

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT				1. CONTRACT ID CODE J	PAGE OF PAGES 1 17
2. AMENDMENT/MODIFICATION NO. 0004		3. EFFECTIVE DATE 25-May-2016	4. REQUISITION/PURCHASE REQ. NO.		5. PROJECT NO.(If applicable)
6. ISSUED BY USA ENGINEER DISTRICT, JACKSONVILLE CONTRACTING DIVISION 701 SAN MARCO BLVD JACKSONVILLE FL 32207-8175		CODE W912EP	7. ADMINISTERED BY (If other than item 6) See Item 6		
8. NAME AND ADDRESS OF CONTRACTOR (No., Street, County, State and Zip Code)				X	9A. AMENDMENT OF SOLICITATION NO. W912EP-16-R-0010
				X	9B. DATED (SEE ITEM 11) 26-Apr-2016
					10A. MOD. OF CONTRACT/ORDER NO.
					10B. DATED (SEE ITEM 13)
CODE		FACILITY CODE			
11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS					
<input checked="" type="checkbox"/> The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offer <input checked="" type="checkbox"/> is extended, <input type="checkbox"/> is not extended. Offer must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.					
12. ACCOUNTING AND APPROPRIATION DATA (If required)					
13. THIS ITEM APPLIES ONLY TO MODIFICATIONS OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.					
A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: (Specify authority) THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.					
B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES (such as changes in paying office, appropriation date, etc.) SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(B).					
C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:					
D. OTHER (Specify type of modification and authority)					
E. IMPORTANT: Contractor <input type="checkbox"/> is not, <input type="checkbox"/> is required to sign this document and return _____ copies to the issuing office.					
14. DESCRIPTION OF AMENDMENT/MODIFICATION (Organized by UCF section headings, including solicitation/contract subject matter where feasible.) Herbert Hoover Dike Rehabilitation, Structure Replacements, S-291 (IP-3) Reconstruction, Glades County, Florida Beach The Receipt of Proposal due date is changed from 02 June 2016 @ 2:00 PM to 07 June 2016 @ 4:00 PM. Please see continuation sheet for summary of changes. All other conditions remain unchanged. Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.					
15A. NAME AND TITLE OF SIGNER (Type or print)			16A. NAME AND TITLE OF CONTRACTING OFFICER (Type or print)		
			TEL: _____ EMAIL: _____		
15B. CONTRACTOR/OFFEROR _____ (Signature of person authorized to sign)		15C. DATE SIGNED	16B. UNITED STATES OF AMERICA BY _____ (Signature of Contracting Officer)		16C. DATE SIGNED

SF 30 CONTINUATION SHEET

HERBERT HOOVER DIKE REHABILITATION, STRUCTURE REPLACEMENTS
S-291 (IP-3) RECONSTRUCTION, GLADES COUNTY, FLORIDA

SUMMARY OF CHANGES

1. SPECIFICATIONS:

A. Replacement clauses are attached to this amendment (see below).

B. In Volume 2 sections, the text changes have been updated with additions noted by underlined text and deletions noted by line/cross-outs, and pertain only to changes made by this amendment. The entire section is replaced if there is any change.

Changes to Specifications:

Volume 1 of 2 - Contract Documents:

DELETE the indicated clauses and **REPLACE** with the following clauses in Section 00700:

52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984)

The Contractor shall be required to (a) commence work under this contract within **30** calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently and (c) complete the entire work ready for use not later than **850 days after the receipt of the Notice to Proceed + 90 days for sodding (for a total of 940 calendar days)**. The time stated for completion shall include final cleanup of the premises.

(End of clause)

52.211-12 LIQUIDATED DAMAGES--CONSTRUCTION (SEP 2000)

(a) If the Contractor fails to complete the work within the time specified in the contract, the Contractor shall pay liquidated damages to the Government in the amount of **\$2,986.00** for each calendar day of delay until the work is completed or accepted and **\$747.00 per calendar day for establishment of sod**.

