

SECTION 16707

COMMUNICATIONS SYSTEMS QUALITY ASSURANCE & TESTING

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. These quality control (QC) system requirements define characteristics, in addition to those in Division 1 of the Specification, of the quality control system that must be implemented by the Contractor during the course of Communications System design, equipment procurement, factory testing, installation and acceptance testing.
- B. The Contractor shall provide and maintain a Quality Assurance Plan, and an Inspection and Testing Plan covering the equipment, materials, and services specified herein.
- C. The CQCS Quality Assurance Program, Quality Assurance Plan, and Inspection and Testing Plan, including related directives, procedures, processes, instructions, forms and schedules, shall be submitted to the Engineer for approval. The basis for approval shall be the Engineer's acceptance of a document describing how the Quality Assurance Program requirements, set forth herein, shall be met and the acceptance of the form and substance of each document submitted for approval. The approved program and plans shall be used by the Contractor in the performance of any inspection of the equipment, materials and services being furnished. If program/plans are returned as unacceptable, the Contractor shall revise and resubmit the Quality Assurance Program or plans to the Engineer within 30 calendar days.
- D. The basis for this quality control (QC) system requirements are the American National Standards Institute (ANSI) Standard ANSI/ISO/ASQC Q9002-1994 entitled "Quality Systems -Model for Quality Assurance in Production and Installation and Servicing.." Quality control systems based on other standards may also be acceptable provided they contain elements that meet these requirements.

1.02 RELATED SECTIONS

- A. Division 1
- B. Division 16 - Communications Sections

1.03 REFERENCES

- A. American National Standards Institute (ANSI) Standard ANSI/ISO/ASQC Q9002-1994

1.04 DEFINITION OF TERMS

- A. Quality Assurance Program: The document containing the Contractor's quality-related policies, practices, procedures and methods, which are utilized to assure compliance with Contract Specifications.
- B. Quality Assurance Plan: A document detailing how the Contractor will implement the Quality Assurance Program

- C. Inspection and Test Plan: A document detailing how the Contractor will inspect and test Contract equipment, materials, workmanship, and services.
- D. Inspection: The physical act of verifying, by measurement and examination of the equipment, materials, workmanship, and services, that they conform to approved documents and established quality requirements.
- E. Audit: An examination of the Contractor's implementation of the approved Quality Assurance Program for the purpose of determining compliance with and conformance to the Quality Assurance Plan and other related documents.

1.05 QUALITY POLICY

- A. The Supplier shall establish and document policies to implement quality control systematically in a manner that meets these QC system requirements. These policies shall be revised or amended until they are accepted by the Engineer.

1.06 QUALITY SYSTEM

- A. The Contractor shall document and implement a quality control system consistent with the policies accepted by the Engineer. The quality system shall include:
 - 1. Written procedures and instructions governing the work covered by this contract.
 - 2. Effective and verifiable implementation of these procedures and instructions.
- B. Activities affecting quality shall be prescribed via documented instructions, procedures, or drawings of a type appropriate to the circumstances and shall be accomplished in accordance with these instructions, procedures, or drawings.
- C. Instructions, procedures, or drawings shall include appropriate measurable or otherwise verifiable criteria for determining that important activities have been satisfactorily accomplished.

1.07 ORGANIZATION

- A. The submitted Quality Assurance Program document shall be organized as follows:
 - 1. Name of Contractor and Contract
 - 2. Revision Dates
 - 3. Index
 - 4. Contents
- B. The Contractor shall identify the elements of its organization involved with this Contract, including subcontractors and Original Equipment Manufacturers (OEMs), and the scope of responsibility and authority of these parties.
- C. Interfaces with OEMs, subcontractors, and WMATA shall be identified and the scope of each group's responsibilities described
- D. The responsibility, authority and the interrelation of personnel who manage, supervise, perform and verify work affecting the quality of items intended for WMATA shall be defined, particularly for personnel who must exercise authority to:
 - 1. Initiate, recommend or provide solutions through designated channels to eliminate identified noncompliance or nonconformance,
 - 2. Control further processing, delivery or installation of items until the noncompliance or nonconformance has been corrected, and

3. Initiate action to prevent the occurrence of noncompliance or nonconformance.
- E. Inspection and testing functions shall have sufficient resources and organizational independence to perform their responsibilities. Except in-process monitoring, they shall not report to the same management as those who performed the work nor have had input as to how the work was accomplished or accepted.

