Tower Safety—It's More Than Just the Harness

By Christine Burke, KØALT

***Editor's Note**: WRO readers in November 2009 were treated to the cover story "One of Them," a humorous look at having a non-ham spouse, by Christine Burke, KØALT. After submitting the piece and attending a seminar on antenna tower safety, Burke learned the old lineman's belt she wore in the cover picture "did not set a very good safety example." This month Burke revisits her tower and brings a new perspective on safety techniques and climbing gear that can help assure antenna work is no accident.*

It started with a bang – or more accurately, a *thunk*.

Mike Higgins, K6AER, stood in front of a room of people interested in learning about antenna tower safety at an amateur radio conference last year with an old leather climbing belt in his hand.

"Do you have one of these in your garage?" he asked. "Throw it away." And into a wastebasket it landed. "If one of these stops your fall, you'll either be dead or paralyzed."

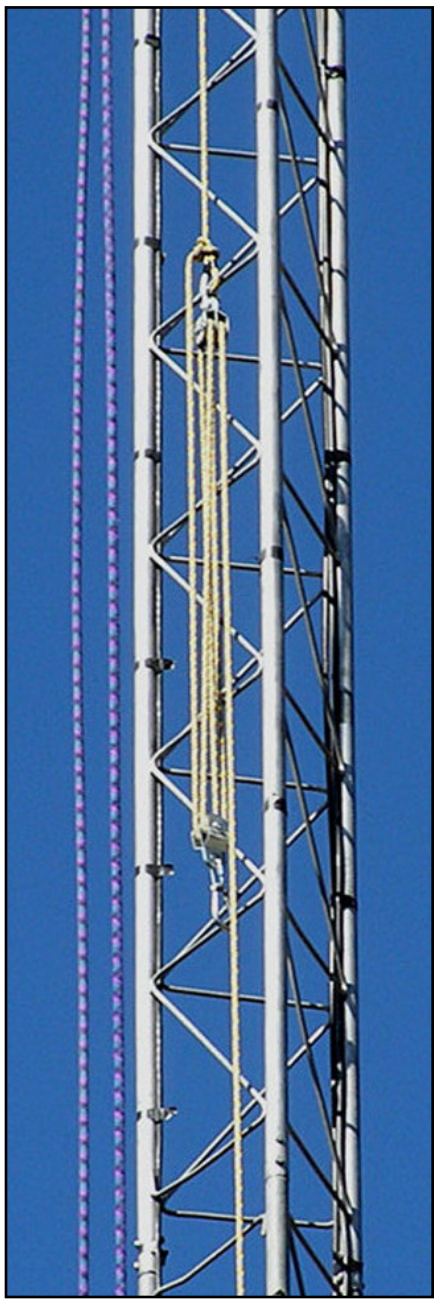
"*Yikes!*" I thought. It looked just like the one in my basement. I had used it many times.

Mike went on to demonstrate the characteristics of an OSHA-approved fall arrest harness. He showed us fall lanyards and positioning lanyards, emphasizing the importance of staying attached to the tower at all times.

Although I was unhappy about the cost, I knew I should purchase a new harness. We didn't need a top-of-the line model. But we did need a fairly decent one that would allow one of us to be on the tower for two or three hours at a time in reasonable comfort.

I procrastinated until one day my tribander stopped working. It was time to plan a tower project.

After exchanging a few e-mails with K6AER, I went shopping on the Internet.



This hoisting system uses two double pulleys, also called "blocks." One pulley is fixed, or "standing" and the other moves. If the hauling rope comes from the standing block, the mechanical advantage is 4. With no friction, a 100 pound load could be lifted with 25 pounds of force. If the hauling rope comes from the moving block, the mechanical advantage is 5. Real-world friction reduces the advantage. Note that a temporary steel thimble protects the rope where it is attached to the top pulley.

Christine Burke, KØALT, got her Novice license in 1970, her General in 1971, and her Extra in 2005. Most of her ham radio activity has been since 2004. She enjoys DXing and contesting from her QTH in rural western Colorado. Her other interests include cycling and whitewater canoeing.

