



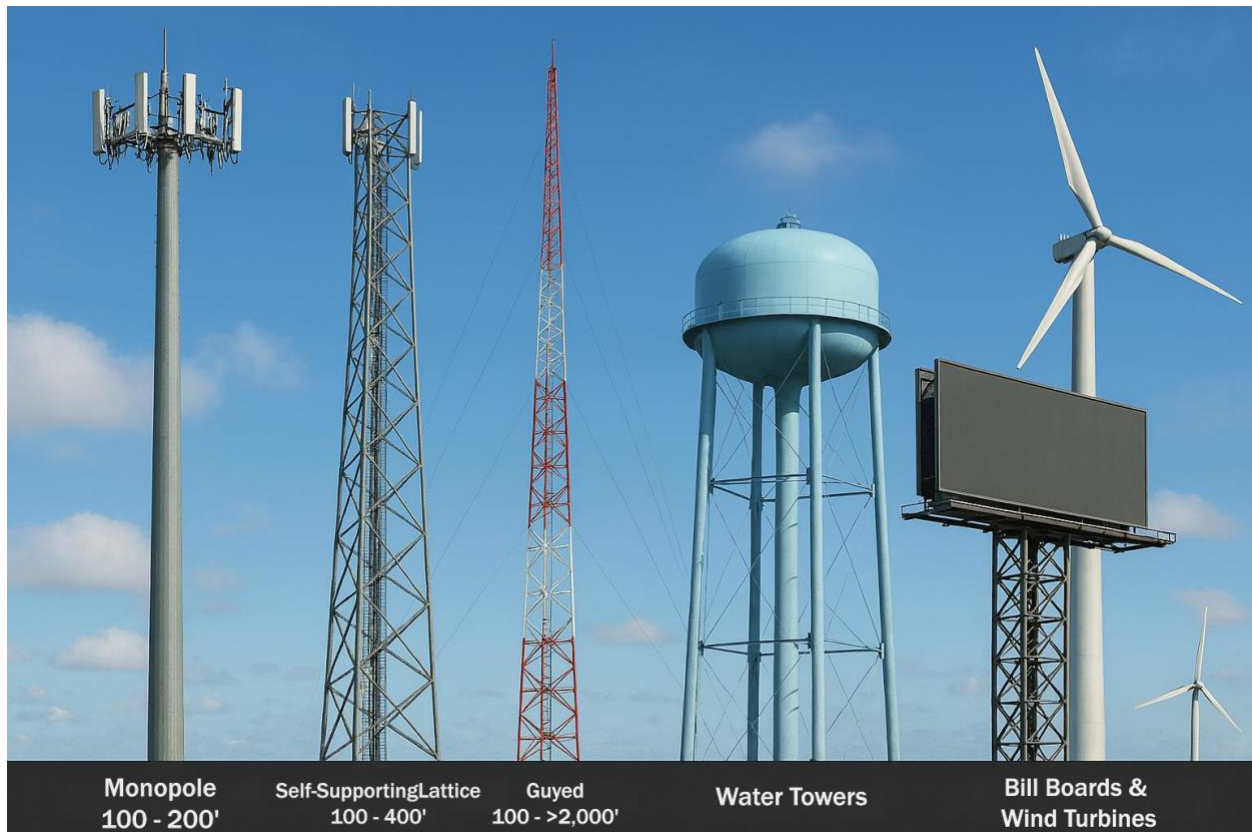
Tower Rescue Techniques and Hazards Overview

| | |
|---|-----------|
| Overview | 3 |
| Tower Types | 3 |
| Bridge Types | 4 |
| Tower Hazards Overview | 5 |
| Environmental Hazards | 5 |
| Biological & Wildlife Hazards | 5 |
| Structural & Mechanical Hazards | 5 |
| RF Hazard Deep Dive | 5 |
| Types of RF Sources | 5 |
| Key Hazards | 6 |
| Mitigation Strategies | 6 |
| Rescue | 7 |
| Motivation & Applications | 7 |
| Who Gets Rescued & Why | 7 |
| Skate Blocks | 8 |
| Tag Lines | 9 |
| Guiding Lines | 9 |
| Tracking Lines | 10 |
| Common Skate Block Variables: | 12 |
| Appendix | 14 |
| Tower Gear Checklists | 14 |
| Tower Emergency Services Locator and Safety Compliance Forms | 16 |
| Pre-Climb Safety Checklist | 18 |

Overview

Rescuers face a combination of technical, environmental, and biological hazards when operating on towers. RF radiation and uncontrolled energy sources demand strict adherence to LOTO procedures. Weather extremes, wind, and lightning amplify risk, while wildlife and structural instability add unpredictability. Every rescue must begin with a thorough hazard assessment and pre-climb checklist to ensure safety for both rescuers and victims.