(b) If the Government terminates the Contractor's right to proceed, liquidated damages will continue to accrue until the work is completed. These liquidated damages are in addition to excess costs of repurchase under the Termination clause.

(End of clause)

Volume 2 of 2 - Technical Specifications:

DELETE Section 25 31 01 and **REPLACE** with the attached revised Section 25 31 01.

DELETE Section 26 41 01 and **REPLACE** with the attached revised Section 26 41 01.

2. DRAWINGS:

DELETE Drawing No. E-08 and **REPLACE** with the attached revised Drawing No. E-08.

(End of Summary of Changes)

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SECTION 25 31 01

STRUCTURE REMOTE TERMINAL UNIT (RTU), SUTRON

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

This section specifies requirements for a remote terminal unit (RTU), Sutron, used for monitoring of a gated structure. The RTU panel is modular in design and includes power supply, battery, processor, I/O cards, relays, surge arrestors, ethernet switch, fiber optic converters, ethernet radios, satellite transmitter, and other components as shown on the drawings and as specified herein. The Contractor shall be responsible for functionally testing the RTU cabinet as detailed herein.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

UNDERWRITERS LABORATORIES (UL)

UL 508

(1999; Reprint Apr 2010) Industrial
Control Equipment

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Layout and Shop Drawings; G, DO

Prior to installation, submit layout and shop drawings including the following:

- a. RTU cabinet layout, including fully dimensioned and detailed views and internal layout.
- b. Electrical schematics, including, but not limited to block diagrams, ladder diagrams, DC panel wiring and instrument wiring, and surge suppression devices.
- c. Layout of relays, breakers, switches and instrumentation provided, and applicable single line and wiring diagrams.

SD-03 Product Data

Catalog Data; G, DO

Prior to installation, submit manufacturer's standard catalog data, including a description and depiction of all control devices and instruments in sufficient detail to demonstrate complete specification compliance. If standard catalog data does not contain sufficient detail to verify compliance, then the Contractor shall submit supplementary documentation to verify compliance.

Spare Equipment and Parts Data

Submit spare equipment and parts data with each item to be furnished as indicated in paragraph SPARE EQUIPMENT AND PARTS below.

SD-07 Certificates

Manufacturer's Representative Qualifications; G, DO

Submit qualifications as indicated in paragraph INSTRUMENT CONTRACTOR PANEL BUILDER QUALIFICATIONS below.

SD-10 Operation and Maintenance Data

Operating Manuals; G, DO

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4 FABRICATOR QUALIFICATIONS

Panel fabrications shall be by a manufacturer or particular division of a manufacturing firm specializing in control panel construction. Fabricator shall have a UL certified shop, and all panels shall be built according to UL 508.

1.5 SPARE EQUIPMENT AND PARTS

Furnish the following spare equipment and parts, tagged and boxed:

- a. One of each type of camera.
- b. One of the network security devices.
- c. One of the broadband routers.
- d. One network radio.
- e. One antenna.
- f. One RTU.

PART 2 PRODUCTS

2.1 RTU CABINET

The RTU as detailed on the drawings and as described herein shall consist of devices and instrumentation to provide monitoring of a gated structure. The Contractor shall construct the Remote Terminal Unit and cabinet as shown and as detailed on the drawings. The Project I/O List shown on the drawings shall summarize the digital inputs, digital outputs, and analog inputs for the RTU. Prior to procurement, the Contractor shall submit any deviation from the specified components and Project I/O List for approval by the Government.

2.2 RTU PROGRAMMING

The Contractor shall be responsible to furnish and install standard manufacturer programs into the new RTU to functionally test each input and output as detailed in paragraph FIELD TESTS below. Following the successful initial functional test of the RTU's I/O, the Contractor shall schedule with the Contracting Officer a second functional test witnessed by the Contracting Officer.

2.3 INCLINOMETER

The inclinometer shall be Applied Geomechanics, Model number A906-ST-B, or approved equal. The inclinometer shall be used for determining whether the flap gates are out of vertical axis and for monitoring gate positioning. Inclinometer shall be compatible with the Sutron RTU. The inclinometer shall have reverse polarity protected power of +8 to +24 VDC and shall have an operation range of no less than +/- 30 degrees. The inclinometer shall be capable of operating in a humid environment with a temperature range of 0 degrees to +150 degrees F. The inclinometer shall be capable of being submersed to 72 psi. See drawings for inclinometer installation.

