system.	344227	1.02.B.1 0							
230.	ATCS Safety	A FEMCA of ATCS system CLASS I hardware.	344227	1.02.B.1 3							
231.	ATCS Safety	All vital functions required to be performed by the ATCS shall be implemented by the vital portion of the system. The vital functions shall be fail-safe and independent of other (non-vital) ATCS functions.	344227	2.01.A							

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232.	ATCS Safety	Perform a comprehensive Fault Tree Analysis (FTA) for the ATCS system provided under this Contract. All safety considerations shall be included. The results of this analysis shall be shown in a Fault Tree with the final result clearly indicated. If the Contractor has extant analyses and documentation that are equivalent to these requirements, they may be submitted for consideration and approval by the Engineer.	344227	2.03.B							
233.	ATCS Safety	ATCS System Software Design Requirements: System software design requirements shall be as follows: 1. Vital Software: a. Vital software shall be designed such that it can be demonstrated to either be error-free or have a calculable PEU and, subsequently, a calculable MTBUE. b. Vital software shall be identified as such in the Contractor's software system block diagrams and by individual routine in the software listings. c. Submit vital software design and implementation standards for approval. Vital software shall be designed to conform to the approved standards.	344227	2.04.D							

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234.	ATCS Safety	Preliminary Hazard Analysis (PHA): Perform an update to the ATCS PHA it to identify all hazardous conditions and the faults that precipitate them. The faults identified in the PHA shall in turn be used to identify those functions, the incorrect performance of which, may cause a hazardous condition to exist, that may influence vital functions.	344227	2.04.F.3 .b.1							
235.	ATCS Safety	Analyze failure modes related to all new component types, such as selfoscillation, susceptibility to spurious signals, vulnerability to electrical or mechanical shock, and electronic phenomena that mimic signals that normally indicate safe conditions. Failure modes shall be classified as self-revealing or non self-revealing. The FMECA shall demonstrate that adequate controls are provided for all hazardous events resulting from combinations hardware failures in the ATCS system, and other factors originating in the ATCS system.	344227	2.05.A							

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236.	ATCS Safety	Provide a description of the safety assurance concepts under which the ATCS equipment is designed and implemented. The description shall indicate how vital functions are performed such that hardware failures or software errors will not result in a more permissive condition or action than the overall system conditions safely permit. The description of the safety assurance concepts shall include a statement of all fundamental assumptions made with regard to the assurance of system safety.	344227	2.06.A							
237.	ATCS Systems Assurance	Preventative Maintenance Plan: The Contractor shall develop and submit a detailed Preventative Maintenance (PM) plan based upon the maintenance concepts and maintainability requirements established in the SAP. The plan shall refine and enhance the PM goals declared in the Contractor's Proposal. The PM plan shall include all servicing, inspections, scheduled overhaul, or any task required on a scheduled basis.	344231	3.04.E							
238.	ATCS Room Equipment	Racks and/or cabinets shall be furnished with provisions for EMI mitigation and ventilation as required for optimum performance.	344235	2.01.I							
239.	ATCS Room Equipment	All circuit boards shall have internal as well as external data and power surge protection.	344235	2.01.G							
240.	ATCS Room Equipment	Separate the power source for input and output functions from the one used for processor logic functions.	344235	2.02.A							

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241.	ATCS Room Equipment	External apparatus and circuits controlled by the vital processor via the hardwire interfaces shall be double break for designs not protected by vital transmission protocol and include, but not be limited to, the following: 1. Switch and Lock Movements, 2. Signal Lighting, 3. Loop Feeds 4. Axle Counters 5. TCR to TCR communications 6. TCR to VCC communications 7. Vital Relays	344235	2.04.E						
242.	ATCS Room Equipment	Instrument racks shall be arranged and mounted in the TCR as indicated on the Contract Drawings. Each signal rack in the TCR shall be electrically insulated from adjacent racks and associated components. Each rack will have a ground termination connected by cable to the room signal ground bus.	344235	3.01.B						
243.	ATCS Room Equipment	Where specific power ripple or regulation specifications exist for the vital controllers or associated equipment, compliance with such ripple or regulation specifications shall be demonstrated to the satisfaction of the Engineer,	344235	3.03.B						

