

Tower Lighting

"It Is Costing You More Than You Think..."

Overview

Tower marking and lighting is necessary and mandated. It is necessary for the safety of the United States air navigation system. It is mandated by the FCC that all towers over the height of 200 feet must meet FCC specifications for lighting and painting. This places a significant burden on the tower owner. Not only does the owner have the burden of ensuring that the tower has proper lighting and painting, but they must also ensure that the lighting and painting provided is properly functioning every single day. Should it fail, the burden is also on the tower owner to promptly notify the FAA that a failure has occurred, when the anticipated repair will be accomplished, and then provide proper notification that the failure has been corrected.

This burden has a significant cost to the owner. Not only does the owner incur the cost of the initial lighting system and painting, but also that system must be maintained so that it is in proper working order continuously. The system must also be monitored every single day and properly inspected per the FCC regulations.

It is estimated that the minimum annual cost for simply complying with the FCC requirements for tower marking is \$9,071 and that number can drastically increase depending upon a variety of factors including tower height, type of marking system and location of the tower.

This white paper explores the FCC requirements and the hidden costs of tower lighting and marking based upon FCC requirements.

FCC Requirements

The Communications Act of 1934 gives the authority to the FCC for overseeing lighting and painting on towers that might constitute a hazard to air navigation.

"Part 17 of the Commission's rules prescribes certain procedures for antenna structure registration (ASR) and sets forth standards to determine whether a structure may impact air navigation, consistent with recommendations made by the Federal Aviation Administration (FAA). In particular, the Commission requires antenna structure owners to register and exercise primary responsibility for painting and lighting of antenna structures meeting the registration criteria."

Under FCC rules, the FAA requires notification for the construction or alteration of any tower where its height exceeds 200 feet above ground level. Other factors are taken into account such

as proximity to an airport. Should the FAA determine that the tower is an air navigation hazard, the tower owner must comply with FCC mandated Lighting and marking rules.

The rules can be summarized as follows:

- Towers determined to be an air navigation hazard must be properly marked
- Once marked, that marking must be properly functioning and maintained (Tower owner's responsibility)
- At least once, every twenty-four (24) hours, the structure must be observed to confirm that the lighting and marking are properly functioning
 - Should the marking system fail, the FAA must be notified along with the estimated date of repair so that the FAA can issue a NOTAM (Notice to Airman)
 - Maintain for a period of two (2) years, the daily logs that show that the marking system was properly working
- The marking system must be inspected
 - Physical on-site inspection quarterly
 - Maintain for a period of two (2) years, the quarterly inspection results
 - Each lens must be inspected every twenty-four (24) months
- Should a tower owner not adhere to this set of rules, the tower owner is subject to penalty including fines.

This paper will now explore each of the above rules, and their associated cost impact on an organization.

Towers Must Be Properly Marked

When a structure is being built, and that structure is determined to be an air navigation hazard, that structure must be marked.

"structure owners ... primary responsibility for painting and lighting of antenna structures..."

The rules prescribe several options regarding that marking. The options include lighting or a combination of lighting and painting of the structure.

Painting of the structure: Structures can be painted for visibility to air navigation but there are requirements for painting of the structure. First and foremost, the painting must meet the FAA's Aviation Orange color requirement - Federal Standard 595 color #17875 for the white and color #12197 for the aviation orange. Also, just painting the structure is not sufficient; therefore each painted structure must have, at minimum, red lights on the tower.

Lighting on the tower: As noted above, should a tower be painted, it also is required to have lights. The basic lighting for painted towers is red lights. There are several lighting alternatives as well including medium intensity white during the day and red at night. The FCC lists a variety of alternatives, but the FAA must approve the method of marking.

The costs associated with the initial marking of the structure can be very large. Not only is the type of marking (painted/lighting) a factor, but also the size and type of tower can have an impact on costs. Also, the type of lighting system can have an impact on cost as well. Choices include incandescent, Xenon, and LED lighting.

Cost of painting of the structure: When evaluating the cost of painting a structure, there are five primary cost drivers.

