FAA-C-2760

September 16, 1985

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DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
SPECIFICATION

DESIGN AND FABRICATION OF ANTENNA TOWERS FOR RADIO COMMUNICATIONS LINK

1. SCOPE. This specification covers design and fabrication of steel antenna towers for a point-to-point radio communication system.

2. APPLICABLE DOCUMENTS. The technical requirements of the following publications of the latest issue as of the date of the invitation for bids or request for proposals form a part of this specification to the extent indicated:

2.1 Federal Specifications

RR-S-001301 Safety Equipment, Climbing

2.2 American Society for Testing and Materials (ASTM) Specifications

A 36 Structural Steel
A 53 Pipe, Steel Black and Hot Dipped, Zinc-Coated, Welded and Seamless Steel Pipe
A 123 Zinc (Hot Galvanized) Coatings on Products Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strips
A 153 Zinc Coating (Hot Dip) on Iron and Steel Hardware
A 307 Low-Carbon Steel Externally and Internally Threaded Standard Fasteners

A 325 High Strength Steel Bolts for Structural Steel Joints Including Suitable Nuts and Plain Hardened Washer
A 385 Practice for Providing High-Quality Zinc Coatings (Hot Dip)
A 441 High Strength, Low Alloy Structural Steel
A 475 Zinc Coated Steel Wire Strand
A 490 Heat Treated Steel Structural Bolts
A 501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A 586 Zinc Coated Parallel and Helical Steel Wire Structural Strand
A 615 Deformed and Plain Billet Steel Bars for Concrete Reinforcement
A 618 Hot Formed, Welded and Seamless High Strength, Low Alloy Structural Tubing

2.3 American Institute of Steel Construction (AISC) Specification

Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, with Commentary.

2.4 American Iron and Steel Institute (AISI) Specification

Specification for the Design of Light Gage Cold-Formed Steel Structural Members

2.5 American Welding Society (AWS) Welding Handbook

D1.1 Structural Welding Code

2.6 Electronic Industries Association (EIA)

RS-222-C Structural Standards for Steel Antenna Towers and Antenna Supporting Structures.

2.7 American National Standards Institute (ANSI) Standard

B 18.22.1 Plain Washers

2.8 Federal Aviation Administration Advisory Circular

AC-70/7460-1 Obstruction Marking and Lighting
AC-150/5345-43 Specification for Obstruction Lighting Equipment
AC-150/5345-1 Approved Airport Lighting Equipment

2.9 Federal Aviation Agency Standard

FAA-STD-003 Paint Systems for Structures
FAA-STD-019 Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities

2.10 National Fire Protection Association (NFPA)

Publication No. 70, National Electrical Code.
Publication No. 78, Lightning Protection Code.

2.11 Occupational Safety and Health Administration (OSHA) Standard

OSHA Standards, 29 CFR, Part 1910

(Information on obtaining copies of Federal Specifications may be obtained from General Services Administration Offices in Washington, D.C., Seattle, San Francisco, Denver, Kansas City, MO, Chicago, Atlanta, New York, Boston, Dallas and Los Angeles.)

(Information on obtaining copies of ASTM Specifications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA, 19103.)

(Copies of AISC Specification may be obtained from the American Institute of Steel Construction, 400 North Michigan Avenue, Chicago, IL, 60611.)

(Copies of AISI Specification may be obtained from the American Iron and Steel Institute, 1000 16th Street N.W., Washington, D.C., 20036.)

(Copies of Federal Aviation Administration Advisory Circular may be obtained from the Department of Transportation, Subsequent Distribution Section, M-494-3, 400 7th Street S.W., Washington, D.C., 20590.)

(Copies of the ANSI Standard may be obtained from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY, 10017.)

(Copies of th EIA Standard may be obtained from Electronic Industries Association, 2001 Eye Street N.W., Washington, D.C., 20006.)

(Copies of NFPA publications may be obtained from National Fire Protection Association, Batterymarch Park, Quincy, MA, 02269.)

(Copies of OSHA Standards may be obtained from Commerce Clearing House, Inc. 4020 West Glenlake Avenue, Chicago, IL, 60646.)

(Copies of AWS Codes may be obtained from American Welding Society, 2501 N.W. 7th Street, Miami, FL, 33125.)

(Copies of FAA Standards may be obtained from Federal Aviation Administration, Administrative and Management Support (APM-11), 800 Independence Avenue S.W., Washington, D.C., 20591.)

