Broadcast Tower Maintenance and Condition Assessment, Standards, and Best Practices for Tower Contractor Selection

2023 Broadcasters Clinic

Wisconsin Broadcasters Association

October 11, 2023

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The Deadliest Job in the United States

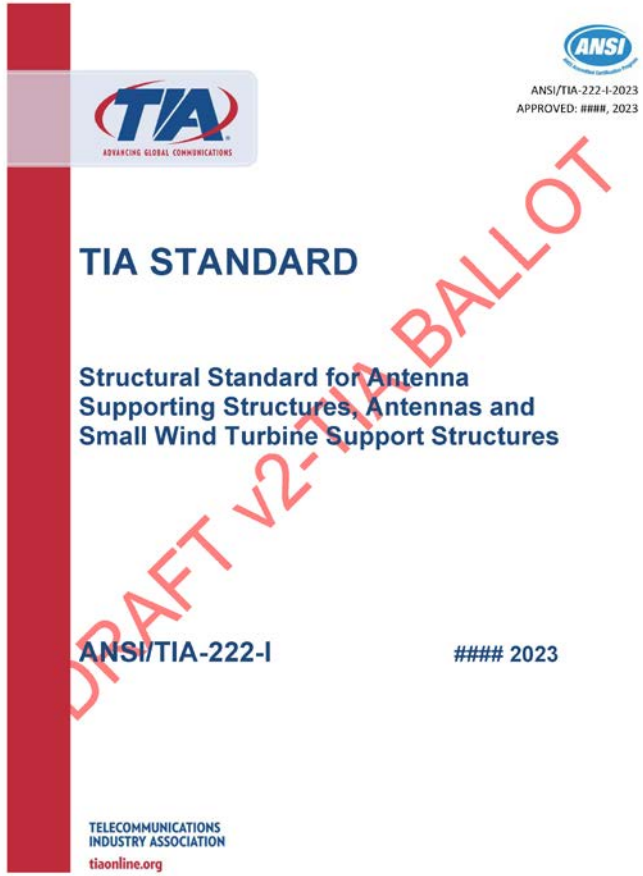
- **Building the Cellular Infrastructure**

"…rapid expansion of AT&T's 3G network … directly contributed to the spike in tower climber fatalities in 2008 that led Edwin Foulke of the Occupational Safety and Health Administration to declare the occupation "the deadliest job in the United States." (OSHA) Rushing to complete their work, with minimal oversight and inadequate fall protection, eleven tower climbers fell to their deaths while working at AT&T sites—more than the number of fatalities at all other providers' cellular sites combined."

TOWERCLIMBER.COM June 16, 2014

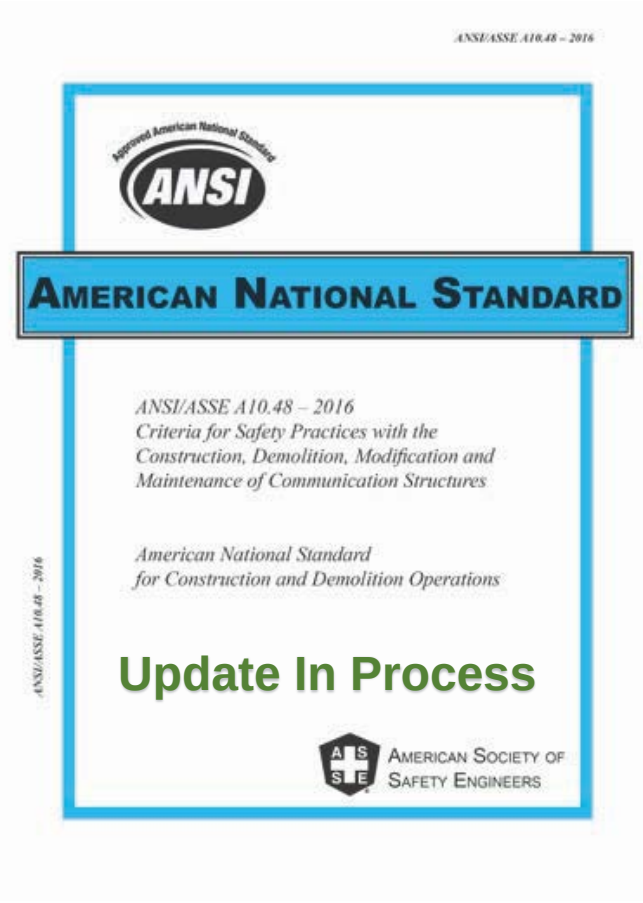
- **Since then, the industry has been engaged in updating and upgrading the engineering standards and the procedures and practices that govern tower design, installation, modification, inspection, and maintenance.**

Governing Standards



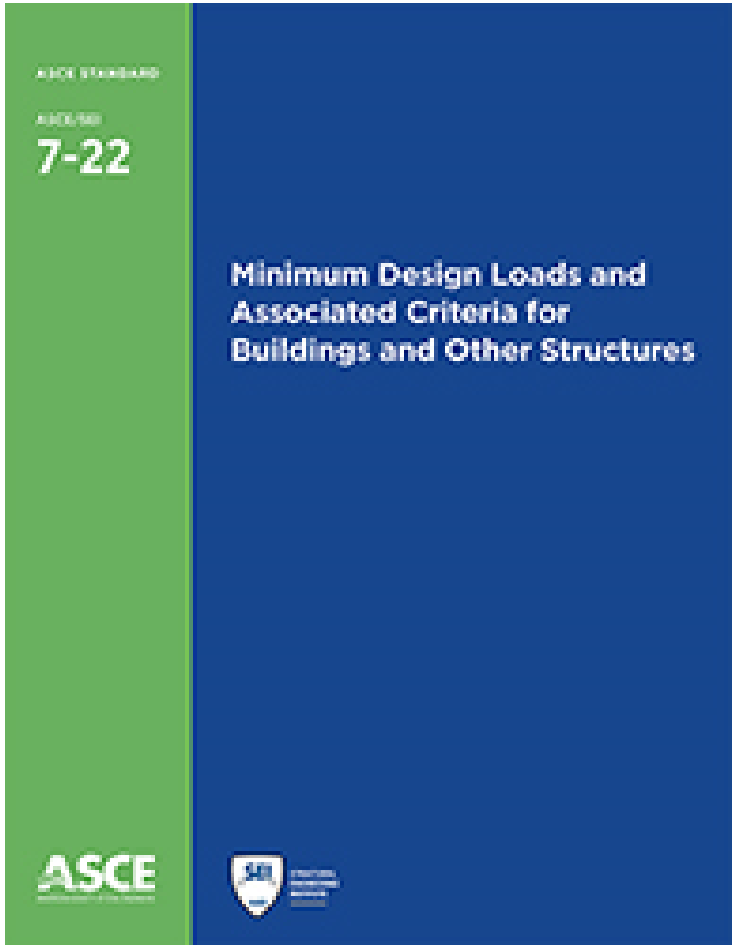
ANSI/TIA-222-I Structural Standard

ANSI/TIA-322-A Engineering Standard



ANSI/ASSE-A10.48 Safety Practices

Driver for Standard Updates



- **ASCE 7-22 Minimum Design Loads and Associated Criteria for Buildings and Other Structures**
  - **First-ever criteria for:**
    - Tornado-resistant structure design
  - **Improvements in models for environmental hazards:**
    - Atmospheric icing
    - Earthquake
    - Tsunami
    - Rain, snow, and wind
  - **Digital Resource ASCE 7 Hazard Tool**
    - https://asce7hazardtool.online/

ANSI/TIA-222-H Risk Categories

Rev G: Structure Class

New

Table 2-1: Risk Categorization of Structures

Use or Description of Structure	Risk Category
Structures that due to use or location represent a low risk to human life and/or damage to surrounding facilities in the event of failure. Structures in this category are used for services that are optional and/or where an extensive delay in returning the services would be acceptable such as: redundant wireless antennas; low-power radio access nodes (small cell); single-appurtenance supporting structures that allow for rapid repair or replacement, residential wireless and conventional 2-way radio communications; television, radio and scanner reception; wireless cable; amateur and CB radio communications.	I
Structures that due to use or location represent a moderate risk to human life and/or damage to surrounding facilities in the event of failure. Structures in this category are used primarily for redundant services (i.e. services that may be provided by other means) such as: commercial wireless communications (cellular, PCS, 3G, LTE, 4G, 5G, etc.); television and radio broadcasting; community access television (CATV); microwave communications; non-hardened sites that support antennas or equipment that may be used for redundant communications by police and fire departments, first responders, etc. during emergencies and small wind turbines. This category applies to all structures except those identified in Risk Categories I, III, and IV.	II
Structures that due to use or location represent a substantial risk to human life and/or damage to surrounding facilities in the event of failure. Structures with the potential to cause mass disruption (loss of power, transportation, water, etc.) of day-to-day civilian life in the event of failure. Structures in this category are used for communications across non-redundant and hardened networks such as: civil or national defense; rescue or disaster operations; military and navigation facilities.	III
Structures that due to use or location represent a substantial hazard to the community in the event of failure. Structures in this category are those that in the event of failure would threaten the functionality or integrity of facilities that are designated as Risk Category IV facilities.	IV

TIA-222-H Major Changes

- **Wind Speeds are now Ultimate Wind Speed instead Nominal Wind Speed used in Rev. G**
- **Separate Wind Speed and Icing maps for each Risk Category**

Rev. G Risk Category II Tower 90 MPH Nominal Wind Speed	**=**	**Rev. H Risk Category II Tower 114 MPH Nominal Wind Speed**

- **Wind Speeds are decreased 10% or more for most of the country**
- **Wind Speeds in central Florida increase by 5% to 10%**

TIA-222-H Major Changes

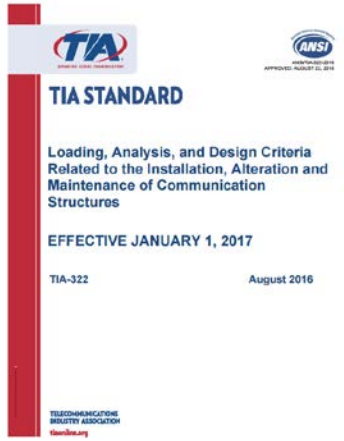
- **Exposure Category**
  - **Surface Roughness B: urban and suburban areas, wooded areas, or other terrain with numerous closely spaced obstructions having the size of single-family dwellings or larger.**
  - **Surface Roughness C: open terrain with scattered obstructions having heights generally less than 30 ft. [9.1 m]. This category includes flat open country, grasslands and athletic fields.**
  - **Surface Roughness D: flat, unobstructed areas, shorelines and water surfaces. This category includes smooth mud flats, salt flats and unbroken ice.**
    - Rev. G applied Exposure C to hurricane coastlines
    - Exposure D applies average wind pressures 10% to 15% higher the Exposure C