1.08 SCOPE

- A. The Contractor shall provide a statement that identifies the functional areas of Contractor work and the locations where such work is performed. The Quality Assurance Program shall apply to all equipment, systems, and services included in these Specifications, except as otherwise stated. The Contractor's functional work area breakdown shall include, but shall not be limited to, management, engineering, procurement, manufacturing, installation, and inspection.

1.09 SUBMITTALS

- A. The Quality Assurance documents shall be submitted within 30 calendar days after Notice-To-Proceed. Contractor test and inspection procedures shall be added to the approved Quality Assurance Program within 30 days after they are developed. Details concerning fabrication processes for equipment and systems that require development shall be added to the approved Quality Assurance Program as the development work progresses (within 30 days after they are developed).

1.10 DELIVERY, STORAGE AND HANDLING

- A. The Contractor shall establish and implement measures for maintaining the integrity, security, and acceptability of items during receiving, handling, storage, movement or placement of items.
- B. The Contractor shall maintain packing and preservation of items to the extent necessary to ensure conformance with this contract until these items are installed. The packaging of items inspected at the receiving point shall be resealed upon completion of the inspection.
- C. The Contractor shall provide secure storage areas to prevent loss of, damage to, or deterioration of items pending their use:
1. Items of different types shall be segregated while in storage;
 2. Measures shall ensure that the shelf life of items which deteriorate over time are reported, and that those with expired shelf life are scrapped;
 3. Special environment, maintenance (when items are stored for long periods), and stacking limits required by the manufacturer shall be observed.
 4. In order to detect deterioration, the condition of items in storage shall be checked and assessed at appropriate intervals.
 5. Appropriate methods shall be established for authorizing receipt or release of items at these storage areas.
- D. Handling
1. The Contractor shall employ qualified personnel, methods and equipment to prevent damage during handling.
 2. Handling equipment and rigging shall be periodically inspected, maintained and tested. Load capacities or ratings shall be visible on the equipment; capacities and ratings shall not be exceeded.

3. Operators shall be trained, and, where required by local codes or elsewhere in this contract, certified. WMATA requirements and rules for use of handling equipment shall also be observed at all WMATA properties, leased premises, or construction sites.

PART 2 - PRODUCT

NOT USED

PART 3 EXECUTION

3.01 QUALITY MANAGEMENT

- A. The Contractor shall identify and describe the organizational units having responsibility and authority for development, implementation, and management of the Quality Assurance Program. Achievement of quality objectives shall be verified by individuals and organizations that are responsible for checking, inspecting, auditing, or otherwise verifying that the work has been performed satisfactorily.
- B. The Contractor shall identify the program for assuring that sufficient records are maintained to provide documentary evidence of the performance of activities affecting quality and for use in managing the Contract. Typical records shall include Quality Assurance plans, procedures, instructions, nonconformance or defect reports, corrective action reports, and such other quality-related documents as are specified in the Contract Specifications.
- C. The Contractor shall identify the program for verifying and determining the cause of unsatisfactory product or workmanship quality and for initiating necessary improvements and corrections to preclude repetition. The Contractor's program should extend, when necessary, to the performance of subcontractors and suppliers.

3.02 DESIGN (AND DEVELOPMENT)

- A. The Contractor shall prepare and maintain a plan for inspecting the quality of engineering, development, testing, and documentation activities. The Contractor shall identify the procedures, practices, tables, charts and diagrams applicable to the effort.
- B. The Contractor shall document the engineering criteria applicable to the product being supplied. Include performance objectives, operating ranges and conditions, requirements for safety, reliability, availability, the requirements (codes, standards, and practices) for materials, fabrication, construction, testing, operation, maintenance, and quality assurance.
- C. Studies, to be conducted in support of the engineering (or development) activity, shall be identified by the Contractor. They shall include analysis of allowable "tradeoffs" and alternatives, identification of potential weaknesses, and the appropriate preventative engineering features, operating and maintenance practices, and safety precautions.
- D. The Contractor shall identify the program for assuring that specifications, drawings, and other engineering documents will delineate, as applicable:
 1. Materials and methods, including fabrication, construction, installation, inspection, maintenance cleaning, packaging, shipping, handling, and storage.
 2. Traceability of materials, parts, components, and processes through appropriate lot, piece part, serial, or other appropriate numbers.
 3. Product or workmanship acceptance criteria and the checkpoints during the work process for verifying compliance with the criteria.

