



BLADE

Despite extreme weather conditions, 18,000-lb payloads that could be delivered only by helicopter crane and a year-long materials supply chain, an Anchorage-based contractor is completing a five-year effort to bring broadband to remote villages By Scott Blair in Kotzebue, Alaska

As 72-ft-dia rotor blades spin overhead, a fearless crew of specialized workers perches atop the four legs of a half-erected communications tower at a desolate mountain-top site, ready to receive the next section of tower. As far as the eye can see, there are no roads, no buildings, no other people. Above, a heavy-lift helicopter, nicknamed Annie, hovers, with her pilots methodically lowering the 18,000-lb payload down toward the workers, aiming to precisely mate the new tower section with the previous one. Once everything falls into position, each worker uses a

specialized tool to grab cable guides hanging from the top section's bolt holes, threading them through the lower section's holes, which helps to deliver the tower onto a flange connection. After the technicians throw a bolt through each connection and snug it, they give the thumbs-up to the helicopter pilots, who release the load and fly off for the next section.

This scene, which played out dozens of times this summer, is just a small facet of the unusual and dangerous work crews have performed in Alaska over the past five years to build a 3,289-mile-long communications network throughout a remote area the size of Texas. With a short summer

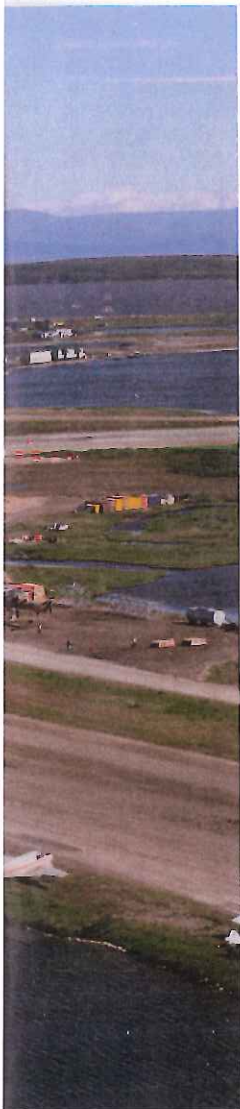
RUNNER





CHAIN LINKS

Barges bring supplies and equipment during brief ice-free periods, often requiring beach landings to unload (left). Materials are staged at village airports, such as Kotzebue (top), and then transported to the tower site via the air crane (above).



build season and few transportation options, the project team had to plan out its supply and materials logistics more than a year in advance and work through the region's extreme weather conditions.

COVER STORY
EXTREME
CONSTRUCTION

TERRA Incognita

Groundwork began in 2008 for the \$300-million Terrestrial for Every Rural Region in Alaska (TERRA) network, which connects rural Alaska villages with ground-based broadband. The project, scheduled for completion this year, will dramatically boost internet and communications capabilities for 45,000 Alaskans in 84 remote villages, most cut off from road networks, power grids and overland communications systems and reachable only by air or boat.

Previously, expensive and slow satellite service provided the only communications option for these areas. General Communication Inc. (GCI), a wireless, internet, phone and cable-TV provider in the state, had been working on designs to improve the system. "When stimulus funding became available through the [American] Recovery and Reinvestment Act, we had a shovel-ready project to deliver the service," says Heather Handyside, GCI's senior director of corporate communications. "We were able to leverage about \$50 million in federal funds and ultimately bring in \$250 million of our own at-risk capital to build out the system."

The new, 3-gigabyte microwave-and-fiber network enables communities to use "telemedicine" so that