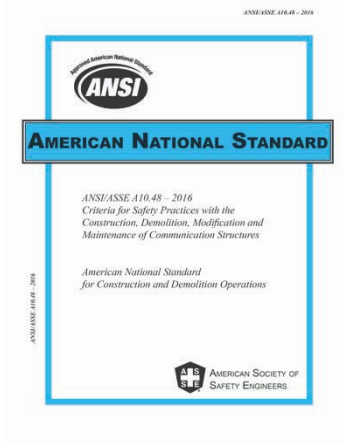
TIA-222-H Major Changes

- **Rev. H Ground Elevation Factor**
  - **Wind pressure decreases with elevation**
    - 2% Reduction for Chicago and most of Michigan
    - 17% Reduction in Denver
    - 7% Reduction in Las Vegas
    - 4% in Atlanta and Phoenix
- **Topographic Factor increased wind pressure on tall hills and ridges**
  - **Rev. H specifically allows the use of site-specific topographical factors**
- **Rooftop Wind Speed Factor: New factor for roof top structures increased wind pressure over rooftops.**
  - **Only applies to buildings that are isolated and 50-feet tall or taller**

ANSI/TIA-322 and ANSI/ASSE-A10.48

- **ANSI/TIA-322 Loading, Analysis, and Design Criteria Related to the Installation, Alteration and Maintenance of Communication Structures**
  - **Engineering Standard**
- **ANSI/ASSE-10.48 Criteria for Safety Practices with the Construction, Demolition, Modification and Maintenance of Communication Structures**
  - **Contractors Standard – Means and Methods**





322/A10.48 Overview

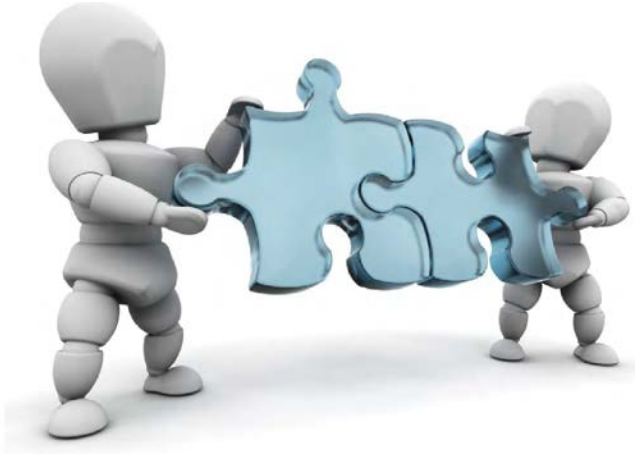
- ANSI/TIA-322 and ANSI/ASSE A10.48 build upon core engineering and accepted safe work practice concepts presented in the ANSI/TIA-1019-A with expanded and focused content to facilitate greater understanding and improved communications between engineers and contractors when planning and assessing tower construction activities
- General conformance to all minimum construction requirements set forth in the ANSI/TIA-1019-A are satisfied or exceeded through proper application of the minimum criteria now established within the ANSI/TIA-322 and ANSI/ASSE A10.48 standards
- When properly utilized, results in reduced construction costs through planning, better procedures, increased risk identification and mitigation, and substantial improvements to overall construction safety and work quality

Roles and Responsibilities–General Contractor

- For all Classes of construction, GC must provide a designated and qualified onsite "Competent Rigger" to identify hazards, take corrective measures to mitigate hazards, and to implement all necessary construction means and methods.
- For Class III and IV construction, GC must provide or engage a designated and qualified "Qualified Person" to assist in developing the rigging plan and to communicate construction requirements to all stakeholders.
- For Class IV construction, GC's "Qualified Person" must assist in rigging plan development while coordinating and engaging necessary involvement of a "Qualified Engineer" to assess supporting structure under all pertinent construction phases

Roles and Responsibilities–General Contractor

- **Competent Rigger:**
  - **Required for ALL classes of construction**
  - **Must be onsite**
  - **Communicates directly with Qualified Person when questions arise on construction activities**



- **Qualified Person:**
  - **Only required on Class III and IV construction activities**
  - **May be onsite, in office, or same individual serving as either Competent Rigger or Qualified Engineer (aka Supervising Engineer)**
  - **Communicates directly with Qualified Engineer when questions arise on construction activities**

Roles and Responsibilities–Engineering

- **Engineer of Record: Registered professional engineer with expertise in the discipline applicable to the scope of work and who assumes responsibility for the design and structural adequacy of the structure in its COMPLETED state**
- **Qualified Engineer: Registered professional engineer who is knowledgeable and experienced in the communication structures industry and capable of understanding the contractor's rigging plan and the scope of work impact upon the structure, and is responsible for analyzing the structure's strength and stability while accounting for construction loads in accordance with the ANSI/TIA-322 standard**
  - **The Qualified Engineer does NOT have the responsibility for development of the rigging plan, field supervision, or implementation of the construction means and methods**
- **Supervising Engineer: Accepts all responsibilities as defined for a Qualified Engineer and assumes or shares the additional responsibilities as defined for a Qualified Person, and may have responsibility in specifying certain portions of the construction means and methods**
  - **Assumes all or a portion of the responsibilities in developing the rigging plan and may additionally provide field supervision or other means of oversight to verify execution of the planned construction means and methods**

Standardized Common Terminology & Definitions

- Establishes key stakeholder titles and responsibilities
- Standardizes terminology for common equipment and components involved in telecommunications construction
- Provides standard set of symbols and notations for consistency in load charts and construction engineering reviews

Construction Classes and Rigging Plans

- **Construction Class determines the minimum personnel which must be provided or engaged by the contractor in the development, review, and implementation of their Rigging Plan**

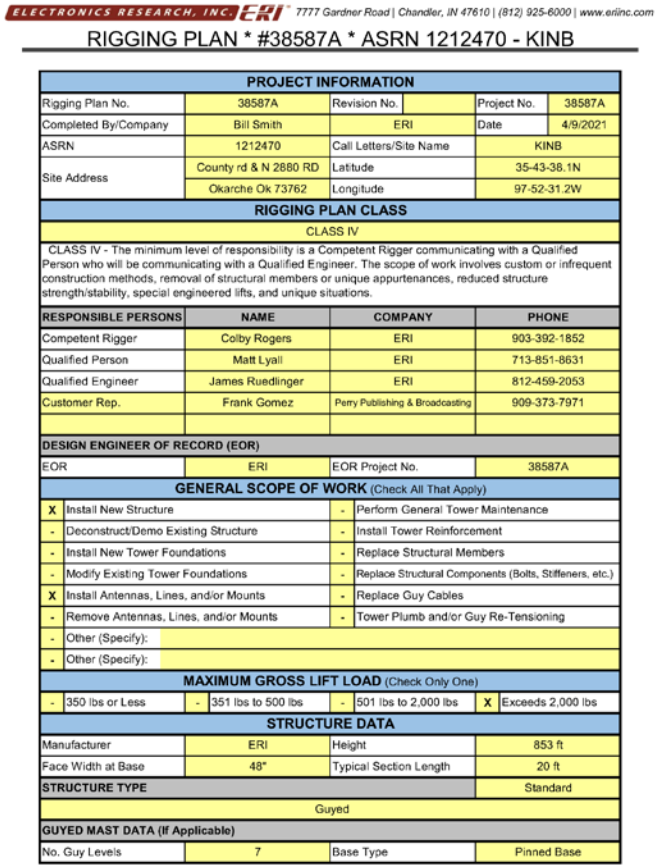
Construction Classes and Rigging Plans

- **When is a Rigging Plan required?**
  - **In short, a rigging plan in accordance with ANSI/ASSE A10.48 is required for ALL tower construction activities including, but not limited to:**
    - Tower installation and/or decommissioning of equipment/appurtenances
    - Tower structural modifications to members/components
    - Tower installation or decommissioning/demolition
    - Tower foundation installation/modification
    - Any construction activity involving a telecommunication structure
  - **ANSI/ASSE A10.48 provides four Construction Classes**
    - Construction classes have lifted load limits
    - Categorized by potential impact to supporting structure's strength/stability
    - Categorized by personnel involved in planning/implementation process
    - Require varying levels of documentation and involvement by project stakeholders
  - **Rigging plans for Class II, III, and IV construction must be documented**

Construction Class Considerations

- **Four Construction Classes With Three Basic "Buckets" Which Determine Class:**
  - **Construction Scope of Work**
    - Includes any potential impacts to supporting structure's strength and/or stability (includes foundation)
  - **Maximum Gross Load Weight when Lift System is Attached to Structure**
    - Staged maximum limits at 350 pounds, 500 pounds, and 2,000 pounds
  - **Construction Procedures**
    - Includes construction sequencing and duration
    - Must account for individuals' experience implementing work

Rigging Plan Overview



ELECTRONICS RESEARCH, INC. ERI 7777 Gardner Road | Chandler, IN 47610 | (812) 925-6000 | www.erlinc.com

RIGGING PLAN * #38587A * ASRN 1212470 - KINB

PROJECT INFORMATION					
Rigging Plan No.	38587A	Revision No.		Project No.	38587A
Completed By/Company	Bill Smith	ERI		Date	4/9/2021
ASRN	1212470	Call Letters/Site Name		KINB	
Site Address	County rd & N 2880 RD	Latitude		35-43-38.1N	
	Okarche Ok 73762	Longitude		97-52-31.2W	
RIGGING PLAN CLASS					
CLASS IV					
CLASS IV - The minimum level of responsibility is a Competent Rigger communicating with a Qualified Person who will be communicating with a Qualified Engineer. The scope of work involves custom or infrequent construction methods, removal of structural members or unique appurtenances, reduced structure strength/stability, special engineered lifts, and unique situations.					
RESPONSIBLE PERSONS	**NAME**	**COMPANY**		**PHONE**	
Competent Rigger	Colby Rogers	ERI		903-392-1852	
Qualified Person	Matt Lyall	ERI		713-851-8631	
Qualified Engineer	James Ruedlinger	ERI		812-459-2053	
Customer Rep.	Frank Gomez	Perry Publishing & Broadcasting		909-373-7971	
DESIGN ENGINEER OF RECORD (EOR)					
EOR	ERI	EOR Project No.		38587A	
GENERAL SCOPE OF WORK (Check All That Apply)					
X	Install New Structure	-	Perform General Tower Maintenance		
-	Deconstruct/Demo Existing Structure	-	Install Tower Reinforcement		
-	Install New Tower Foundations	-	Replace Structural Members		
-	Modify Existing Tower Foundations	-	Replace Structural Components (Bolts, Stiffeners, etc.)		
X	Install Antennas, Lines, and/or Mounts	-	Replace Guy Cables		
-	Remove Antennas, Lines, and/or Mounts	-	Tower Plumb and/or Guy Re-Tensioning		
-	Other (Specify):				
-	Other (Specify):				
MAXIMUM GROSS LIFT LOAD (Check Only One)					
-	350 lbs or Less	-	351 lbs to 500 lbs	-	501 lbs to 2,000 lbs
X	Exceeds 2,000 lbs				
STRUCTURE DATA					
Manufacturer	ERI	Height		853 ft	
Face Width at Base	48"	Typical Section Length		20 ft	
STRUCTURE TYPE				Standard	
Guyed					
GUYED MAST DATA (If Applicable)					
No. Guy Levels	7	Base Type		Pinned Base	