I sorted through a bewildering array of harnesses and lanyards, looked around for the best price and placed my order for a harness, a positioning lanyard and two fall lanyards.

I got a size medium, which would fit either my husband or me.

With the harness on the way, I began calling friends and discussing the details of the project with my husband, Mike Gross. When it comes to planning the actual maneuvers on the tower, he is the brains of our operation.

I knew we needed to pull the rotator, loosen the U-bolts on the monobander, and lower the heavy mast until the tribander, which was the top antenna, came within reach.

But how were we going to handle all that weight? "Let me think about it," Mike said. He began making sketches for a pulley system.

Ropes and Pulleys

Having proper climbing equipment is only one aspect of safe tower work. Another major consideration is handling heavy loads. To lift or lower them safely and efficiently requires practical skills with ropes and pulleys.

Although it involves some expense, it's essential to have a good quality rope of sufficient length.

Christine Burke, KØALT, practices using her new fall arrest safety climbing harness on the 69-foot tower at her rural western Colorado station.

The main load-hauling rope needs to be twice as long as your highest attachment point (probably a gin pole length above your top section), plus 20 or 30 feet for your ground crew to pull on, plus more for a block and tackle.

Depending on how you position your hoisting gear on the tower, the block and tackle could easily use another 30 to 50 feet of line. Any part of the line that has to pass through a pulley should be continuous and free of knots.

Once I was on a ground crew that had to stop, tie off a heavy load and untie a knot to get the line through the pulley at the bottom of the tower. It didn't feel safe.

Rope that is appropriate for your hauling system is unlikely to be available in the sale bin at the local home improvement store. What you'll find there is mostly in 100-foot lengths, and it might be too stretchy.

We got our hauling rope from a discount camping store that carries mountaineering rope. The low-stretch, tightly braided polyester rope used by climbers and rescue teams is called "static line" or "accessory cord."

It is durable, abrasion-resistant, and will pull your load rather than stretching out when you haul on it. (Climbers also use stretchy "dynamic" ropes for fall protection, so take care to get the right kind.)

For our purposes, the diameter should be at least 3/8 inch, or 8 mm. If you get your rope from a marine supply store, look for low-stretch line that is suitable for halyards.

Besides the main hauling system, we also use a delivery system for sending tools, the rotator, and other small items up and

Mike Gross, KØALT's husband, connects a balun to her lowered tribander antenna during a recent tower climbing excursion.

down the tower. You can be less choosy about this rope.

The delivery system only requires a single pulley at the top. The canvas tote bags that are given away at conventions make handy delivery buckets.

When we maneuver an antenna up through the guys, a person on the ground uses a tag line to adjust its angle or position. A 100-foot rope from the hardware store will probably be sufficient for this use. And because no pulleys are involved, you can safely tie two ropes together to get the desired length.

To lower our mast, Mike rigged a pulley system with several components. At one end of the line was a cast iron hook secured in the bottom of the mast. From there, the line went up to the top of the tower, through a pulley, and down the tower. Part way down the tower, on the outside, he inserted a double block and tackle.

At the bottom of the tower was one more pulley to allow for a horizontal pull. A load that would have been dangerously heavy became easily manageable for me with the help of one backup person.

For more information about rigging ropes and pulleys to create a mechanical advantage, there's a great little illustrated book called *Moving Heavy Things*, by Jan Adkins.

A tie-off post about twenty feet from the tower allows the ground crew to rest while work is being performed above. We sank a four-by-four with about three feet in the ground and two feet above ground.

Not All Knots Are Safe

If you are going to use ropes to do work, you'll need to know a few good knots.

There's a difference between *hitches*, which attach ropes to objects, and *bends*, which tie two ropes together.

I was surprised to learn that the reef or square knot that we learned as children is not an all-purpose knot. When improperly used, it can be downright dangerous.