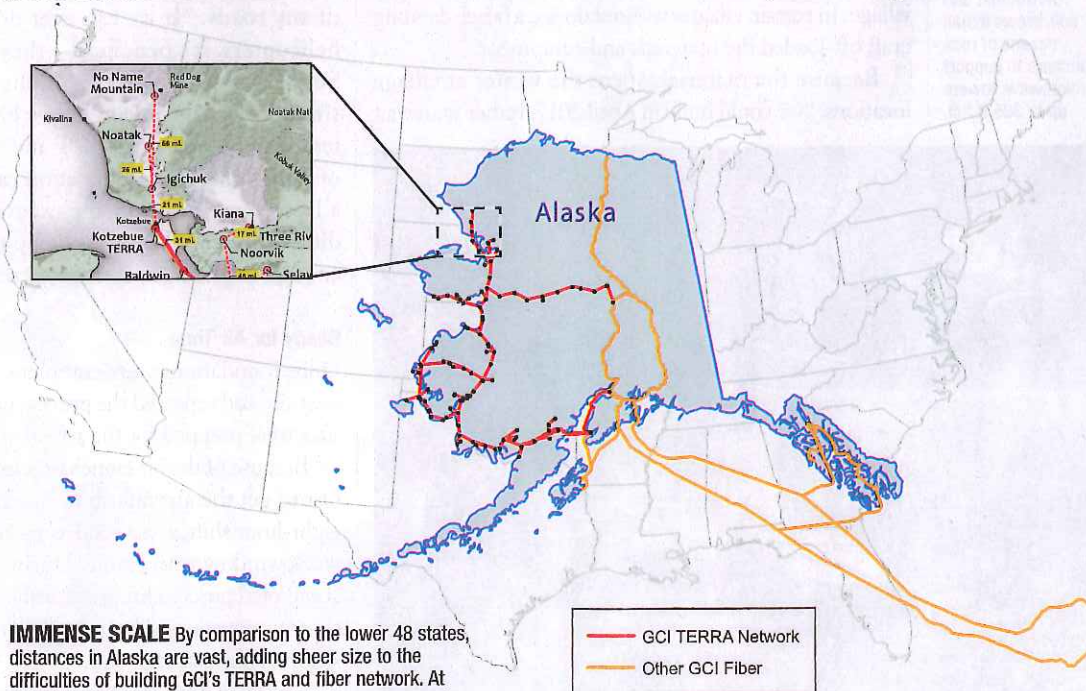
patients can be examined by specialists without having to fly down to a major city. The system also supports educational videoconferencing and provides economic stimulus and public safety benefits, GCI says.

With three previous TERRA phases under its belt between 2011 and 2014, GCI in January 2016 awarded a \$76-million contract to Anchorage-based contractor STG Inc. to wrap up TERRA by building out a critical final link in a network "ring" through some of the state's most isolated territory. The current phase also adds multiple spurs to connect villages in the network's northernmost reaches.

In telecommunications parlance, a "ring" serves an important role, providing "a redundant path for the data on the network so that it's not all traversing one large, strung-out span," says Patrick Goodyear, GCI's project engineer. The data "can go around the other direction if you have a break," he notes, adding that it also provides larger capacities.

The ring includes some fiber-optic cabling, laid in the early phases of the project, plus an extensive network of 120 microwave antennas mounted atop 30 towers as high as 305 ft tall. "It's probably one of the biggest, if not the biggest, long-haul, contiguous microwave systems in the world," Goodyear says.

The entire TERRA project includes 95 towers and 108 sites, 24 of which are on mountaintops. The average shot—the distance that the microwaves need to travel between antennas—is 35 miles, with the longest at 83 miles.



IMMENSE SCALE By comparison to the lower 48 states, distances in Alaska are vast, adding sheer size to the difficulties of building GCI's TERRA and fiber network. At Iglichuk, north of Kotzebue (inset), crews used snow roads to position some materials before the air crane's work.

PHOTOS: (TOP) BY HYBRID
COLOR/TRAVIS SMITH; (ABOVE
AND MAP, RIGHT) COURTESY GCI;
(LEFT) COURTESY STG

Prep work for the final phase of the project built upon lessons learned in previous phases. STG, which also served as contractor on the earlier phases, leveraged its planning expertise to get materials staged for 40 separate worksites, including 15 new towers, so its crews could hit the ground running for the final push during the short, May-through-September build seasons. This approach enabled crews to do more work during this final phase than had been attempted in any of the first three phases.

"The amount of planning for the logistics is incredible," says Jordan Summers, STG's senior field operations manager. "You miss a day, you miss the season. All of a sudden, one day there's ice in the rivers, and the barge can't go up them anymore. And before you know it, your equipment is stuck there for the entire winter."

To avoid delays, the team had to consider factors such as materials acquisition, barge schedules, airplane cargo transport and worker lodging in remote villages months if not more than a year in advance.