F07-WIC7517 JMR Rev 9

- **A systematic and detailed presentation showing the equipment and procedures required for construction in accordance with the ANSI/ASSE A10.48 that will provide for the safety of personnel and for the stability of the structure and lifted components.**
- **Basic Rigging Plan Elements Include:**
  - **Project/Site Specific Information**
  - **Key Stakeholders Responsible for Construction Planning and Implementation**
  - **Construction Class**
  - **Scope of Work**
  - **Supporting Structure Information & Site Layout**
  - **Construction Sequence and Duration**
  - **Lifting System Details/Info & Lifted Load(s) Information**
  - **Construction Equipment and Rigging Information, Including Size and Capacity, and Attachment/Anchorage Details**
  - **Any Special Procedures, Details, or Documents Needed to Ensure A Safe Work Environment During Construction**
    - Monitoring requirements, proof testing requirements, etc.

Rigging Plan Classes

- **Class I Rigging Plans**
  - **“Minimum” Required Class For The Following:**
    - Gross lift loads for lift systems attached to the structure shall not exceed 350 pounds (excludes cranes or other lifting systems not attached to structure)
    - Construction activities do **NOT** adversely impact the strength or stability of the supporting structure and SOW does not require any special, custom, or unique construction methods.
    - Prepared by Qualified Person and/or Competent Rigger

Rigging Plan Classes

- **Class II Rigging Plans**
  - **“Minimum” Required Class For The Following:**
    - Gross lift loads for lift systems attached to the structure shall not exceed 500 lbs. (excludes cranes or other lifting systems not attached to structure)
    - Construction activities do **NOT** adversely impact the strength or stability of the supporting structure and SOW does not require any special, custom, or unique construction methods.
    - Prepared by Qualified Person and/or Competent Rigger

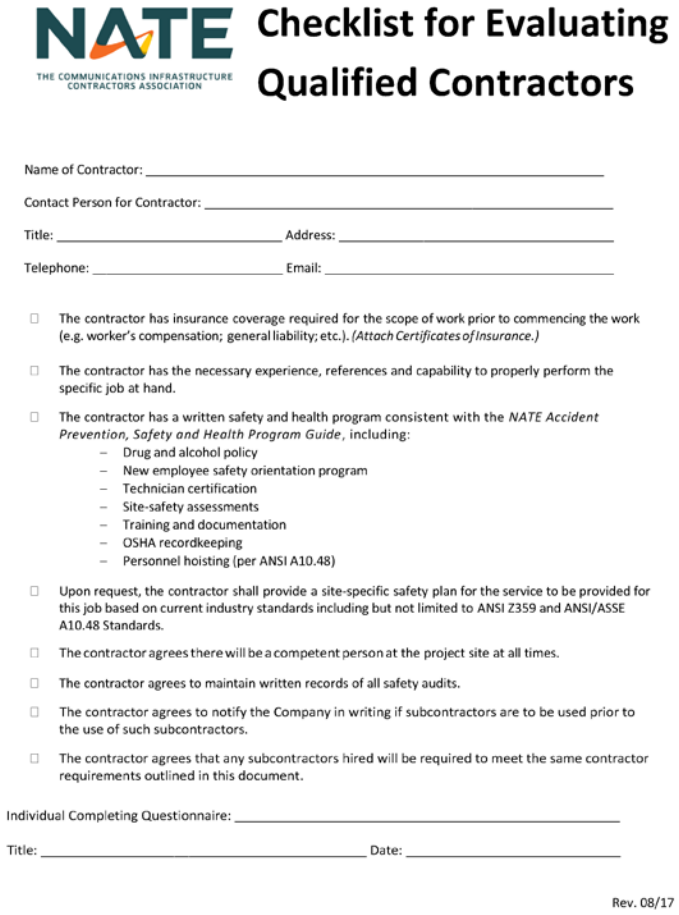
Rigging Plan Classes

- **Class III Rigging Plans**
  - **“Minimum” Required Class For The Following:**
    - Gross lift loads for lift systems attached to the structure shall not exceed 2,000 lbs. (excludes cranes or other lifting systems not attached to structure)
    - All new structure and foundation construction
    - All construction activities involving cranes or other lifting devices not attached to structure
    - Construction activities do NOT adversely impact the strength or stability of the supporting structure and SOW does not require any special, custom, or unique construction methods.
    - Prepared by Competent Rigger and Qualified Person

Rigging Plan Classes

- **Class IV Rigging Plans**
  - **“Minimum” Required Class For The Following:**
    - Any planned lift exceeding 2,000 pounds where the rigging system is directly attached to the structure (excludes cranes or other lifting systems not attached to the structure)
    - Removal of structural members or any activities involving reduced supporting structure strength or stability (i.e., structural member removal/replacement, guy wire installation/removal/replacement, significant foundation work impacting stability, etc.)
    - Removal of unique appurtenances where either imposed construction loading or supporting structure strength/stability is questioned by the Contractor
    - SOW involves custom or infrequent construction methods
    - Specially engineered lifts
    - Unique situations
    - All tower decommissioning and demolition
    - Prepared by a Competent Rigger and Qualified Person with a Qualified Engineer

Qualified Contractor Requirements



NATE
THE COMMUNICATIONS INFRASTRUCTURE CONTRACTORS ASSOCIATION

Checklist for Evaluating Qualified Contractors

Name of Contractor: _____

Contact Person for Contractor: _____

Title: _____ Address: _____

Telephone: _____ Email: _____

- ☐ The contractor has insurance coverage required for the scope of work prior to commencing the work (e.g. worker's compensation; general liability; etc.). *(Attach Certificates of Insurance.)*
- ☐ The contractor has the necessary experience, references and capability to properly perform the specific job at hand.
- ☐ The contractor has a written safety and health program consistent with the *NATE Accident Prevention, Safety and Health Program Guide*, including:
  - Drug and alcohol policy
  - New employee safety orientation program
  - Technician certification
  - Site-safety assessments
  - Training and documentation
  - OSHA recordkeeping
  - Personnel hoisting (per ANSI A10.48)
- ☐ Upon request, the contractor shall provide a site-specific safety plan for the service to be provided for this job based on current industry standards including but not limited to ANSI Z359 and ANSI/ASSE A10.48 Standards.
- ☐ The contractor agrees there will be a competent person at the project site at all times.
- ☐ The contractor agrees to maintain written records of all safety audits.
- ☐ The contractor agrees to notify the Company in writing if subcontractors are to be used prior to the use of such subcontractors.
- ☐ The contractor agrees that any subcontractors hired will be required to meet the same contractor requirements outlined in this document.