3. REQUIREMENTS

3.1 General Requirements - Each tower designed and furnished by the contractor shall be complete in accordance with all specification requirements, including 4½" pipe antenna supports, anchor bolts, safety climbing device, rail and two belts with slides, protective grounding, obstruction lighting and marking, and all hardware essential for erecting the tower. The contractor shall provide all materials, supplies, equipment and services necessary to design and fabricate the tower. The number of antenna supports to be furnished with each tower being ordered will be stated on the purchase order.

3.2 Special Requirements - Unless otherwise indicated, EIA Standard RS-222-C shall govern the design and fabrication of the towers. The design shall be in accordance with AISC and AISI specifications and established engineering practices.

3.3 Service Conditions - Towers with six 10-foot standard parabolic antennas located in the top 40 feet of the towers with 1.9" diameter waveguide shall sustain the maximum stresses imposed by the following ambient conditions without permanent deformation, damage or degradation to operation. The operating frequency range of the antennas will be between 7.125 GHz and 8.4 GHz. The maximum allowable twist or sway of the tower at the antenna mounting position shall be 0.5°.

Temperature	-50°C to +60°C
Wind Load	Zone B of EIA Standard RS-222-C (40 and 48 psf) with ½ inch radial thickness of clear ice on all members of structure, including guys and antennas
Relative Humidity	5% to 100%, including condensation
Environment	Salt Spray Urban Industrial Fumes Wind Borne Sand and Dust
Antenna Dead Load	Six 10-foot diameter microwave antennas with radomes weighing 447 pounds each without ice and 681 pounds with ice.
Waveguide Dead Load	0.6 pound per linear foot.

3.4 Design Requirements

3.4.1 Work Required - The contractor shall submit structural design calculations and design fabrication, foundation, and erection drawings for the heights of structures to be procured. All design calculations shall be indexed and arranged in an orderly manner, with appropriate sketches, so that any element may be easily identified. Complete structural calculations are required covering all parts of the structures and all related items. Tower twist, sway and displacement shall be determined by analytical method. All design loads shall be identified; design methods and assumptions shall be indicated. When computer printouts form a portion of the design calculations, the contractor shall include all input diagrams and information needed to relate the printout to the design elements. The computer programs utilized shall be identified and a brief description of each shall be included. The submittal data shall be certified by a Registered Professional Engineer.

3.4.2 Tower Drawings - The drawings shall include plan and elevation views, guy levels (if guyed tower), antenna mounts, protective grounding system and any pertinent notes such as guy size, guy length, guy tension, etc. Erection drawings shall indicate member location, bolt sizes and number, ladder attachment with safety climbing device, antenna mounts and all other information to clearly depict requirements for field erection. A parts list showing the member number, size, and length shall be provided in the erection drawings. Drawings shall be provided for installation of the obstruction lighting system.

3.4.3 Tower Bases for Guyed Towers - Guyed towers shall be designed with articulated bases.

3.4.4 Foundation Designs - Two foundation and guy anchor designs shall be provided for each height of tower. One design shall be based on a safe soil bearing pressure of 2500 psf (pounds per square foot) and one on a safe soil bearing pressure of 4000 psf. The design shall be based on a compressive strength of concrete at 3000 psi (pounds per square inch) at 28 days. Reinforcing steel shall be intermediate grade billet ASTM A-615, Grade 60 deformed bars. Forming shall be required for foundations and guy anchors.

3.4.5 Foundation Drawings - The foundation drawings and guy anchor drawings (if guyed tower) shall include both plan and elevation views. Drawings shall include reinforcing bar size, quantity and position, anchor bolt size and position, and other pertinent information for constructing the foundations and anchors.

3.4.6 Antenna Mounts - The antenna will be installed on 4½ O.D. pipes. The contractor shall submit designs of the antenna mount and its attachment to the tower.

3.4.6 Ladder - A ladder shall be mounted for the full height of the tower. The ladder design shall conform to OSHA standards including clearances.

3.4.7 Protective Grounding Design - The grounding design shall conform to FAA-STD-019, Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities. The design will be for the tower and will not include the earth electrode system. The design shall include air terminals, down conductor, fasteners and ancillary items.

3.4.8 Obstruction Marking and Lighting - The contractor shall submit designs of the obstruction lighting system which shall be in accordance with "Red Obstruction Lighting Standards" of Advisory Circulars AC 70/7460-1, AC 150/5345-43, and NFPA Publications No.70 and 78. The obstruction marking design shall be in accordance with "Marking" of AC 70/7460-1.

