To: Prospective Bidders

From: Wold Architects and Engineers

Date: February 28, 2023

Comm. No: 213106

Subject: Addendum No. 1 for Bidding Documents for the
ROCF (**Regional Operations and Communications Facility) Radio Towers**
Libertyville, Illinois

BIDS DUE MARCH 9, 2023, AT 11:00 A.M.

This addendum forms a part of the Contract Documents dated January 30, 2023. Acknowledge receipt of this Addendum on the space provided on the Bid Form. Failure to do so may result in disqualification of Bid.

This Addendum consists of one (1) typed sheet and attachments:
Memorandum: Addendum #1
Specifications: 00 01 10 – Book 1

CLARIFICATIONS

A. See Attached Memorandum for RFI Responses

PROJECT MANUAL

1. **SPECIFICATION – Project Manual I**
   B. Reissued this addendum.

END OF ADDENDUM #1

Wold Architects and Engineers
220 North Smith Street, Suite 310
Palatine, IL 60067
woldae.com | 847 241 6100

PLANNERS
ARCHITECTS
ENGINEERS

Memorandum
Addendum #1

ROCF Radio Towers Project – RFI Log and Responses

1. Are the tower's exact location with respect to the new ROC facility been determined? I downloaded the ROCF plans and did not see the towers indicated on the drawings. All I've seen is the rendering showing the towers very close to the building with no compound or fencing.
    1. If they are that close, how do you want access to the tower compound to be done? Driveway attached to parking lot? Or will access require going over grass? - The towers shall be located as illustrated on ROCF building drawings. Although, giving proper room for installation of the tower foundation from the building foundation, thus allowing proper backfilling of each structure. Access will go across the grass.
    2. How big of a fenced compound do you want for each tower? - The compound fence shall extend past the tower foundation 5-foot minimally on the non-building sided and within 2-inches of the building wall, minimally. If this distance does not allow the tower contractor enough room for proper equipment installations the contractor shall alter the design as needed.
    3. Will we have to run power from the street or will the ROCF already have power to the site? - The building electrical contractor (EC) will provide pathways to the tower areas. The radio equipment provider will install wired circuits as required for their installations.
    4. Do you want a concrete pad for a shelter for the tower equipment at the base or just pads for equipment? - There is no outside shelter or enclosure. All radio equipment will be located within the building.

2. When would you expect the construction on these towers to begin (I saw completion in July 2024)? The reason I ask is that we continue to see double digit inflation on steel and concrete, so the price in 2024 is going to a lot higher than 2023. Will we have to wait for the building to be completed (or near completion) to start? - The timing of the tower construction shall be coordinated with the ROCF design team and general contractor (GC). The tower structure contractor (TC) shall be responsible for coordinating their grounding/bonding to the GC installed building/tower, one continuous ring, and radials.

3. Can you confirm that we do not need to install equipment on the tower? - Per RFB; (a) ntenna, antenna mounts, and cabling will be supplied and installed by other. The Auxcomm tower, however, requires the Tower Contractor to provide and install the center mast and the associated equipment including the provisions for the bypass grounding kit (RFB 4.23, items 5 through 6).

4. If awarded, will we have access to the ROCF site plan cad drawings? – Yes, CAD documents can be provided to the awarded contractor.

Wold Architects and Engineers
220 North Smith Street, Suite 310
Palatine, IL 60067
woldae.com | 847 241 6100

Project Manual I

ROCF RADIO TOWERS

LAKE COUNTY
656 WINCHESTER RD,
LIBERTYVILLE, IL 60048

JANUARY 30, 2023

Reissued Addendum No. 1

Set No: _____

Comm No: 213115

Lake County, Illinois

Development of Two Radio Towers
for the
Regional Operations and Communications Facility

Comm. 213115

January 30, 2023

Table of Contents

1. PROJECT OVERVIEW

1.1. Project Intent

A. Lake County (County) is issuing this request for bid (RFB) for site construction and development to improve the coverage of its radio communications system, which supports mission-critical public safety communications within the county.

B. This construction will facilitate the installation of two towers to be collocated with the County's new Regional Operations and Communications Facility (ROC).

1.2. Project Summary

A. The purpose of this RFB is for two radio tower installations at their new ROC, a greenfield site. The two towers for development have been assigned names by the County and will be referred to as such throughout this document.

1. 911 Tower: "911" Site – Located plan West of the facility.

2. Auxiliary Communications Tower: "Auxcomm" Site – Located plan East of the facility.

B. Surveys and geotechnical studies have been conducted for ROC site. Geotechnical borings were performed at the projected location for the respective towers. These documents are in Appendix A.

C. The Tower Contractor shall perform a National Environmental Policy Act (NEPA) study or determination as required by Federal Communications Commission (FCC) and/or another governing federal agency.

D. The following additional work was completed for the sites in preparation and support of leasing efforts:

1. ROC construction drawings and specifications. These documents are in Appendix B.

2. 911 Tower Conceptual Drawings. These documents are in Appendix C.

3. Auxcomm Tower Conceptual Drawings. These documents are in Appendix D.

E. These specifications generally describe the work to be completed by the Tower Contractor at each site, methods to be used, and the materials to be furnished, including but not limited to:

1. Furnish and install a new 75-foot, 911 tower monopole tower and ancillary equipment, including, but not limited to, subgrade development, manufacturer engineered tower foundation, radio frequency (RF) cable underground pathways, tower cable supports and ports, anti-climbing devices/methods, Federal Aviation Administration (FAA)-required marking/lighting, lightning protection, Motorola's *Standards and Guidelines for Communication Sites* (Motorola R56®) grounding, and securing all required permits associated with such work.

(a) ***The Tower Contractor is responsible for applying and securing all the required permits from Village of Libertyville and Lake County. The Tower Contractor is responsible for the permit fees.***

(b) Antenna, antenna mounts, and cabling will be supplied and installed by other.

2. Furnish and install a new 75-foot, Auxcomm self-supporting tower and ancillary equipment, including, but not limited to, subgrade development, manufacturer engineered tower foundation, radio frequency (RF) cable ice bridge, tower cable support ladder, wall-mounted entry port, anti-climbing devices/methods, FAA-required marking/lighting, lightning protection, Motorola's *Standards and Guidelines for Communication Sites* (Motorola R56®) grounding, and securing all required permits associated with such work.

(a) ***The Tower Contractor is responsible for applying and securing all the required permits from Village of Libertyville and Lake County. The County is responsible for the permit fees.***

(b) Antenna, antenna mounts, and cabling will be supplied and installed by other.

F. The Tower Contractor shall ensure that all site work, grounding, and equipment installation are completed per RFB, ROC facility drawings and specifications, Motorola R56, and meet all applicable federal, state, and local codes. The more stringent shall apply. ***The ROC site general contractor is responsible for installation of the building/tower ground ring which includes the portion bumping out around each tower. The GC will install tower leg radials, one per leg, as shown on the ROC building drawings. Leaving enough radial for the tower contractor to attach to each tower leg. The tower contractor shall properly bond the radials to the tower and bond other grounding components, e.g., tower ground bus bar (TGB), ice bridge posts, exterior ground bus bar (EGB), and other ancillary metallic equipment to the building/tower ground ring.***

G. The Tower Contractor shall provide a preliminary tower design for each tower showing compliance to the RFB.

H. The Tower Contractor shall provide all submittals including specifications, plans, documents, and exhibits for approval by ROC site general contractor (GC) and design team within 30-days of project's Notice to Proceed.

I. The Tower Contractor shall procure and manage all permits and inspections ***with the Village of Libertyville*** for a turnkey project~~**, at their own cost**~~**.** ***The County will pay for the cost of permits.***

J. Respondents shall complete the compliance matrix provided in Appendix E. Failure to respond to any item in the compliance matrix may impact your eligibility.

K. Respondents shall prepare and submit a separate schedule of values with their RFB submittal.

L. The County will be developing the new ROC facility under a separate contract for General Construction. The County's General Contractor (GC) shall be responsible as the "Coordinating Contractor" for sequencing of work being installed at the project site. The Tower Contractor will be expected to provide the following:

1. Coordinate with County's GC and their subcontractors for scheduling, sequencing, and installing of Work related to the towers.

2. Furnish the County's GC with shop drawings for the towers.

3. Furnish the County's GC with regular production, delivery, and installation schedules to be incorporated with the master construction schedule for the ROC facility.

2. TECHNICAL SPECIFICATIONS

2.1. Site Development

2.1.1. Site

A. The Tower Contractor shall keep each project site neat and free from the accumulation of waste material and debris. This shall be completed daily before leaving each project site.

B. The successful Respondent shall clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

C. Cleanup activity related to installation shall be the Tower Contractor’s responsibility.

D. The Tower Contractor shall perform site clearing and proper disposal of refuse, per federal, state, and local codes and/or ordinances.

E. The Tower Contractor is responsible for removal of concrete spoils generated from the tower project.

1. The Tower Contractor shall document, by photograph, existing site conditions before beginning site development.

2. The Tower Contractor shall inform the ROC site GC and design team of any existing spoils.

F. Onsite burning shall not be allowed anywhere on the properties.

G. The Tower Contractor shall conduct a site walk at each site with the ROC site GC and design team to identify any areas requiring special attention prior to beginning work.

H. The Tower Contractor shall be responsible for a four-point (Wenner) method soil resistance testing; providing a tower grounding system design to meet specifications within the bid document; providing the engineered construction design of the foundations needed; and supplying, delivering, and installing the tower and accessory items.

2.1.2. Water and Drainage

A. The Tower Contractor shall grade the soil around each tower area to assure proper drainage and prevent water accumulation. Water drainage shall not be toward the building or adjacent properties.

1. Grading and tower compound finishing shall be coordinated with the ROC site GC and design team to ensure that the tower grading dovetails with any existing or future site plan.

2.1.3. Site Preparation

A. The Tower Contractor shall provide a final set of state-engineered stamped construction drawings for review and comment by the ROC site GC and design team prior to commencing final system design. Appendix B, *ROC Construction Drawings and Specifications*, indicates the location for the tower and other structures. Locations shall require field verification with the ROC site GC and design team prior to approval.

B. The Tower Contractor shall implement erosion-control measures during the performance of work for the duration of the project.

1. The Tower Contractor and its subcontractor(s) shall comply with Illinois Department of Environmental Conservation and Illinois State Soil and Water Conservation guidelines for erosion and sedimentation (E&S) control.

2. The Tower Contractor shall clear areas to be occupied by permanent construction of trees, brush, roots, stumps, logs, wood, and other materials and debris in accordance with these specifications. Subgrades for fills shall be cleaned and stripped of vegetation, sod, topsoil, and organic matter.

3. Excavating deep foundation construction (e.g., guyed-tower anchors, tower, wooden telecommunications poles, and other foundations) shall be removed to three feet below the ground surface as specified by the engineered site and/or tower documents. The more stringent shall apply.

4. The Respondent shall carefully examine and study existing conditions, difficulties, and utilities affecting execution of work. Later claims for additional compensation due to additional labor, equipment, or materials required due to difficulties encountered shall not be considered.

5. Protection:

   (a) The Tower Contractor shall protect and maintain benchmark, monument, property corner, and other reference points, reestablishing them by registered professional surveyor if disturbed or destroyed, at no cost to the County.

   (b) The Tower Contractor shall locate and identify existing utilities that are to remain and protect them from damage, reestablishing them if disturbed or destroyed, at no cost to the County.

(c) The Tower Contractor shall install protection such as fencing, boxing of tree trunks, or other measures as required and approved by the County or County's representative.

6. The Tower Contractor shall conduct operations with minimum interference to public or private accesses and facilities; maintain ingress and egress at all times; and clean or sweep any roadways daily or as required by the governing authority. At such times as deemed necessary by the County, dust control shall be provided with water sprinkling systems or equipment provided by the Tower Contractor or its subcontractor(s) as deemed necessary by the AHJ.

7. When appropriate, the Tower Contractor shall provide traffic control as required, in accordance with contract documents, the U.S. Department of Transportation's Manual of Uniform Traffic Control Devices, and the Illinois State Department of Transportation. The County, the County's engineer, and the County representative shall not be responsible to the Tower Contractor for damages because of the Respondent's failure to protect utilities encountered in the work.

8. The Tower Contractor shall not interrupt utilities serving neighboring residences, unless permitted and approved by the AHJ, and then only after arranging to provide temporary utility services according to indicated requirements.

2.1.4. Security Fencing

A. Fencing shall comply, minimally, with building codes of each municipality and their fencing guidelines. ***The Contractor shall coordinate with GC on type of fencing requirements for the two towers, should the permit authorities require fencing around the towers. The fencing for the towers shall match the GC fence for the ROC facility, if required by the permit authorities.***

B. The Tower Contractor shall furnish material and installation for an 8-foot total height perimeter security chain-link fence at each tower site. The fence shall have chain-link fencing 7-feet high with three rows of equally spaced deterrent wire oriented at a 45-degree outward angle and 1-foot high.

C. The Tower Contractor shall reference Unified Facilities Criteria (UFC) 4-022-03, *Security Fences and Gates*, for material and installation clarification.

D. The specifications described below are minimal.

E. Framework: Type I or Type II Steel Pipe

1. Type I: Schedule 40 steel pipe with 1.8 ounces of zinc coating per square foot of surface area conforming to ASTM F1083, *Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures*.

2. Type II: Pipe manufactured from steel conforming to ASTM A1011, *Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High*

Strength. External surface shall be triple coated per ASTM F1043, *Standard Specification for Strength and Protective Coatings on Steel Industrial Fence Framework*. Type II pipe shall demonstrate the ability to resist 1,000 hours of exposure to salt spray with a maximum of 5 percent red rust in a test conducted in accordance with ASTM B117, *Standard Practice for Operating Salt Spray (Fog) Apparatus*.