Individual Completing Questionnaire: _____

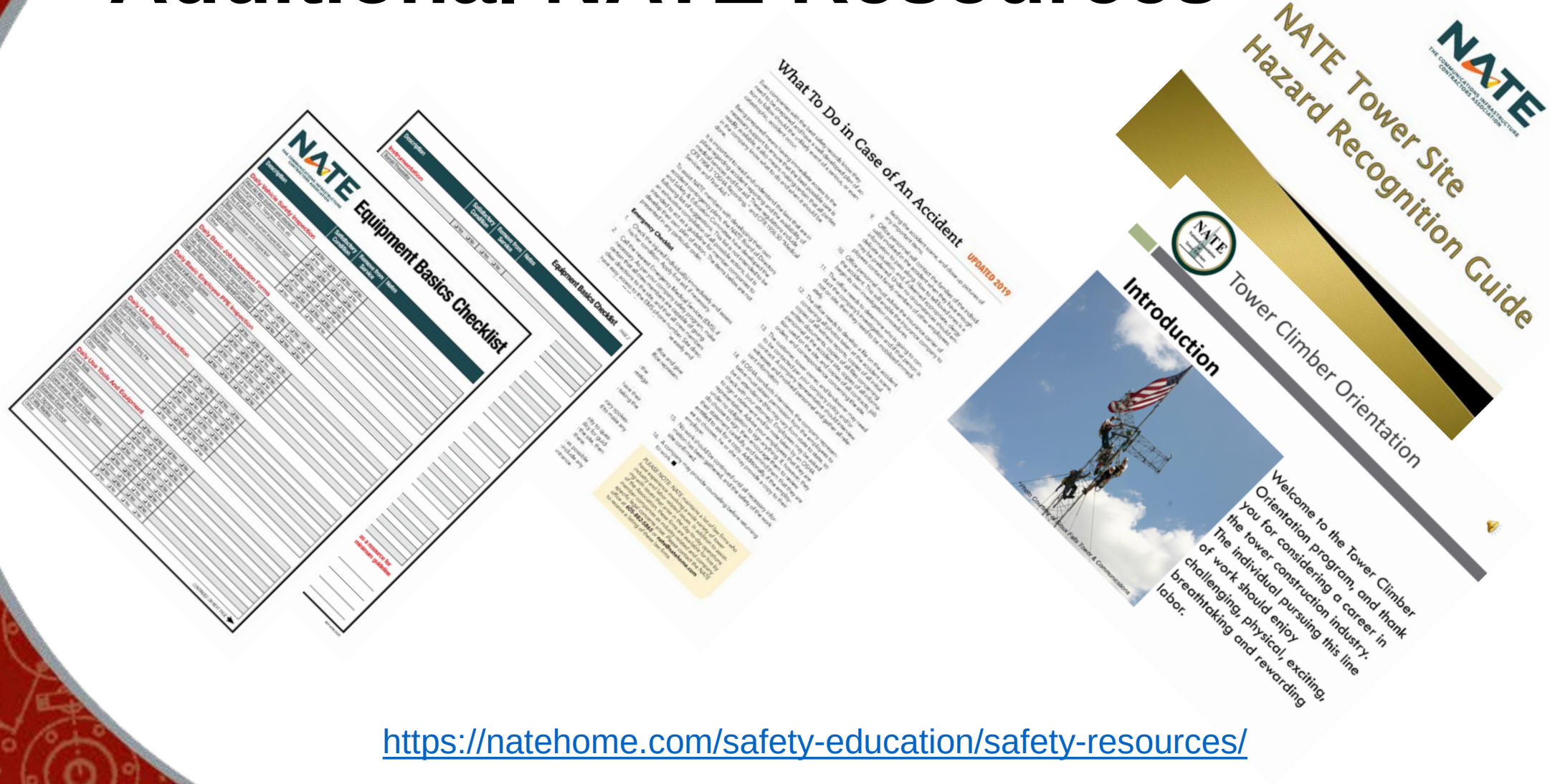
Title: _____ Date: _____

Rev. 08/17

- **Resources**
  - **National Association of Tower Erectors(NATE)**

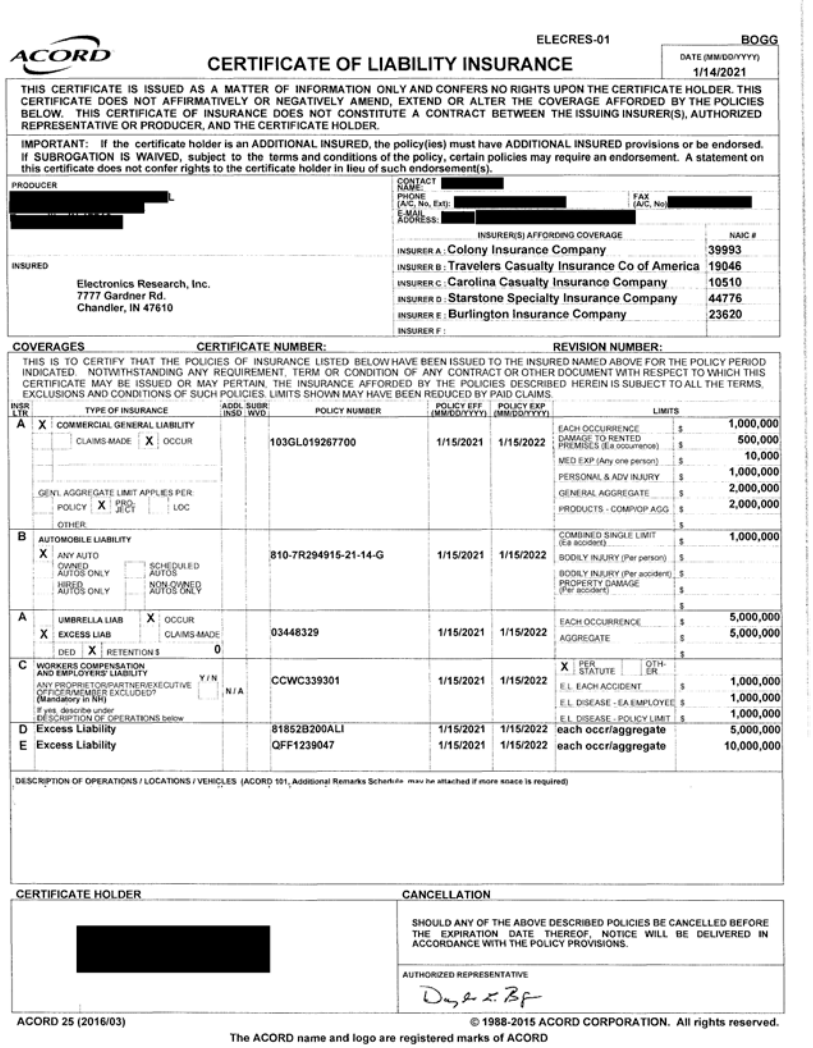
    https://natehome.com/safety-education/safety-resources/
    - Many free templates, checklists, and presentations useful to tower owners

Additional NATE Resources



https://natehome.com/safety-education/safety-resources/

Qualified Contractor Requirements



ELECRES-01 BOGG

ACORD

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 1/14/2021

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER [redacted]

CONTACT NAME: [redacted]
PHONE (A/C, No, Ext): [redacted] FAX (A/C, No): [redacted]
E-MAIL ADDRESS: [redacted]

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : Colony Insurance Company	39993
INSURER B : Travelers Casualty Insurance Co of America	19046
INSURER C : Carolina Casualty Insurance Company	10510
INSURER D : Starstone Specialty Insurance Company	44776
INSURER E : Burlington Insurance Company	23620
INSURER F :	

INSURED
Electronics Research, Inc.
7777 Gardner Rd.
Chandler, IN 47610

COVERAGES **CERTIFICATE NUMBER:** **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY						EACH OCCURRENCE	$ 1,000,000
	CLAIMS-MADE X OCCUR			103GL019267700	1/15/2021	1/15/2022	DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 500,000
							MED EXP (Any one person)	$ 10,000
							PERSONAL & ADV INJURY	$ 1,000,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						GENERAL AGGREGATE	$ 2,000,000
	POLICY X PRO-JECT LOC						PRODUCTS - COMP/OP AGG	$ 2,000,000
	OTHER							$
B	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
	X ANY AUTO			810-7R294915-21-14-G	1/15/2021	1/15/2022	BODILY INJURY (Per person)	$
	OWNED AUTOS ONLY / SCHEDULED AUTOS						BODILY INJURY (Per accident)	$
	HIRED AUTOS ONLY / NON-OWNED AUTOS ONLY						PROPERTY DAMAGE (Per accident)	$
								$
A	UMBRELLA LIAB X OCCUR						EACH OCCURRENCE	$ 5,000,000
	X EXCESS LIAB CLAIMS-MADE			03448329	1/15/2021	1/15/2022	AGGREGATE	$ 5,000,000
	DED X RETENTION $ 0							$
C	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N						X PER STATUTE / OTH-ER	
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) N/A			CCWC339301	1/15/2021	1/15/2022	E.L. EACH ACCIDENT	$ 1,000,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
D	Excess Liability			81852B200ALI	1/15/2021	1/15/2022	each occr/aggregate	5,000,000
E	Excess Liability			QFF1239047	1/15/2021	1/15/2022	each occr/aggregate	10,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule may be attached if more space is required)

CERTIFICATE HOLDER

[redacted]

CANCELLATION

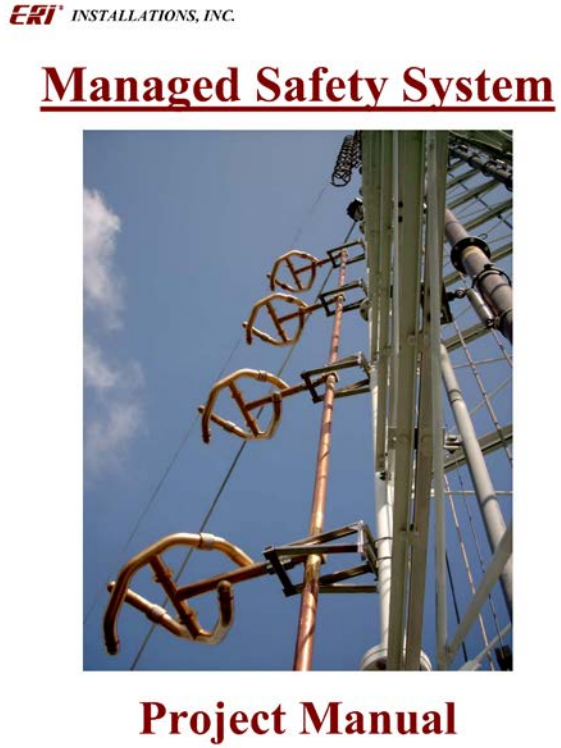
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

ACORD 25 (2016/03)

- **Does the contractor have the insurance coverage required for the project:**
  - **Commercial Liability**
  - **Automobile Liability**
  - **Workers Compensation and Employer Liability**
  - **Excess Liability up to the value of the project**
- **Get a Certificate of Insurance from the Contractor with your company as a Named Additional Insured**

Qualified Contractor Requirements


ERI INSTALLATIONS, INC.

Managed Safety System

Project Manual

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- Does the Contractor have the necessary experience needed to perform the work required
- Does the contractor have written Health and Safety Plans including:
  - Drug and alcohol policy
  - New employee safety orientation program
  - Technician certifications
  - Site-safety assessments
  - Training and documentation
  - OSHA recordkeeping program
  - Personnel hoisting (per ANSI A10.48)

Qualified Contractor Requirements

- **Require that there be a Competent Person on-site at all times work is being performed**
  - **OSHA defines a competent person in 29 CFR 1926.32(f) as**
    - "one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate them."
  - **The Competent Person must be identified before work begins.**

Qualified Contractor Requirements

- **Hard Hats**
  - **Inspected Daily**
  - **Must have a chin strap when climbing on tower**
  - **Everyone on site should wear one**
- **CPR/First Aid and Rescue Trained climber(s) as members of the crew**