2.4 CABLE REEL ENCLOSURE

The cable reel enclosure assembly shall comprise a NEMA 4X stainless steel, 20-inch by 20-inch by 8-inch enclosure and a stainless steel spring driven cable reel with bottom wind direction and a constant tension device. The enclosure shall be provided without a latch pawl. The spring driven cable reel shall be capable of holding thirty feet of 3/8 inch flexible conduit.

2.5 CAMERAS

2.5.1 Stationary

Stationary cameras shall be weatherproof IP network cameras with a minimum of three megapixel resolution in color mode. The cameras shall include two telephoto lenses with a color or black-and-white sensor for use around the clock. Depending on the lighting conditions, the camera automatically switches between the color sensor with the daylight lens and the more light-sensitive black-and-white lens. The cameras shall be capable of alarm notification via email or ftp, internal DVR capable, include internal microphone and speaker, live recording capable, include web interface for viewing, virtual PTZ, capable of motion detection alarming via ftp, email and visual LEDs located on the cameras, and multilevel password protection. All configuration and remote viewing software shall be included. The cameras shall be Mobotix Allaround Dual M15 or approved equal. The cameras shall be installed on camera poles using manufacturer's recommended mounting hardware, and adjusted to cover the entire upstream and downstream areas for gate operations. The cameras shall include all necessary accessories as described on the drawings.

2.5.2 Movable

Movable camera shall be IP network pan/tilt/zoom (PTZ) camera that shall include autofocus, high-resolution integrated camera/optics packages. The camera shall include day/night, minimum 540 TVL, motion detection with image enhancement, and shall be weatherproof, with web interface for viewing and configuration, multilevel password protection, and contain onscreen compass and tilt display. The camera shall be Pelco Spectra model

IV SE or approved equal. The camera shall be installed below the stationary camera on the lakeside pole using manufacturer's recommended arm mount with protective cage facing the structure area. The camera shall include all necessary accessories as described on the drawings.

2.6 NETWORK SECURITY DEVICE

Provide a secure Unified Threat Management (UTM) firewall. The unit shall provide effective anti-malware, intrusion prevention, and content/URL filtering along with mobile platform support. The unit shall be network capable with a built-in web configuration tool backup network. The unit shall be a Dell Sonicwall TZ 215 or approved equal.

2.7 BROADBAND ROUTER

The unit shall provide wired Ethernet and 3G/4G wireless WAN connectivity. The unit shall be capable of being connected to an AT&T 3G/4G air card and shall include (or be capable of including) a minimum of eight ports. The router shall be capable of day-in, day-out 24/7 internet connectivity. LAN connections shall be protected with advanced WiFi encryption, LAN segmentation, and VLAN capabilities. Office access and POS transactions shall be protected by VPN capability and other security features to ensure the network stays secure. The broadband router shall be CradlePoint MBR 1400 or approved equal.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall furnish and install all cable, wiring, and conduit as required and as specified in the drawings and herein to power and monitor the RTU installation.

3.2 FIELD TESTS

Upon the completion of the RTU cabinet installation, the Contractor shall procure the services of an authorized RTU Manufacturers Representative to functionally test the RTU cabinet and Sutron.

3.2.1 RTU Cabinet Site Validation Testing

As a minimum, RTU testing shall include the following:

- a. Using manufacturer's standard program, simulate each discrete input and each analog input from the signal device back to the RTU cabinet. With the RTU energized, show to the Contracting Officer that the RTU's processor received the input signal.
- b. Using manufacturer's program, simulate each discrete output from the RTU to the end device.

The Contractor shall develop a Validation Report Checklist for each site and use it to record the test results.