- E. The Contractor shall identify the methods and procedures for defining and controlling engineering interfaces with other project participants and design organizations. The procedures shall cover the exchange of required engineering data, analysis and resolution of engineering interface problems.
- F. The Contractor shall identify procedures for controlling release of documents for authorized use.
- G. The Contractor shall identify procedures for documenting the reporting, verifying, analysis, and correcting of troubles that occur during development.
- H. Design criteria and input, including computer applications software, shall be identified, documented, and their selection reviewed by those responsible for the technical adequacy of the design. In all cases, the names of the preparer, checker, and the date the checker accepted the document shall be shown.
- I. Incomplete, ambiguous, or conflicting requirements shall be resolved by those who drew up the design criteria and input and those who approved their selection.
- J. The design input obtained from surveys of existing systems, structures, or facilities shall be documented and identified.
- K. Design output (calculations, specifications, and drawings) shall be documented as requirements in a clear, logical, and uniform manner.
- L. In all cases, the names of the preparer, checker and the date the checker accepted the document shall be shown.
- M. Where required by the applicable Code, design standard, or this contract, design output shall be certified and/or sealed by the appropriate professional practitioner.
- N. The calculation method or computer program shall be identified (including computer software version). The reference source of special, state-of-the-art, or experimental features that are not widely accepted in the railroad industry shall also be identified and those features briefly summarized.
- O. Where the design output is a computer or computer software, specifications, user manuals, and testing and validation files shall be provided. Where the contract conveys to WMATA the license to duplicate, upgrade, repair, and modify the computer or computer code, detailed schematic diagrams, specifications, any special tools, and working standards shall be provided to enable the exercise of the license.
- P. The design shall be verified to have met the requirements of this Contract. Design verification shall be documented and may take the form of design review, checking, alternative analysis or calculation, comparison with proven design, or performance of qualification tests and demonstrations. Design verification documentation. (including OEM equipment qualification testing) shall be made available to the Engineer upon request.
- Q. The Contractor shall establish and implement measures to identify, control, and assess the impact of proposed design changes (including those from the OEMs) on specified functional, safety, and quality requirements, and added cost and schedule changes are identified and justified.

- R. Design changes shall be reviewed, verified and approved in the same manner as the original version. The Contractor shall assign qualified personnel to review and coordinate design changes.
- S. The Contractor shall obtain the Engineer's approval of proposed changes prior to implementing these.

3.03 DOCUMENT CONTROL

- A. The Contractor shall establish and implement measures to control reports, procedures, contract technical deliverable documents, OEM and subcontractor technical submittals, and other records and information it generates or receives that relate to equipment performance characteristics, qualification testing, factory testing, installation, inspection, and acceptance testing. This control shall ensure that:
 - 1. The latest, approved versions of documents or information described above are available where affected Supplier's activities are performed.
 - 2. Revised documents are redistributed to those who received the previous issue.
 - 3. Superseded or obsolete documents are promptly removed from areas of work and stations where controlled documents must be distributed.
 - 4. Changes are reviewed and approved by the same functions or organizations that performed the original review and approval or their designated successors.
 - 5. A means (such as a list or computerized database) to identify the current revision of instructions, procedures, drawings, specifications, or calculations is available.
 - 6. Communications (memorandums of meetings, requests for clarification, etc.) and reports are issued or responded to in a timely manner.
- B. The Contractor shall establish and implement measures to revise and maintain procedures and other records that relate to the performance characteristics, installation, inspection, and testing of components, equipment, or systems in an updated condition. Current as-built condition of equipment shall be retained on file.
- C. Purchasing documents shall contain data clearly describing the product ordered, including, where applicable:
 - 1. The type, class, style, grade, or other precise requirements,
 - 2. The title, number designation and revision of specifications, drawings, process requirements, inspection/test requirements and other relevant technical and quality control requirements, including requirements for approval or qualification of product, procedures, process or inspection equipment and personnel.
 - 3. The title, number and revision of any applicable technical and quality standards to be applied to the product.
 - 4. As a minimum, OEMs shall be required to furnish Certificates of Conformance to the design and manufacturing standards specified by the Supplier, together with the equipment supplied.

3.04 PROCUREMENT

- A. The Contractor shall identify the procedures for controlling the receipt, inspection, testing, handling, storage, and distribution of received equipment and its protection from damage, deterioration, loss or substitution. Inspection instructions and test procedures shall provide for verification of characteristics required by the Contract Drawings and Specifications, and documentation of results.