Qualified Contractor Requirements

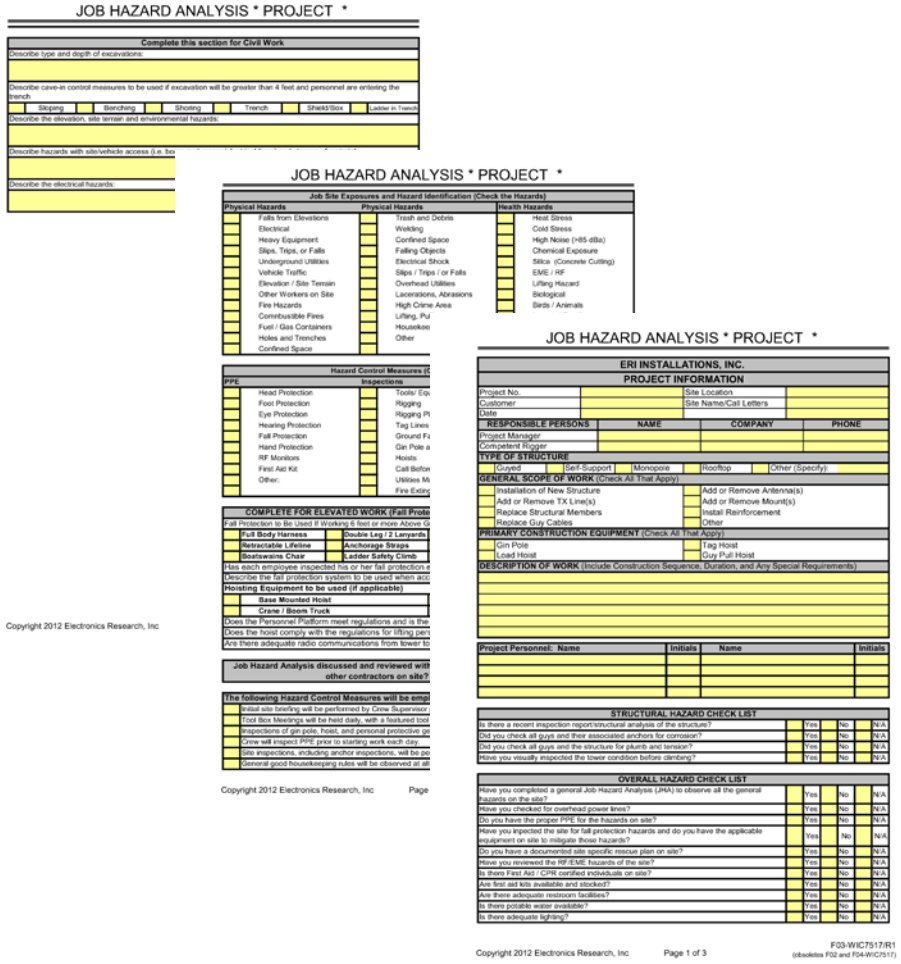
- Crew members should have Personal Protective Equipment which includes appropriate clothing
  - Footwear
  - Eye protection
  - Hand protection
  - Work clothing
  - Hearing protection

Qualified Contractor Requirements

- **Full Body Harness**
  - **Any Climber on your tower should have a Full Body Harness**
- **6’ Dual Shock Absorbing Lanyard**
  - **Connect Small Snap Hook to Dorsal D-Ring**
  - **Required For 100% Tie Off**
  - **Work positioning hooks are not considered fall protection equipment**

Site Hazard Analysis

- **Job specific site hazard analysis for installation and tower modification projects**
- **Should be written**
- **OSHA provides the definition of a hazard as: "a danger which threatens harm to employees" or "unsafe workplace conditions or practices (dangers) that could cause injuries or illness (harm) to employees." To identify hazards in a workplace, contractors should use a systematic approach. There are various strategies that can be used, depending on the type of work.**


JOB HAZARD ANALYSIS * PROJECT *

Complete this section for Civil Work

Describe type and depth of excavations:

Describe cave-in control measures to be used if excavation will be greater than 4 feet and personnel are entering the trench

Sloping | Benching | Shoring | Trench | Shield/Box | Ladder in Trench

Describe the elevation, site terrain and environmental hazards:

Describe hazards with site/vehicle access (i.e. bo

Describe the electrical hazards:

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JOB HAZARD ANALYSIS * PROJECT *

Job Site Exposures and Hazard Identification (Check the Hazards)

Physical Hazards	Physical Hazards	Health Hazards
Falls from Elevations	Trash and Debris	Heat Stress
Electrical	Welding	Cold Stress
Heavy Equipment	Confined Space	High Noise (>85 dBa)
Slips, Trips, or Falls	Falling Objects	Chemical Exposure
Underground Utilities	Electrical Shock	Silica (Concrete Cutting)
Vehicle Traffic	Slips / Trips / or Falls	EME / RF
Elevation / Site Terrain	Overhead Utilities	Lifting Hazard
Other Workers on Site	Lacerations, Abrasions	Biological
Fire Hazards	High Crime Area	Birds / Animals
Combustible Fires	Lifting, Pu	
Fuel / Gas Containers	Housekee	
Holes and Trenches	Other	
Confined Space		

Hazard Control Measures (

PPE	Inspections
Head Protection	Tools/ Eq
Foot Protection	Rigging
Eye Protection	Rigging Pl
Hearing Protection	Tag Lines
Fall Protection	Ground Fa
Hand Protection	Gin Pole a
RF Monitors	Hoists
First Aid Kit	Call Before
Other:	Utilities M
	Fire Extin

COMPLETE FOR ELEVATED WORK (Fall Prote

Fall Protection to Be Used If Working 6 feet or more Above G

Full Body Harness	Double Leg / 2 Lanyards
Retractable Lifeline	Anchorage Straps
Boatswains Chair	Ladder Safety Climb

Has each employee inspected his or her fall protection e

Describe the fall protection system to be used when acc

Hoisting Equipment to be used (if applicable)

Base Mounted Hoist	
Crane / Boom Truck	

Does the Personnel Platform meet regulations and is the

Does the hoist comply with the regulations for lifting per

Are there adequate radio communications from tower to

Job Hazard Analysis discussed and reviewed with other contractors on site?

The following Hazard Control Measures will be emp

Initial site briefing will be performed by Crew Supervisor

Tool Box Meetings will be held daily, with a featured tool

Inspections of gin pole, hoist, and personal protective ge

Crew will inspect PPE prior to starting work each day.

Site inspections, including anchor inspections, will be pe

General good housekeeping rules will be observed at all

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JOB HAZARD ANALYSIS * PROJECT *

ERI INSTALLATIONS, INC.

PROJECT INFORMATION

Project No.		Site Location	
Customer		Site Name/Call Letters	
Date			

RESPONSIBLE PERSONS	NAME	COMPANY	PHONE
Project Manager			
Competent Rigger			

TYPE OF STRUCTURE

Guyed | Self-Support | Monopole | Rooftop | Other (Specify):

GENERAL SCOPE OF WORK (Check All That Apply)

Installation of New Structure	Add or Remove Antenna(s)
Add or Remove TX Line(s)	Add or Remove Mount(s)
Replace Structural Members	Install Reinforcement
Replace Guy Cables	Other

PRIMARY CONSTRUCTION EQUIPMENT (Check All That Apply)

Gin Pole	Tag Hoist
Load Hoist	Guy Pull Hoist

DESCRIPTION OF WORK (Include Construction Sequence, Duration, and Any Special Requirements)

Project Personnel: Name	Initials	Name	Initials

STRUCTURAL HAZARD CHECK LIST

Is there a recent inspection report/structural analysis of the structure?	Yes		No	N/A
Did you check all guys and their associated anchors for corrosion?	Yes		No	N/A
Did you check all guys and the structure for plumb and tension?	Yes		No	N/A
Have you visually inspected the tower condition before climbing?	Yes		No	N/A

OVERALL HAZARD CHECK LIST

Have you completed a general Job Hazard Analysis (JHA) to observe all the general hazards on the site?	Yes		No	N/A
Have you checked for overhead power lines?	Yes		No	N/A
Do you have the proper PPE for the hazards on site?	Yes		No	N/A
Have you inspected the site for fall protection hazards and do you have the applicable equipment on site to mitigate those hazards?	Yes		No	N/A
Do you have a documented site specific rescue plan on site?	Yes		No	N/A
Have you reviewed the RF/EME hazards of the site?	Yes		No	N/A
Is there First Aid / CPR certified individuals on site?	Yes		No	N/A
Are first aid kits available and stocked?	Yes		No	N/A
Are there adequate restroom facilities?	Yes		No	N/A
Is there potable water available?	Yes		No	N/A
Is there adequate lighting?	Yes		No	N/A

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F03-WIC7517/R1

(obsoletes F02 and F04-WIC7517)

Overhead Electrical Wires

- The hazards associated with overhead electrical lines impact the safety of the crew
- OSHA requires an electrical safety plan be established for each project where equipment or work operations may contact or disrupt power lines
- Each project is to have a plan that provides for identification and marking of all electrical lines

Material Safety Data Sheets

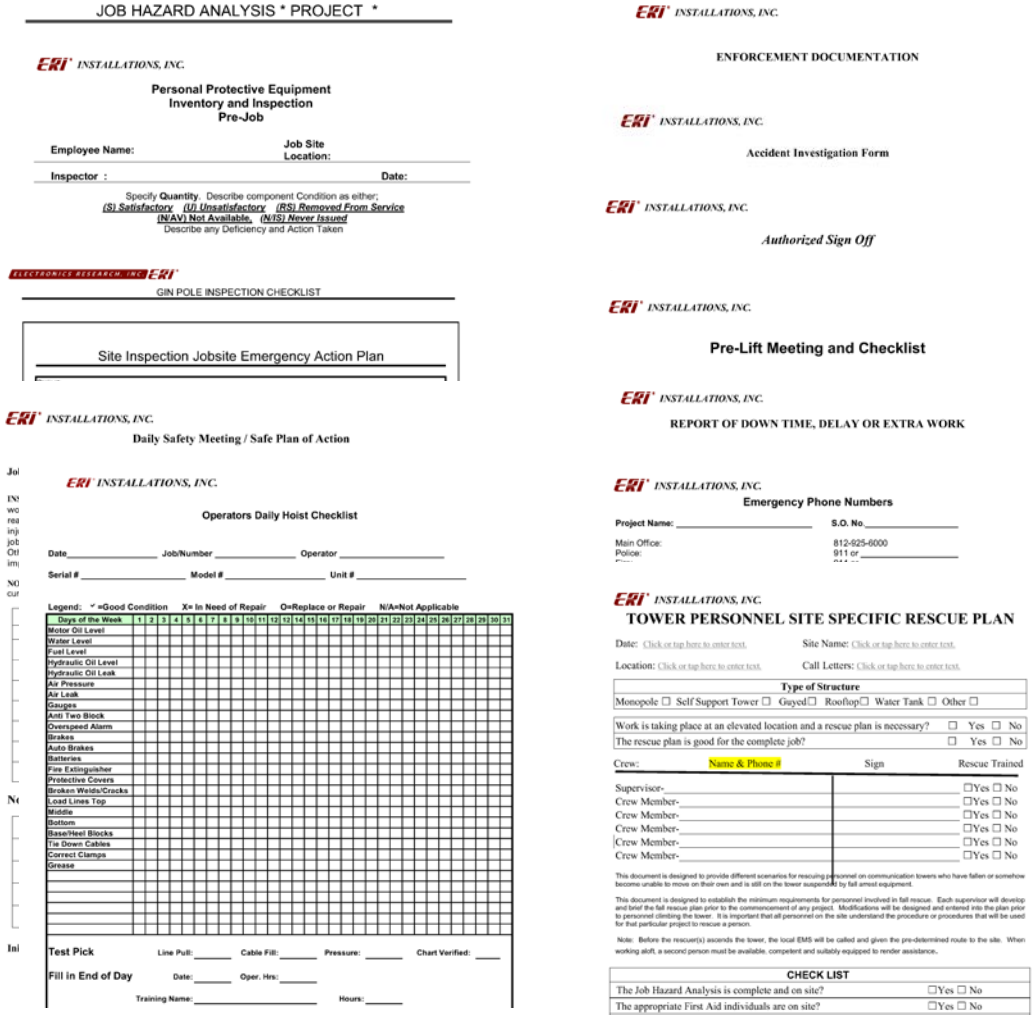
- Are Safety Data Sheets (SDS) readily available for all chemicals with which the crew may come into contact
- OSHA requires contractors to ensure that the hazards of all chemicals produced or imported are evaluated, and that all information concerning their hazards is transmitted to employers and employees
- This information should be transmitted using a comprehensive hazard communication program
- The program should include all container labeling and all forms of warning, material safety data sheets and employee training
- Contractors should have SDS for any hazardous chemicals on site