- **Material cost of paint** - This can range from \$66 to \$82 per gallon for paint and coating. Each gallon covers roughly 400 sq. ft.
- **Tower crew labor cost** - The cost of the tower crew to paint the tower is based typically on the hours of work required for the painting. It is relatively easy though to convert that to a cost per foot. Typically, prices will range from \$25 per tower foot to \$80 per tower foot depending on tower type and tower height
- **Tower type** - There are three primary tower types, Guyed, Self-Supported, or Monopole. Each tower type is unique and requires a different amount of labor to complete.
- **Height of tower** - The height of the tower directly impacts the amount of labor required to do the painting.
- **Tower location** - Tower crews will charge to mobilize to the site. The more difficult it is to get to the location, the more the tower crew will charge in order to get there.

Summary of tower painting costs: Each tower is priced uniquely for tower painting. The prices can range from \$5,336 for a nearby guyed tower at 200 feet to \$80,040+ for a 1,000 foot broadcast tower in a congested area.

Cost of lighting on the tower: Similarly to the painting of a structure, there are a variety of cost drivers which determine the cost of the lighting system on the tower.

- **Lighting type** - The FCC defines lighting requirements based upon factors including height of tower, painted or not, and location of tower. The types are identified from A-F. Each type has a different cost.
- **Material cost based upon bulb type** - The type of bulb that the system uses also has an impact on the cost of the lighting system installation. Incandescent, Xenon and LED are the most popular forms of bulb type. Material costs can range from \$4,002 to \$133,400+ depending on variety of factors.
- **Tower crew labor cost** - The cost of the tower crew to install the lighting system on the tower is based typically on the hours of work required for the installation. It is relatively easy though to convert that to a cost per foot. Typically, prices will range from \$33 per tower foot to \$93 per tower foot depending on tower type and tower height

- **Tower type** - There are three primary tower types, Guyed, Self- Supported, or Monopole. Each tower type is unique and requires a different amount of labor to complete.
- **Height of tower** - The height of the tower directly impacts the amount of labor required to do the installation.
- **Tower location** - Tower crews will charge to mobilize to the site. The more difficult it is to get to the location, the more the tower crew will charge in order to get there.

Summary of tower lighting costs: Each tower is priced uniquely for tower lighting installation. The prices can range from \$13,340 for a 200 foot, LED, red light only, guyed tower that is relatively close to the tower crew, to \$133,400+ for a LED high intensity lighting system on a remote 1,000 foot broadcast tower.

Properly Functioning And Maintained

Once a tower is marked, the marking must be maintained. If it is a painted tower, paint fades over time. The FCC mandates verification that the paint is not in need of repainting, or if it is, to repaint the tower. If it is a lit tower, the lighting system must be properly functioning. If a bulb goes out, the bulb must be replaced. If the lighting controller malfunctions, the controller must be repaired.

"...the FAA's "In-Service Aviation Orange Tolerance Chart" is the benchmark for determining whether a structure needs to be cleaned or repainted... Antenna structure owners must use the chart in a manner consistent with FAA guidelines, which currently provide that the color should be sampled on the upper half of the structure. ... We note that visibility of the top half of the structure is the most important for safe air navigation and that the color of the top half of the structure is likely to fade faster than other parts of the structure due to weather conditions."

There are three common cost drivers in order to maintain a properly functioning and marked tower:

Cost of painting test and repaint: The FCC rules require that the FAA's "In-Service Aviation Orange Tolerance Chart" be used as the benchmark for determining whether a structure needs to be cleaned or repainted. Also, the FCC requires that this test be performed at the top of the tower. After all, the top of the tower is the part that is most exposed to the elements and is most important to be visible for air navigation.

There are two potential cost impacts with this requirement:

- Test annually the fade of the paint and record the result. Due to the fact that the FCC requires the test at the top of the tower, a certified climbing crew is required. The tower crew is priced based upon the mobilization requirements and time it takes to do the

test. If the tower is relatively close to the tower crew, the cost may be \$1,601 and this can go even higher depending upon tower location, height and type.

- Tower repaint may be required. The costs for a tower repaint are very similar to the initial tower painting and begin at \$5,336 and can be much more costly.

Cost of light bulb replacement: The FCC requires that lit structures remain lit, but depending upon the type of lighting system and bulb, the life of that bulb will vary. If a light bulb goes out, that light bulb must be changed.