- B. The Contractor shall identify the procedures for controlling purchased items that do not conform to Specifications. The procedures shall provide for prompt identification, documentation, segregation, technical review, and disposition of non-conforming items.
- C. The Contractor shall establish and implement measures for obtaining items and services from suppliers or subcontractors that conform with specified requirements:
 - 1. The Contractor shall select its OEMs, subcontractors and other sub-suppliers on the basis of their ability to meet specified requirements
 - 2. Any procurement requirement which differs from those in the selected OEM, subcontractor, or other sub-supplier's proposal or offer is resolved and the resolution incorporated into the purchase order or contract, and
 - 3. Records are maintained to show acceptability of the selected OEM, subcontractor, or other sub-supplier (where available, records of previously demonstrated capability and performance should be provided to show acceptability of the selected supplier).

3.05 MANUFACTURING, FABRICATION, AND ASSEMBLY

- A. The Contractor shall identify the procedure and instructions that will be used to assure that fabrication, processing, and assembly operations are being satisfactorily performed.
- B. The Contractor shall identify the inspection and test plans that will be applied to all manufacturing activities for the purpose of verifying conformance to procedures and instructions.
- C. The Contractor shall identify the method employed for tracing the identity of materials and items throughout fabrication, processing, or assembly operations.
- D. The Contractor shall identify the procedures, instructions, and checklists for the control of the fabrication and assembly processes. This shall include such items as shop orders, process sheets, travelers, and inspection instructions, covering all mechanical, electrical, and metallurgical processes. Inspection instructions shall identify the nondestructive examination processes employed.
- E. The Contractor shall identify the methodology of the program including record maintenance.
- F. The Contractor shall identify the procedures for prompt identification, documentation, segregation, technical review, and disposition of non-conforming items.
- G. The Contractor shall identify the procedures and instructions for handling, preserving, packing, packaging, storing, and shipping items shipped to the construction site.

3.06 INSTALLATION

- A. The Contractor shall identify the procedures, check off lists, and instructions governing receipt inspection of equipment on arrival at the construction site. The Contractor shall include in the procedures the control of non-conforming items.
- B. The Contractor shall identify the procedures for on-site configuration control. This shall include the control of drawings, specifications, work instructions, quality-control procedures, inspection instructions, and testing procedures, used in connection with installation.
- C. The Contractor shall identify the procedures and work instructions that apply to installation methods, tests, repairs and rework, cleaning and protection.

- D. The Contractor shall identify the inspections and tests to be performed to verify installation suitability.
- E. The Contractor shall identify the procedures for controlling the on-site identification, documentation, segregation, technical review, and disposition of non-conforming supplies or workmanship.

3.07 INSPECTION AND TESTING

- A. The Contractor shall establish and implement a Unified Test Program that will ensure all communications and related systems, equipment, material and services, furnished during the performance of this Contract, meet the technical requirements and standards specified, as well as all performance criteria.
- B. As part of the Contractor's area of responsibility for the Unified Test Program, the Contractor will be required to:
 - 1. Develop a comprehensive Test Plan detailing methods and test procedures to be utilized to ensure compliance with all applicable specifications.
 - 2. Develop detailed test procedures for each individual test within each category of testing, except Authority tests.
 - 3. Submit the Test Plan (including Authority System Validation Tests, Substantial Completion Acceptance, and Final Acceptance Programs) and all test procedures to the Engineer for evaluation, review, and acceptance or rejection. Revise and resubmit until acceptance by the Engineer is received.
 - 4. Furnish personnel, calibrated test equipment, tools, and miscellaneous supplies as necessary to perform all tests and retests, and to maintain all systems and equipment during the test period and until acceptance by the Authority.
 - 5. Coordinate Unified Test Program activities with the schedules and activities of other contractors and with the Engineer, to avoid conflicts with Authority operational requirements.
 - 6. Perform tests and inspections as detailed in all approved test procedures.
 - 7. Evaluate test procedure and inspection results and documentation. Prepare detailed test evaluation reports, summary reports and progress reports.
 - 8. Submit all raw test data, test results, evaluations, and summary reports for evaluation, review and acceptance or rejection by the Engineer.
 - 9. Prepare and submit revised test procedures and test plans to correct procedural and technical errors or omissions discovered in those documents, after their initial Authority acceptance.
 - 10. Furnish corrective actions to effect Specification compliance, including: Remedy test program deficiencies, and system, equipment, material, workmanship, and documentation deficiencies promptly upon request by the Engineer.
 - 11. Perform retesting and additional inspections until successful results are obtained, evaluated, and accepted by the Engineer.
 - 12. Participate in Authority Pre-final Inspections, Substantial Completion (if any), and Final Acceptance activities. Clean the equipment and work site, secure the equipment, and remain responsible for prompt repair or replacement in the event of loss or damage until acceptance by the Authority is received. Furnish inventory services and demonstrate system or equipment operation in support of requests by the Authority. Provide support and access so that the Authority Engineers, Technicians, Mechanics and Inspectors can inspect and test any portion of the work during normal work hours.