3.2.2 Standing Wave Ratio Testing

The standing wave ratio (SWR) of the radio antenna systems shall be tested using the following procedure:

- a. Purpose. The purpose of this procedure is to describe how to properly measure the transmitter power output of the radio and subsequently, the reflected power back to the radio. The following steps are based on the use of a Bird Electronic Corp. model 43 Wattmeter with the appropriate Thruline elements of "slugs".
- b. Items Needed. The items needed for implementing this procedure are a Bird 43 Wattmeter and slugs with a power range and frequency range suitable for each antenna.
- c. Typical Procedure:
 - (1) Connect the Wattmeter in series with the radio and the PolyPhaser. The Contractor may need assorted RF Connectors and Patch Cable to connect Wattmeter in series.
 - (2) Power Output - Forward Power. On the Wattmeter, turn the slug so that the arrow is pointed away from the radio and toward the antenna. Key the RTU radio. Record the value in the SIM Site Worksheet 2. If the power output is out of specification, replace with a new/tested Radio, then go to Reflected Power.
 - (3) Reflected Power. Turn the slug in the opposite direction. It should be facing toward the radio to measure reflected power from the antenna. Key the RTU radio and read the Wattmeter. Record the value in the Validation Report Checklist. STOP if reflected power is out of specification, Troubleshoot RF Transmission Line, PolyPhaser, Antenna, and Connectors for any possible defect. Reflected power should ideally be 0 Watts reflected or less than 10% of transmitter power output.

3.2.3 RTU Radio Communications Validation Testing

As a minimum, RTU radio communications testing shall include the following:

- a. Using radio service utility program, verify that the radio has been programmed with the correct technical/operational parameters and radio frequencies.
- b. Working with the USACE technical personnel, perform RF signal level optimization for the radios and install RF attenuators if instructed by USACE personnel.
- c. Verify that the RTU is communicating to the District SCADA network.

The Contractor shall develop a Radio Validation Report Checklist for each radio and use it to record the test results.

3.2.4 Camera Testing

The operation of the cameras shall be demonstrated under both daylight and nighttime conditions. The Contractor shall make any necessary adjustments to the cameras to provide the camera views necessary for the safe operation of the structure. The Contractor shall provide any equipment necessary to demonstrate the proper operation of the cameras.

3.3 INSTRUMENT CONTRACTOR PANEL BUILDER QUALIFICATIONS

The RTU Instrument Contractor Panel Builder shall be knowledgeable on all

aspects of the RTU system, including the initial testing, startup, programming, and integration of the system. The Contractor shall supply the services of a qualified Manufacturer's Representative, and shall submit their qualifications for Government review.

3.4 INSTRUMENT CONTRACT PANEL BUILDER AVAILABILITY

In addition to the time required by the RTU Instrument Contractor Panel Builder for the specified checkout and startup of the RTU installation, furnish his services for minimum of two site visits with a total of 20 on site man-hours to assist the Government with the programming and the integration of the RTU systems and/or conducting on site training. The Government's use of the RTU Instrument Contractor Panel Builder shall be at the discretion of the Contracting Officer upon 48 hours prior notification to the Contractor. The Instrument Contractor Panel Builder shall be furnished at no additional cost to the Government including travel time, plane ticket costs, room and board, overtime premium, and other costs.

3.5 WARRANTY

The RTU Panel and all panel devices supplied under this section shall be warranted for a period of one (1) year by the equipment manufacturer. The equipment shall be warranted to be free from defects in workmanship, design, and materials. If any part of the equipment should fail during the warranty period, it shall be replaced and the unit restored within 72 hours at no expense to the Government. The warranty shall include parts, labor, travel expenses, and labor to remove/reinstall said equipment. The warranty period shall commence on the Contractor's final completion date. Manufacturer's warranty period shall run concurrently with the Contractor's warranty period. No exception to this provision shall be allowed.