Proper Safety Signs

- Are appropriate safety signs in place to provide adequate warning of potential hazards
- Generally, signage should be located on each side of the project area within 50-feet of the project boundary.
- Note if the safety signs appropriate to the work are placed in obvious locations to warn of the hazards associated with the work
- The signs should warn of the hazard before it is approached

Emergency & Rescue Plan

- Emergency Phone Numbers
- Site Location and Directions
- Communications (Radio, Cell Phone, etc.)
- RF Safety Plan
- Checklist of Rescue Equipment & Written Rescue Procedures
- Identification of Competent Rescue Climber
- BEFORE A RESCUE ATTEMPT ALWAYS CALL 911 (just in case you both need rescued)



JOB HAZARD ANALYSIS * PROJECT *

ERI INSTALLATIONS, INC.

Personal Protective Equipment
Inventory and Inspection
Pre-Job

Employee Name: Job Site Location:

Inspector : Date:

Specify Quantity. Describe component Condition as either;
(S) Satisfactory (U) Unsatisfactory (RS) Removed From Service
(N/AV) Not Available, (N/IS) Never Issued
Describe any Deficiency and Action Taken

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GIN POLE INSPECTION CHECKLIST

Site Inspection Jobsite Emergency Action Plan

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Daily Safety Meeting / Safe Plan of Action

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Operators Daily Hoist Checklist

Date Job/Number Operator

Serial # Model # Unit #

Legend: ✓ =Good Condition X= In Need of Repair O=Replace or Repair N/A=Not Applicable

Days of the Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Motor Oil Level																															
Water Level																															
Fuel Level																															
Hydraulic Oil Level																															
Hydraulic Oil Leak																															
Air Pressure																															
Air Leak																															
Gauges																															
Anti Two Block																															
Overspeed Alarm																															
Brakes																															
Auto Brakes																															
Batteries																															
Fire Extinguisher																															
Protective Covers																															
Broken Welds/Cracks																															
Load Lines Top																															
Middle																															
Bottom																															
Base/Heel Blocks																															
Tie Down Cables																															
Correct Clamps																															
Grease																															

Test Pick Line Pull: Cable Fill: Pressure: Chart Verified:

Fill in End of Day Date: Oper. Hrs:

Training Name: Hours:

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ENFORCEMENT DOCUMENTATION

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Accident Investigation Form

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Authorized Sign Off

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Pre-Lift Meeting and Checklist

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REPORT OF DOWN TIME, DELAY OR EXTRA WORK

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Emergency Phone Numbers

Project Name: S.O. No.

Main Office: 812-925-6000
Police: 911 or

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TOWER PERSONNEL SITE SPECIFIC RESCUE PLAN

Date: Click or tap here to enter text. Site Name: Click or tap here to enter text.

Location: Click or tap here to enter text. Call Letters: Click or tap here to enter text.

Type of Structure
Monopole ☐ Self Support Tower ☐ Guyed ☐ Rooftop ☐ Water Tank ☐ Other ☐

Work is taking place at an elevated location and a rescue plan is necessary?	☐ Yes ☐ No
The rescue plan is good for the complete job?	☐ Yes ☐ No

Crew:	Name & Phone #	Sign	Rescue Trained
Supervisor-			☐Yes ☐ No
Crew Member-			☐Yes ☐ No
Crew Member-			☐Yes ☐ No
Crew Member-			☐Yes ☐ No
Crew Member-			☐Yes ☐ No
Crew Member-			☐Yes ☐ No

This document is designed to provide different scenarios for rescuing personnel on communication towers who have fallen or somehow become unable to move on their own and is still on the tower suspended by fall arrest equipment.

This document is designed to establish the minimum requirements for personnel involved in fall rescue. Each supervisor will develop and brief the fall rescue plan prior to the commencement of any project. Modifications will be designed and entered into the plan prior to personnel climbing the tower. It is important that all personnel on the site understand the procedure or procedures that will be used for that particular project to rescue a person.

Note: Before the rescuer(s) ascends the tower, the local EMS will be called and given the pre-determined route to the site. When working aloft, a second person must be available, competent and suitably equipped to render assistance.

CHECK LIST	
The Job Hazard Analysis is complete and on site?	☐Yes ☐ No
The appropriate First Aid individuals are on site?	☐Yes ☐ No

Accident Report Forms

- **Are emergency data forms available**
  - **Forms are required for reporting details regarding accidents and injuries for OSHA 300 logs and insurance first report claims**
  - **Make certain the Supervisor is aware of his/her responsibilities should an accident occur**
  - **Some companies utilize dial-in services for someone to take the information over the telephone**
  - **Make sure the Supervisor has the forms or number available, in case of an emergency**
  - **Necessary information including maps or directions to hospitals and numbers for emergency services should be updated and verified as accurate**

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Accident Investigation Form

Injured Employee:_____ Date:_____

Age:_____ Job Title:_____

Date & Time of Accident:_____

Nature of Injury or Property Damage:_____

Statement of employee involved in the injury or accident (what

Witness 1 statement:__

Witness 1 Name & Job

Witness 2 statement:__

Witness 2 Name & Job

Supervisor/competent p

Was there an injury?__

Signature of Supervisor

Report Investigated by:

Report reviewed by:__

Findings:
Cause of incident:____

Means to prevent a rep

This record will be maintained
longer retention is required by
If more than 10 employees a
which are used to record and
301 within seven days of rec

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Names and Addresses of Persons Riding With You:

1. Name:
Address:
City State ZIP Code

Driver's Auto Accident-

A complete this form and submit it to your Office immediately.

ake photos if possible.

nothing! – Sign

dent except:

ne of the accident.
l driver's license

ury or death, telephone
g Office.

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Emergency Phone Numbers

Project Name: _____ S.O. No._____

Main Office:	812-925-6000
Police:	911 or _____
Fire:	911 or _____
Ambulance:	911 or _____
Hospital:	_____
Poison Control:	800-362-9922
Bill Smith, Installations Manager	Office (812) 925-6000 ext 274 Cell (812) 480-0284
Kathy Stieler, Director ERI Installations and Safety	Office (812) 925-6000 ext 249 Cell (812) 204-8832
Sean Cooper, Safety & Training Coordinator	Cell(540) 529-3253

Site Telephone Number:_____

GPS Coordinates (Long/Lat): _____

Site Address (To be given to emergency responders):

Street: _____ City: _____ State: _____

Directions for EMS to Site: _____

Directions to Hospital: _____

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Emergency Medical Response

Should an injury occur that requires an emergency medical responder, the below actions will be taken:

1. Call the emergency response number posted adjacent to this plan.
2. Call the administrative office at:_____
3. If appropriate, provide MSDS sheets to emergency responders.
4. Provide medical assistance you are trained and certified to do, NOT assistance you are not trained in.
5. Assigned First Aid Providers:

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Hoisting Personnel

- Per OSHA Directive CPL 02-01-036 hoisting of personnel is allowed
- However, Compliance Guidelines must be adhered to
  - Proper hoist operator training and pre-lift meetings
  - Specific equipment and rigging to be used
  - Trial lifts and documentation
  - Maximum accent & decent speeds
  - Maximum number of personnel per lift
  - Communications and weather restrictions

Site Housekeeping

- Debris on a job site can be hazardous in numerous ways, from creating tripping hazards to the combustible nature of substances
- OSHA requires employers to be aware of and keep work sites free of such potential hazards

Qualified Contractor Evaluation Checklist

- **Benchmarks of Experience and Professionalism**
  - **Appropriate insurance coverage**
  - **Experience, references and capability to work**
  - **Written safety program and regular safety audits**
  - **Site-specific safety plan**
  - **Competent person on-site**
- **Prepared Employees**
  - **Appropriate and documented training**
  - **Physically able to meet job demands**
  - **Drug tested**

Qualified Contractor Evaluation Checklist

- **Safety on Site**
  - **Conduct a hazard assessment**
  - **Maintain good housekeeping on the job site**
- **Provide Notification and Records**
  - **Provide an orientation and awareness program for new hires**
  - **Maintain written records of the safety audits**
  - **Maintain written documentation of all training as required**

Qualified Contractor Evaluation Checklist

- **Follow Guidelines**
  - **Agree that subcontractors hired will meet all the same contractor requirements**
  - **Adhere to the provisions of OSHA Directive CPL 2-1.36**
  - **If required to maintain OSHA 300 logs, have logs available for the past two years**

TIA-222-H Section 14.3 Intervals

- **Maintenance and condition assessment recommendations for communication structures follows:**
  - **Three-year intervals for guyed masts and five-year intervals for self-supporting structures**
  - **After severe wind and /or ice storms, severe seismic events or other extreme conditions**
  - **Shorter intervals may be required for Risk Category III or IV structures and coastal regions, in corrosive environments, and in areas subject to frequent vandalism**

Special Considerations

- **Severe loading conditions can be interpreted to be any condition, which subjects the tower and/or supported equipment to high or unusual stresses. Such occurrences include, but are not limited to:**
  - **sustained wind velocities in excess of 60 MPH**
  - **significant ice accumulation**
  - **seismic action**
  - **galloping guy lines**
  - **flooding, etc…**
  - **Major additions, modifications, or changes in the type and location of equipment erected on the tower will require structural verification and may require special inspection.**
- **In addition to the elevator or equipment hoist maintenance inspection procedures required by the manufacturer, all local and state inspection procedures shall be followed.**