13. Provide Unified Test Program reports on a monthly basis beginning within 30 days after the Engineer's acceptance of the Test Plan, and continuing until the final completion of all contract work.
- C. The performance of each task requirement shall be subject to the Engineer's acceptance of methods, procedures, and results, for Specification compliance, and as to scheduling for the benefit of the Authority.
- D. A Preliminary Test Plan shall be submitted to the Engineer for review. Subsequently, the Final Test Plan shall be submitted to the Engineer for review and acceptance or rejection. In the event of rejection or subsequent rejections, corrected re-submissions shall be delivered to the Engineer within 15 days after the receipt of each rejection. An accepted Test Plan shall be required prior to implementing any category of tests except for factory tests and inspections, installation and completion tests, inspections for cable, and associated terminal equipment, which may be accepted on an individual basis for equipment, and materials that are scheduled to be installed or delivered prior to NTP + ###.
- E. Detailed test procedures shall be submitted to the Engineer for review and acceptance or rejection. In the event of rejection or subsequent rejections, corrected re-submissions shall be delivered to the Engineer within 15 days after receipt of each rejection. Approved test procedures shall be required prior to commencing any associated test.
- F. Each individual test procedure shall include, but not be limited to: An outline of test objectives, detailed step-by-step procedures with required results and allowable tolerances for each measurement or observation, diagrams illustrating all required test set-ups, manufacturer and model number of each unit and accessory item of required test equipment, and further details as may be required by the Engineer to ensure that both Contractor and Authority field forces are presented with a totally comprehensive, understandable and accurate working procedure.
- G. The Contractor shall include complete and adequate safety procedures, warnings, and emergency instructions in Test Plans and test procedures, as appropriate. Test procedures shall also include complete examples of test Data Record Forms with required resultant values and allowable tolerances, in accordance with Specification requirements.
- H. The Authority reserves the right to perform additional non-destructive tests and inspections at any time during the course of the contract work. Results indicating deficiencies involving noncompliance with Specification requirements will be reported to the Contractor for corrective action.

3.08 DEFICIENCIES

- A. If the Engineer determines from test data acquired from any category of test(s) that the system, equipment, materials, technical documentation, or services furnished do not conform to any Specification requirement(s), the Contractor shall recommend appropriate remedial action based on an analysis of test results within fifteen days after receipt of the Engineer's notice of deficiency. When such recommendations relate to engineering deficiencies, the Contractor shall, upon receipt of the Engineer's approval, make the necessary changes to all equipment and documentation of the type to be delivered or previously delivered (even if previously accepted) during the course of the Contract, at no additional cost to the Authority.
- B. When recommendations relate to other deficiencies such as quality control and installation workmanship, the Contractor shall correct all deficiencies at each location, at no additional

cost to the Authority. Retesting after the changes have been completed (Factory Tests and Inspections, Installation Completion Tests and Inspections, and Technical Documentation Verifications) shall be required in whole or part, as determined by the Engineer, at no additional cost to the Authority. If the timely correction of all deficiencies is not completed to effect Specification compliance, as evidenced by the Engineer's acceptance of retest results, the Engineer will initiate remedial actions to the benefit of the Authority. Such actions may include the exercise of warranty, correction of deficiency, delay of payments, disputes or default, and termination actions, in accordance with the General Provisions, or actions of benefit to the Authority, in accordance with any combination of these and other Specification provisions.

3.09 CATEGORIES OF TESTS

- A. Tests and inspections shall be required in each of seven categories, as listed below:
 - 1. Factory tests and inspections, including factory certifications and factory calibration certifications.
 - 2. Installation completion tests and inspections.
 - 3. System and integration tests.
 - 4. System validation tests and evaluations (Authority Conducted Program).
 - 5. Substantial Completion acceptance tests and inspections (if any) (Authority Conducted Program).
 - 6. Technical documentation verification inspections.
 - 7. Final acceptance tests and inspections (Authority Conducted Program).
- B. Each test and inspection in each category shall be comprehensive, so that sufficient test result data and inspection result data is furnished to permit complete detailed examination and evaluation, as determined by the Engineer.
- C. Additional specialized testing shall also be furnished, as defined in individual system specification Sections .
- D. Retesting, and the acceptance or rejection of test results, documentation, and evaluations, shall be within the discretion of the Engineer.