According to Clifford W. Ashley in *The Ashley Book of Knots*, "There have probably been more lives lost as a result of using a Square Knot as a bend (to tie two ropes together) than from the failure of any other half dozen knots combined."

Useful bends include the sheet bend, the carrick bend, and Ashley's bend.

For attaching a rope to a mast, an antenna, or a piece of coax, use a hitch, such as a rolling hitch. The bowline is excellent when you need a loop that doesn't cinch up.

It's not necessary to invest in the encyclopedic, though fascinating book by Ashley. A smaller book, such as *The Handbook of Knots, A Step-by-Step Guide to Tying and Using More Than 100 Knots*, by Des Pawson, can be a fine resource for learning the basics.

Site Inspection

It's easy to become so goal-driven that you develop tunnel vision. When my tribander stopped working, I spent a lot of time fussing over traps and worrying about the rapid approach of winter.

It didn't even occur to me that the tower guys might have become loose after a couple of years of no adjustments. I'm embarrassed to say that a friend had to point it out to me. We get into more about guys in the sidebar *"Tower Safety: Areas of Special Concern."*

So, before starting a tower project, do a site inspection. Look at the area around your tower base. Cut or remove tall, thick grass and weeds that can obscure trip hazards such as rocks and holes. Your ground crew needs a clear path for rope-pulling and other tasks.

Also check any areas where you might need to drag a rope. We learned the hard way that if you drag a rope through a patch of prickly pear cactus, you'll get a rope full of spines. Fortunately, the spines came out after we ran the rope through the clothes washer. (Always wash rope inside a mesh bag!) I also dug up the offending plants before the next work session.

Hard Hats Only Work When They're On Your Head

Any good article on tower safety will mention hard hats, especially for the ground crew. The problem is that the hat only works if you wear it.

It's a challenge to get people to use them. Without a chin strap, even a snug-fitting hat can fall off the first time you look up at the top of the tower.

Tower Safety: Areas of Special Concern

- **Don't over-tighten tower bolts**. It can compromise the structural integrity of the tubing, or make it tougher to remove the sections if you need to take it down.
- **Tower legs are particularly vulnerable** to corrosion near the concrete base. The concrete should be crowned so that water drains away and dirt does not collect there. Even galvanized metal can rust. Bill Brown, KØUK, applies a coat of rust-resistant paint on the lowest tower section if it is used as a base.
- **Water collecting in tower legs** can cause serious damage, especially when it freezes. The installation specifications for Rohn towers call for the tower legs to extend into a gravel bed underneath the concrete base for drainage purposes. Even so, water can build up in the legs. Bill drills a tiny weep hole in each leg, near the concrete. Each year Bill applies some rust resistant paint to this hole, making sure it doesn't block the hole.
- **Over-engineer the guy anchor points.** Bill sets a piece of four-inch or six-inch steel I-beam in concrete, with a couple of feet extending above ground. Elevating the attachment point above ground level makes it easier to work on.
- **Maintain the proper guy tension.** Guys will normally loosen a little during hot weather due to thermal expansion, and this is acceptable. If you remove too much of the summer slack, they will be too tight in the winter. This will either cause the guys to stretch, or it will put too much tension on the tower. Some old timers can adjust guys by feel. It's probably better to obtain a tension measuring device. The Rohn manuals provide tension specifications for guys at 60 degrees Fahrenheit.
- **Inspect critical components once a year.** Check guy cables for rust. Examine guy assemblies, turnbuckles, nuts and bolts, and the overall appearance of the tower.
- **Always wear safety glasses** when working with steel cables, as well as a good pair of gloves. Leather is preferred due to toughness, but other materials can also work well.
- **Take care of your ropes.** Keep them clean and store them indoors. Ultra-violet light can weaken ropes. Before each use, inspect them for abrasion and other damage.
- **If you are climbing a tower other than your own,** find out who installed it and what specifications they used. Plus, do a thorough inspection of all critical areas similar to your maintenance routine.