"We were ordering materials for two of our sites in April 2016 because we wanted to build in April 2017," says Jay Ubben, STG project engineer. This meant that as soon as STG won the contract in January 2016, the design-build firm had just two months to work with its geotechnical and structural engineers to get designs finalized and sent to the tower steel fabricator in Spokane, Wash. In turn, the fabricator had to ship the steel pieces to Alaska in April, so that they could be distributed to staging areas. Then, during a brief ice-free window in July, barges delivered the materials to each individual village. In certain villages without docks, a beach-landing craft off-loaded the materials and equipment.

Because the materials spent the winter at village locations, "we could build in April 2017, rather than wait

until the river ice breaks up in June," Ubben says. "That kind of planning—a full year in advance to get materials on site nine months before you actually want to start the job—is what allows us to get this many sites done in a season."

The team relies upon systematic checking and re-checking of supply lists and tracking of tools and materials. "This is a really big, spectacular project. But, to be honest, it's successful and has gone well because of these small, very mundane, average-sounding details," says Mark Carlson, project manager with GCI.

Once STG commences work at a particular site, crews arrive and begin ferrying the pre-staged materials—lumber, concrete, rock anchors, drill rigs, excavators and temporary encampments, among them—to the jobsite via midsize helicopters, such as Hueys.

Then, crews stay on site for several weeks as they build tower foundations along with the foundations for two shipping-container-sized modules: one housing all the station's communications equipment and the other housing generators and power.

For the towers, crews excavate as much as 10 ft to reach competent rock and then drill as many as eight rock anchors per tower leg to a depth of around 30 ft. Once grouted, each anchor-bolt cluster gets topped with a 5-ft-dia, 2.5-ft-deep concrete pier.

At one particular tower site at Igichuk Mountain, north of Kotzebue, STG elected to perform the foundation work in the middle of winter, when crews could use a temporary snow road in an area normally devoid of any roads. "If we can ever do anything without helicopters, it's beneficial—they are so expensive," Summers says. However, working at the mountaintop site in February meant crews had to contend with temperatures as low as -40°F and with just a few hours of daylight. During foundation casting, STG formed a large tarp tent over the excavation site and used diesel-powered heaters to keep temperatures warm enough to place grout and concrete.

Ready for Air Time

Once foundations were complete, crews moved to the next site and repeated the process until all of the season's sites were prepped for the arrival of the air crane.