3.10 FACTORY TESTS AND INSPECTIONS

- A. All equipment and materials, including custom developed Additional Equipment and any custom developed Test Equipment, furnished in accordance with these Specifications, shall be subject at all times and during all stages of manufacture and assembly, to inspection, test, and rejection by the Engineer. The Engineer may elect to accept factory or Contractor certifications in lieu of complete test result data for certain items when, 1) a WMATA accepted factory test has been previously conducted on one or more production samples or identical deliverable products, 2) the same brand and model of the product to be furnished has proven reliable in Authority revenue service for one year or more, or 3) to simplify test program administration when not adverse to achieving Test Program objectives.
- B. Before offering items for inspection or test, the Contractor shall furnish a complete set of applicable drawings for Authority use including, but not limited to, schematics, wiring diagrams, major assembly drawings, manufacturing drawings for custom developed equipment, and detailed specifications for the equipment and materials to be tested.
- C. The Contractor shall submit Factory Test and Inspection Plans and Procedures to the Engineer for review. Tests required shall be performed at the point of manufacture and the

point of assembly before shipment to the field. The Contractor shall furnish additional testing by an independent testing laboratory if the manufacturer's Factory Test Plan or Procedures are determined by the Engineer to be inadequate to verify Specification compliance (a maximum of three major items may be designated by the Engineer for independent laboratory testing at no additional cost to the Authority).

- D. After the Engineering Development Review for each system has been submitted and approved by the Engineer, Factory Tests and Inspections shall be scheduled for major items, custom prototypes, and other items of equipment and material designated for such testing by the Engineer, to verify compliance with environmental criteria, quality assurance, specified performance, grade of components, reliability, and workmanship including manufacturing processes. The Contractor shall advise the Engineer, in writing, when manufacturing of equipment begins and again two weeks prior to date of scheduled inspection or tests.
- E. A "Report of Factory Visit" for the purpose of confirmation and subsequent agreement of any decisions made on site shall be prepared by the Contractor and submitted to the Engineer ten working days subsequent to each factory visit by the Contractor, Engineer, or designated Authority Representative. Each report shall include the purpose of the visit, summary of tests performed and decisions made or required prior to factory certification and shipment.
- F. Two copies of test results certified by the manufacturer or an independent laboratory shall be furnished to the Engineer for review and acceptance or rejection prior to shipment. Equipment shall not be shipped before the factory test results have been accepted by the Engineer. Optionally, the Authority may elect to accept Contractor certified test and inspection results in lieu of manufacturer or independent laboratory certified test results.
- G. A 200 hour burn-in period (power on - attended or unattended) shall be required for all units of electrically operated and powered custom-made major items of equipment prior to installation, in accordance with instructions from the Engineer. Each unit of custom made equipment shall be set up and powered on the Contractor's, Subcontractor's, or supplier's premises. Reports of such activity shall be furnished to the Engineer.
- H. The Contractor shall assemble all of the rack-mounted equipment for a Passenger Station Communications Equipment Room and test prior to shipment to the installation site.

3.11 INSTALLATION COMPLETION TESTS AND INSPECTIONS

- A. Installation Completion Tests and Inspections shall be performed after installation to ensure that equipment and materials were not damaged in shipment and that they are properly installed and functioning in accordance with specified criteria, parameters and good commercial practice. Installation Completion Tests and Inspections shall consist of:
 - 1. Visual inspection with check-off lists to verify the following:
 - a. That full compliance with requirements detailed in the General Equipment and Material Standards and General Installation Standards sections of these Specifications has been met.
 - b. That only approved products have been used.
 - c. That Factory Tests and Inspections have been satisfactorily completed for major items, as required.
 - d. That inventory of major equipment and material items is available and accurate.
 - e. That equipment is installed in agreement with approved installation shop drawings.

- f. That wire and cable terminations as to location, cable identification, routing, color code, and workmanship have been identified.
 - g. That Time Domain Reflectometry (TDR) measurements of all coaxial and outside plant cables have been made. Printed TDR records of each coaxial and outside plant cable shall be delivered to the Authority to illustrate the length of cable run (proven by demonstrating an open and a short condition before final termination), and the absence of any detectable faults on each coaxial cable and each outside plant cable pair after installation of the cable.
2. Detailed testing shall be required to demonstrate that material and equipment installed meet the criteria and possess the characteristics and parameters contained in the Contract Specifications; including additional requirements and stated tolerances that are specified in Contractor engineering and product approval data submissions and in manufacturer's published specifications attributed to approved products.
- B. The testing of all items of equipment and material shall include electrical, mechanical, operational, and functional parameters. Such parameters include, but are not limited to: Levels of voltages, currents, power, distortion, noise, cross-talk, insulation resistance, continuity, attenuation (optical and electrical), physical strength, suitability of mounting method, paint and marking quality, graphics quality and style, location of operating controls and adjustments, and maintainability.
 - C. These tests shall be performed after the installation of material and equipment and shall be in addition to any Factory Tests and Inspections previously performed. The Contractor shall perform all necessary alignments, adjustments, and maintenance prior to requesting the scheduling of Installation Completion Tests and Inspections.
 - D. The Contractor shall advise the Engineer, in writing, two weeks prior to the date(s) of scheduled tests and inspections. The Engineer will witness these tests. Two certified copies of Installation Completion Test and Inspection data shall be submitted to the Engineer within seven (7) days after test completion for review and acceptance or rejection.