— Christine Burke, KØALT

After that, what are the chances that you will bother to put it back on? Chin straps can be purchased as accessories, or you can fashion your own.

There is apparently a shortage of chin straps on ships and oil rigs operating in the Gulf of Mexico. In recent years, hundreds of hard hats have washed up on the beaches of Texas. Mike and I picked up two nice ones while on vacation last year.

According to Mike Higgins, K6AER, hard hats should meet the OSHA safety rating 1910.135 or ISO International Standard No. 3873-1977.

Listen to the Old Timers

Bill Brown, KØUK, has been a ham since he was 13 and has been climbing towers even longer.

As a young man in Kentucky, he helped his uncle and others with projects on both ham towers and commercial towers. Since he moved to Colorado in 1973, he's been involved in building several of the big contesting stations, as well as commercial tower work, such as taking down the old KSTR tower in Grand Junction.

"The main thing is common sense," Bill says. "It just doesn't make sense to work on the tower when it's too windy, rainy, or snowy, or when there is lightning nearby. And getting too close to power lines with any kind of object – that's just not smart."

"You should never be rushed. Your approach to the work needs to be calm and well-planned. If you start to get tired, come down the tower and take a break.

"If your hands or your feet start to get cramped, you'll start making mistakes. And you have to be strong and fit. If you're not, you shouldn't be up there. It's physically demanding. Know what your body can take.

"Also, I don't climb in the mid-summer when it's too awfully hot. I work on my tower in the mild weather."

Over-Engineer for Safety

Falling people and falling objects are not the only potential risks in tower work. The tower can buckle, or worse, fold or collapse, if it is not properly installed and maintained.

Bill stresses the importance of following the engineering specifications when installing a tower. "If you don't have the engineering manual for your tower, you can probably find it on the Internet," he says.

"Those specifications have a good margin of safety in them. Build to that spec, or even stronger, and don't cut corners. That way, if the wind blows, you know you have the extra 15 to 30 percent of strength."

Respect, Not Fear

Bill Brown was nine years old when he first hopped onto a tower and climbed up 20 feet to retrieve a dipole support rope. That's when his uncle realized it was time to teach the boy about safe climbing techniques.

"I started out with the old-style linesman's belt," he recalls. "I was never really afraid, but I always had respect. Fear doesn't do you any good. Working on a tower is the same at 30 feet as it is at 200 feet – it just doesn't feel that way to a lot of people. But you have to be calm and relaxed.

"Don't try to do something that is out of your league. Leave it alone, or ask someone who has the knowledge and experience to help you."

Teamwork and Planning

Bill Brown's advice for beginners is to "be a grunt on the ground until you really know what you're doing. As you mature and get stronger, you can climb higher."

I asked him what he looks for in a ground crew. "You've got to have people with experience, and people who listen to them.

"In an inexperienced person, I look for the ability to take directions and not be a know-it-all. I don't want to work around macho behavior – people who are taking chances.

"An older fellow who used to climb a lot – but can't now – is wonderful to have on the ground crew. He is in synch with me. He or she will generally know what I'm doing, and anticipate what I need next.

"We have to be able to think two or three moves ahead. We have to understand the forces that are involved, and not stress the equipment or ourselves."

Working in three dimensions while 70 feet up can get complicated. When a project involves more than just a minor tweak, my husband writes a list of every step in the project.

Often, the act of making the list will raise new issues that we can deal with ahead of time. This reduces the amount of time spent on the tower, and prevents us from forgetting a step.

Forgotten steps can be costly in terms of time and energy. Once, we forgot to drill a hole. Mike had to send the part down, come down the tower, drill the hole, and climb back up. Even if he had trusted me to drill the hole, he would have had to wait on the tower.

I've learned a lot since we installed our tower in 2004. The antenna project in 2009 showed me that I still have plenty to learn.

Fortunately, my mistakes have been small ones, such as getting cactus spines in a rope, or forgetting to drill a hole. In the future, I'll continue to listen to the voices of experience, and remember to keep the big picture in mind.