3. Coatings shall be applied inside and out after welding.

4. Unless otherwise noted, Type II framework shall be provided.

5. Pipe shall be straight, true to section, and conform to the following weights:

Table 1: Type I and Type II Steel Pipe Specifications

Pipe Size Outside Diameter	Type I Weight Lb./Ft.	Type II Weight Lbs./ Ft.
1 5/8"	2.27	1.84
2"	2.72	2.28
2½"	3.65	3.12
3"	5.79	4.64
3½"	7.58	5.71
4"	9.11	6.56
6 5/8"	18.97	

F. Fabric

1. Aluminized fabric shall be manufactured in accordance with ASTM A491, *Standard Specification for Aluminum-Coated Steel Chain-Link Fence Fabric*, and coated before weaving with a minimum of 0.4 ounces of aluminum per square foot of surface area. The steel wire and coating shall conform to ASTM A817, *Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire*. Fabric shall be 9-gauge woven in a 2-inch diamond mesh. The top selvage shall be twisted and barbed. The bottom selvage shall be knuckled.

2. Zinc-coated fabric shall be galvanized after weaving with a minimum of 1.2 ounces of zinc per square foot of surface area and conform to ASTM A392*, Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric,* Class I. Fabric shall be 9-gauge wire woven in a 2-inch diamond mesh. The top selvage shall be twisted and barbed. The bottom selvage shall be knuckled.

3. The fabric shall be extended to within 2 inches of the firm, finished grade and anchored using a horizontal bottom rail.

G. Fence Post

Table 2: Fence Posts Specifications

Fence Posts Type I – II		
Fabric Height	**Line Post O.D.**	**Terminal Post O.D.**
Under 6’	2”	2½”
6’–9’	2½”	3”
9’–12’	3”	4”

H. Gate Post

Table 3: Gate Post Specifications

Gate Posts Type II		
Single-Gate Width	**Double-Gate Width**	**Post O.D.**
Up to 6’	Up to 12’	3”
7’–12’	13’–25’	4”

I. Rails

1. Rails shall be $1^{5}/_{8}$-inch outside diameter (O.D.).

J. Braces

1. Brace rails shall be $1^{5}/_{8}$-inch O.D.

2. Steel truss braces shall have a minimal nominal diameter of ⅜-inch with turnbuckle tensioners.

K. Tension Wires

1. Tension wires shall not be used in lieu of specified top and bottom rails.

2. When tension wires are permitted; they shall be interwoven within the fabric at the top and bottom, or the fabric may be attached with wire ties or hog nose rings.

L. Fabric Tension Bar

1. The bar shall be threaded through the last vertical link of fabric and attached to line, terminal, or gate posts by galvanized tension bands.

M. Fabric Ties

1. Ties shall be minimally 9-gauge steel.

2. The tie coating shall be electrolytically compatible with the fence fabric and other fence components.

3. When installed on tension wires, ties shall be installed by three full twists, minimally.

4. When hog nose rings are used on tension wires, they shall be 9-gauge steel, minimally.

N. Post Footings

1. The posts' minimum footing shall be as noted below or by manufacturer specifications. The more stringent shall apply.

2. No footing shall be less than four times the post diameter.

3. Gate post footings, per post diameter, are as follows:

   (a) For an 8-inch diameter post, install a 40-inch diameter footing

   (b) For a 6-inch diameter post, install a 36-inch diameter footing

   (c) For a 4-inch diameter post, install a 24-inch diameter footing

4. The depth of the footing shall be 42 inches, minimally.

   (a) The posts shall be suspended to a 36-inch post depth allowing a 6-inch footing pocket beneath.

5. The footings shall be filled with 4,000 pounds per square inch (psi) concrete, minimally.

O. Post Capping

1. Each post shall receive a top capping to inhibit collection of debris, weather, and insect migration. The top capping may consist of, but not be limited to, top guard supports, top rail loop caps, or termination caps. The capping shall be secured welding.

P. Fasteners, Clamps, Hardware, and Ties

1. Hot-dipped galvanized steel shall be used on aluminum and galvanized steel fence installation.

Q. Top Guards (Outriggers)

1. Top guards will support three rows, minimally, of 12-gauge barbed wire equally spaced on the top guard. The top guard will increase the fence height by 1 foot, minimally.

R. Barbed Wire

1. Barbed wire consists of two wires twisted together forming a strand. Two- or four-point barbs are tightly wrapped and held in place at specified intervals; reference ASTM A121, *Standard Specification for Metallic-Coated Carbon Steel Barbed Wire*, and ASTM F1665, *Standard Specification for Poly(Vinyl Chloride) (PVC) and Other*

Conforming Organic Polymer-Coated Steel Barbed Wire Used with Chain-Link Fence.

S. Drainage Ditches, Utility Openings, and Tunnels

1. Protective measures to inhibit unwanted access to the site at any ditch, opening, or tunnel greater than 96 square inches in area—with the smallest side being more than 6 inches—shall be properly secured.

T. Fence Installation

1. General: Fence installation shall conform to ASTM F567, *Standard Practice for Installation of Chain-Link Fence*.

2. Component Placement: Posts, rails, bracing, and tension wires shall be placed on the inside of the fence, to inhibit tampering.

3. Height: Fence height shall be as indicated on contract drawings. The compound fence shall be 7-feet high, plus 1 foot for barbed wire, as indicated on compound drawings.

4. Post Spacing: Line posts shall be uniformly spaced between angle points at intervals not exceeding 10 feet.

5. Post Alignment: Posts shall be installed vertically within plus or minus 2 degrees in any direction.

6. Post Foundation: Foundations shall be per requirements in Section 2.1.5.N: Post Footings.

7. Bracing: Gate, terminal, and end posts shall be braced back to adjacent line posts with horizontal brace rails and diagonal truss rods. The rod shall extend from near ground level to within 6 inches of the fabric top of the adjacent post.

8. Top Rail: Top rails shall be installed through the line post loop caps connecting sections with sleeves to form a continuous rail between terminal posts. The connecting sleeves, with a 6-inch minimal length, shall allow for expansion and contraction of the rail. A top rail with a 3-inch swage end is acceptable in lieu of a connecting sleeve.

9. Bottom Rail: Bottom rails shall be installed at 2 inches parallel to the ground in a way that will prevent even a small child from crawling underneath. These rails shall further be installed so that the use of a pry bar will not allow them to bend for anyone to crawl under the fence. The Tower Contractor should contemplate pegging these rails to meet this requirement.

   (a) Fencing shall have a bottom rail instead of a tension wire.

10. Fabric: The fabric shall be pulled taut with the bottom selvage 2 inches above grade. The fabric shall be fastened to the terminal posts with tension bars threaded through mesh and secured with tension bands at maximum 15-inch intervals. The fabric shall be tied to the line posts and top rails with tie wires spaced at a maximum of 12 inches on posts and within 4 inches from the top and bottom of the post. The fabric shall be tied to the rails on intervals of 24 inches maximum and within 4 inches from posts. The fabric shall be attached to the bottom rail with top rings at maximum 24-inch intervals.

11. Top Guards: Guards shall be permanently installed at an outward (i.e., away from the protected site) 45-degree angle on top of each fence line, terminal, and gate post. The guards shall be attached with tamperproof screws or by welding. They will support three rows of barbed wire, minimally. The guards shall be the same material as the fencing material, reference ASTM F626, *Standard Specification for Fence Fittings*.

12. Barbed Wire: Three rows of 12.5-gauge barbed wire, equally spaced, shall be installed on permanent post-mounted support arms, pulled taut and firmly installed in the slots of the line, terminal, and gate post support arms. The wire shall be of the same material as the fencing material.

    (a) The barbs shall be, minimally, 4-point and spaced at 5 inches on centers.

13. Drainage Ditches, Utility Openings, and Tunnels: Should the fence cross a ditch or drainage swell, the method of securing the opening would be to install ⅜-inch diameter rods, electrolytically compatible with the fence material and with the environment, driven vertically 18 inches into the ground on 4-inch centers. The rods will be woven through the fence fabric or affectively attached to the bottom rail to provide security for these areas.

2.1.5. Security Fence Gates

A. Security fence gates are designed for access control into a restricted zone. The design for gate installation must consider the following items, but not be limited to:

1. Pedestrian traffic

2. Traffic flow

3. Types of vehicles entering the restricted zone

4. Site operational security plan

B. Pedestrian and vehicular gates should be separated and clearly labeled.

C. Gates: Frame assembly of 2-inch O.D. pipe (Type I or Type II) with welded joints. Weld areas shall be repaired with zinc-rich coating applied per manufacturer's directions. The fence fabric shall match the fence posts, gateposts, and gates. Gate accessories, hinges, latches,

center stops, keepers, and necessary hardware shall be of a quality required for industrial and commercial application. Latches shall permit padlocking.

1. The gate shall be secured by a locking latch that can be secured by a padlock provided by the County.

2. The construction of the gate shall include reinforcing to prevent sagging or bending.

D. Vehicular Gate: A 12-foot double-swing gate shall be installed, per drawing location. Adjustments to the location may be made with approval from the ROC site GC and design team.

1. The gate shall run parallel along the fence line upon opening.

2. The gate shall move freely and be installed plumb and level.

3. The gate shall open onto grade that is parallel to the gate bottom or at a slight downward grade.

4. When closed, the gate shall maintain a 2-inch or less distance from the bottom rail to the road or firm soil surface. The gate shall not drag, and ample distance shall be accounted for surface upheaval during seasonal freeze-thaw periods.

5. The gate shall be secured by a locking latch that can accept a County-supplied padlock. This latch assembly shall include a pin-type mechanism that secures the gate by causing a pin to enter the top of the fence and a socket secured in concrete at the bottom. When closed the gates shall be 3-inches or less apart.

2.1.6. Gate Operation

A. The vehicular double-swing gate shall be manually operated.

2.1.7. Site Finishing

A. The enclosed area of each tower compound shall be graded level and tamped with sod and large stones removed.

B. Vegetation stop and aggregate shall be applied to the entire compound area (i.e., the area inside the fencing) and 2 feet beyond the fencing.

1. Care shall be given to avoid damage to any underground cabling, grounding, or other infrastructure.

2. Sod, large rocks, and other debris shall be removed.

   (a) A smooth flat surface is required

3. A water permeable (to allow drainage) weed-blocking fabric shall be installed over the topsoil to at least 2 feet outside the perimeter fence.

(a) Aggregate shall be applied 6 inches in depth and consist of American Association of State Highway and Transportation Officials (AASHTO) #10 coarse aggregate.

(b) The stone shall be raked level and evenly dispersed in the compound.

(c) The stone shall be filled in beyond the outside of the perimeter fence for 2 feet or until it meets the roadway surface.

4. Pre-existing sub-course, and grassy areas that have been excavated, shall be returned to their original condition.

(a) The sub-course shall be restored to meet erosion control and site drainage requirements.

(b) Certified compaction testing is required.

2.1.8. Disposal

A. The Tower Contractor shall remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials—including trash and debris—and legally dispose of them off owner property.

B. The Tower Contractor shall separate recyclable materials produced during site clearing from non-recyclable materials.

C. The Tower Contractor shall store or stockpile without intermixing with other materials.

D. The Tower Contractor shall transport recyclable materials to recycling facilities.

2.1.9. Restoration

A. The Tower Contractor shall restore surface features, including vegetation, at areas disturbed by work of this section.

B. The Tower Contractor shall re-establish original grades, unless otherwise indicated.

C. If sod has been removed, the Tower Contractor shall replace it as soon as possible after backfilling is completed.

D. The Tower Contractor shall restore areas disturbed by trenching, storing of dirt, and other activities to their original condition. This shall include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch, as required.

2.1.10. Area Perimeter and Signage Requirements

A. The radio site requires appropriate signage to indicate the presence of electromagnetic RF radiating equipment.

B. Coordination with the ROC site GC and design team shall be required to finalize signage and perimeter marking requirements.

C. Signage shall be installed, as appropriate, to inform public and professional personnel of the area entry requirements.

D. The Tower Contractor shall post applicable warning signs in accordance with Motorola R56 guidelines, and Federal Communications Commission (FCC) and Occupational Safety and Health Administration (OSHA) rules.

3. FOUNDATIONS AND CONCRETE

3.1. Foundation Design

A. The Tower Contractor shall install a concrete foundation for the equipment facility and the tower structure.

B. All detailed drawings of structures and foundations shall be sealed by a professional engineer (P.E.) registered in the State of Illinois and competent in civil and structural design. Submittal and seal shall attest that the design is in full compliance with the mechanical, structural, and electrical parameters established by these specifications.

C. After completion of the foundation and other construction below grade, and before backfilling, excavations shall be clean of vegetation, trash, debris, and inorganic materials.

3.2. Tower Foundation

A. The tower manufacturer shall provide the tower foundation and structural design based on the geotechnical report from the soil survey in Appendix A.

B. The foundation for a tower structure shall be in accordance with design and manufacturer's specifications.

C. The tower support piers shall have their rebar electrically connected to the tower anchoring bolts.

1. All anchoring bolts and the rebar cage shall be electrically bonded.

2. The components shall be properly connected to the grounding electrode system.

D. The tower and foundation shall be designed to support an additional 50% of proposed current loading to account for future loading.

E. Complete structural calculations shall include sufficient information to allow an independent engineer to thoroughly review the design of the proposed tower foundation.

3.3. Foundation Construction

A. If the Tower Contractor, in the process of digging the foundation, finds a condition that makes use of the proposed foundation impossible, it shall do the following:

1. Notify the ROC site GC and design team.

2. Provide drawings and specifications for a revised foundation as designed by the Tower Contractor's certified P.E. and provide a written quotation of the cost for the revised foundation.

3. Upon receipt of the notice, drawings, specifications, and price quote, the County may do any or a combination of the following:

   (a) Determine through its professional engineering sources if the price quoted is reasonable.

   (b) Issue a change order reflecting the increased cost to the County and, once approved, authorize the Tower Contractor to proceed with the work.

   (c) If the quote is deemed unreasonable by the County, the Tower Contractor shall reconsider the price quoted in light of the evaluation and seek and receive competitive bids for the revised foundation using the drawings and specifications provided by the Tower Contractor's P.E.

4. Any reasonable amount of time lost due to redesign and acquisition of the revised tower foundation shall not be charged against the time allocated for completion.