3.12 SYSTEM AND INTEGRATION TESTS

- A. System and Integration Tests shall be on-site performance tests to verify that all operating parameters and functions perform as specified and that each system performs as specified in conjunction with each system or subsystem with which it interfaces. The Contractor shall demonstrate that all material and equipment elements of each installed system function together to meet the system criteria specified. Each system shall be powered a minimum of 48 hours prior to commencing system and integration tests. The Engineer shall be notified, in writing, seven (7) days prior to equipment being powered. Failures shall be recorded by the Contractor and findings furnished to the Engineer at the end of the 40 hours. The Contractor shall also include a description of corrective actions taken.
- B. The Contractor shall be responsible for meeting all System and Integration Test requirements including testing and documenting interface compatibility and integration with existing Authority-owned systems and equipment.
- C. Each and every interface shall be verified as to operation, function, level, and voltage. The Contractor shall test across the interface points; however, these tests shall only be made under the supervision of appropriate Authority personnel. When minor adjustment to, or reconfiguration of, existing equipment is required, the Contractor shall notify the Engineer, in writing, of the required adjustment or reconfiguration. Authority personnel will make the

adjustment or reconfiguration in the presence of the Contractor. The Contractor shall be responsible for the necessary adjustments or reconfigurations of Contractor-furnished equipment to ensure proper functioning, as specified.

- D. The successful completion of all specified Factory Tests and Inspections, and Installation Completion Tests and Inspections, including the correction of all outstanding discrepancies and subsequent retesting, is required as a prerequisite to System and Integration Tests.
- E. The tests will vary with each specific system. However, each test shall include all operating parameters and functions. Tests shall be conducted on a location-by-location basis with all failures and discrepancies noted. The Contractor shall not engage in further testing until the Engineer has verified that the Contractor has taken necessary corrective action with respect to those failures and discrepancies. The Contractor shall retest after each successive failure and corrective action to verify Specification compliance.
- F. The Contractor shall advise the Engineer, in writing, two weeks prior to the date(s) of scheduled tests. Prior to commencing the System and Integration Tests, the Contractor shall provide failures recorded and corrective action taken, at the conclusion of powering equipment a minimum of 40 hours. The Engineer will witness these tests. Two certified copies of System and Integration Test data sheets shall be submitted to the Engineer within seven (7) days after test completion for review and acceptance or rejection.

3.13 MEASURING AND TEST EQUIPMENT

- A. The Contractor shall establish and implement measures for the selection, calibration, and control of measuring and test equipment (M&TE) used to determine conformance.
- B. M&TE of a range, accuracy, and sensitivity conforming with measurement tolerances specified within this contract shall be selected and used.
- C. Calibration procedures shall require M&TE identification and establish frequency of calibration, calibration method, acceptance criteria, records to be generated, and the action to be taken when results are unsatisfactory.
- D. M&TE shall be periodically calibrated using certified references traceable to the National Institute of Standards and Technology (NIST), to other nationally recognized standards when no such NIST standards exist, or to a documented standard acceptable to the Engineer when none of the preceding standards exist.
- E. The calibration of M&TE shall be checked at prescribed intervals if testing or inspection will continue over an extended period.

3.14 INSPECTION AND TEST STATUS

- A. The Contractor shall establish and implement measures to identify and maintain the inspection and test status of systems, equipment or components until these are accepted by the Engineer, to ensure that only purchased items that have passed the required inspection and test have been used.
- B. The means for status identification shall be such that the surface of the item is not damaged nor its use impaired. Status identification may also be via inspection records, test software, physical location, or other suitable means, which indicate the conformance or nonconformance of these items with regard to inspection and tests performed.