-- End of Section --

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SECTION 26 41 01

LIGHTNING PROTECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 70 (2014) National Electrical Code
- NFPA 780 (2014) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

- UL 467 (2007) Grounding and Bonding Equipment
- UL 96 (2005; Reprint Oct 2010) Standard for Lightning Protection Components
- UL 96A (2007; Reprint Jul 2012) Standard for Installation Requirements for Lightning Protection Systems
- UL Electrical Constructn (2012) Electrical Construction Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings of Each Major Component; G, DO

SD-07 Certificates

Materials

Proof of compliance with requirements of UL, where material or equipment is specified to comply. The label of or listing in UL Electrical Constructn will be acceptable evidence. In lieu of the label or listing, a written certificate from an approved nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform

to the requirements and testing methods of Underwriters Laboratories may be submitted. Submit a letter of findings certifying UL inspection of lightning protection systems provided on the control building.

1.3 QUALITY ASSURANCE

Submit **detail drawings** consisting of a complete list of material, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instructions. Detail drawings shall demonstrate that the system has been coordinated and will function as a unit. Drawings shall show proposed layout and mounting and relationship to other parts of the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide a system consisting of the standard products of a manufacturer regularly engaged in the production of lightning protection systems and which is the manufacturer's latest UL approved design. The lightning protection system shall conform to **NFPA 70** and **NFPA 780**, **UL 96** and **UL 96A**, except where requirements in excess thereof are specified herein.

2.2 MATERIALS

2.2.1 General Requirements

Do not use any combination of materials that form an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture, unless moisture is permanently excluded from the junction of such metals. Where unusual conditions exist, which would cause corrosion of conductors, use conductors with protective coatings or oversize conductors. Where a mechanical hazard is involved, increase the conductor size to compensate for the hazard or protect the conductors by covering them with molding or tubing made of wood or nonmagnetic material. When metallic conduit or tubing is used, the conductor shall be electrically connected at the upper and lower ends.

2.2.2 Main and Secondary Conductors

Conductors shall be in accordance with **NFPA 780** and **UL 96** for Class I, Class II, or Class II modified materials as applicable.

2.2.2.1 Copper

Copper conductors used on nonmetallic stacks shall weigh not less than **375 pounds/thousand feet**, and the size of any wire in the cable shall be not less than No. 15 AWG. The thickness of any web or ribbon used on stacks shall be not less than No. 12 AWG. Counterpoise shall be copper conductors not smaller than No. 1/0 AWG.

2.2.2.2 Aluminum

Aluminum shall not contact the earth nor shall it be used in any other manner that will contribute to rapid deterioration of the metal. Appropriate precautions shall be observed at connections with dissimilar metals. Aluminum conductors for bonding and interconnecting metallic bodies to the main cable shall be at least equivalent to strength and

cross-sectional area of a No. 4 AWG aluminum wire. When perforated strips are provided, strips that are much wider than solid strips shall be. A strip width that is at least twice that of the diameter of the perforations shall be used. Aluminum strip for connecting exposed water pipes shall be not less than No. 12 AWG in thickness and at least 1-1/2 inch wide.

2.2.3 Air Terminals

Terminals shall be in accordance with UL 96 and NFPA 780. Air terminals on the roof of the control building shall be 3/8 inch in diameter and 18 inches in length. Air terminals on the pole as specified shall be 3/8 inch in diameter and 36 18 inches in length. ~~Air terminals more than 24 inch in length shall be supported by a suitable brace, with guides not less than one half the height of the terminal.~~

2.2.4 Ground Rods

Rods made of copper-clad steel shall conform to UL 467. Ground rods shall be not less than 3/4 inch in diameter and 10 feet in length.

2.2.5 Connectors

Clamp-type connectors for splicing conductors shall conform to UL 96, class as applicable, and, Class 2, style and size as required for the installation.

2.2.6 Lightning Protection Components

Lightning protection components, such as bonding plates, air terminal supports, chimney bands, clips, and fasteners shall conform to UL 96, classes as applicable.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work. No departures shall be made without the prior approval of the Contracting Officer.

3.2 INTEGRAL SYSTEM

3.2.1 General Requirements

Provide a lightning protection system consisting of air terminals, roof conductors, down conductors, ground connections, and grounds, electrically interconnected to form the shortest distance to ground. All conductors on the structures shall be exposed except where conductors are in protective sleeves exposed on the outside walls. Secondary conductors shall interconnect with grounded metallic parts within the building. Interconnections made within side-flash distances shall be at or above the level of the grounded metallic parts.