B. Concrete forms of wood, metal centering, cores, molds, and so forth shall be used as required for the proper execution of plain and reinforced concrete work. Sufficient quantities shall be used to properly execute and expedite work without endangering the safety or strength of any part of the construction.

C. Steel reinforcement shall be furnished and installed in accordance with the approved foundation drawing.

D. Concrete used in the foundation shall meet or exceed the tower manufacturer's foundation design requirements.

3.4. Concrete Test

A. Compressive strength test results shall be made available to the County's representative and engineer for review prior to the first concrete pour. The target for compressive strength shall meet the requirements of the design specified by the tower designer.

B. Prior to erecting steel or placing the facility on the foundation, the Tower Contractor shall provide the County's representatives and engineer with a sample of each truck load of concrete that has been tested for compliance with the foundation specifications set forth by the tower engineer. Written reports certifying the strength of the concrete shall accompany each test cylinder.

C. If any concrete used in the foundation does not meet specifications, the Tower Contractor shall remove the foundation and repour using compliant materials at no expense to the County.

D. Testing of composite samples of fresh concrete, obtained according to ASTM C172, *Standard Practice for Sampling Freshly Mixed Concrete*, shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cubic yards (cu. yd.), but less than 25 cu. yd., plus one set for each additional 50 cu. yd., or fraction thereof.

2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd., or fraction thereof, of each concrete mixture placed each day.

   (a) When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C143/C143M, *Standard Test Method for Slump of Hydraulic-Cement Concrete*; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

4. Air Content: ASTM C231/C231M, *Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method*; pressure method for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M, *Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete*; one test hourly when air temperature is 40 degrees (°) Fahrenheit (F) and below and when 80° F and above, and one test for each composite sample.

6. Unit Weight: ASTM C567/C567M, *Standard Test Method for Determining Density of Structural Lightweight Concrete*; fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.

7. Compression Test Specimens: ASTM C31/C31M, *Standard Practice for Making and Curing Concrete Test Specimens in the Field*:

   (a) Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample

   (b) Cast and field cure two sets of two standard cylinder specimens for each composite sample

8. Compressive-strength Tests: ASTM C39/C39M, *Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens*:

   (a) Test one set of two laboratory-cured specimens at seven days and one set of two specimens at 28 days.

(b) Test one set of two field-cured specimens at seven days and one set of two specimens at 28 days.

(c) Compressive-strength test shall measure the average compressive strength from a set of two specimens obtained from the same composite sample and tested at the age indicated.

4. GROUNDING

4.1. General

A. The Tower Contractor shall ensure that each site and related structure, equipment, and system is Motorola R56-compliant; for any differences between the RFB and Motorola R56, the more stringent shall apply.

1. The Tower Contractor shall provide design for a grounding electrode system with an earth/ground resistance of 5 ohms or less. Chemical ground electrode enhancement material shall not be used in the initial design.

When the tower is being constructed along with a facility project the two building grounding systems shall be properly bonded together. Both grounding systems being bonded together shall be one system and shall be tested together.

(a) Chemical ground electrode and enhancement materials shall only be used with the approval of the County and its representatives.

(b) The towers will not have separate ground rings. The building rings shall go around the towers as indicated on the ROC build***ing*** drawings. The tower contractor shall bond the ***tower radials, installed by the ROC general contractor, to the tower and other ancillary equipment to the building/tower ground ring. The tower contractor shall present their designed grounding methods to the design team for approval.***

2. The Tower Contractor shall verify the installed system meets the 5 ohms or less requirement by using a Fall-of-Potential Test.

(a) The test shall be witnessed by the ROC site GC and design team.

(b) Test results shall be published within a typed document and photos provided showing setup, intent, execution, and results.

3. If testing proves that the 5 ohms requirement was not met, the Tower Contractor shall propose a remediation design and a proposal that provides the best possible value for the ROC site GC and design team to review. Use of chemical electrode grounding is not a preferred solution.

B. ***The tower contractor shall bond the tower and ancillary equipment to the existing building ground ring. The contractor shall present their designed grounding methods to the design team for approval.*** ~~**The Tower Contractor shall be responsible for installing each tower ground ring earthing system and for coordinating and connecting the tower and associated ground systems to the existing ground ring.**~~ The grounding system shall meet applicable standards, including the following:

1. Subterrain
2. Tower
3. Facilities
4. Compound equipment
5. Ice bridge
6. Lighting and controls
7. Generator
8. Heating, ventilation and air conditioning (HVAC)
9. Fencing and access gates

C. The Tower Contractor shall ensure that equipment is electrically bonded, grounded, and protected in accordance with NEC and Motorola R56.

D. The Tower Contractor shall provide grounding and lightning protection equipment, including surge arrestors, to comply with Motorola R56 and NEC requirements for equipment being installed and connected as part of the system.

E. The Tower Contractor shall install proper grounding conductors, per Motorola R56, to bond various pieces of equipment, conduit, trays, etc., together.

F. There shall only be one grounding system at each site. Utility grounds, underground piping, structural steel, concrete reinforcing material, lightning protection, and other grounding components shall be bonded together to form one system. This system is referred to as a single-point ground system.

G. The main point of connection for all ground conductors within a facility or building shall be at the primary bonding bar (PBB).

1. The PBB shall be bonded to the external grounding electrode system (ground ring) via a properly sized grounding conductor.

2. An internal perimeter bonding bus (IPBB), secondary bonding bar (SBB) and/or rack bonding bar (RBB) may be installed when multiple grounding conductors are needed to bond numerous items to the ground system.

3. The IPBB, SBB and/or RBB will be bonded to the PBB either directly or through each other progressively, per Motorola R56 specifications.

4.2. Additional Concerns

Several practices shall be followed to allow for neat and secure grounding and wiring.

A. When stripping insulation from ground conductors, only the required amount of insulation needed to be removed shall be removed. Reference R56 sections 4.8.2 and 5.8.2.

B. All ground conductors shall be kept as short as possible. Reference R56 sections 4.6.2 and 5.6.6.7.

C. No braided conductor shall be used in the grounding system. Reference R56 sections 4.6 and 5.6.6.

D. Grounding/bonding conductor bending radius shall be 8 inches or more and not less than a 90° angle; 120° is preferable. The conductor shall be run in a manner that is direct to the grounding electrode system. No short bends or narrow loops shall be permitted as this would increase the conductor's impedance to ground and may cause flash points. Although, this is not always the most aesthetically pleasing, it is the best method to drain off surges. Reference R56 sections 4.6.2 and 5.6.6.3.

E. Paint or galvanic coating shall always be removed prior to making metal-to-metal connections. After attachment, the connection and bared metal area shall be recoated to prevent oxidation. Reference R56 sections 4.8 and 5.8.4.

F. Surfaces shall always be cleaned before making connections. Reference R56 sections 4.8 and 5.8.4.

G. All metal-to-metal connections shall be treated with an approved antioxidant compound to avoid oxidation and corrosion. Reference R56 sections 4.8.6 and 5.8.6.

H. All ground connections shall be made in the direction of the direct path to ground. Reference R56 sections 4.6.2 and 5.6.6.7.

I. Beneath grade connection to the grounding system shall be done by exothermic weld or high-compression irreversible crimp. Reference R56 section 4.8.1.

J. Proper sized irreversible crimped lugs and compression taps shall always be used. The tap shall be insulated with green electrical tape to inhibit incidental contact. Reference R56 sections 4.8.2, 5.8.2 and 5.8.10.

K. Mechanical set-screw lugs and split-bolt style bugs shall NOT be used. Reference R56 sections 4.8.2, 5.8.2, and 5.8.10.

L. Stainless-steel 300-series hardware shall be used for mechanical attachment of lugs, clamps, etc.; an exception, would be if bolt and hardware is same material as the bus bar (ex: copper bus bar with copper alloy bolts). Reference R56 sections 4.8.3 and 5.8.3.

M. Sheet metal or Tech-style fasteners shall not be used for continuous electrical bonds. Per NEC® two-threads shall be engaged within the bonding surface. Reference R56 section 5.8.1.

N. Two-hole tin-plated copper irreversible crimp lugs shall be used to attach ground conductors to bus bars and ancillary equipment. There are some exceptions, but two-hole lugs

are the preferred method over one-hole lugs, thus, preventing movement. Reference R56 sections 4.8.2 and 5.8.1.

O. One-hole tin-plated copper irreversible crimp lugs may be used on rack ground bus bars (RGBs) for equipment bonding only; although, two-hole is preferred and when bonding to equipment that only has one grounding stud (ex: power distribution unit). Reference R56 sections 5.8.1, 5.8.2, 5.8.9.3, and Table 5-5

P. Clamping devices used for grounding and bonding shall be listed for the application and material shall be compatible with conductors and item being grounded/bonded. As an example, bonding steel or aluminum metallic objects shall be bonded by using tin-plated copper or stainless-steel clamps. Reference R56 section 5.9.1.8.

Q. Use of shrink tube or wrapping with electrical tape on compression lugs is required to prevent incidental contact. Reference R56 section 5.8.10.

R. Wire and cable ties shall be trimmed back. Reference R56 section 9.10.6.2.

S. Bare and/or insulated cabling shall be secured with conductor compatible clamps; nylon "P-Ring" type cable clamps may be best. Closed loop ferrous metallic clamps shall not be used. Reference R56 sections 4.6.3, 5.9 and 9.10.1.2.

T. Interior ground conductors shall be green insulated copper stranded conductors; an exception would be plenum areas that may require bare conductors. Reference R56 section 5.6.6.1.

U. Grounding conductor insulation shall be rated for its environment. Reference R56 section 5.6.6.1.

V. Grounding conductors are to maintain at least 2-inch spacing from other cable groups (4-inches from RF transmission cabling). The exception is when conductors come together, as they are entering the same piece of equipment and where they cross over one another at a 90° angle. Reference R56 section 5.6.6.4.

W. Grounding conductors shall be protected against abrasion while passing through metallic enclosures. This must be done per NEC® standards. Reference R56 sections 4.6.3 and 5.6.6.5.

X. If the hole that the conductor passes through is slightly larger, the conductor shall be bonded to the metallic enclosure. If the hole is larger, enough to accommodate several conductors (allowing at least 2 inches between conductor and ferrous metal enclosures), then the conductor does not have to be bonded to enclosure. Reference R56 section 5.6.6.4.

Y. All unused existing cabling and grounding components currently present and after completion of the grounding enhancement shall be removed or abated properly. Reference NFPA 70 and R56 Chapter 9.

Z. Where physical damage may occur or incidental contact of other metallic media, the bonding/grounding conductor should be protected by non-conductive conduit. Generally, a

flexible conduit is used, although there may be cases where ridged would work better. Either is acceptable. Reference R56 sections 4.6.3, 4.6.5.3, 4.7.4, 5.6.1.5 and 5.6.6.6.

AA. If metallic conduit is specified, by the project, the two ends of the conduit shall be bonded to the ground conductor per NEC®. All metallic boxes used as handholes and pull boxes shall be bonded the ground conductor. Reference R56 section 4.6.3.

BB. When factory, NEC® minimum bending radius conduit is used, the conduit size shall not exceed 1-1/2" conduit. Reference R56 sections 4.6.2 and 5.6.6.3

CC. On exterior installations the conduit shall start 6 - inches below grade (up to 16-inches is preferable) and extend a minimum of 6 feet above grade or as near to conductor connection as feasibly possible. This is not only for conductor protection but will reduce step potential on the ground near the conductors. Reference R56 section 4.6.3.

DD. For exterior installations, all wall penetrations and the top and bottom, if applicable, of the conduit and around the grounding conductor shall be sealed with a silicone sealant. This will inhibit weather elements and wildlife migration. Reference R56 section 3.7.2.

EE. The grounding conductors shall be supported within 3-foot intervals, minimally, or per project specifications. The more stringent shall apply. Reference R56 sections 4.6.3 and 5.6.6.6.

FF. All local or jurisdictional codes and safety standards shall be followed. These shall supersede standards and/or procedures mentioned in this document. This includes but is not limited to NEC® and OSHA. Reference R56 section 4.1.

4.3. Grounding Components

The radio communications sites are newly developed tower sites collocated with a (greenfield) facility construction project. The Tower Contractor shall install a new grounding system for the exterior, tower, and any other ancillary support equipment.

4.4. Ground Rod Installation

A. The ground rods that are to be used for this project shall be copper-clad steel, 10 feet in length and ¾-inch in diameter.

B. The ground rods have a slightly beveled (pointed) tip at one end to allow for easier driving of the rod into the earth.

C. Ground rods shall be driven to a depth of no less than 30 inches below grade, or beneath the frost-line. The more stringent shall apply. This shall be done by excavating (usually a trench) in the area in which the rod will be driven.

D. Ground rods shall be driven exactly vertical into the earth. If rock prevents this, the ground rods may be driven at a 45-degree angle. This method only shall be used in the most extreme circumstances and otherwise is not recommended. If rods cannot be driven, as noted above, ground plates shall be used in lieu of ground rods and installed per Motorola R56.

E. The ground rods shall be driven 12.5 feet to 18.75 feet apart.

F. If heavy clay soil is encountered, it is strongly recommended that a pneumatic jackhammer be utilized to drive the rods. Clay soil is very hard and manual driving of the rods is next to impossible.

G. Care shall be used to avoid damaging the top end of the rods while driving them into the earth. If a ground rod is damaged, a few inches shall be cut off from the end of the rod. The top end of the rod shall be clean and shiny to facilitate a proper exothermic bond.

H. Attachments to the ground rods shall be done using an exothermic weld. No mechanical connections to the ground rods are permitted under any circumstances.

I. When the exothermic weld has cooled, it shall be struck with a hammer to ensure a positive weld connection has taken place.