Tower Types



Bridge Types



Many of the hazards and rescue techniques discussed here could also apply to other structures such as bridges. The lead climbing section will focus more on climbing techniques for structures where horizontal movement is necessary, as well as vertical.

Tower Hazards Overview

Environmental Hazards

- **Heat / Cold Stress** Extreme temperatures can lead to hypothermia or heat stroke. Rescuers and victims may suffer rapid fatigue or cognitive decline.
- **Wind & Precipitation** High winds increase fall risk and structural movement; rain, snow, or ice reduce grip and stability. Lightning is a severe hazard—avoidance is the only mitigation.
- **Atmospheric Conditions** Oxygen deficiency or enrichment, carbon monoxide, and explosive gases may exist in enclosed tower spaces or adjacent facilities.

Biological & Wildlife Hazards

- **Birds & Nests** Aggressive birds (e.g., hawks) can attack climbers; nests may obstruct anchor points.
- **Insects & Small Animals** Bees, wasps, or rodents in tower cavities can create unexpected hazards.

Structural & Mechanical Hazards

- **Falling Objects** Loose hardware or tools pose severe struck-by risks.
- **Unexpected Movement** Guyed towers flex under wind stress; components like dishes or turbine blades may rotate unexpectedly.

RF Hazard Deep Dive

Radio Frequency (RF) energy is one of the most critical hazards in tower rescue operations. RF systems are dangerous even when operating normally, and damaged systems introduce additional risks. Understanding RF sources, characteristics, and mitigation strategies is essential for responder safety.

Types of RF Sources

- **AM Transmission Towers**
 - Very long wavelengths; can induce voltage in nearby metal objects.
 - Vehicles, cranes, and even ships have recorded voltages exceeding OSHA limits (e.g., 632 V/m vs. 100 mA limit).
 - Typically fenced and labeled “High Voltage” despite no visible power lines.
 - **Mitigation:** Ground all vehicles and equipment when operating near AM towers.
- **FM Radio Towers**
 - Shorter wavelengths; coverage typically 30–100 miles.
 - Energy emitted directly from antennas, not the tower structure.
 - **Hazard:** Burns or tissue damage from prolonged exposure near active antennas.

- **Microwave Transmitters**
 - Drum-shaped antennas; highly directional and extremely dangerous.
 - Can cause immediate and permanent injury if in the beam path.
 - **Mitigation:** Identify and avoid transmission paths; use RF meters.
- **Cellular Systems (LTE, 5G)**
 - Compact, high-energy antennas mounted on towers and rooftops.
 - No “safe zone” when energized; omnidirectional antennas increase exposure risk.
 - **Hazard:** Broken or “leaky” cables can emit unexpected RF energy.
 - **Mitigation:** Always wear RF monitors; visually inspect for damaged cables.

Key Hazards

- **Thermal Burns & Eye Damage**

High-intensity RF can cause burns or blindness similar to welding arcs.
- **Induced Voltage**

AM and VLF systems can electrify metal objects in the vicinity.
- **Hidden Energy Sources**

Backup systems may re-energize if not properly locked out.

Mitigation Strategies

- **Pre-Climb Checklist**
 - Verify RF systems are de-energized.
 - Perform Lockout/Tagout (LOTO) on primary and backup systems.
 - Inspect grounding systems and lightning protection.
- **RF Monitoring**
 - Wear RF meters at all times during tower operations.
 - Treat any visible energy discharge as an immediate hazard.
- **Pre-Planning**
 - Coordinate with tower owners for site-specific RF hazard maps and emergency contacts.

Rescue

Motivation & Applications

- **Cell Towers & Other Structures**
Rescue scenarios often involve telecom workers, sign installers, or maintenance crews stranded at height.
- **Water Towers & Bridges**
These add complexity due to confined spaces and slippery surfaces.
- **Bottom-Up Rescue**
Initiating rescue from below requires advanced rigging and hauling systems.

Who Gets Rescued & Why

- **Workers** – Injuries, equipment failure, or medical emergencies.
- **Kids / Trespassers** – Curiosity-driven climbs.
- **Medical Conditions** – Hypothermia, heat stroke, or psychological distress triggered by height and isolation.