3.2.1.1 Air Terminals

Air terminal design and support shall be in accordance with NFPA 780. Terminals shall be rigidly connected to, and made electrically continuous with, roof conductors by means of pressure connectors or crimped joints of

T-shaped malleable metal and connected to the air terminal by a dowel or threaded fitting. Air terminals at the ends of the structure shall be set not more than 2 feet from the ends of the ridge or edges and corners of roofs. Spacing of air terminals 2 feet in height on ridges, parapets, and around the perimeter of buildings with flat roofs shall not exceed 25 feet. In specific instances where it is necessary to exceed this spacing, the specified height of air terminals shall be increased not less than 2 inch for each foot of increase over 25 feet. On large, flat or gently sloping roofs, as defined in NFPA 780, air terminals shall be placed at points of the intersection of imaginary lines dividing the surface into rectangles having sides not exceeding 50 feet in length. Air terminals shall be secured against overturning either by attachment to the object to be protected or by means of a substantial tripod or other braces permanently and rigidly attached to the building or structure. Metal projections and metal parts of buildings, smokestacks, and other metal objects that do not contain hazardous materials and that may be struck but not appreciably damaged by lightning, need not be provided with air terminals. However, these metal objects shall be bonded to the lightning conductor through a metal conductor of the same unit weight per length as the main conductor. Where metal ventilators are installed with air terminals mounted thereon, the air terminal shall not be more than 24 inch away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement. Where metal ventilators are installed with air terminals mounted adjacent, the air terminal shall not be more than 24 inches away from the farther edge or corner. If the air terminal is farther than this distance, an additional air terminal shall be added in order to meet this requirement.

3.2.1.2 Roof Conductors

Roof conductors shall be connected directly to the roof or ridge roll. Sharp bends or turns in conductors shall be avoided. Necessary turns shall have a radius of not less than 8 inch. Conductors shall preserve a downward or horizontal course and shall be rigidly fastened every 3 feet along the roof and down the building to ground. Metal ventilators shall be rigidly connected to the roof conductor at three places. All connections shall be electrically continuous. Roof conductors shall be coursed along the contours of flat roofs, ridges, parapets, and edges; and where necessary, over flat surfaces, in such a way as to join each air terminal to all the rest. Roof conductors surrounding tank tops, decks, flat surfaces, and flat roofs shall be connected to form a closed loop.

3.2.1.3 Down Conductors

Down conductors shall be electrically continuous from air terminals and roof conductors to grounding electrodes. Down conductors shall be coursed over extreme outer portions of the building, such as corners, with consideration given to the location of ground connections and air terminals. Each building or structure shall have not less than two down conductors located as widely separated as practicable, at diagonally opposite corners. On rectangular structures having gable, hip, or gambrel roofs more than 110 feet long, there shall be at least one additional down conductor for each additional 50 feet of length or fraction thereof. On rectangular structures having French, flat, or sawtooth roofs exceeding 250 feet in perimeter, there shall be at least one additional down conductor for each 100 feet of perimeter or fraction thereof. On an L- or T-shaped structure, there shall be at least one additional down conductor; on an H-shaped structure, at least two additional down conductors; and on a wing-built structure, at least one additional down conductor for each

wing. On irregularly shaped structures, the total number of down conductors shall be sufficient to make the average distance between them along the perimeter not greater than 100 feet. On structures exceeding 50 feet in height, there shall be at least one additional down conductor for each additional 60 feet of height or fraction thereof, except that this application shall not cause down conductors to be placed about the perimeter of the structure at intervals of less than 50 feet. Additional down conductors shall be installed when necessary to avoid "dead ends" or branch conductors ending at air terminals, except where the air terminal is on a roof below the main protected level and the "dead end" or branch conductor is less than 16 feet in length and maintains a horizontal or downward coursing. Down conductors shall be equally and symmetrically spaced about the perimeter of the structure. Down conductors shall be protected by placing in rigid steel conduit for a minimum distance of 72 inch above finished grade level. If the conduit is metal, the down conductor shall be bonded at the top and bottom of the conduit.