3.4.9 Submittals - The contractor shall submit five copies of required drawings and calculations to the Contracting Officer for approval. Two sets will be returned to the contractor with comments. Fabrication shall not commence until after submittal approval except as directed in writing by the Contracting Officer. The contractor shall furnish the Contracting Officer the originals of the required submittals after approval. Unless otherwise stipulated in the invitation for bids, all drawings shall be made with pencil and be prepared on tracing paper with the size, title block and drawing numbers as directed by the Contracting Officer. The tracing paper shall be of 17 lbs. weight, 100% long life highest grade, new white rag, equal to 1000H Clearprint as manufactured by Clearprint Paper Company, San Francisco, California. All drawings shall remain easily legible when reduced to one-fourth size.

3.5 Materials

3.5.1 General - Unless otherwise indicated, materials shall conform to the specifications and other requirements indicated below. Where no specification is indicated, the materials shall be of good commercial quality suitable for the Government's intended use and shall be subject to the approval of the Contracting Officer. Unless otherwise provided by the Invitation for Bid, the contractor shall furnish all materials and items required for the complete structure, and in addition, shall furnish nuts, bolts, washers and other minor items in an amount 10% in excess of the quantity required for erection.

3.5.2 Tower Legs - The tower legs shall be fabricated of steel pipe, structural angles or plates having a minimum yield strength of 36,000 lbs. per square inch per ASTM A-36 for angles and plates or 33,000 lbs. per square inch per ASTM A-53 or A-501 for pipe. Legs fabricated from steel having a minimum yield strength of 50,000 lbs. per square inch shall conform to ASTM A-618, Grade 3 for pipe or ASTM A-441 for angles or plates.

3.5.3 Bolts, Nuts and Washers

3.5.3.1 High Strength Bolts, Nuts, and Washers - Shall conform to ASTM A-325 or A-490.

3.5.3.2 Bolts and Nuts, Other Than High Strength - Shall conform to ASTM A-307, Grade A.

3.5.3.3 Plain Washers, Other Than Those in Contact With High Strength Bolt Heads and Nuts - Shall conform to ANSI Standard B-18.22.1, Type B.

3.5.4 Guy Strand - Zinc coated guy strand shall conform to ASTM A-475 or ASTM A-586.

3.5.5 Safety Climbing Devices - A rigid (Type 1) Safety Climbing Device Rail conforming to interim Federal Specification RR-S-001301 including all mounting attachments shall be furnished for the ladder on the tower. Two safety climbing device belt assemblies intended for use with the rigid rail, complete with safety belt, lanyard, safety sleeve, instruction manual and parts list shall be furnished with each tower.

3.5.6 Galvanizing - All ferrous parts shall be hot dip galvanized after fabrication in conformance with ASTM A-123 and A-385. Hardware (nuts, bolts, washers and other minor items) shall be galvanized by the hot dip method in conformance with A-153. The projection portions of anchor bolts plus twelve inches shall be galvanized. The interior of any pipe shall be galvanized.

3.5.7 Anchor Bolts and Guy Anchors - The contractor shall deliver anchor bolts and guy anchors as directed by the Contracting Officer for installation prior to shipment of the tower.

3.5.8 Obstruction Lights - The obstruction lighting equipment shall be the product of one of the manufacturers whose equipment has been qualified and listed in Advisory Circular AC 150/5345-1. Ancillary items such as conduit, conductors, etc., shall be provided for a complete installation.

3.5.9 Obstruction Marking. Towers requiring obstruction marking shall be prepared and painted in accordance with FAA-STD-003. The paint shall be applied over the galvanized steel after the surface has been solvent cleaned and pre-treated. Paint shall be provided for touch-up after erection.

3.5.10 Grounding System. A grounding system shall be included with each tower. It shall include air terminals, down conductor, and ancillary items such as fasteners, clamps, etc., for the tower. The down conductors shall be of sufficient length to extend to a ground rod installed adjacent to the foundation.

3.6 Fabrication

3.6.1 General - Fabrication shall be in accordance with the AISC specification. Members shall have no sharp edges which will be hazardous during handling or other irregularities which will interfere with erection. Welding shall conform to the AWS Structural Welding Code.

3.6.2 Marking - Each separate member, except bolts, washers and similar items shall be clearly marked by stamping into the steel the mark shown on the drawings. Marks shall be a minimum of 5/8 inch high. All like parts shall be marked in the same relative position. Mark shall be stamped into the steel before galvanizing and shall be clearly visible in the erected structure. After galvanizing and painting where required, each member shall be marked with a permanent steel marking marker. Each piece shall be marked with one-inch high letter/number combination.

4. QUALITY ASSURANCE PROVISIONS - Quality Control shall be in accordance with the American Institute of Steel Construction Specification. Unless otherwise specified in this specification or in the contract, all tests and inspections to determine compliance with the requirements of the contract specifications shall be made by the contractor and shall be subject to Government observation or verification. The extent of shop inspection shall be at the discretion of the Government.