4.5. Exterior Ground Ring System

A. ***The exterior ground ring is provided by the GC per the ROC plans.*** ~~**The Tower Contractor shall install a buried ground ring system to provide a common, single-point ground for the facility, outdoor equipment, and tower.**~~

B. ~~**The top of the ground rod shall be driven to the same depth as the ground ring conductor (i.e., 30 inches deep or below the frost-line). The more stringent shall apply.**~~

C. ~~**The ground rods shall be attached to the ground ring by exothermic weld. It may be necessary to dig out additional earth around the top of the ground rod to allow easier exothermic welds to the ground ring.**~~

D. ~~**A ground ring (exterior facility grounding system) shall be installed encircling the facility foundation with a minimum of 3-feet spacing from the facility foundation.**~~

E. ~~**A second ground ring (tower ground ring) shall be installed encircling the tower base at a minimum of 2 feet from the base of the concrete pad or piers.**~~

F. ~~**The tower and facility rings shall be bonded to each other in two locations in like manner as the building to the facility. Connections of the two ground ring conductors shall be via exothermic weld and the bonding radials shall be spaced 10 feet apart, minimally**~~

G. ~~**If the size of the site, tower, and facility foundations is closer than 20 feet and does not allow proper installation for two ground rings, then one may be used.**~~

1. ~~**The ground ring shall encircle the facility and tower, keeping proper distances from foundations.**~~

2. ~~**A minimum of three radial conductors shall be installed, radiating away from the tower and facility.**~~

H. ~~**All beneath-grade connections and attaching of ground ring bonding jumpers to the external ground bus bar (EGB) and tower ground bus bar (TGB) shall be via exothermic weld.**~~

4.6. Radial Grounding Conductors

A. Radial grounding Conductors shall be sized and installed in the same manner as the ground ring conductor.

B. Each tower site shall have three radial conductors, minimally, and shall radiate away from the structures.

C. There shall be three radial conductors, minimally, from the tower and others may be from the building ground ring.

D. Radial conductors shall be sized between 25—80 feet and of different lengths (i.e., +or-5%).

E. The tower radials shall attach to the tower base and weld to the ring where they cross.

F. Radial conductors radiating from the building ground ring shall bond to the ring where they cross.

G. Test wells shall be installed on the radial at the connection to the ground ring.

H. If space does not allow installation of straight radial conductors, ground plates, grids, or a crow's foot configuration, as per the illustration in Lightning Protection Institute (LPI)-175*, Standard of Practice for the Design – Installation – Inspection of Lightning Protection Systems,* may be used.

4.7. Exterior Equipment Grounding

A. The Tower Contractor shall bond all metallic ancillary equipment within 10-feet of the exterior grounding system or a grounded object to the earth grounding system to reduce negative step and touch potentials and protect outdoor equipment from possible damage.

B. Metallic objects shall be bonded to the external grounding electrode system as follows:

1. A No. 2 AWG solid, tin-plated bare conductor, minimally.

2. One end of the conductor shall be exothermically welded to the ground ring.

3. The other end shall be attached to the equipment via two-hole, tin-plated copper, high-compression, irreversible lugs, and stainless-steel bolts, lock washers, and nuts. Nylon lock nuts shall not be used.

4. Where physical damage may occur, the conductor shall be protected by PVC conduit. No metallic conduit is to be used. The conduit shall begin 16 inches below grade and extend to a minimum of 6 feet above grade. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.

5. Non-conductive strapping on the PVC conduit is preferred.

6. The conduit and/or grounding conductor shall be supported within 3-foot intervals.

7. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of same material as the conductor or installed per the technique for joining dissimilar metals.

8. The area to which the lug is to be applied shall have all paint removed (burnished) down to bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and the surface to which it is attached. After attachment, the connection and bared metal area shall be recoated to prevent oxidation.

C. A list of metallic objects, but not limited to, on the exterior that shall be bonded to the grounding system and not requiring additional electrodes is as follows. The list is only for reference and objects include:

1. Metallic members of incoming telco cables
2. Main telco ground
3. Metallic conduits, raceways, and piping
4. Wall-mounted HVAC units
5. Ventilation hoods (if not grounded inside)
6. Wall-hung light fixtures
7. Junction boxes
8. Facility tie-down strapping
9. Facility metal soffits, fascia, and trim pieces
10. Generator quick-connection receptacle enclosure
11. Cameras
12. Steel security bollards
13. Alarm boxes

14. Fence fabric and fence support framework

D. Metallic objects that are bonded to the grounding electrode system by buried electrode bonding conductors or radial conductors shall be attached to the external grounding system in the same manner as bonded metallic objects, with the exception of using main sized conductor AWG, bare, copper-stranded, tin-plated conductor and installing additional grounding electrodes along the buried bonding and radial conductors as described within this RFB. Reference the ground ring and radial conductor sections within this RFB.

A main sized conductor is the grounding electrode and/or lighting protection system (LPS) main sized conductor as established by the facility project. The more stringent shall apply.

E. A list of metallic objects bonded by buried bonding and radial conductors, but not limited to, on the exterior that shall be grounded to the earth ground system follows. The list is only for reference and objects include:

1. Generator chassis

2. Generator steps and work platforms; removable platform parts shall have bonding jumpers installed
3. Generator fuel supply tank (if allowed)
4. Large wall-hung cabinets
5. Light poles
6. Flag poles
7. Fence posts
8. Facility metallic skidding and/or structural support members
9. Ice bridge
10. Tower
11. Storage tanks above or below grade (if allowed)
12. Support masts
13. Any other grounding electrode systems
14. Any pad-mounted equipment (including larger HVAC units)
15. Steel facility housings
16. Pad-mounted HVAC units
17. Steel facility

4.8. Fence Grounding

A. Fencing, including posts, rails, fabric, and barbed wire, shall be bonded together and connected to the earth ground system.

B. Bare, tinned, copper wire no less than No. 2 AWG shall be used and exothermically welded to the top and bottom rails of each fence post (on both sides) at corners, within 40-foot intervals on straight runs, and at gates.

C. Each fence post shall be connected to the earth ground system. Bare, tinned, stranded copper wire shall be used for this purpose. The wire shall be exothermically welded to the fence posts. Connections to the ground system also shall be by exothermic weld. No mechanical ground connections are permitted.

D. The gates shall be bonded together in the manner specified above. A flexible gate jumper with a surface equivalent to or greater than the cross-section area of 1/0 AWG cable (0.0829 square inch) shall be used to bond the center of each fence gate to the adjacent gate post.

E. The fence fabric (chain links) shall be bonded to the ground ring at both sides of the posts at each corner, within 40-foot intervals on straight runs, wherever the fence run changes direction, where continuity of fabric is broken, and at each gate. The deterrent wire (only if not electrified) at the top of the fence fabric shall be grounded via the conductor that grounds the fence fabric.

1. The fence fabric and deterrent wire shall be bonded to the ground ring via the use of a No. 2 AWG bare, solid, tinned, copper conductor exothermically welded to the adjacent fence post. The fence fabric shall mechanically connect to the conductor via fence fabric ground clamps.

2. A minimum of three clamps shall be utilized, evenly spaced, vertically on the fence fabric, and each row of deterrent wire shall be bonded by a clamp. The other end of

the conductor shall be bonded to the bottom area of the fence post via exothermic weld.

3. The fence and deterrent bonding conductor shall be run in such a manner that it would not cause any incidental contact with any fence component or other metallic objects. This may be accomplished by shielding the non-bonded bare conductor with flexible PVC conduit. Both ends of the conduit shall be sealed from weather and insect migration.

4.9. Tower Grounding

A. ***The exterior ground ring is provided by the GC per the ROC plans.*** ~~**The Tower Contractor shall install a tower ground ring encircling each tower at a minimum of 2 feet from its concrete tower base or leg piers. The tower structure shall be bonded to the tower ring at each leg. The minimum number of ground rods around the ring shall be equal to the number of tower legs. Additional ground rods may be required to maintain proper ground rod spacing requirements.**~~ ***The towers will not have separate ground rings. The building rings shall go around the towers as indicated on the build drawings. The tower contractor shall bond the tower and ancillary equipment to the existing building ground ring. The contractor shall present their designed grounding methods to the design team for approval.***

B. Tower grounding shall be installed per the following procedure:

~~**1. A main sized conductor bare, tinned, stranded copper conductor ground ring shall be installed.**~~

2. Each tower leg shall be bonded to the ~~**tower**~~ ***building*** ground ring via a main sized conductor bare, tinned, stranded copper conductor.

If the tower is a monopole, it shall be bonded to the tower ground ring via three equally spaced main sized conductors.

3. The conductor shall be attached to the tower leg, preferably via exothermic weld (unless strictly prohibited by the manufacturer) or by an irreversible tin-plated copper crimp lug. A two-hole lug is preferred although not always practical due to anchoring restrictions.

4. If by lug, the conductor shall attach to the tower leg via existing holes or by sharing existing mounting bolts. No holes will be drilled into the tower.

5. Stainless-steel (300-series) hardware with lock washers and nuts shall be used to fasten lugs to the tower leg. Nylon locking nuts shall not be used.

6. The tower leg shall be cleaned, and an antioxidant coating compound shall be applied between the tower leg and lug. The other end of the grounding conductor shall be attached to the ~~**tower**~~ ***building*** ground ring conductor via exothermic weld at the point of attachment of a ground rod. This conductor shall be attached as vertical and downward toward the ~~**tower**~~ ***building*** ground ring conductor as possible.

Conductor bending radius shall be 8 inches or more and not less than a 90-degree angle; 120-degree is preferable.

4.10. Ice Bridge

A. The Tower Contractor shall isolate the ice bridge from the tower and facility where possible.

B. Bonding jumpers shall be installed, on both sides, where the ice bridge makes a mechanical splice to itself and/or the tower and facility.

C. When an ice bridge is supported by the facility and tower, the use of a slip-joint fiberglass fastener can be used to support the ice bridge to the tower. This will both isolate the bridge and allow it seismic adjustment.

D. A self-supported ice bridge shall have support posts bonded to the ground ring system by a main sized conductor bare, tinned, stranded copper conductor. The conductor shall be exothermically welded to both the leg and ground ring.

E. A self-supporting ice bridge shall maintain 6-inch separation between the tower and facility structures.

F. Ice bridge support legs shall be grounded to the exterior grounding system. Each support leg shall be bonded to either the tower or facility ground rings, whichever is closer. Pairs of support legs (across the width of the ice bridge) may share a common grounding conductor. This may be accomplished via exothermically welding a tail of equal size to the grounding conductor beneath earth.

G. Each section of the ice bridge shall be bonded to the support legs via a No. 2 AWG, solid, tinned copper conductor. The conductor shall be exothermically welded to the leg and shall be attached to the ice bridge via exothermic weld or irreversible two-hole, high-compression, tinned lug, and stainless-steel hardware including lock washer.

H. If multiple ice bridge sections are used, they shall be bonded at their splice point via a No. 2 AWG, solid, tinned copper conductor. The conductor shall be attached by exothermic weld or irreversible two-hole, high-compression, tinned lug, and 300-series stainless-steel hardware including lock washer.

I. The area to which the lug is to be applied shall have paint removed (burnished) down to bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and surface to which it is attached.

J. All bared metallic surfaces after grounding/bonding attachment shall be properly recoated to inhibit oxidation.

K. The grounding/bonding conductor bending radius shall be 8 inches or more and not less than a 90-degree angle. The conductor shall be run in a manner that is direct to the grounding electrode system. No short bends or narrow loops shall be permitted as this would increase the conductor’s impedance to ground and may cause flash points.

L. Exothermic welds on legs and other galvanized equipment bonds shall be treated with a coating of cold-galvanizing spray (Valmont #B364 or equivalent) to prevent corrosion and oxidation.

4.11. Exterior Ground Bus Bar Installation

A. The Tower Contractor shall position the EGB just below the ice bridge and entry port to each facility.

B. The EGB shall be sized according to the number of antenna transmission lines entering each facility.

C. The EGB shall be mounted to the facility beneath the entry port via stainless-steel mounting brackets, hardware, and insulators (polyester fiberglass, 2 kilovolts [kV] minimum voltage rating).

D. The EGB minimum size shall be ¼-inch thick, 2-inches wide, and length determined by the number of antenna transmission cables being grounded and provide for 50% growth.

E. The bar shall be of a tin-plated copper material.

F. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate a two-hole irreversible crimp connector for each antenna transmission cable grounding conductor.

G. The EGB shall be bonded to the exterior facility grounding system via two main sized conductors stranded, bare, tinned copper conductors.

H. Each conductor shall attach to the bottom left and right corners of the EGB respectively via irreversible high-compression crimp or exothermic weld.

I. The grounding conductors from the EGB to the ground ring shall be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the EGB as physically possible. This is not only for conductor protection; it also will reduce step potential on the ground near the conductors.

J. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.

K. Non-conductive strapping on the PVC conduit is preferred.

L. The conduit and/or grounding conductor shall be supported within 3-foot intervals.

M. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.

N. The other end of the conductors shall be connected to the ground ring conductor using an exothermic weld.

4.12. Tower Ground Bus Bar Installation

The TGB minimal size shall be ¼-inch thick, 2-inches wide (4-inch preferred), and 12 inches in length.

A. The bar shall be sized for 50-percent growth for future tower loading.

B. The bar shall be of a tin-plated copper material.

C. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate a two-hole irreversible crimp connector for each antenna transmission cable grounding conductor and provide for 50% growth.

D. A TGB shall be installed at the bottom of the tower below the transmission line grounding kit near the point where the transmission line vertical run meets the horizontal run toward the facility. When transmission lines are run underground via PVC conduits, the TGB shall be mounted below the top of the conduits.

E. A TGB may be installed at the top of the tower within 6 feet of where the transmission lines turn to run down the tower. This will provide a convenient grounding point for the transmission line ground kits.

F. Additional TGBs may be installed to maintain maximum spacing between transmission line ground kits at less than 75 feet.

G. The TGB shall be mounted to the tower frame via conductive fasteners suitable for preventing corrosion from dissimilar metals. This will reduce impedance to earth.

H. The bottom tower TGB shall be bonded to the ~~**tower**~~ ***building*** ground ring via two main sized conductors stranded, bare, tinned copper conductors or by means of direct attachment, thus less insulators. The attachment shall be made via stainless-steel hardware.