Skate Blocks

Skate Blocks are a valuable resource that we adopted from the tower industry for rescue purposes. They are a version of a ground based lowering system that requires no special equipment and once they are understood can be adopted into a variety of different rescue plans. In all mirrored systems it is advantageous to use separate anchor slings and single pulleys in lieu of a single anchor sling and a double pulley. Most double pulleys are capable of holding the entire weight of the system with an adequate Safety Factor. Using 2 anchor slings and single pulleys provides a layering of safety, commonly referred to as redundancy, and provides a more thorough Dual Protection system to not have all system components rely on a single piece.



Photo Credit: Alan Sunshine, Rope Geeks Inc.

In the above picture we can see an attendant on a basket being lowered. The configurations of the system uses the rope coming up from the ground station going through a pulley on the structure and then back onto itself with an additional pulley and terminates at the rescue package. This configuration provides two advantages.

The package is now prevented from spinning because of the 2 connection points and the package is also being pulled away from the structure and prevents any snagging or injuries that may occur from contacting the structure. Installing two identical systems, called Mirroring, provides a very safe, simple system and can be operated by one person, depending on the device choices.

A disadvantage of all ground based lowering systems is they require ropes that are more than twice the height of the victim. Skate Blocks require ropes that are 2.5-3 times the height of the victim. The further away the ground anchor is from the tower the further it will pull the package away from the structure, which is beneficial for self supporting towers that are wider at the base then they are at the top but requires more rope length.

Tag Lines

Tag Lines are a simple solution for manipulating the rescue package as it lowered. It is simply a rope connected to the rescue package and a few ground based persons walk in the direction they want the package to move. Tag Lines are useful for moving the package in and out as well as left and right. Personnel need to continue to take up on the rope as it's lowered and unless a lot of force is applied the package will not move very far.

Guiding Lines

Guiding Lines are similar to Tag Lines in that they are controlled by manpower on the ground but the line terminates at the top of the tower and the rescue package is connected to the Guiding Line with a pulley or a carabiner. This eliminates the need for the ground personnel to have to take up on the line as the package is lowered.

Tracking Lines

Tracking Lines are a low-tension line that is installed from the top of the tower and terminates in a device connected to an anchor. The rescue package is connected to the Tracking Line with a pulley or a carabiner and the package tracks along the line to the installed anchor. The tracking line should have very low tension as it's not intended to add large amounts of force to the system and should be tensioned by 1 person using only a 3:1 MA system. Because the Tracking line is secured to an anchor this type of system can only move the rescue package away from the tower, as side-to-side manipulation is not possible. The Tracking Line is the only option that can be used for Tower Based rescues to bring the package away from the tower and is useful when the height of the victim exceeds the length of available ropes for a Ground Based Rescue but sufficient equipment exists for the addition of a third line.

An ASAP can be installed to travel behind the pulley on the Tracking Line and the Tracking Line can become part of the Safety System or if no Safety Line is employed can become the entire system safety, eliminating the need for a 3rd rope. Consideration must be given to a procedure that will enable the rescue team to raise the rescue package back sufficiently to reset the ASAP should it be activated. Should there be a catastrophic failure of the Main Line in this scenario, how will the now suspended victim and potentially the attendant be lowered safely to the ground? One solution, if no hazards exist, maybe to simply “lower” the tracking line through a device on the ground, such as the Clutch in the example below.

Knowing what equipment is available to you and your team, both on the trucks and available by Mutual Aid is necessary for planning any rescue. Taking that



knowledge and pre-planning known sites in your response area will help to ensure that responses to these unique and dangerous sites are handled efficiently and safely.

Common Skate Block Variables:

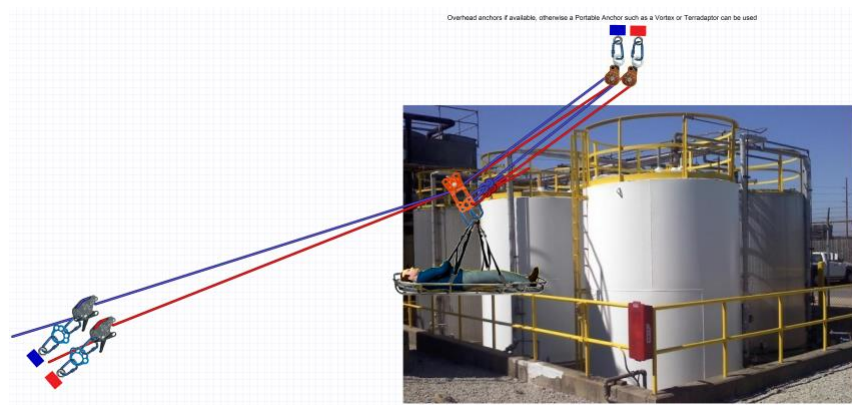
Height of structure / anchor

Horizontal distance from structure to ground anchor

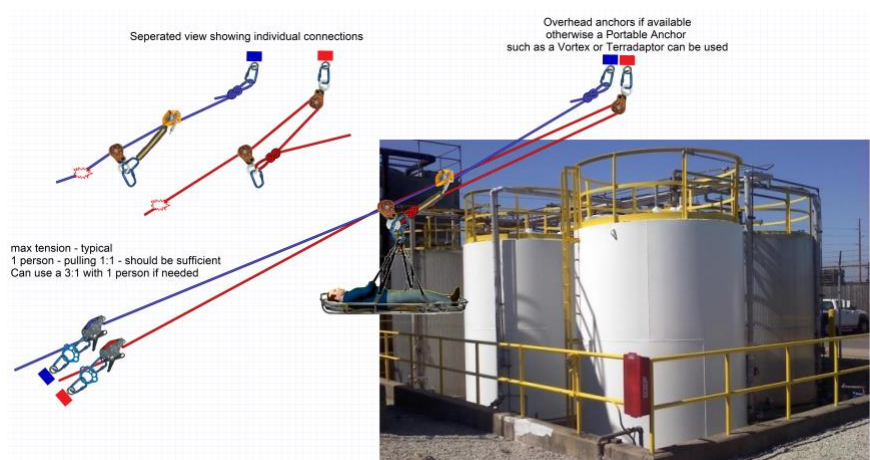
Weight / load being raised or lowered

Rope Stretch

All of these factors tell us that typically the load will travel away from the structure between $\frac{1}{3} - \frac{1}{4}$ the distance from the structure to the ground anchor when being lowered.



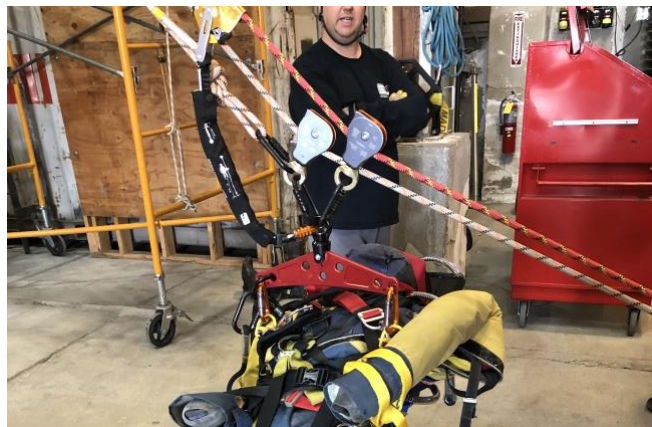
Traditional Skate Block



Tracking Skate Block - Hybrid



Skate Block - may require tension on one line to get to landing area



Tension Skate Block - Hybrid

In the above consider what would happen if the ASAP were to lock. What about the main line?
How would we solve this problem?

| | Advantages | Disadvantages |
|------------------------------|----------------------------------|--|
| Skate Blocks | Fully redundant | LZ fairly close to structure |
| Tension Skate Block - Hybrid | Gets further away from structure | Less redundant ASAP Locking requires rescue plan Main line failure requires rescue plan from a tensioned line. |



Appendix

Tower Gear Checklists

https://www.gmesupply.com/pdf/Gear_Checklist_GME.pdf



www.gmesupply.com
 (800) 940-6762
 info@gmesupply.com

GEAR CHECKLIST

Make ordering easy with these convenient checklists. Use them as a guide to make sure you have everything you need or give them to each person on your crew. To make things even easier, we can turn your list into a custom kit with a part number unique to your company. Call our Gear Experts® at (800) 940-6762 for more info.



TOWER CLIMBING

| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|---------------------------|---------|-------------|
| | Climbing Helmet | | |
| | Harness | | |
| | Twin Leg Lanyard | | |
| | Cable Safety Sleeve | | |
| | Rope Grab with 3' Lanyard | | |
| | Snaphook Spreader Bar | | |
| | Positioning Device | | |
| | Anchor Slings | | |
| | Bolt Bags | | |
| | Carabiners | | |
| | Tool Lanyards | | |
| | Gear Bag | | |

Equipment for: _____

Need by date: _____

GENERAL PPE & SAFETY

| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|--------------------|---------|-------------|
| | Hard Hat | | |
| | Safety Glasses | | |
| | Gloves | | |
| | Hearing Protection | | |
| | Work Boots | | |
| | First Aid Kit | | |
| | Hi-Viz Apparel | | |
| | Job Site Signs | | |

