

'Mars antenna' gets repairs

October 7 2010, By Kurt Streeter, Los Angeles Times

Frequented more by packs of stray burros than by cars, the road is a lonely one. Thirty-five miles north of Barstow, Calif., 30 minutes from the nearest highway, it ambles through parched desert before dropping into a low valley.

Here, where the pavement ends, the great antenna rises.

"Only this isn't just any ordinary antenna," said Peter Hames, an engineer who oversees the massive structure for La Canada Flintridge's Jet Propulsion Laboratories. "It doesn't get much fanfare, but this is one of the main contributors to our understanding of the solar system."

Deep Space Station 14 -- informally dubbed the Mars antenna because its initial task, in 1966, was to track a spacecraft after it flew past Mars -- spreads from the ground like a looming, 10-story poppy. Its most eye-catching element is its parabolic dish, which stretches nearly the length of a football field and weighs -- struts and radio equipment included -- nearly 2,000 tons.

Despite its heft, it easily tilts and twists as it tracks asteroids, rovers on distant planets, and probes rocketing as far as 11 billion miles away.

Tucked inside a federally owned swath of the Mojave known as Goldstone, the antenna is little known outside JPL and NASA's Washington, D.C., headquarters.

Yet there are few larger antennas in the world, and those that have more

size, said Hames, have less ability: Either they are fixed in the ground and unable to rotate fully, or they can't both send and receive data.

None can match Deep Space Station 14 for its combination of communications power and historical significance, said Cornell astronomy professor Steven Squyres, lead scientific investigator for the Mars Rover project.

If the dish -- scanning space with the help of a pair of newer, nearly identical antennas in Spain and Australia -- didn't exist, he said, "the rovers we send into space just might as well not even be there. We wouldn't even be able to try."

As the decades have passed, however, the 44-year-old edifice has grown increasingly troublesome. By last year, maintenance crews were spending almost 20 hours a week repairing it.

So in March, in anticipation of a series of spacecraft launches over the next five years that could lead to a manned flight to Mars, a major remodeling job began.

The focus of the \$5.6 million project, led by JPL and paid for by NASA, has been on the guts of the structure, an 80-foot-wide ring of steel and cement known as the hydrostatic bearing. It provides a foundation for the dish, allowing it to spin on a horizontal plane. Like a puck on slippery ice, the dish rotates by sliding on a thin coat of oil constantly pumped on the bearing's surface.

Because even a slight uncontrolled movement can send the dish's radio beam wildly off target, the bearing has to remain remarkably flat. But as the years passed for a structure that was originally expected to last only until the 1980s, the bearing often cracked and became uneven.

The remodel began with workers separating the dish from its foundation, raising it and then dropping it down onto three temporary, 40-foot-tall support legs. That allowed crews on narrow catwalks to take apart the bearing. Then they painstakingly poured flatter, more durable cement and created a new metallic surface for the oil.

NASA needs the antenna to be operational by Nov. 1, in time to communicate with an orbiter during its flyby of the comet Hartley 2, which will be between Earth and Mars.

"The accuracy we're having to work with out here, that's really the biggest challenge," Hames said as he scaled a scaffolding while performing an inspection. Because the dish's radio signals are programmed to come from a fixed point on Earth, the repairs can't alter the antenna's size or location in any significant way. The job must be finished without changing the height of the 235-foot structure by more than one-eighth of an inch, a requirement made difficult by fierce desert winds and soaring temperatures that expand the antenna's metal.

"It's like a living, breathing thing," Hames said. "But when we're done, it can't have changed any more than the thickness of five sheets of paper."

The antenna was conceived at the beginning of the space race because NASA needed one more powerful, accurate and nimble than it had ever built. Goldstone -- 52 square miles of desert that is home to 11 smaller space antennas -- was chosen because it was so far from cities that the airspace wasn't cluttered with competing radio signals that can wreak havoc on transmissions to space.

Since its first year, Deep Space Station 14 has shepherded, at least partly, every NASA spacecraft that has traveled far past the moon. That includes the Galileo mission to Jupiter, the Cassini to Saturn, the Mariner missions to Mars and the Voyagers 1 and 2, which are at the

edge of the solar system.

The antenna also played a role in several famed manned space flights. In 1969, after the first manned mission landed on the moon, it captured Neil Armstrong saying: "That's one small step for man, one giant leap for mankind."

In 1970, when the Apollo 13 moon mission had to be aborted after an on-board explosion, vital communication went through the Deep Space Station 14. After a risky return through the Earth's atmosphere, Apollo 13 made it safely home.

"They were operating on such low power with their radio transmitter that the only station with enough sensitivity to be able to carry the voice back to Houston was the Mars antenna," said Douglas Mudgway, a former JPL operations manager who has written a pair of books on the structure.

"Without that radio link, my God, it would have been very, very difficult to have a successful return."

What will the future hold?

Plans are under way for a system using much smaller dishes -- laid together in clusters, working in unison -- that will eventually replace the antenna.

But when Deep Space Station 14 eventually fades into retirement, its place in history will be secure, said Hames.

"This is like a classic automobile," he said. "It gets under your skin and requires a lot of care and feeding, love and attention. But even when the newer models arrive, it'll never really leave your heart, just because of all that it has done."

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Citation: 'Mars antenna' gets repairs (2010, October 7) retrieved 15 May 2024 from <https://phys.org/news/2010-10-mars-antenna.html>

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