I. Each conductor shall attach to the bottom left and right corners of the TGB, respectively, via exothermic weld.

J. The grounding conductors from the TGB to the ground ring shall be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the TGB as physically possible. This is not only for conductor protection, but also will reduce step potential on the ground near the conductors and deter incidental contact with the tower.

K. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.

L. Non-conductive strapping on the PVC conduit is preferred.

M. The conduit and/or grounding conductor shall be supported within 3-foot intervals.

N. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.

O. The other end of the conductors shall be connected to the ~~**tower**~~ ***building*** ground ring conductor using an exothermic weld.

4.13. Internal Bus for Facility Grounding

The Tower Contractor shall provide and install a PBB within the facility as the main point of connection for ground conductors within the facility.

4.14. Internal Perimeter Bonding Bus

A. The Tower Contractor shall install an IPBB to provide a suitable grounding for ancillary equipment, conduits, and other non-electronic metallic items back to the PBB.

1. Two equidistant, No. 2 AWG minimal, sized per Motorola R56 Table 5-3, stranded, green-jacketed, THW conductors shall originate at the PBB and run in opposite directions around the perimeter of the room.

2. The conductors shall run horizontally along the wall and be located approximately 1 foot above the floor.

B. The IPBB shall be supported by 2-inch insulated standoffs at 2-foot intervals.

C. The two conductors shall be separated from joining by at least 4 inches. They shall meet at an area approximately opposite the PBB.

4.15. Ground Bus Conductors

A. A ground bus conductor shall be used to bond equipment cabinets, racks, and other systems. They always terminate at the PBB or SBB. The other end(s) generally is left unterminated (although insulated with green electrical tape) but can be terminated to the last rack. The ground bus conductor and any extensions shall be of the same size.

B. A No. 2 AWG, copper, stranded, green-jacketed conductor shall be run the entire length of the cable tray system. If the run is greater than 32 feet, the No. 2 AWG shall be sized according to Motorola R56 Table 5-3.

C. One end shall terminate to the facility's PBB or SBB via a two-holed, tin-plated, copper, irreversible crimp lug.

D. The other end shall terminate to the most extreme rack or be left unterminated in the rack with the end insulated with green electrical tape.

E. Ground bus extension conductors may "Y" off the ground bus conductor and travel along perpendicular pieces of cable tray. This is to assist in bonding other racks in the facility.

Connections made to the ground bus conductors always must flow toward the PBB or SBB by using an irreversible C-type crimp connector.

F. The conductors shall be supported by a cable tray inside the facility, along the bottom outside edge or along the outside wall and/or by the equipment rail (framework). Proper cable separation shall be maintained per Motorola R56.

4.16. Primary Bonding Bar

A. The PBB shall be located as close to the electrical service entrance as possible.

B. The PBB minimal size shall be ¼-inch thick, 4-inches wide, and 12-inches long.

C. The PBB shall be a tin-plated, bare, solid copper bus bar.

D. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate multiple two-hole irreversible crimp connectors.

E. A Harger Type “J” Hole Pattern GBIP144xxJPBB or equivalent shall be used. The “xx” stands for the bar length. This shall be determined by the number of grounds being connected to the PBB, plus approximately 50% for future growth. This bar pattern shall accommodate bonding conductors and IPBB connection.

F. Stainless-steel mounting brackets (at least 2 inches offset from the structure), and hardware shall be used.

G. Insulators shall be polyester fiberglass, 2 kV minimum voltage rating.

H. The PBB shall be bonded to the exterior facility grounding system via a main sized conductor AWG, stranded, bare, tinned copper conductor.

I. The conductor shall attach to the bottom of the PBB via irreversible crimp or exothermic weld.

J. For irreversible crimp connection, the metallic surface shall be treated with an antioxidant compound approved for the lug and surface to which it is attached. The lug shall be fastened to the PBB using ⅜-16 stainless-steel bolts, lock washers, and nuts. No nylon locking hardware shall be used.

K. The grounding conductor from the PBB to the exterior facility grounding system shall exit through the facility wall or floor at no less than a 135-degree downward angle (toward the exterior ground ring) and be protected by PVC conduit. No metallic conduit shall be used. The conduit shall begin 16 inches below grade and extend as close to the PBB as physically possible. This is not only for conductor protection but also will reduce step potential on the ground near the conductors.

L. The top of the conduit and around the grounding conductor shall be sealed with a silicone sealant.

M. Non-conductive strapping on the PVC conduit is preferred.

N. The conduit and/or grounding conductor shall be supported within 3-foot intervals.

O. When supporting the grounding conductor itself, non-conductive straps shall be used. When using metallic straps, they shall be of the same material as the conductor or installed per the technique for joining dissimilar metals.

P. The other end of the conductors shall be exothermically connected to the exterior facility grounding system conductor using an exothermic weld.

4.17. Secondary Bonding Bar

A. The SBB is used to provide a single termination point for facility interior grounding conductors, equipment bonding conductors, and IPBB conductors. The SBB is an extension of the PBB. The SBB generally is installed to connect multiple objects to the internal grounding system. It is customary to see an SBB installed at the telco equipment and another at the entry port for the transmission lines. This is when the utilities enter the facility on different walls or are not in close proximity.

B. The SBB minimum size shall be ¼-inch thick, 2-inches wide, and 12-inches long.

C. The SBB shall be a tin-plated, bare, solid copper bus bar.

D. Hole spacing for each connector shall be at least ¾-inch on center. There shall be enough to accommodate multiple two-hole irreversible crimp connectors.

E. A Harger Type “J” Hole Pattern GBI144xxJ or equivalent shall be used. The “xx” stands for the bar length. This shall be determined by the number of grounds being connected to SBB, plus approximately 50% for future growth.

F. Stainless steel mounting brackets (at least 2 inches offset from the structure), and hardware shall be used.

G. Insulators shall be polyester fiberglass, 2 kV minimum voltage rating.

H. When the SBB is installed for transmission line and/or telco lines and is physically more than 20 feet from where the PBB bonding conductor to the exterior facility grounding system enters the earth, an additional bonding conductor from the SBB to the exterior facility ground ring shall be installed.

I. The additional grounding conductor shall be the same size and attached in a like manner as the PBB conductor to the exterior facility grounding system is installed. Refer to Section 5.19, Primary Bonding Bar.

J. The SBB shall be bonded to the PBB via a main sized conductor stranded, green-jacketed, THW or THHN (thermoplastic high-heat resistant nylon-coated) copper conductor. This is if an additional grounding conductor to the exterior facility grounding system is needed.

K. The SBB shall be bonded to the PBB via a No. 2 AWG (minimum, sized per Motorola R56 Table 5-3), stranded, green-jacketed, THW conductor when the additional grounding conductor to the exterior facility grounding system is not needed.

4.18. Interior Facility Ancillary Equipment Grounding

A. All metallic ancillary equipment within 8 feet vertically and 8 feet horizontally of any ground or object being grounded shall be bonded to the PBB, SBB, or IPBB. This will be a very labor-intensive task, though one of the most important described in this specification. All ancillary equipment shall be bonded to the PBB, SBB, or IPBB by a No. 6 AWG, copper, stranded, green-jacketed conductor. Daisy-chaining of equipment is **NOT** permitted except for the grounding of conduit.

B. A No. 6 AWG, copper, stranded, green-jacketed conductor shall bond to each object via a two-hole, tin-plated, copper, irreversible crimp lug.

C. The area to which the lug is to be applied to the equipment shall have all paint removed (i.e., burnished) down to the bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and surface to which it is attached.

D. The lug shall be fastened to the unit using ¼-20 stainless-steel bolts, lock washers, and nuts. No nylon locking nuts shall be used.

E. The other end shall be attached to the PBB, SBB, or IPBB via a two-hole, tin-plated, copper, irreversible crimp lug.

F. The area to which the lug is to be applied to the busbar shall have all paint removed (i.e., burnished) down to the bare metal. The metallic surface shall be treated with an antioxidant compound approved for the lug and surface to which it is attached.

G. The lug shall be fastened to the bus using ⅜-16 stainless-steel bolts, lock washers, and nuts. No nylon locking nuts shall be used.

H. When attaching the bonding conductor to the IPBB, it shall be via a C-style, copper, irreversible crimp connection. Connection shall be wrapped with green insulating electrical tape to inhibit incidental contact.

I. If a two-hole lug is infeasible for connection to the object, a one-hole lug will be permissible.

J. All ground conductors shall be kept as short as possible

K. Grounding/bonding conductor bending radius shall be 8 inches or more and not less than a 90-degree angle. The conductor shall be run in a manner that is direct to the grounding electrode system. No short bends or narrow loops shall be permitted as this would increase the conductor’s impedance to ground and may cause flash points. Although this is not always the most aesthetically pleasing, it is the best method to drain off surges.

L. The IPBB has been installed specifically to accommodate connections for ancillary equipment, which includes, but is not limited to:

1. Heater chassis
2. Wall-mount HVAC chassis
3. Ventilation duct/louvers
4. Lights
5. Window/door frames
6. Metallic ceiling grids
7. Metallic raised-floor systems
8. Electrical enclosures
9. Conduits
10. Metallic piping systems
11. Exposed metallic building structure members

4.19. Doors and Frames

A. Doors and door frames shall be bonded to the grounding system.

B. The door frame is to be bonded to the IPBB by a No. 6 AWG, copper, stranded, green-jacketed conductor. A C-style copper irreversible crimp connection shall be used to make this connection.

C. The metal door shall be bonded to the frame using a No. 6 AWG, copper, highly flexible cable (e.g., welding cable). **No braided conductor shall be used anywhere in this project.** This will help to limit the effects of intermodulation (IM) due to corrosion of the braiding.

4.20. Electrical Panels and Cabinets

The chassis of electrical panels and cabinets shall be bonded to the IPBB.

4.21. Cable Ladder Tray (Ladder Runway) Grounding

A. Grounding conductors shall be installed to the interior far side or exterior of the tray. Cable groups shall maintain a 2-inch clearance from other cable groups. Exception: RF transmission cables for transmitting stations shall maintain a 4-inch minimum clearance from the power, data, and signal cable groups.

B. The cable and/or ladder tray shall be grounded to the PBB or SBB.

C. A No. 6 AWG, copper, stranded, green-jacketed conductor shall bond to the tray via a two-hole, tin-plated, copper, irreversible crimp lug.

D. The other end shall be attached to the PBB or SBB via a two-hole, tin-plated, copper, irreversible crimp lug.

E. If the tray is a single straight unit running away from the ground bus, it only shall be required to be bonded at one point back to the PBB or SBB.

F. If the tray is parallel to the ground bus, it shall be bonded to the PBB or SBB in both directions by two individual bonding conductors.

G. If the tray is shaped in a “U” configuration and running parallel to the ground bus, it shall be bonded on both sides of the “U” that are closest to the ground bus back to the PBB or SBB.

H. The tray shall **not** be used as a grounding conductor.

I. All tray splices and joints shall have a No. 6 AWG, copper, stranded, green-jacketed conductor bonding jumper with a two-hole, irreversible crimp lug on each end.

J. When the tray, its splicers, and interconnecting components are labeled as suitable for grounding purposes, jumpers shall not be required.

4.22. Electrical Surge Protection

A. Power circuits to and from the communications facility shall be protected by an SPD located at the main power disconnect.

1. SPDs in compliance with Motorola R56, Type 2B, shall be mounted to provide protection for the generator ATS utility and emergency sides.

    (a) This may be accomplished by adding the SPD at the main disconnect located before the ATS or by using a tap-rule per NEC.

    (b) The emergency side would be protected if it feeds directly to the facility’s critical equipment distribution panel. An SPD in compliance with Motorola R56, Type 2A, shall be installed on the facility’s critical equipment distribution panel.

2. SPDs shall be installed on the generator control, alarm, crankcase heater, and battery charging circuits at the generator and within 24 inches of entry of the building interior.

    (a) SPDs shall comply with Motorola R56 standards and manufacturer specifications.

B. SPD alarm circuits shall run back to the facility’s alarm punch-down block.

C. New exterior alarm circuits shall be run beneath grade and installed in IMC or RMC conduit, or direct burial shielded cabling installed within PVC conduit.

1. When installed in IMC or RMC, within 2–4 feet of the generator, ATS, MTS, and other metallic enclosures, the conduit shall change to Schedule-40 PVC.

D. SPDs shall be installed on alarm circuits within 24 inches of entry into the facility. Type and location shall be verified with the ROC site GC and design team.

E. Alarm circuits shall be clearly labeled.

F. The installation of SPDs is required at all sites that have communications/electronic equipment and other electrical equipment. Abnormal electrical surges, overvoltage occurrences—created by lightning or power surges from distribution equipment and/or auxiliary equipment—can cause great damage to equipment and harm personnel. Care must be taken to protect personnel as well as equipment.

G. Properly grounding the site on the exterior, as well as the interior, as described in this specifications document is a good defense against personnel and equipment being harmed. However, that alone is not enough. SPDs also must be installed on all electrical, transmission, and communications lines entering the facility, building, or area that houses the communications equipment and/or personnel.

H. Common-mode SPDs shall not be used on AC electrical circuits. These devices may fail in a short-circuit situation, which would cause undesirable voltage on the grounding conductor. This is from the neutral being bonded to the ground from the fault. All SPDs used in the United States shall be listed with UL 1449, *Standard for Surge Protective Devices*, 4th Edition or later.

I. Metal Oxide Varistor (MOV) and Silicone Avalanche Diode (SAD) are the SPD types that are to be used in communication sites within the United States. They are used together as a hybrid at the building's main electrical disconnect.

J. Type 2A SPDs provide protection for the critical equipment or main service entrance panel and branch panels located within the same equipment area. SAD technology shall be used on the primary modules and MOV on the secondary modules.