LIFTING & RIGGING

| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|-------------------------------|---------|-------------|
| | Capstan Hoist | | |
| | Mount | | |
| | Generator | | |
| | Handline Block / Snatch Block | | |
| | Slings | | |
| | Shackles | | |
| | Load Rated Carabiners | | |
| | Canvas Buckets | | |

RESCUE

| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|------------------|---------|-------------|
| | Rope | | |
| | Descent Device | | |
| | Pick-Off System | | |
| | Small Carabiners | | |
| | Anchor Strap | | |
| | Gear Bag | | |

ROPE

| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|-------------|---------|-------------|
| | Safety Line | | |
| | Load Line | | |
| | Tag Line | | |
| | Pulleys | | |
| | Rope Bag | | |

TOWER TOOLS

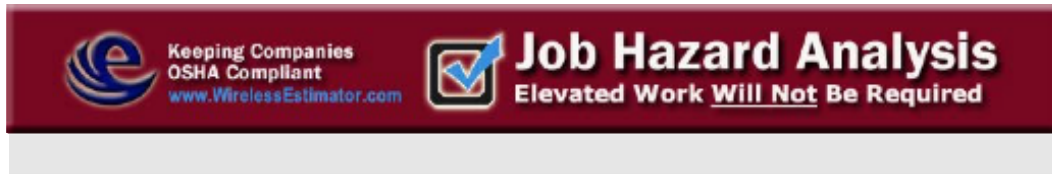
| QTY | ITEM | PAGE(S) | PART NUMBER |
|-----|------------------------------|---------|-------------|
| | RF Monitor | | |
| | Two Way Radios & Accessories | | |
| | Power Tools | | |
| | Grounding Molds | | |
| | Antenna Alignment Tool | | |

Capital Technical Rescue and Safety Consultants, LLC



Tower Emergency Services Locator and Safety Compliance Forms

<https://wirelessestimator.com/emergency/>



| JOB DETAILS | | Date: |
|-----------------------|-----------------|-------|
| Company Name: | Job Name: | |
| Customer: | Job Supervisor: | |
| Project Manager: | Emerg. Contact: | |
| Job Address: | | |
| Nearest Intersection: | | |
| Latitude: | Longitude: | |

EMERGENCY CONTACT INFORMATION

| | | |
|----------------------------------|------------------------|--|
| Fire Department Info: | Municipal Police Info: | County Sheriff Info: |
| Dept Name: | Dept Name: | Dept Name: |
| Phone: | Phone: | Phone: |
| Utility Company: | | |
| Do cell phones work at the site? | Yes No | If no, directions to nearest landline: |

EMERGENCY MEDICAL FACILITY

| | |
|---|-------------------|
| Hospital Name: | Hospital Address: |
| Hospital Phone: | |
| Directions to Hospital (see attached map) : | |
| | |

NON EMERGENCY CARE

| | | |
|--------------|---------------|-----------------|
| Clinic Name: | Clinic Phone: | Clinic Address: |
| | | |

Pre-Climb Safety Checklist

1. Site Assessment

- ☐ Confirm structure type (tower, bridge, monopole, lattice, guyed, etc.)
- ☐ Identify hazards: RF energy, electrical lines, wildlife, weather conditions
- ☐ Verify access routes and emergency egress options

2. Weather & Environmental Conditions

- ☐ Check forecast for wind, precipitation, lightning risk
- ☐ Use lightning detection apps/devices
- ☐ Assess temperature extremes (heat/cold stress risk)

3. RF & Electrical Safety

- ☐ Perform RF hazard assessment with RF meter
- ☐ Lockout/Tagout (LOTO) all primary and backup systems
- ☐ Inspect grounding systems and lightning protection
- ☐ Confirm RF systems are de-energized before ascent

4. Equipment & PPE

- ☐ Inspect harnesses, helmets, lanyards, and ropes for wear/damage
- ☐ Verify anchor points and rigging integrity
- ☐ Ensure RF monitor, fall arrest system, and communication devices are functional

5. Rescue & Emergency Readiness

- ☐ Assign roles (climber, belayer, rescue lead)
- ☐ Confirm rescue plan and backup plan
- ☐ Check medical kit and hypothermia/heat stress supplies
- ☐ Establish communication protocol with ground team and EMS

6. Documentation

- ☐ Log pre-climb inspection in site safety record
- ☐ Record RF readings and LOTO confirmation
- ☐ Note weather conditions and time of climb