3.2.1.4 Interconnection of Metallic Parts

Metal doors, windows, and gutters shall be connected directly to the grounds or down conductors using not smaller than No. 6 copper conductor, or equivalent. Conductors placed where there is probability of unusual wear, mechanical injury, or corrosion shall be of greater electrical capacity than would normally be used, or shall be protected. The ground connection to metal doors and windows shall be by means of mechanical ties under pressure, or equivalent.

3.2.1.5 Ground Connections

Ground connections comprising continuations of down conductors from the structure to the grounding electrode shall securely connect the down conductor and ground in a manner to ensure electrical continuity between the two. All connections shall be of the clamp type. There shall be a ground connection for each down conductor. Metal water pipes and other large underground metallic objects shall be bonded together with all grounding mediums. Ground connections shall be protected from mechanical injury. In making ground connections, advantage shall be taken of all permanently moist places where practicable, although such places shall be avoided if the area is wet with waste water that contains chemical substances, especially those corrosive to metal.

3.2.1.6 Grounding Electrodes

A grounding electrode shall be provided for each down conductor located as shown. A driven ground shall extend into the earth for a distance of not less than 10 feet. Ground rods shall be set not less than 3 feet, nor more than 8 feet, from the structures foundation. The complete installation shall have a total resistance to ground of not more than 10 ohms. Ground rods shall be tested individually prior to connection to the system and the system as a whole shall be tested not less than 24 hours after rainfall. When the resistance of the complete installation exceeds the specified value or two ground rods individually exceed 10 ohms, the Contracting Officer shall be notified immediately. A counterpoise, where required, shall be of No. 1/0 copper cable or equivalent material having suitable resistance to corrosion and shall be laid around the perimeter of the structure in a trench not less than 2 feet deep at a distance not less than 3 feet nor more than 8 feet from the nearest point of the structure. All connections between ground connectors and grounds or counterpoise, and between counterpoise and grounds shall be electrically continuous. Where

so indicated on the drawings, an alternate method for grounding electrodes in shallow soil shall be provided by digging trenches radially from the building. The lower ends of the down conductors are then buried in the trenches.

3.3 INTERCONNECTION OF METAL BODIES

Metal bodies of conductance shall be protected if not within the zone of protection of an air terminal. Metal bodies of conductance having an area of 400 square inch or greater or a volume of 1000 cubic inch or greater shall be bonded to the lightning protection system using main size conductors and a bonding plate having a surface contact area of not less than 3 square inch. Provisions shall be made to guard against the corrosive effect of bonding dissimilar metals. Metal bodies of inductance shall be bonded at their closest point to the lightning protection system using secondary bonding conductors and fittings. A metal body that exceeds 5 feet in any dimension, that is situated wholly within a building, and that does not at any point come within 6 feet of a lightning conductor or metal connected thereto shall be independently grounded.

3.4 FENCES

Except as indicated below, metal fences that are electrically continuous with metal posts extending at least 2 feet into the ground require no additional grounding. Other fences shall be grounded on each side of every gate. Fences shall be grounded by means of ground rods every 1000 to 1500 feet of length when fences are located in isolated places, and every 500 to 750 feet when in proximity (100 feet or less) to public roads, highways, and buildings. Where the fence consists of wooden posts and horizontal metal strands only, down conductors consisting of No. 8 copper wire or equivalent shall be run from the ground rod the full height of the fence and fastened to each wire, so as to be electrically continuous. The connection to ground shall be made from the post where it is of metal and is electrically continuous with the fencing. All metal fences shall be grounded at or near points crossed by overhead lines in excess of 600 volts and at distances not exceeding 150 feet on each side of line crossings.

3.5 INSPECTION

The lightning protection system will be inspected by the Contracting Officer to determine conformance with the requirements of this specification. No part of the system shall be concealed until so authorized by the Contracting Officer.

-- End of Section --