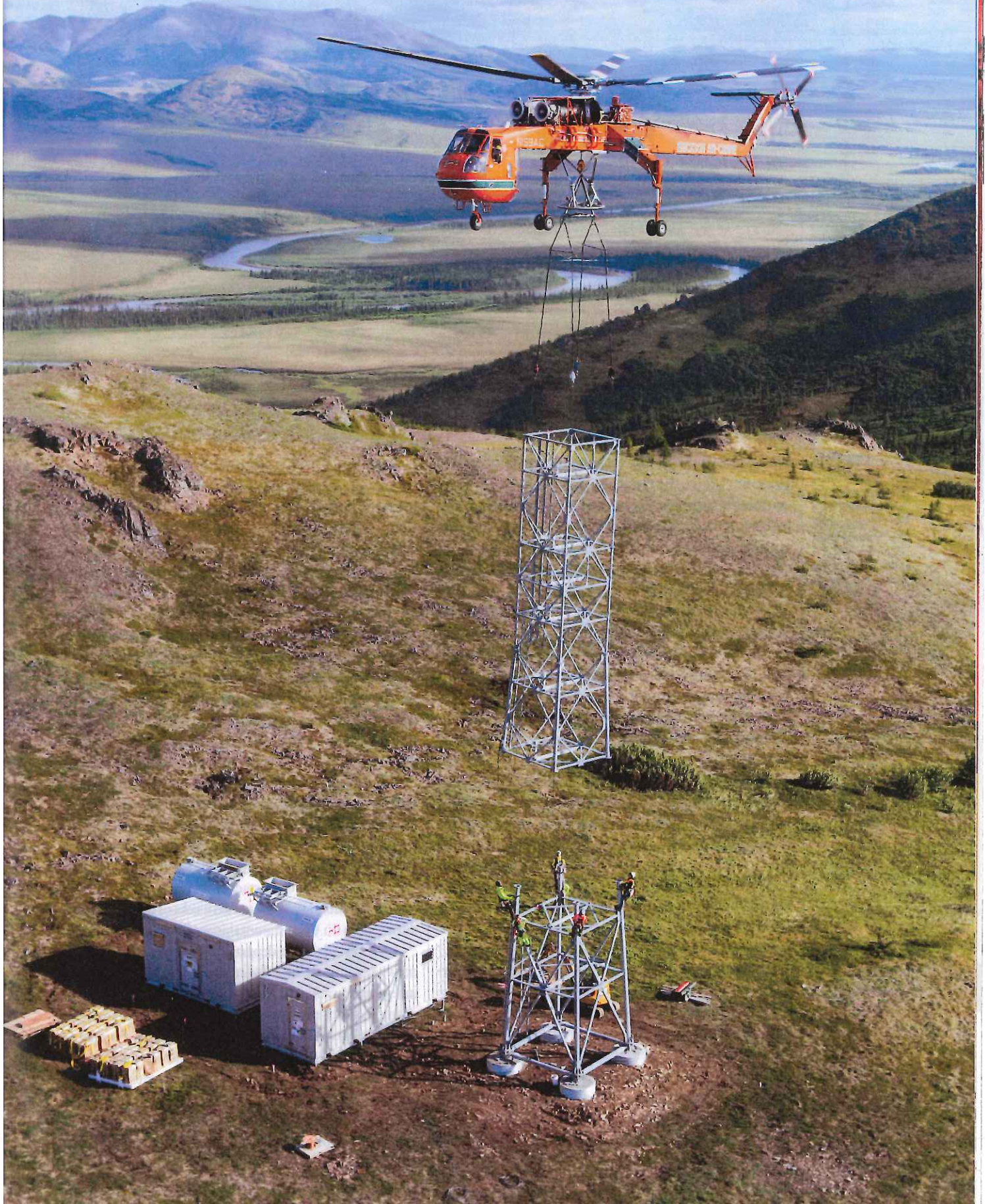
Because of the air crane's expense—it costs \$250,000 just to get the aircraft up to Alaska, then \$65,000 per eight-hour shift, says Goodyear—STG had only a two-week window with Annie. During that time, the craft completed picks to lift preassembled tower sections and communications and generator modules to each tower site from the staging areas.

Erickson Inc. manufactures and operates the air cranes, including Annie. The Salem, Ore.-based firm

COLD BORE After excavating through permafrost and soil, crews install dozens of rock anchors to support microwave towers up to 305 ft tall.



PRECISE PICK Three pilots control the air crane during precision lifts. A rear-facing pilot controls and lowers the load before it's mated with the already placed tower section.





LESSONS LEARNED

After snow and ice buildup led to high maintenance costs at Askinuk Mountain, GCI lowered the height of the tower to minimize surface area.

bought the patent for the existing Sikorsky Skycrane in 1994; since then, the firm has made about 180 different engineering improvements and modifications to the machine, rebranding it as an “air crane.” “It’s a unique aircraft, and there’s really nothing else that can do exactly what it does,” says Andy Mills, Erickson president of commercial aviation.

While the air crane’s lift capacity maxes out at 25,000 lb, typical picks for the TERRA project ranged from 14,000 lb to 18,000 lb since the craft’s fuel weight and flight time impacts the payload weight. For example, at Igichuk, the air crane had to fly about 20 minutes between Kotzebue and the mountaintop; in comparison, a Huey would need to make four to six trips to move the same payload weight.

“The air crane was designed with the main load-lifting beam directly under the center of the helicopter and directly beneath the transmission—the strongest part of the aircraft,” Mills says. “It was designed from the very beginning as a repetitive heavy-lift aircraft.”

Where a typical helicopter’s body would be located, the air crane instead features a patented anti-rotation device from which the payload rigging is suspended. It gives the air crane a shape akin to a dragonfly. Another anomaly can be found in the pilot’s cockpit: Two pilots fly side by side in the front, but during precision lifts for construction work, a third aft-facing pilot sits in a bubble just behind and below the two front-facing pilots. From this rearward vantage point, the third pilot has a clear view of the payload and uses his own set of controls to guide about 30% of the flight of the aircraft, Mills notes.