1. Normal-mode type only; no common mode shall be used.

2. Primary module is SAD-rated at 20 kiloamperes (kA) per phase, per polarity, with minimum energy absorption.

3. Secondary module is MOV.

4. SPDs shall be certified to meet Motorola R56 requirements.

5. Enclosure rating of NEMA 4.

6. The facility shall have an integral overcurrent protection device rated at 25,000 amps for short circuit.

7. SPDs shall be fed by a copper No. 6 AWG conductor or larger. The overcurrent device shall govern if larger than No. 6 AWG is needed. The conductor, minimally, shall be sized based on the overcurrent device to which it is attached, per NEC.

8. Indicator lamps shall be visible to monitor SPD status.

9. A set of form C dry contacts—rated minimally at 250 volts AC (VAC) and 2 amps with a power factor of 1 for remote alarming—shall be integral in the SPD.

10. No. 22 AWG copper wire or larger shall be used for remote alarming.

11. SPDs shall be UL 1449, *Standard for Surge Protective Devices*, 4th Edition or later, listed.

12. SPD testing results by a UL-approved lab shall be made available.

K. Type 2B SPDs shall be used to provide protection for other equipment panels located within the same equipment room. This includes a facility main disconnect feeding an ATS.

1. Normal-mode type only; no common mode shall be used.

2. Primary modules are MOV.

3. Suppression components are to be voltage limiting, not voltage switching.

4. The facility shall have integral overcurrent protection device rated at 25,000 amps for short circuit.

5. SPDs shall be certified to meet Motorola R56 requirements.

6. Enclosure rating of NEMA 4.

7. SPDs shall be fed by a copper No. 6 AWG conductor or larger. The overcurrent device shall govern if larger than No. 6 AWG is needed. The conductor minimally shall be sized by the overcurrent device to which it is attached, per NEC.

8. Indicator lamps shall be visible to monitor SPD status.

9. A set of form C dry contacts—rated minimally at 250 VAC and 2 amps with a power factor of 1 for remote alarming—shall be integral in the SPD.

10. No. 22 AWG copper wire or larger shall be used for remote alarming.

11. SPDs shall be UL 1449, *Standard for Surge Protective Devices*, 4th Edition or later, listed.

12. SPD testing results by a UL-approved lab shall be made available.

L. Type 3 individual equipment SPDs may be of receptacle-replacement, plug-strip, or plug-in-adapter type or provided as a PDU. All units shall be Motorola R56-compliant.

1. Normal-mode type only; no common mode shall be used.

2. The plug-in adapter shall be the type that only plugs into a single simplex outlet.

3. The plug-strip type may accommodate secondary protection for receptacle, data, and telephone.

4. The plug-strip style shall have a metallic casing with mounting tabs and an exterior ground stud to accept a No. 6 AWG or larger grounding terminal.

5. No on/off switch is required. If furnished, it shall have a physical barrier to avoid nuisance switching.

6. Indicator lamps shall be visible to monitor SPD status.

7. Shall be installed on critical loads when located 10-foot conductor length (5-foot circuit length) or more from a Type 1 SPD.

8. Shall be installed on loads when located greater than 50-foot conductor length (25-foot circuit length) from a Type 1 SPD.

9. Shall be UL 1449, *Standard for Surge Protective Devices*, 4th Edition or later, listed.

10. SPD testing results by a UL-approved lab shall be made available.

11. If data and/or telephone protection is integral, then the plug-strip type shall be UL 1449, *Standard for Surge Protective Devices*, and UL 497, *Standard for Protectors for Paired-Conductor Communications Circuits*, listed.

12. For standalone pole- or pad-mounted cabinets that do not have Type 2A or Type 2B SPDs mounted on the utility panelboard, a Type 3 SPD shall be installed on all loads.

M. Telephone, Data, and Control Circuits

1. Common-mode SPDs may be used.

2. SPDs shall be installed on metallic conductors as close as practical upon entry into the facility.

3. SPDs shall be installed as close as practical to the equipment they are protecting (e.g., generator display, battery charger, fuel gauge).

4. Interior facility SPDs shall be bonded to the interior grounding system.

5. Exterior equipment SPDs shall be bonded to the exterior ground electrode system.

6. SPDs installed on 2-pair conductors may be No. 12 AWG, green-jacketed, copper conductors of a length no greater than 4 feet.

7. Multiconductor SPDs (greater than 2-pair) shall be No. 6 AWG, green-jacketed copper conductors.

4.23. Tower Lightning Protection System (LPS)

A. Air terminals (lightning rods) shall be properly installed on the tower per NFPA 780, *Standard for the Installation of Lightning Protection Systems*; UL; and this bid document. The more stringent shall apply.

1. Air terminals shall be compatible with the tower structure, stainless steel rods are preferred, and have a Class 2 rating (minimum).

2. Air terminals shall be directly attached to the tower legs by approved methods.

3. When using air-terminal extension rods, a proper size and material down lead shall be used and properly attached to the top extreme of the leg.

4. Copper or copper-alloy air terminals, conductors, or attachment hardware **shall not** be used on galvanized towers. Stainless steel is recommended. Aluminum is acceptable.

5. The Auxcomm tower shall utilize the center mast as the air terminal. The installation shall meet the requirements of NFPA 780 sections 4.5.1.4 and 4.5.3.

6. A bearing bypass grounding kit may be utilized and is suggested as long as the installation meets the requirements of NFPA 780.

7. Any obstructions (e.g., side marker lights and antennas) mounted above 150 feet on the tower shall have properly installed horizontal air terminals. Two terminals, spread at the vertex to cover obstruction width, shall be mounted directly above and below the obstruction. The terminals shall extend past the obstructions by 10 inches, at a minimum.

5. COMMUNICATIONS TOWERS

5.1. Intent

A. The new towers shall meet the current American National Standards Institute (ANSI)/Telecommunications Industry Association (TIA) 222-H, *Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures*, Risk Category IV standard. Towers upon which structural analysis shall be performed shall be considered as Risk Category IV structures as defined in ANSI/TIA 222.

B. Self-supporting structures shall be designed and installed, at a minimum, to be in accordance with the latest revision of ANSI/TIA-222, *Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures*, while meeting the County's specifications as detailed in this RFB and the attached drawings. In all cases where there are conflicting requirements, those listed in this section shall take precedence in the installation and construction of communications towers. If the requirements cannot be met, the Respondent shall provide a statement as to why they cannot be met.

C. The Tower Contractor shall comply with the requirements of their specific subsections or associated tasks. Adherence to Motorola R56 shall be applicable to all aspects of execution of the bid document.

D. The Respondent shall adhere to the specifications detailed in the federal, state, and local building codes, as well as Lake County-imposed or -required codes, standards, or regulations.

5.2. Tower Structures

Tower requirements at each location shall be as follows:

A. 911 Tower – One 75-foot, monopole; Valmont hot-dipped galvanized or approved equal.

B. Auxcomm Tower – One 75-foot, self-supporting tower; Valmont V-Series or approved equal.

5.3. Construction

A. The safety factor shall meet ANSI/TIA-222, Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures, latest revision.

B. The Respondent shall confirm that each tower it is bidding is designed per ANSI/TIA-222, *Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures*, latest revision, in accordance with the height, style, and present and future loading specifications contained herein and with consideration of the anticipated soil as indicated above. Further, prior to commencing work, the Tower Contractor shall provide to the County's representative complete detailed drawings of the structure and its foundation. Such drawings shall include a certification and seal of a competent State of Illinois-licensed and -registered P.E. attesting that the design is in full compliance with the mechanical, structural, and electrical parameters established by these specifications.

C. The Respondent shall design each tower to support an additional 50% of proposed current loading to account for future loading.

D. Prior to erecting steel on the foundation, the Tower Contractor shall provide to the County's representative a sample of each truckload of concrete that has been tested for compliance by an independent certified concrete lab with the foundation specifications set forth by the tower engineer. Written reports certifying the strength of the concrete are to accompany each test cylinder and be provided to the County's representative.

1. Tests are to be conducted, minimally, at 7 days and 28 days after the foundation is poured to ensure that the concrete meets the specifications set forth in the foundation design.

E. If any concrete used in the foundation does not meet specifications, the Tower Contractor shall be required to remove the foundation and to pour one utilizing compliant materials at the Tower Contractor's expense.

F. The structure shall maintain microwave stability within the allowable signal degradation in accordance with ANSI/TIA-222-H, Annex D, *Twist and Sway Deformation Limitations for Microwave Antennas*.

G. Each tower and components shall be fabricated from solid steel protected by hot-dip galvanizing or other approved methods to prevent rusting.

H. Sections shall be attached to each other using flange plates. Except monopole may be by engineered slip joint splices.

I. Welding shall be done in the factory prior to the galvanizing process. Field welding is not acceptable.

J. The Tower Contractor shall provide drawings for the structure and foundation for approval by the County and County's representative prior to manufacture.

K. Drawings and certifications shall be sealed by a Illinois State-licensed and -registered P.E.

L. A Illinois State-licensed and -registered P.E. shall certify that the tower and foundation meet or exceed requirements.

M. The Tower Contractor shall be responsible for required signage at the sites.

N. Signage shall meet Motorola R56 minimum signage requirements and owner requirements.

O. The geotechnical reports, found in Appendix A, may be referenced for foundation design. In the event the Respondent feels the report is inconclusive, the Tower Contractor is advised to assume rocky soil, similar to a mountaintop site, capable of being moved by a moderately sized excavator, in designing the tower foundation.

P. If the Tower Contractor, in the process of digging the foundation, finds a condition that makes use of the proposed foundation impossible, the Tower Contractor shall do the following:

1. Notify the County and County's representative.

2. Provide drawings and specifications for a revised foundation as designed by the Tower Contractor's certified P.E. and provide a written quotation regarding the cost for the revised foundation.

3. Upon receipt of the notice, drawings, specifications, and price quote, the County may do any or a combination of the following:

   (a) Determine through its professional engineering sources whether the price quoted is reasonable.

   (b) Issue a change order reflecting the increased cost to the County and once approved, authorize the Tower Contractor to proceed with the work.

   (c) If the quote is deemed unreasonable by the County, the Tower Contractor shall reconsider the price quoted in light of the evaluation and seek and receive competitive bids for the revised foundation using the drawings and specifications provided by the Tower Contractor's P.E.

4. Any reasonable amount of time lost due to redesign and acquisition of the revised tower foundation shall not be charged against the time allocated for completion.

5.4. Foundation

A. Foundation design shall be provided by the tower manufacturer based on Tower Contractor-supplied borings and any other site information required by the tower manufacturer.

B. Complete structural calculations shall include sufficient information to allow an independent engineer to thoroughly review the design of the proposed tower foundation.

C. The Tower Contractor shall install the concrete foundation for each tower structure.

D. Foundation design for towers and other equipment shall be based on site soil conditions as noted in the geotechnical reports.

E. The foundation shall be appropriate for the structure.

F. The foundation for a tower structure shall be in accordance with the design and manufacturer's specifications.

G. Concrete forms of wood, metal centering, cores, molds, and so forth shall be used as required for the proper execution of plain and reinforced concrete work. Sufficient quantities shall be used to properly execute and expedite work without endangering the safety or strength of any part of the construction.

H. Steel reinforcement shall be furnished and installed in accordance with the approved foundation drawings.

I. After completion of the foundation and other construction below grade, and before backfilling, excavations shall be clean of vegetation, trash, debris, and inorganic materials.

J. Compressive-strength requirements, per tower manufacturer, shall be made available to the County, County's representative, and engineer for review prior to the first concrete pour. Unless otherwise stated or specified by the tower designer, the targeted compressive strength shall be obtained within 28 days.

K. Prior to erecting steel on the foundation, the Tower Contractor shall provide the County's representative and engineer with a sample of each truckload of concrete that has been tested for compliance with the foundation specifications set forth by the tower engineer. Written reports certifying the strength, slump, etc. of the concrete shall accompany each test cylinder.

L. If any concrete used in the foundation does not meet specifications, the Tower Contractor shall remove the foundation and repour using compliant materials at no expense to the County.

M. Concrete used in the foundation shall meet or exceed the tower manufacturer's foundation design requirements.

N. Each tower and foundation shall be designed to support proposed attachments as identified by the County's representative for this project.

O. The Tower Contractor shall engage, at their expense, with a County-approved third-party testing agency to verify soils, reinforcement, and concrete pours meet the tower manufacturer's engineered design.

5.5. Tower Design and Loading

A. Each tower structure and supporting concrete foundations shall be designed and manufactured in accordance with these specifications and ANSI/TIA-222-H, *Structural Standards for Steel Antenna Towers and Antenna Supporting Structures*, latest revision, and shall be designed as a Risk Category IV structure.

B. Each tower and tower foundation shall be designed to support both proposed and additional 50-percent future antennas, side arms, mounting hardware, and cable loading.

5.6. Design Calculations and Drawings

A. The Tower Contractor shall submit structural calculations for each tower and foundation, and erection drawings for the selected bid. Complete structural calculations shall include sufficient information to allow an independent engineer to thoroughly review the designs.

B. Drawings must include tower name and height; manufacturer's name and model number; elevation and plan views indicating tower orientation, tower height and antenna azimuth; and section assembly information including tower members, part numbers, accessories, and appurtenances.

C. Drawings, certifications, and design calculations shall be prepared by a P.E. licensed and registered in the State of Illinois.

5.7. Wind and Ice Load Design

D. Each tower shall be designed and installed to the maximum of the loading conditions from ANSI-EIA/TIA-222-H, *Structural Standard for Antenna Supporting Structures and Antennas and Small Wind Turbine Support Structures*, for a Risk Category IV structure.

5.8. Antenna Load

A. The Tower Contractor shall account for antenna side arms, standoffs, and mounting hardware to support the proposed microwave dishes and antenna systems in the design of the tower.

B. The brackets used for design purposes shall be the appropriate standoff based on frequency requirements—high frequency (HF), 6 feet; very-high frequency (VHF) and below, 3 feet; ultra-high frequency (UHF) and above, 2 feet.

C. The actual mounting devices will be provided by the radio vendor and will not be the responsibility of the Tower Contractor.

D. Climbing Access

A. A ladder or AHJ approved climbing devices, beginning at a point above ground, shall be included as an integral part of the tower to permit access by authorized personnel.