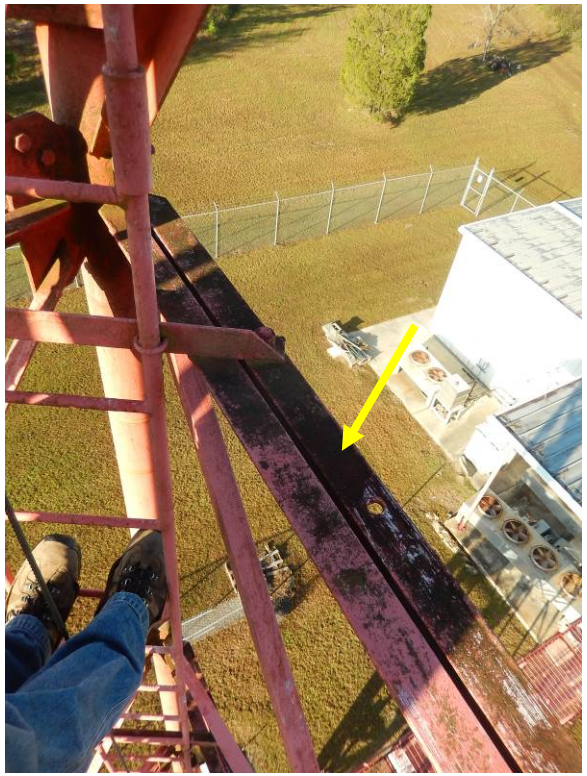
Maintenance and Condition Assessment

Picture 13: Kinked diagonal

- **Structure Condition**
  - **Damaged members (legs and bracing).**
  - **Loose members.**
  - **Missing members.**
  - **Loose and/or missing bolts and/or nut locking devices.**
  - **Visible cracks in welded connections including cracks underneath canister mounts for flag poles and other similar connections.**
  - **Pole flange and base plate cracks visible in base metal or at ends of plate stiffeners (cracks in base metal may only be visible on the inside surface of a pole).**
  - **Record temperature, wind speed and direction, and other environmental conditions.**

Maintenance and Condition Assessment

Picture 17: Organic material on tower



- **Finish**
  - **Paint and/or galvanizing condition.**
  - **Rust and/or corrosion condition including mounts and accessories.**
  - **FAA or ICAO color marking conditions.**
  - **Water collection in members (to be remedied, e.g., unplug drain holes, etc.).**

Maintenance and Condition Assessment

Picture 23: Damaged conduit box

- **Lighting (external portions of components only)**
  - **Conduit, junction boxes, and fasteners (weather tight and secure)**
  - **Drain and vent openings (unobstructed)**
  - **Wiring condition**
  - **Light lenses**
  - **Bulb condition**
  - **Controllers**
    - Flasher.
    - Photo control.
    - Alarms.
  - **Obstructions to lighting system**

Maintenance and Condition Assessment

Picture 26: Cut ground

- **Grounding**
  - **Connections**
  - **Corrosion**
  - **Lightning protection**

Note: Lightning rods are not required for the protection of the structure in accordance with this Standard but may be required at or near the top of the structure for the protection of equipment or lighting systems.

Maintenance and Condition Assessment

Picture 40: Rusted mount/hardware

- **Antenna and Mount condition:**
  - **Proper tie-back of microwave dishes**
  - **Damage to supporting structure at connections**
  - **Defects, deformations, loose, missing members, etc.**
  - **Loose or missing hardware**
  - **Condition of antenna covers**

Maintenance and Condition Assessment

Picture 34: Loose butterfly

- **Feed line condition**
  - **Flanges, seals, dents, jacket damage, grounding, etc.**
  - **Properly secured/supported on the structure and mount**
  - **Hanger condition (snap-ins, bolt on, kellum grips, etc.)**
  - **Secured to structure (waveguide ladder)**

Maintenance and Condition Assessment

Picture 62: Loose ladder bolt

- **Other appurtenances (Ice shields, walkways, platforms, climbing facilities, sensors, floodlights, etc.) Condition**
  - **Obstructions to climbing path or safety climb systems**
  - **Defects, deformations, loose or missing members, etc.**
  - **Loose or missing hardware**
  - **Secured to structure**

Maintenance and Condition Assessment

Picture 8: Insulator covered in paint

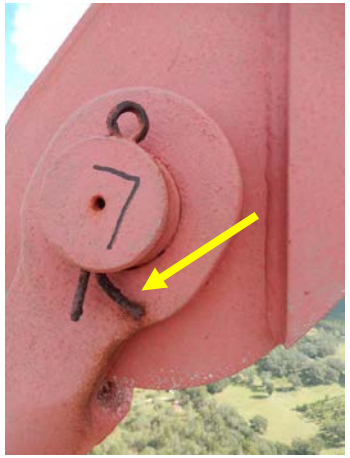
- **Insulators (Base insulator, AM detuning kits, fiberglass rods, porcelain insulator, non-metallic guys, etc.)**
  - **Cracking and chipping**
  - **Cleanliness of insulators**
  - **Spark gaps**
  - **Isolation transformer**
  - **Bolts and connections**
  - **Delamination, UV degradation, rod slippage**

Maintenance and Condition Assessment

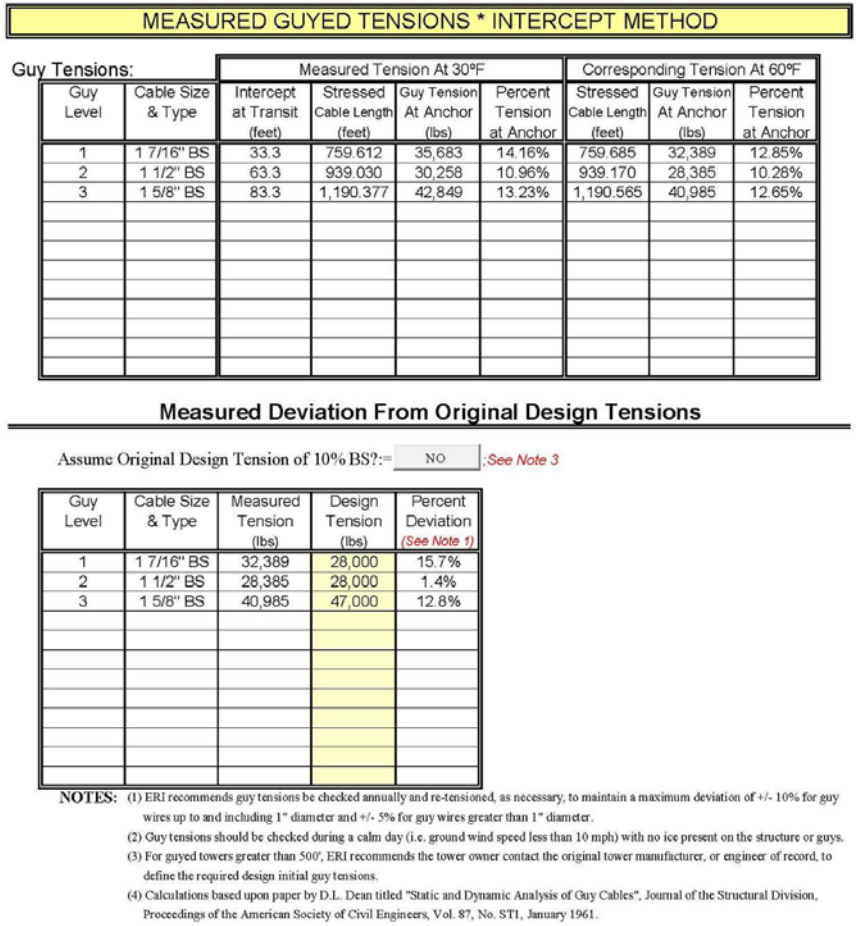
- **Guys**
- **Strand condition (corrosion, breaks, nicks, kinks, etc.).**
  - **Guy hardware conditions**
    - Turnbuckles or equivalent
      - Thread extended past body
      - Secured with safety cable or equivalent
      - Cracks, defects, damage, etc.
    - Cable thimbles
    - Ice clips
    - Cable connectors (end fittings)
      - Cable clamps applied properly and bolts tight
      - Wire serving
      - Slippage or damaged strands
      - Deadend grips – fully wrapped, end sleeve/ice clips (on anchor end)
      - Poured sockets – signs of separation, twisting, etc.
      - Shackles, bolts, pins and cotter pins
    - Inspect tension rods / anchor rods welded to fan plates for fatigue cracks.

Picture 69: Jam nuts not tight

Picture 71: Rusted cotter pins



Maintenance and Condition Assessment



MEASURED GUYED TENSIONS * INTERCEPT METHOD

Guy Tensions:

Guy Level	Cable Size & Type	Measured Tension At 30°F: Intercept at Transit (feet)	Stressed Cable Length (feet)	Guy Tension At Anchor (lbs)	Percent Tension at Anchor	Corresponding Tension At 60°F: Stressed Cable Length (feet)	Guy Tension At Anchor (lbs)	Percent Tension at Anchor
1	1 7/16" BS	33.3	759.612	35,683	14.16%	759.685	32,389	12.85%
2	1 1/2" BS	63.3	939.030	30,258	10.96%	939.170	28,385	10.28%
3	1 5/8" BS	83.3	1,190.377	42,849	13.23%	1,190.565	40,985	12.65%

Measured Deviation From Original Design Tensions

Assume Original Design Tension of 10% BS?:= NO ;See Note 3

Guy Level	Cable Size & Type	Measured Tension (lbs)	Design Tension (lbs)	Percent Deviation (See Note 1)
1	1 7/16" BS	32,389	28,000	15.7%
2	1 1/2" BS	28,385	28,000	1.4%
3	1 5/8" BS	40,985	47,000	12.8%

NOTES: (1) ERI recommends guy tensions be checked annually and re-tensioned, as necessary, to maintain a maximum deviation of +/- 10% for guy wires up to and including 1" diameter and +/- 5% for guy wires greater than 1" diameter.
(2) Guy tensions should be checked during a calm day (i.e. ground wind speed less than 10 mph) with no ice present on the structure or guys.
(3) For guyed towers greater than 500', ERI recommends the tower owner contact the original tower manufacturer, or engineer of record, to define the required design initial guy tensions.
(4) Calculations based upon paper by D.L. Dean titled "Static and Dynamic Analysis of Guy Cables", Journal of the Structural Division, Proceedings of the American Society of Civil Engineers, Vol. 87, No. ST1, January 1961.

- **Guys**
  - **Guy tensions.**
    - Measure guy tensions
    - Record temperature, wind speed and wind direction

Note: Minor variations in guy tensions are to be expected due to temperature, wind speed conditions, anchor elevation differences, etc.