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244.	ATCS Wayside Equipment	O & M Manuals: At least 30 days prior to operational testing of the installed system, the Operation and Maintenance manual for the wayside equipment shall be provided. The O&M manual shall be written to provide all necessary information to train technicians to service, troubleshoot, repair and modify the system and shall include as-built layout plans, wiring and schematic diagrams, customized cover and introduction, and shall reference and include standard manuals.	344237	1.02.B.7							
245.	ATCS Wayside Equipment	Protective devices shall be provided to protect the system from EMI. All fuses shall have the correct voltage rating, current rating, interrupting rating and blowing times to provide the best obtainable protection for the given application without nuisance blowing.	344237	2.01.C							
246.	ATCS Wayside Equipment	The contractor shall provide concrete foundations and grounding arrangement for the electrical equipment as shown on the drawings and in accordance with DPW Standard Specifications.	344237	2.02.B							
247.	ATCS Wayside Equipment	Manual operation shall be by hand-crank and shall disable both local and remote control movement commands. Switches shall not automatically reset positions after manual operation is discontinued.	344237	2.02.E							

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248.	ATCS Wayside Equipment	Provide 6 aspect ATCS signals as shown on both northbound and southbound tracks at the Chinatown interlocking to control movement of Non-ATCS trains.	344237	2.03.A							
249.	ATCS Wayside Equipment	All station platforms shall be equipped with two emergency stop buttons for passenger use as indicated on Contract Drawings.	344237	2.07.A							
250.	ATCS Wayside Equipment	Buttons shall be provided in a red enclosure with a lockable door facing the track which it controls.	344237	2.07.B							
251.	ATCS Wayside Equipment	The ATCS system shall have the capability to support platform intrusion devices.	344237	2.08.B							
252.	ATCS Wayside Equipment	The Contractor shall provide foundation and grounding arrangements for trackside cases and cabinets.	344237	3.01.B							
253.	ATCS Wayside Equipment	LRT signals shall be positioned and oriented for best visibility to provide Operators with non-conflicting visual feedback.	344237	3.02.A							
254.	ATCS Wayside Equipment	Provide loops throughout ATCS territory as shown in drawings. Loop antenna shall be installed between the rails with transpositions occurring approximately every 82feet.	344237	3.03.A							
255.	ATCS Wayside Equipment	The portal intrusion detection system shall allow rail vehicles to pass through without alarming but an intruder (person or large animal) entering the portal shall cause an annunciated alarm at the OCC.	344237	3.04.A							
256.	ATCS Central Equipment	The power source for input and output functions shall be separate from the one used for processor logic functions.	344239	2.02.A							

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257.	ATCS Central Equipment	Provide an Emergency Stop function using the existing Emergency Stop System that is safety critical and fully redundant. No failure mode shall result in the System being incapable of stopping trains. Failure modes that could have unsafe consequences are eliminated, prevented, or otherwise accounted for by design. The design shall also be fully redundant such that no single point failure within the System can result in a stop command being activated.	344239	2.05.A							
258.	ATCS Central Equipment	Provisions for EMI mitigation (shielding) shall be made as determined by results of the Contractor's investigation to ensure proper operation of equipment relative to the environment.	344239	3.01.G							
259.	ATCS Testing	Submit an ATCS Testing and Startup Program Plan for Engineer and approval review within 30 calendar days of Notice to Proceed.	342141	1.02.B							
260.	ATCS Testing	Test procedures shall be submitted for approval at least 60 days in advance of each scheduled test, unless noted otherwise in the various sections of the Specifications.	342141	1.02.C							

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261.	ATCS Testing	Six (6) certified copies of each Test Report shall be submitted to the Engineer and to the Contractor Quality Control System Manager for acceptance within five (5) working days after completion of each test. Test Reports must contain all the data obtained during tests, and analysis of the data and conclusions relating to the test pass/fail criteria outlined in the test procedure.	342141	1.02.D							

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