B. These devices shall be designed and installed so that it rises in a straight line from base to top. Ladders having both angled and vertical combinations shall not be acceptable.

C. The ladder shall be equipped with an OSHA-approved anti-fall safety device.

1. This device shall not interfere with the climber's ease of reach by hand or foot from one rung of the ladder to the next, either going up or coming down.

D. A portable section of ladder shall be included to provide access to the permanent ladder on the tower. This ladder shall be designed and constructed so that it is securely held to the tower and firmly supported at the bottom when in use. Clamps, hooks, or similar devices shall be acceptable for securing the top and bottom of the ladder in a vertical position.

E. Cable Ladder

1. The transmission line shall be anchored to the tower using hardware recommended by the transmission line manufacturer for that type of tower.

2. Transmission lines shall not be installed in a way that will impede climbing or safety devices.

3. Transmission line installation should be planned with consideration for future expansion.

4. Spacing of anchoring hardware shall be at 3-foot intervals maximum unless the RF cable manufacturer requires less distance between supports. The width shall accommodate planned RF cabling and 50% growth for each cable quantity.

5.9. Labeling and Identification

A. Make, model, and serial numbers shall be clearly labeled near the base of each tower.

B. The tower height in feet shall be clearly labeled near the base of each tower.

C. Latitude and longitude in degrees/minutes/seconds shall be clearly labeled near the base of each tower.

D. FAA and FCC identification numbers, if applicable, shall be clearly labeled near the base of each tower.

E. Labeling shall be weatherproof and durable, such as a stamped metal plate or equivalent. Labeling can be attached to a leg or cross brace.

5.10. Tower Lighting

A. The Tower Contractor shall have an FAA aeronautical study performed and the determination by FAA shall be followed for tower marking and lighting.

B. Tower obstruction marking and lighting shall be supplied as required by the local municipality and shall meet compliance to FAA regulations as NVG compatible lighting for this project and fully compliant with FAA AC #AC70/7460-1M (or latest revision), Obstruction Marking and Lighting.

C. The Tower Contractor shall ensure the obstruction lighting system is installed by registered certified installers for the manufacturer and the installers have completed applicable training programs as required by the lighting system manufacturer. Copies of certification shall be provided to the Owner.

D. Unless otherwise required by the FCC, the Tower Contractor shall provide a L-810 LED Night Vision Compatible Steady-Burning Red Obstruction Light.

E. System control circuitry shall be enclosed in galvanized rigid metallic conduit or other owner approved method to be in compliance with NEC®, as well as local electrical codes in effect at the site of installation.

F. System control circuitry shall provide synchronization and intensity control of the obstruction lighting system and shall monitor the overall integrity of the lighting system for component failures or improper operation.

G. Form C, dry alarm output relay contacts, rated at .3A minimum at 24 volts direct current (VDC)/125 VAC, shall be provided to indicate illumination and power failure.

H. The Tower Contractor shall wire alarms to a Tower Contractor-provided Type 66 block located in the communications facility or equipment room. Alarms shall be clearly labeled and tested.

I. The control enclosure shall be located on the exterior wall of the facility or the base of the tower.

1. The power shall be supplied by the facility's equipment panel. The voltage will be determined by the light manufacturer's specifications.

2. Surge protection devices shall be installed per Motorola R56 on all power and control/alarm circuits within 24-inches of entry into the facility.

5.11. Tower Grounding

A. The Tower Contractor shall provide materials and labor required to ground each tower as specified in Section 5, Grounding, within this document.

B. If the tower design allows the foundation to extend into the area designated on the drawings in Appendix B for the ground system, the tower contractor shall be required to adjust the grounding and fencing so that the spacing shown on the drawings is maintained. Any added materials and labor shall be the responsibility of the Tower Contractor.

5.12. Ice Bridge

A. The Tower Contractor shall provide the materials, installation, and grounding of the ice bridge structures.

B. The ice bridge grounding shall comply with Section 5, Grounding, within this document.

C. The Tower Contractor shall install an ice bridge and cable support system so that an underground conduit system is not being used between the tower and the facility.

D. The ice bridge and cable ladders shall be installed between the cable conduit exit point and facility entry port.

E. The ice bridge width shall provide protection for RF cables per the width of the cable entry port.

F. The ice bridge shall be built in accordance with industry standards using hot-dipped galvanized construction.

G. The ice bridge shall be installed in such a manner that it runs the entire length of distance between the tower and the entry port on the building.

H. The ice bridge shall be installed to allow for proper RF cable support for entry into the top ports of the entry port.

I. A trapeze system shall be installed allowing for three levels of cable attachment beneath the bridge.

5.13. Below Ground RF, Electrical, and Data Cabling Conduits (911 Tower Only)

A. Conduits will be provided by the building project base bid. They will be installed by the EC.

B.

5.14. Tower Finishing

A. The enclosed area of each tower compound shall be graded level and tamped with sod and large stones removed. A water-permeable, weed-blocking fabric and stone shall be applied.

1. Backfilled soil shall be graded level and tamped.

2. Care should be given not to damage any underground cabling, grounding, or other infrastructure.

B. Sod, large rocks, and other debris shall be removed.

C. The site shall be finished with the application of 2B stone at a minimum depth of 6 inches throughout the entire compound.

1. The stone shall be raked level and evenly dispersed in the compound.

2. The stone shall be filled in beyond the outside of the perimeter fence for 2 feet or until it meets the roadway surface.

D. Pre-existing asphalt, concrete, sub-course, and grassy areas that have been excavated are to be returned to their original condition.

E. The sub-course shall be restored to the requirements of the site plan and certified compaction testing is required.

5.15. Final Testing and Acceptance

A. During installation and upon completion, each tower installation shall be inspected and tested to verify compliance with the manufacturer's requirements. The testing shall be performed by a third party or as detailed within the ROC building project specifications.

B. The Tower Contractor shall provide to the County as-built documentation and contractual documents.

C. Upon completion of the work, documentation detailing final inspection and testing shall be submitted, addressing the following:

1. Steel structure:

   (a) Vertical alignment and plumb
   (b) Bolts tight and torqued to specification
   (c) No damaged or missing structural members
   (d) No signs of stress or vibration
   (e) Climbing ladders and other devices installed correctly
   (f) Labels and tags

2. Foundation:

   (a) Concrete finish/lack of cracks/blemishes
   (b) Backfilling and grading

3. Grounding:

   (a) Verify lugs and exothermic welds
   (b) Ground resistance test and record

4. Ice bridge:

   (a) Installed per specification

5. Photographs:

   (a) Overall structure from north, east, south, and west
   (b) Footers
   (c) Grounding and lightning protection documented for both beneath- and above-grade applications

D. The Tower Contractor shall coordinate with the ROC site GC and design team for third-party inspections to meet ROC building project requirements.

6. FACILITY

6.1. Intent

A. The Respondent shall provide a wall-mounted cable entry port for the Auxcomm Tower.

B. The Respondent shall provide for RF cabling, future electrical, and data to leave the 911 Tower monopole via buried conduits from the tower to the equipment room.

C. The Respondent shall provide all components necessary to bond/ground, pathways, etc. from the tower structure to the equipment demarcation point, i.e., rack, cabinet, etc.

D. The County's representative and the Tower Contractor shall conduct a walkthrough of each facility to identify any electrical upgrade requirements; the Tower Contractor shall complete identified electrical upgrades provided by approved change order or approved addendum to the contract.

6.2. Cable Trays

A. Cable trays shall be a minimum of 6 inches above equipment racks.

B. There shall be a minimum of 12 inches between the cable tray and ceiling.

C. Cable trays shall not be placed under sprinkler heads or smoke detectors.

D. Cable trays shall be bonded at connection points and connected to the internal interior grounding system.

E. Cable tray minimum width shall be 18 inches and sized appropriately to carry all communications cabling and provide for 50% growth.

6.3. Site Preparation

A. The Tower Contractor shall prepare each tower for equipment installation.

B. The Tower Contractor shall place each tower and/or equipment as described in this document.

C. The Tower Contractor shall bond each tower and ancillary equipment to the single-point grounding to the grounding system as described in this document.

6.4. Antenna Cable Entry Ports

1. RF cable shield grounds shall be connected to each facility EGB with tin-plated copper irreversible ground lugs and a non-oxidizing compound applied to prevent corrosion.

2. The entry port requires no less than 12 ports, 4-inches in size to allow for an additional 50-percent future expansion.

3. The entry port shall be specifically designed for cabling.

4. Entry of antenna transmission lines into a facility requires weatherproofing and a commercially made port assembly specifically designed for this purpose.

5. Openings shall be properly booted to provide a good weather seal.

6. Unused cable ports shall be properly sealed with manufacturer-approved materials.

7. The entry port shall be grounded to the EGB on the outside of each facility.

7. GENERAL INSTALLATION REQUIREMENTS

A. Installations shall be coordinated with Lake County's radio service provider.

B. Installation shall include delivery to the tower sites; unloading equipment inside; setting in place; fastening to walls, floors, counters or to the structure fixtures where required; internal wiring and connection of components to the system; and all other work, whether or not expressly required herein, which is necessary to result in each complete tested and operating system.

C. The Tower Contractor shall provide electrical service to the equipment, as needed for a complete operable system. The Respondent shall determine proper cable and/or conductor lengths for the equipment to be installed.

D. Installation shall be performed in accordance with the applicable standards, requirements, and recommendations of NEC, IEEE, Motorola R56, and the local AHJ.

7.1. Tower Climbing and Installation Safety Practices

A. Because each tower installation requires working at heights, the County is very concerned that all work be done in a safe manner.

1. The Respondent must submit as part of its RFB response the Respondent's written environmental safety and health program, to which the Respondent agrees it will adhere.

B. The Tower Contractor must adhere to the following:

1. When any work on an antenna support structure is being performed above ground level, there must always be at least two certified competent tower climbers onsite. All personnel working on the tower or in the tower compound must wear hard hats during these times.

2. All tower climbers and their supervisors must have completed an OSHA-approved tower climbing safety and rescue course, such as those offered by ComTrain or Tractel, within the last five years. At least one person within the Respondent's company must have completed the course within the last year, to bring others in the

company up to date with any new changes in safety regulations, requirements, and procedures. The Respondent must submit certification cards for its personnel with its response.

3. An industry-standard rescue bag must be ready at the tower site whenever a climber is working on a tower. The bag must include at least one 400-foot, properly rated rescue rope with appropriate safety pulley system and all necessary items to allow the safe lowering of an injured worker. The Respondent must supply evidence that it owns at least one of these kits.

4. All climbers must always wear a full-body safety harness—with the appropriate approved shock-absorbing safety lanyard attached to a single D-ring at the top of the climber's back—when on a tower. Each climber must be issued, equipped, and use fall-protection equipment that must ensure a 100% tie-off while climbing. All fall-protection and safety equipment must meet ANSI and OSHA standards and may be inspected by the County or its representatives at any time during the project.

5. A pre-climb safety meeting is required before each climbing of an antenna support structure. A log of such meetings is required and may be inspected by the County at any time during the project.

C. The County may perform unannounced safety inspections at any time during the project; this in no way infers that the County has accepted any liability for any safety procedure, equipment condition, safety condition, or work action taken by the Tower Contractor, regardless of whether the County was aware of the procedure, condition, or work action. The County has the right, as solely determined by the County, to inform the Tower Contractor of any actions, procedures, conditions, or equipment that it deems to be unsafe or potentially hazardous. The County also reserves the right to halt work on the site until such time that the County agrees that the action, procedure, condition, or equipment has been returned to a safe condition. No additional charges will be incurred by the County for the above work stoppage.

D. All standard, best safety practices must always be followed when working at the radio sites. The Tower Contractor shall be solely and completely responsible for the safety and supervision of its employees and any other persons engaged by the Respondent for this project.

E. The Respondents must submit a copy of its written drug and alcohol policy, including information on what drug and alcohol testing policies are currently used by the Respondent.

F. When performing any work on an antenna support structure, or near any RF emitters, such as antennas and microwave dishes, the Tower Contractor must comply with the FCC's OET[1] Bulletin 65, Edition 97-01 (including Supplement A), *Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields*. The Respondent must show proof that its personnel have received training in RF exposure, such as a description of a course taken, or other details on the training received, along with the names of the personnel who will be working on this project and as such may be exposed to RF electromagnetic fields.

[1] Office of Engineering and Technology.

1. In addition, the proposal must contain the model number and serial numbers of at least two personal RF safety monitors.

2. The Tower Contractor shall be solely and completely responsible for the RF exposure compliance and safety and supervision of its employees, and any other persons engaged by the Respondent for this work.

7.2. Labeling and Identification

Panels, cables, and connectors shall be clearly identified by number and function for all equipment and demarcations.

7.3. Field Quality Control

A. Installation Monitoring and Reporting

1. The County shall be permitted to monitor any activity associated with the implementation of each radio site development.

B. Inspection

1. During the course of the project, the Tower Contractor shall maintain an adequate inspection system and shall perform such inspections to ensure that the materials supplied, and the work performed, conform to contract requirements.

C. Pre-Final Testing

1. The entire site development, as well as all components, shall be thoroughly tested and documented before being placed in service.

2. The Tower Contractor shall submit test plans for each component and the overall systems.

   (a) The Respondent shall submit sample test plans as part of its response.

   (b) Specific detailed test plans shall be required to be submitted and approved after final system design is completed.

3. The intent of this requirement is to ensure that all test plans will provide for the thorough exercise and documentation of functionality and performance as required by this bid document, as well as other features or enhancements that may be proposed.

D. Reports

1. The Tower Contractor shall provide written reports of tests and observations for the County’s analysis.

2. The Tower Contractor shall provide printed test result documentation directly from the test equipment used, indicating that all testing was completed and that all irregularities were corrected and retested, prior to installation acceptance.

   (a) The Tower Contractor shall provide records of defective materials, workmanship, and unsatisfactory test results for the County's analysis.

   (b) The Tower Contractor shall provide records of repairs and adjustments for the County's analysis.

8. FINAL TESTING AND ACCEPTANCE

A. The Tower Contractor shall test, verify, and document that each facility's electrical and mechanical systems are functioning properly.