Maintenance and Condition Assessment

Picture 40: Foliage in anchor points

- **Concrete Foundations**
  - **Ground condition**
    - Settlement, movement or earth cracks
    - Erosion
    - Site condition (standing water, drainage, trees, etc.)

Maintenance and Condition Assessment

Picture 75: Rusted anchor shaft

- **Concrete Foundations**
  - **Anchorage condition:**
    - Top and bottom base plate nuts tight
    - Nut locking device
    - Grout condition
    - Anchorages
    - Anchor rods

Maintenance and Condition Assessment

Picture 74: Slab not formed properly

- **Concrete Foundations**
  - **Concrete condition**
    - Cracking, spalling, or splitting
    - Chipped or broken concrete
    - Honeycombing
    - Low spots to collect moisture

Maintenance and Condition Assessment

Picture 56: Secondary concrete

- **Concrete Foundations**
  - **Guyed Mast Anchors**
    - Settlement, movement or earth cracks
    - Grade sloped away from anchors
    - Anchor shaft condition below grade
    - Corrosion control measures (galvanizing, coating, concrete encasement, cathodic protection systems, etc.)
    - Anchor heads above grade, clear of vegetation, obstructions, etc. and turnbuckles free to articulate

Maintenance and Condition Assessment

Twist and Out-Of-Plumb Determination For Triangular Towers

Site Information:

Date Measured: 5/14/2014 — Wind: 5-10 ;mph
Temperature: ~75 ;°F — Wind Direction: NW

OBSERVED MAST DATA

Mast Elevation (feet)	Span (feet)	Face Size (A) (in)	Leg Size (in)	D1 (leg ratio)	D2 (leg ratio)	D3 (leg ratio)	D1 (in)	D2 (in)	D3 (in)
119.5	119.5	60	3.75	0.25	0.125	0	0.9375	0.46875	0
239.5	120	60	3.5	0.4375	0.25	0	1.53125	0.875	0
359.5	120	60	3.5	0.5	0.5	0	1.75	1.75	0
479.5	120	60	3.5	0.5625	0.75	0	1.96875	2.625	0
619.5	140	60	3.25	0.5625	1.25	0.4375	1.828125	4.0625	1.421875
759.5	140	60	3	0.5625	1.5	0.875	1.6875	4.5	2.625
899.5	140	60	2.75	0.625	2.5	2.5	1.71875	6.875	6.875
959.5	60	24	2	0	1.25	1.5	0	2.5	3
1019.5	60	24	2	-0.5	1.5	2	-1	3	4

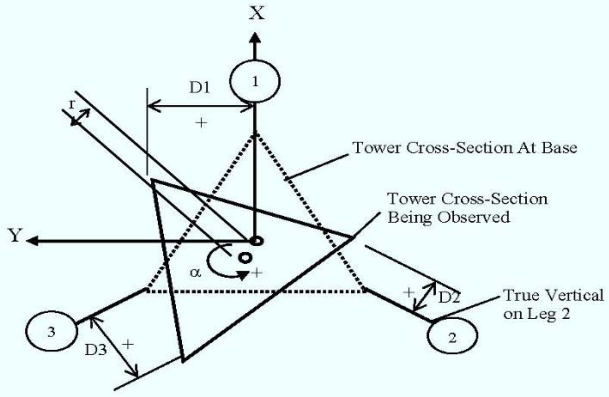
Calculations:

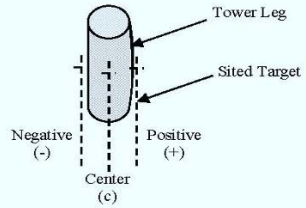
	CALCULATED TWIST			CALCULATED OUT-OF-PLUMB				CALCULATED TOLERANCES		
Mast Elevation (feet)	d (in)	e	[3]α (deg)	x (in)	y (in)	r (in)	r' (in)	[2]%R	[3]T (deg/10')	
119.5	0.469	0.014	0.775	0.271	0.469	0.541	0.541	**0.038%**	**0.065**	OKAY
239.5	0.802	0.023	1.327	0.505	0.729	0.887	0.350	**0.024%**	**0.046**	OKAY
359.5	1.167	0.034	1.930	1.010	0.583	1.167	0.526	**0.037%**	**0.050**	OKAY
479.5	1.531	0.044	2.533	1.516	0.438	1.577	0.526	**0.037%**	**0.050**	OKAY
619.5	2.438	0.070	4.035	1.525	-0.609	1.642	1.047	**0.062%**	**0.107**	OKAY
759.5	2.938	0.085	4.864	1.083	-1.250	1.654	0.778	**0.046%**	**0.059**	OKAY
899.5	5.156	0.149	8.560	0.000	-3.438	3.438	2.441	**0.145%**	**0.264**	*OUT*
959.5	1.833	0.132	7.603	-0.289	-1.833	1.856	1.630	**0.226%**	**0.160**	*OUT*
1019.5	2.000	0.144	8.299	-0.577	-3.000	3.055	1.202	**0.167%**	**0.116**	*OUT*

- **Structure Alignment**
  - **Structure Plumb and Twist**

Nomenclature:

A:= Tower Face Size ;(in)
d:= (D1+D2+D3)/3 ;(in)
e:= (d√3)/A
α:= $\sin^{-1}(e) \leq 5°$;(deg)
x:= (D2-D3)/√3 ;(in)
y:= (2*D1-D2-D3)/3 ;(in)
r:= $\sqrt{(x^2+y^2)}$;(in)
r':= $\sqrt{(\Delta x^2+\Delta y^2)}$;(in)
Span:= Span Between Two Elevations
%R:= (r'/Span)*100 ≤ **0.25%** ;Plumb Percent Ratio
T:= (Δα/Span)*10 ≤ **0.5°** ;(deg) Twist per 10 ft





ERI Suggests Quarterly Inspections

- **Tower Shaft Inspection**
  - **The tower shaft should be visually inspected at least once every three months (quarterly) or after any severe loading condition. The intent of this inspection is to view the tower shaft from the ground, or by elevator if provided, and to verify the following:**
    - Look around to see if there are any bolts, nuts, clamps, other tower or appurtenance parts that have become loose and fallen to the ground, or any evidence that this has occurred on the tower.
    - Verify that members and appurtenances up the tower look to be in place. This can be accomplished by use of a transit or binoculars. If the tower is equipped with an approved elevator, this visual inspection should preferably be conducted while riding up and down the elevator.
    - Verify that all equipment such as antennas, transmission lines, or other appurtenances are positioned at their specified locations and in accordance with the approved tower loading plans and specifications.
    - Visually inspect the tower component coating systems (galvanizing or paint) for any signs of deterioration or spots of local corrosion.
    - Look up the tower and verify that the mast looks straight and is not excessively leaning or is out-of-straightness a noticeable amount.

ERI Suggests Quarterly Inspections

- **Guy and Guy Anchor Inspection**
  - **Visually inspect the guy lines to verify that they are in place at the anchor and at the tower. Look at the sags from the anchor to the tower and verify that they look reasonably consistent at each anchor point. This will give an indication if one or more lines have become significantly loose compared to the other guy lines**
  - **Make a visual and physical inspection of each guy wire for high frequency vibration. Grasp the strand approximately 2-3 feet away from the guy anchor socket and feel for any rhythmic vibrations or jerks on the line. Listening for any sound frequencies given off from the wires. Inspect the socket at the hairpin socket, ESCO socket, rocket socket or turnbuckle. Make sure safeties are in place, if provided, and that the threaded portions of the fasteners are not backing off. Anchor nuts and lock nuts should be securely in place to prevent loosening. The use of spray paint or tape at the threads of these connections can be used as a gage to easily determine if movement has occurred**
  - **All guy wires should be inspected for broken individual wires in the outer layer of the guy strand. A broken wire may be the result of a fatigue break and will likely occur at the closed strand bridge socket at the guy anchor or at the open strand socket at the connection to the tower. The top and bottom 5 feet of guy strand should be inspected for fatigue wire breaks when possible**
  - **Check for signs of corrosion at the point where the strand enters the socket, corrosion of the socket, or corrosion of guy strand wires. Inspect preforms, closed bridge socket “U” bolts, ESCO socket connections, turnbuckles, or shackles for any deterioration, including corrosion**
  - **The guy pins or bolts used as pins at the guy anchor assembly and at the open strand socket at the tower attachment plate shall be inspected for any signs of movement or rotation. Verify that all cotter pins and guy pin bolts are in place and in good condition**
  - **All grounding connections should be inspected to ensure that they comply with the approved grounding system design plans and are properly connected. Inspect connections of ground wires where possible to determine if they remain tight and determine if any visible corrosion or wear is occurring**
  - **Anodes for special corrosion protection shall be visually checked to verify the caps are accessible and that connection wires are in place**

ERI Suggests Quarterly Inspections

- **Foundation Inspection**
  - **The surfaces of all concrete above grade shall be visually inspected for cracks, chips, spalling, or other visible signs of damage.**
  - **Check the condition of grout under any plates. Look for cracks or any loose material.**
  - **Inspect the soil around the guy anchors and the center pier for signs of movement or subsidence. The finish grade of the soil above the guy anchors and center pier should be marked or otherwise referenced for positive drainage of surface water away for the guy anchor assemblies and center pier.**
  - **Guy anchor assemblies, anchor bolts, plates, rods and embedded material shall be verified that they are sufficiently above grade to prevent excessive corrosion. If steel materials are not above grade, then a check of their corrosion protection should be made. This may involve verifying that coating systems such as galvanizing, painting, or special wrappings are in place.**

ERI Suggests Quarterly Inspections

- **Lighting System Inspection**
  - **It should be verified that each light at each level is in working condition.**
  - **Obstruction lighting and associated electrical systems shall be inspected quarterly in accordance with the system manufacturer's requirements and as outlined in the manufacturer's maintenance manuals.**
  - **The obstruction lighting system shall also be inspected as required by federal and local government codes including the Federal Aviation Administration (FAA) and the Federal Communications Commission (FCC).**

ERI Suggests Quarterly Inspections

- **Guy Wire Damper Inspection**
  - **Verify that the location and number of all vibration dampers (high and low frequency) are in accordance with the approved drawings.**
  - **Check the condition of each vibration damper, all safeties, and connection hardware for signs of wear, corrosion, or deterioration.**
- **Elevator or Equipment Hoist Inspection**
  - **Tower elevator or equipment hoist systems shall be visually inspected quarterly of all items outlined in the manufacturer's maintenance manuals. In addition, they shall be inspected as required by state and/or local governmental codes.**

Questions?

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