Because of its special niche in the aviation industry,

Erickson has been tasked with one-of-a-kind jobs throughout its more than four-decade history, including lowering an MRI machine down through the roof of a hospital in downtown Chicago, replacing the refurbished statue on top of the U.S. Capitol dome in Washington, D.C., and constructing a power line through the Himalayan Mountains in Kashmir. The aircraft routinely delivers HVAC modules to building rooftops and can drive caissons in environmentally sensitive areas without touching the ground, Mills says. With a custom water-syphon attachment that can slurp up thousands of gallons of water in just seconds, the unit often gets enlisted to fight fires.

During TERRA’s first phase, STG assembled the telecommunications towers entirely on site using the gin-pole method, “which was dangerous and took several weeks,” says Brennan Walsh, STG president. In subsequent years, once the team understood the air crane’s capabilities, STG revised the build sequence to prefabricate the tower sections horizontally on the ground at the staging sites; then, the air-crane crew stacked them at the tower site, “which probably saved about two weeks of manpower and duration up on these mountaintops,” Walsh adds.

Once the air crane departs each season, STG’s tower crews begin installing the microwave antennas. Next, integration crews set up the generators and link the power-systems module to the communications module. Each site includes redundant equipment: two generators; dual 4,500-gallon fuel tanks, to power the location up to 16 months; 4,000 lb of backup batteries; and extra microwave antennas.

Once STG completes the work at each location, GCI sends in its own group of specialized technicians to test,

COVER STORY
EXTREME
CONSTRUCTION



optimize and then fire up all the communications equipment and take the broadband system operational.

No One Goes in Alone

From frostbite and dangerous wildlife to the imposing air crane, construction crews face potential hazards at every turn. Despite this, STG has not logged a single lost-time incident during TERRA, Walsh says.

No one ever gets sent alone to a mountaintop, Carlson adds. All teams carry satellite phones and personal locator beacons. Because weather could prevent a helicopter from fetching crews or maintenance staff from the remote sites after work is completed, GCI stocks each mountaintop location with emergency supplies, cold-weather gear and enough food and water to last two weeks inside the communications module. "At any point, they are able to stick it out and survive if they had to," Carlson says. One season, a team became stuck at a site for 10 days after a storm blew in and prevented the helicopter from extracting them. "They were fine but a little bored, obviously," he says.

During operations involving the air crane, Erickson brings in its own aviation safety-management system. The firm's safety managers conduct a full audit of the worksite and, usually weeks before the air crane's arrival, hold safety meetings with anyone who will be on the jobsite or near the aircraft, Mills says. Despite the challenging nature of power-line and other work performed by the aviation company over its 40-plus-year history, Erickson has never had an accident, he adds.

Fresh Start

While Erickson's fleet of 20 air cranes remains busier than ever throughout the world, the firm's acquisition of

Evergreen Helicopters in 2013 saddled the company with a large amount of debt, which precipitated Erickson filing for Chapter 11 bankruptcy protection at the end of 2016.

"The financial restructuring ... allows [Erickson] to have the fresh ownership and balance sheet to chart a way forward as a continuing company," says Doug Kitani, who took over as CEO and director on Aug. 31.

With only 45,000 potential customers, it also remains to be seen how profitable TERRA will be for GCI. Just keeping the system operational through the harsh Alaskan winters takes a team of technicians working year-round. Every site receives routine maintenance at least once a year, requiring a three- to four-day visit by the staff. At one of the network's westernmost sites, Askinuk Mountain, a tower became so battered by ice and wind that it needed \$1 million of maintenance in each of its first two seasons, says Goodyear. After performing hyperaccurate surveys of the microwave path, GCI determined the tower had been overbuilt. Crews shortened it to 85 ft from 140 ft, eliminating much of the problem.

While GCI's Handyside acknowledges that many villagers might be excited to watch Netflix on the new network, she looks forward to ways TERRA will connect remote communities with health-care and other services. "I know someone who has a child with a speech impediment, and they have weekly meetings with a speech therapist," she says. "That's something that I think people take for granted in the Lower 48, but it's a huge challenge if you are in a remote community with 300 people, with no roads, and you have to fly if you want to go anywhere." ■

HARDY

Tower crews endure high winds, extreme temperatures and close quarters with Annie's formidable rotor blades.