There are three potential cost impacts with this requirement:

- **Life of the bulb** - All bulbs having varying degrees of life and cost. An incandescent light might have a life of 8,000 hours or almost a year, a Xenon bulb might have a life of 20,000 hours or 2.28 years and an LED bulb will be warranted for 5 years with a lifespan beyond that.
- **Cost of the bulb** - The costs typically range from \$400 to over \$1,334 for the bulb.
- **Tower crew labor to replace bulb** - The same factors apply here as to lighting system installation costs - tower height, type of lighting system, tower height, weather delays and mobilization. Costs can range anywhere from \$1,601 to beyond \$6,670 per bulb change.

Lighting System Maintenance: Lighting systems have electronic components that fail, just like any computer, router or switch. Many times, the lighting system components are installed in harsh conditions. Should a board, component or entire controller fail, the item must be repaired.

There are two potential cost impacts with this requirement:

- **Cost of the equipment** - The costs also will range from \$400 and upwards to the cost of replacement of the entire lighting system.
- **Technician or tower crew to replace equipment** - The same factors apply here as apply to lighting system installation cost such as where equipment is located (on tower or in shelter), type of lighting system, labor hours and mobilization. Costs can range anywhere from \$667 to beyond \$5,000.

Lights Are on - Every 24 Hours and Log It

It is required that the lighting be functioning properly and that this has been verified every 24 hours. All sorts of methods have been used in the past including contracting with the local farmer to check the lights to deploying employees to check to make sure all is functioning properly. The newer lighting systems provide for daily monitoring. Each has its own cost associated with it.

"These rules require the owner of an antenna structure to observe the antenna structure's lights to make sure they are functioning properly at least once every 24 hours either visually or by observing an automatic properly-maintained indicator designed to register any failure of these lights... antenna structure owners to provide the FAA with regular updates on the status of their repairs of lighting outages so that the FAA can maintain notifications to aircraft throughout the entire period of time the antenna structure remains unlit. ... if a lighting outage cannot be repaired within the FAA's original NOTAM period, we require the antenna structure owner to notify the FAA of that fact. In addition, the antenna structure owner must provide any needed updates to its estimated return-to-service date to the FAA. Moreover, an antenna structure owner must continue to provide these updates to the FAA every NOTAM period until its lights are repaired. We find it necessary to ensure that a NOTAM is reissued every NOTAM period so long as any outage continues, and that a current estimate of the return-to-service date is included in each notification, to clarify the scope of the malfunction and help focus the repair process toward a fixed repair date. ...two year retention period and the obligation to submit such records to the Commission upon request..."

This takes time and has a cost associated with it.

Cost of everyday monitoring: There are a variety of cost drivers that go into the daily monitoring, logging and reporting.

- **Daily verification** - There is time involved in verifying that the lighting system is up and running every day. If the lighting system is not automated, then there is the time and cost that it takes to verify that the lights are on. Also, in many instances, an outside party is paid to visually verify that the lighting is on. There is a cost in this as well.
- **Daily logging and tracking** - log needs to be maintained that shows that the lights are on. If the lighting system is not automated, someone must log this information into a tracking system. If the method for inspection is an outside party, the call to that outside party must be made, verified and logged. Again this takes time and money.
- **FAA reporting of outages** - Should an outage occur, the outage must be reported to the FAA within 30 minutes. Although this process is straight forward, there is labor involved in this as well. The outage must be verified. The data including ASR and more must be gathered. The FAA must be called by phone as this is the only method of reporting currently allowed by the FAA. The FAA must receive an estimated date as to when the outage will be corrected. A follow up call must be placed to the FAA when the lights are restored. Should the repair take longer than 15 days, a new call must be logged to the FAA for extension of NOTAM. Even simple power outages must be reported.
- **Outage project tracking** - Should an outage occur, the lighting system must be brought back live. This requires coordination with a variety of resources, including the Power Company if there is an outage, internal resources to mobilize to the site, and tower crew resources to fix burnt out bulbs or other aerial issues. This requires personnel to be involved until the FAA can be notified that the lighting system has been restored.

- **Record maintenance** - A system must be put in place to log the daily occurrences of the lighting system. In effect, each tower owner must have proof that the lighting system was on, that any outages have been reported, and all has been tracked and maintained for a period of two years. A system of logging must be created and that system must be maintained while the tower is in place.