3.15 CONTROL OF NONCONFORMANCE

- A. The Contractor shall establish and implement measures to prevent the inadvertent use or installation of nonconforming items.
- B. Procedures shall provide for identification, segregation, documentation, evaluation, and disposition of nonconforming items, define the responsibility and authority for the disposition of nonconforming item.
- C. Nonconforming items shall be positively identified and the matter brought to the attention of Supplier's management representative, the Engineer, and the appropriate OEM, subcontractor or sub-supplier.
- D. The Contractor shall hold the nonconforming item from further work and, where possible, shall be physically segregated in an area clearly marked, until the responsible parties have provided for the disposition of the item.
- E. The disposition of a nonconforming item may be:
 - 1. Reworked (to meet original requirements)
 - 2. Accepted as-is
 - 3. Repaired (to meet an alternative criteria)
 - 4. Re-graded (for alternative use)
 - 5. Rejected, returned to vendor, or scrapped
- F. The Contractor shall obtain written approval from the Engineer prior to using a nonconforming item as-is or repairing it to be acceptable to a standard different from the original standard.
- G. Nonconforming items that have been repaired or reworked shall be re-inspected or retested by the party responsible for the original inspection or test in accordance with approved acceptance standards before being declared acceptable.
- H. The technical details of nonconformity that have been accepted as-is and of any repairs made shall be included in "as-built" documentation.
- I. Items for return to vendor shall be removed from the area of work and controls placed to prevent the reuse of the item or any part of it.
- J. Rejected or scrapped items shall be removed from the area of work and rendered unusable in a manner that prevents their inadvertent use.

3.16 CORRECTIVE ACTION

- A. The Contractor shall establish and implement measures to:
 - 1. Investigate the cause(s) of noncompliance and nonconformance, and identify action(s) to prevent recurrence.
 - 2. Implement corrective action to minimize or eliminate noncompliance or nonconformance.
 - 3. Apply controls over the implementation of corrective action.
 - 4. Incorporate the preventive action into procedures.

3.17 QUALITY CONTROL RECORDS

- A. The Contractor shall establish and implement measures to identify, collect, index, file, and store quality control records as required in the Special Conditions of this Contract.
- B. Quality control records shall be available at designated, controlled, but accessible areas at work locations. Procedures shall identify the responsible custodians for these records.
- C. Quality control records shall be stored and maintained in such a way that they are readily retrievable and provided with a suitable environment that minimize deterioration or damage, and prevent unauthorized alteration or loss.
- D. Quality control records shall be legible, reproducible, identifiable with the item involved, and contain the date of origination and identity of the originator, verifier, and/or responsible supervisor.
- E. Retention period for quality control records shall be defined, and shall be at least as long as the term required in the Special Conditions of this Contract. Quality control records shall be made available to WMATA or its representative throughout the retention period.

3.18 AUDITS

- A. By WMATA
 - B. Quality audits may be conducted by WMATA or its representatives. Direct access to Contractor personnel, original records, items in process, and facilities where work is performed shall be provided by the Contractor. The Contractor shall ensure, via procurement documents, that such access are also provided by their subcontractors and suppliers.
 - 1. The Contractor shall provide a written response within 15 days after receipt of the audit report, fully describing the methods and timetable by which compliance will be achieved. Deficiencies shall be corrected within 30 days after receipt of the audit report.
 - 2. Any survey, audit or inspection performed by WMATA or its representatives shall not relieve the Contractor of any of the responsibilities under this contract.
- C. By The Contractor
 - 1. The Contractor shall carry out a comprehensive system of planned and documented audits to verify whether activities within its scope of responsibility are performed in compliance with applicable portions of this Quality Control system requirements, and to determine the effectiveness of quality control.
 - 2. Audits and follow-up actions shall be carried out in accordance with documented procedures and by qualified personnel. Audit schedules shall be established to ensure coverage of the scope of the quality control system at least once in the life of this Contract.
 - 3. Results of the audits shall be documented and brought to the attention of the personnel having responsibility in the area audited. Management responsible for the area shall take timely corrective action on the deficiencies found by the audit.

3.19 TRAINING AND PERSONNEL QUALIFICATION

- A. The Contractor shall ensure that the Quality Policy are understood and implemented by all elements of its organization that affect the quality of the items or services provided to WMATA.
- B. When qualified personnel are required by this Contract, personnel qualification shall be based on an appropriate combination of education, training and experience. Where

required by the applicable code or standard, personnel qualification shall also be certified. Appropriate records of qualification, training and certification shall be maintained as quality records.

3.20 STATISTICAL TECHNIQUES

- A. The Contractor shall identify any statistical technique to be used for sampling inspections or testing. Acceptance by means of representative sampling shall be in accordance with generally accepted statistical methods.

END OF SECTION