B. At substantial completion, the Tower Contractor shall conduct a site walk at each location with the County's representative to complete punch lists.

1. Substantial completion shall be defined as when the Respondent has completed the installation, so it is fit to be used for its intended purpose.

C. The Tower Contractor shall correct punch-list items within 30 days of substantial completion, unless otherwise noted in contract documents.

D. Closeout documentation shall be provided within 30-days of substantial completion, unless otherwise noted in contract documents. Each document shall be provided on USB and downloadable PDF format shall be furnished in tabbed and organized format. The following items minimally shall be part of the closeout documents.

1. Operator manuals
2. Installation manuals
3. Approved submittals
4. Spare part list
5. Tower and site stamped and/or approved drawing and specification packages
6. Inspection reports, e.g., concrete, compaction, etc.
7. Red-line as-build drawings

E. A one-year warranty for all equipment and labor shall start at substantial completion. Unless otherwise noted in contract documents.

1. The warranty shall include all labor and materials to correct any deficiencies.

2. All deficient equipment shall be replaced with new. An additional one-year warranty includes labor and material, of the newly installed equipment shall start after the correction of the deficiency has been accepted by the AHJ.

F. The Tower Contractor shall conduct follow-up inspections, if required.

G. Acceptance of the site will not be granted until all testing has been completed, reviewed, and approved by the County.

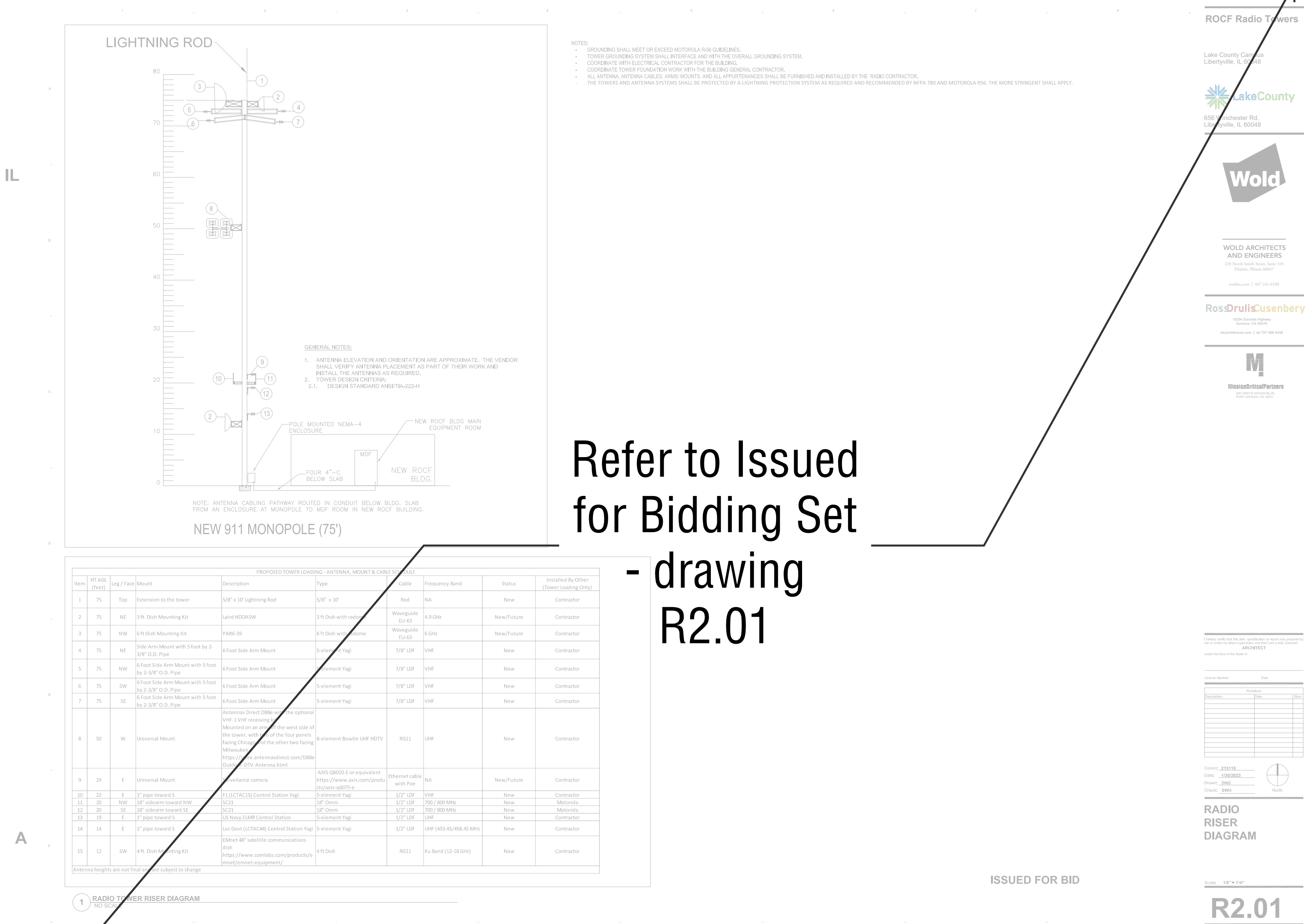
APPENDIX A: GEOTECHNICAL SURVEYS & LAND SURVEYS

The ROC geotechnical & land surveys will be available upon request.

APPENDIX B: ROC CONSTRUCTION DRAWINGS AND SPECIFICATIONS

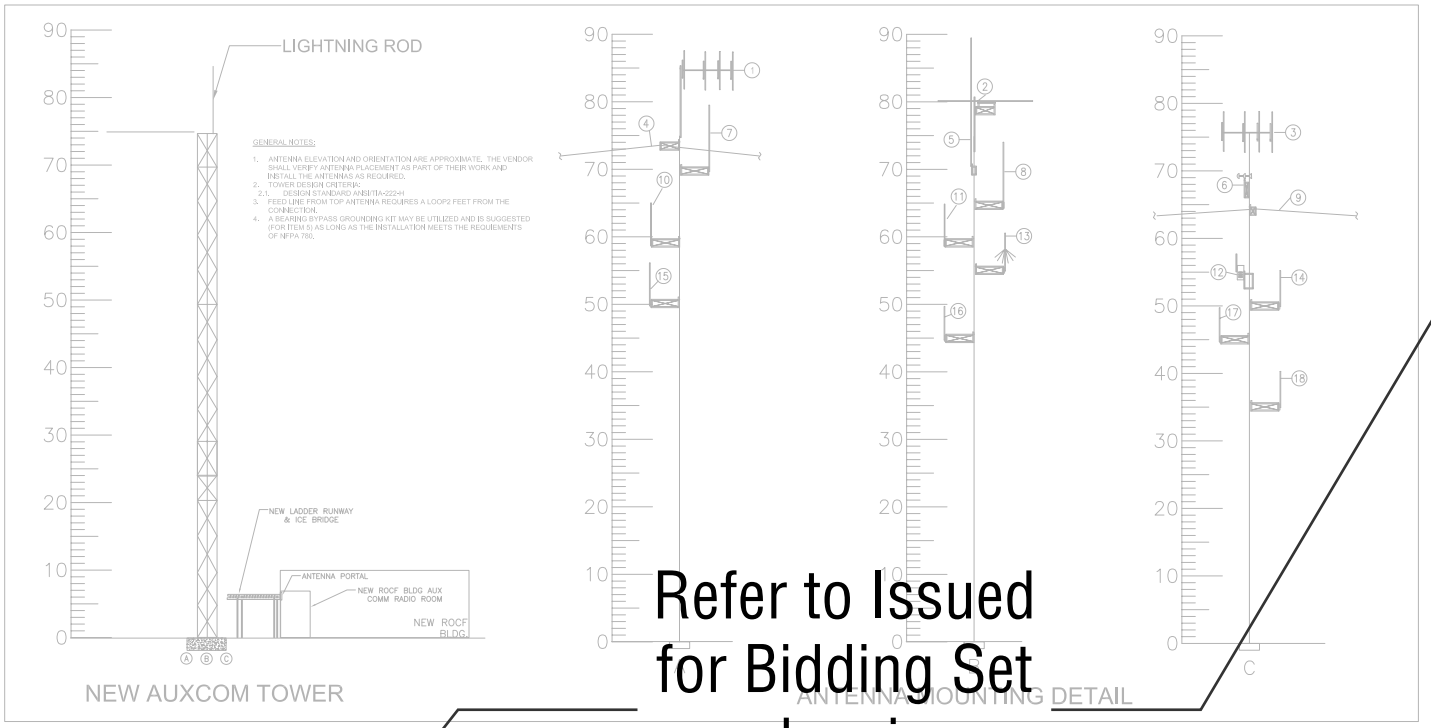
The ROC construction drawings and specifications applicable to tower construction will be available upon request.

APPENDIX C: 911 TOWER CONCEPTUAL DRAWINGS



Refer to Issued for Bidding Set - drawing R2.01

APPENDIX D: AUXCOMM TOWER CONCEPTUAL DRAWINGS



PROPOSED TOWER LOADING - ANTENNA, MOUNT & CABLE SCHEDULE

Item	Antenna HT Base / Mounting Point AGL (feet)	Leg / Face	Mount	Description	Type	Cable	Frequency Band	Status	Installed By Other (Tower Loading Only)	Manufacturer	Notes
1	85	Top	Mast	CUSHCRAFT A270-10S	5 element beam	1/2" LDF	VHF/UHF Amateur	New	Contractor		
2	80	Top	Mast	7.2 MHz Rotatable Dipole	Cushcraft D7	1/2" LDF	7.2 MHz	New	Contractor	https://www.dxengineering.com/	Horizontal whip
3	75.5	Top	Mast above thrust bearing	Mosley CL 36M	Mosley CL 36M 14-21-28 Mhz beam	1/2" LDF	14 - 28 MHz	New	Contractor	http://www.mosley-electronics.com/classic.html	Horizontal yagiee top mounted
4	74		2' Side arm	Alpha Delta DX-80 80m 3.8 Mhz dipole (wire) w/end insolators	Alpha Delta DX-80 80m 3.8 Mhz dipole (wire) w/end insolators	1/2" LDF	3.8 MHz	New	Contractor	https://www.hamradio.com/detail.cfm?pid=HD 005116	Wire with supporting ropes
5	70.5	Inside	Mounted to Rotator	17.5-Ft. Mast	ASTM A120 Hot-dipped galvanized Sch 80 1.5-inch pipe mast with threaded cap.	N/A	N/A	New	Contractor		
6	70	Inside	Fixed plate	Antenna Rotator	HY-Gain HAM-IV	8-conductor Special	N/A	New	Contractor	https://rmfjenterprises.com/products/ham-iv#description	
7	68	N	Direct Leg	WX Anemometer	Davis	Wireless	N/A	New	Contractor		
8	64	E	3' Side Arm	F22A VHF	10.5' VHF Vertical	1/2" LDF	VHF P.S.	New	Contractor	https://www.diamondantenna.net/F22a.html	Whip
9	64	W	3' Side Arm	CX-333 V,U,L	10.5' Vertical	1/2" LDF	VHF/220/UHF Amate	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/tri-band-3/	
10	64		3' Side Arm	RW Antennas RW-G580 GSRV 3 – 30 Mhz dipole (wire) w/end insolators	RW Antennas RW-G580 GSRV 3 – 30 Mhz dipole (wire) w/end insolators	1/2" LDF	30 MHz	New	Contractor		Wire with supporting ropes
11	59	N	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
12	59	S	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
13	55	S	Direct Leg	Solar sensor	Davis	Wireless	N/A	New	Contractor		
14	55	W	3' Side Arm	Discone	Telewave - ANT220K - 30-3000 MHz Unity Gain Wideband Discone Antenna	1/2" LDF	Broadband Rx	New	Contractor	https://resources.tessco.com/attachments/511644_ANT220K.pdf	Discone Whip
15	50	N	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
16	50	S	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
17	45	E	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
18	45	W	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
19	35	N	3' Side Arm	GP3 V/UHF	4.2' V/UHF Vertical	1/2" LDF	VHF/UHF Amateur	New	Contractor	https://cometantenna.com/amateur-radio/base-antennas/ba-dual-band/	Whip
20	20	E	Univer Mount	Surveillance Camera	AXIS Q6010-E or equivalent	Ethernet cable with Poe	N/A	New/Future	Contractor	https://www.axis.com/products/axis-q6075-e	

1. Antenna heights are not final and are subject to change
*N/S and E/W side arms are designed to be a single structure that extends 3' beyond the face of the tower in each direction

1 RADIO TOWER RISER DIAGRAM
NO SCALE

NOTES:
- GROUNDING SHALL MEET OR EXCEED MOTOROLA R56 GUIDELINES.
- TOWER GROUNDING SYSTEM SHALL INTERFACE AND WITH THE OVERALL GROUNDING SYSTEM.
- COORDINATE WITH ELECTRICAL CONTRACTOR FOR THE BUILDING.
- COORDINATE TOWER FOUNDATION WORK WITH THE BUILDING GENERAL CONTRACTOR.
- ALL ANTENNA, ANTENNA CABLES, ARMS/ MOUNTS, AND ALL APPURTENANCES SHALL BE FURNISHED AND INSTALLED BY THE RADIO CONTRACTOR.
- THE TOWERS AND ANTENNA SYSTEMS SHALL BE PROTECTED BY A LIGHTNING PROTECTION SYSTEM AS REQUIRED AND RECOMMENDED BY NFPA 780 AND MOTOROLA R56. THE MORE STRINGENT SHALL APPLY.

ISSUED FOR BID

ROCF Radio Towers
Lake County Campus
Libertyville, IL 60048
Lake County
656 Winchester Rd,
Libertyville, IL 60048
Wold
WOLD ARCHITECTS AND ENGINEERS
Ross Drulis Cusenbery
ARCHITECT
RADIO RISER DIAGRAM
R2.02

APPENDIX E : COMPLIANCE MATRIX

The Compliance matrix is provided as a separate Excel file.