The nation's power companies do an outstanding job of providing power. However, outages still occur regularly due to storms, aging infrastructure, vegetation, equipment failures, and other causes. Current U.S. data indicates a typical customer experiences approximately 1.4 to 1.5 power interruptions per year, and hundreds of thousands of outage events are recorded across the country annually. The length of an outage can vary significantly depending on the cause. When major disasters are excluded, interruptions tend to average about 2 hours per year, while major weather-related events can cause much longer disruptions. In severe cases, outages can last for days. This means power-related lighting outages remain a real and recurring risk, and each qualifying outage may require reporting to the FAA. Think about how many times a remote tower site may experience power loss during a year.

This only considers power related failures and not lighting system failures, bulb failures, and communication failures. Clearly the tracking, reporting and maintenance of lighting systems takes considerable time and system resources.

If we examine the time it takes a person to verify, log, report, coordinate, repair and track the lights daily, it is estimated that over a year's time, a minimum of 62 hours of labor will be used. If the loaded cost of these resources was \$40 per hour, this cost alone would equate to almost \$2,535 of labor per year.

Inspections

The FCC mandates that each lighting system be physically inspected quarterly. The only exception to this rule is in the case where specific requirements are met for a NOC based monitoring system. If the tower owner can meet those requirements, a waiver of the requirement can be applied

"Owners must also inspect, at least quarterly, all automatic or mechanical control devices, indicators, and alarm systems associated with the antenna structure lighting to ensure that they are functioning properly... exempt qualifying NOC-based monitoring systems from quarterly inspection obligations. Based on the record, we conclude that it would serve the public interest to eliminate the quarterly inspection obligation for those antenna structures using sufficiently robust monitoring systems. These systems employ self-diagnostic functions (such as alarm notification, 24-hour polling, and manual contact), an operations center staffed with trained personnel capable of responding to alarms 24 hours per day, 365 days per year, and a backup Operations Center that can monitor systems in the event of catastrophic failure."

The exception is a very high cost due to the systems required and the need for a primary and back up NOC capable of monitoring 24 hours a day and 365 days a year. Since most organizations do not wish to incur this large expense, they typically choose to physically inspect each tower lighting system quarterly.

Cost of quarterly inspections: There are a variety of cost drivers that derive quarterly inspections.

- **Technician cost** - In order to physically inspect "all automatic or mechanical control devices, indicators, and alarm systems" the technician must have sufficient experience and understanding of the systems they are inspecting. In many instances, this work has to be outsourced. The inspection takes technician time.
- **Mobilization** - Even if the tower owner has a technician on staff, there is the cost of getting to the site for the inspection. In most instances, the towers are not within walking distance. Should this inspection be outsourced, the mobilization costs alone can quickly exceed \$1,000.
- **Logging and tracking of each quarterly inspection** - As each quarterly inspection is completed, the results of each inspection must be logged and maintained. The records must be maintained for a period of two years. This takes people and system resources.
- **Inspections are required quarterly** - This means that four times a year, this cost will be incurred.

The cost associated with quarterly inspections will typically require four hours including technician's travel time. This could be more costly should portions of the equipment that need to be inspected be located on the tower itself. There is also the mobilization cost which requires a truck roll. If the four hours were taken into account, and the site was a one hour drive for the technician, and the technician's loaded rate is \$50.64 minimum cost of inspection would be approximately \$594 per inspection or \$2,375 annually.

An additional requirement is that all lenses must be inspected every twenty-four months. This means that a tower crew must climb, inspect, and document that each and every lens is free of defect including cracking, hazing, blocked by dirt and other issues. The same factors apply here as would apply to any inspection that requires a climbing crew. It comes down to labor hours and mobilization. Costs can range anywhere from \$667 to beyond \$5,000.

There is a significant risk that is being taken by not complying with the FCC rules regarding tower marking. First and foremost, there is a risk to the air navigation system of the United States, so people lives are put in danger once a tower owner chooses not to comply. Additionally the cost of non-compliance could include significant fines. Overall, operating obstruction lighting systems is costing you more than you think.

If you have additional questions or need help with your system please call LumenServe's sales and account management support team at (512) 580-4600 or email at Sales@LumenServe.com.

The information provided here is believed to be current but not a replacement for FCC rules which are subject to change. Please refer to the current FCC rules and regulations.

Sources: FCC 47 U.S.C. § 303(q), FAA Advisory Circulars. 47 CFR §§ 17.21-17.58, FCC Report and Order - FCC 14-117 published August 8, 2014, Wirelessestimator.com, and Eaton Blackout Tracker Annual Report 2014.