National Radio Astronomy Observatory
VLBA Antenna Memo Series – No. 106

David Paul

TRIP REPORT – MAUNA KEA, May 9-17, 2023
DISH PANEL REPLACEMENT

1. Trip Summary

A group from the VLA traveled to the Fort Davis, TX VLBA station (FD) to replace a 60 degree section of azimuth rail (bolts 1-20). Piece of rail removed had a low spot where it had been welded up originally.

David Paul
Patrick Martinez (Ant Mech)
Sean Tracy (Ant Mech)
Lorenzo Benavidez (Ant Mech)
Helen Schledewitz-McGinnis (ES&S)

Along with the VLA staff, there were the FD VLBA site techs on site to help.

Tony Sylvester (MK)
Simeon Johnson (MK)
Ray McFarlin (KP)
Ken Lakies
Juan DeGuia (FD)
Del Correa (SC)

Figure 1: The Mauna Kea VLBA station antenna

2. Plan Summary

A Tiger Team maintenance activity is going on while here for the replacement of damaged dish panels. Other repairs include damage to the feed housing, damaged dichroic panel replacement and any other repairs identified by the site techs.

3. Trip Details

Monday, May 8, 2023

- Fly from ABQ to Kona, Hawaii, pickup rental car and get checked into hotel.

Tuesday-Wednesday, May 9-17, 2023

Travel to Mauna Kea access, acclimate at 9,000 ft visitor center for 15-30 minutes then proceed up mountain to VLBA site at 12,300 ft elevation. Meet site techs Tony and Simeon and get a general

look at the site. Site grounds and control building are very clean and tidy. They have shelves, cabinets and racks to organize their parts, tools and equipment. Due to the controversial nature of this site, in recent years, they keep it very tidy and squared away. The antenna is not visible from the main road and the signage is very subdued. From higher up on the mountain this site is visible. The "Rangers" stop by the site multiple times per day to look things over.

The first morning we setup the Wilde level and shot the rail using a target on the idler wheel with the encoder. The elevation values are all pretty consistent with the splices being a low spot in every case (0.020-0.030 inches). The rail and grout is in pretty good condition overall.

The feed housing in the dish had several damaged spots in the surface down to the aluminum structure. The spots were filled with silicon caulking and smoothed with a putty knife. The whole housing was painted with Henry silicon white roof coating. (see Figures 2 & 3)

Figure 2: Repairing Ice Damaged Spots on Feed Housing

Damaged aluminum dish panels were replaced in tiers 1, 2 and 3. The existing rivets were center punched using an automatic punch. All of the existing countersunk head solid aluminum aircraft rivets were drilled out. Each panel has 100+ rivets so spare drill bits were needed due to breakage and dulling. (See Figure 3)

Figure 3: Drilling Out the Old Rivets

The new panel was checked for fit then the old panel was laid over it and the old rivet holes were marked with a Sharpie. The panel was placed in its new location in the dish and new holes drilled between the old marked holes. (#19 drill bit) The new panel was held in place with Cleco temporary fasteners while the rest of the holes were drilled. (see Figure 4) The new holes in the skin were countersunk so the head of the new rivets set flush. A depth adjustable aviation counter sink tool was used in a drill motor to create the countersink.

Figure 4: New Panel Retained with Clecos

The rivets used are Cherry (pop rivet style) part numbers CR3212-5-03 and CR3212-5-04. The -03 vs the -04 is the grip length. The -04 with the longer grip length was used where there are three thickness of aluminum to rivet. The under-support structure flange only has enough space to rivet one panel. To attach the adjacent panel a double strip is used. (see Figure 5)

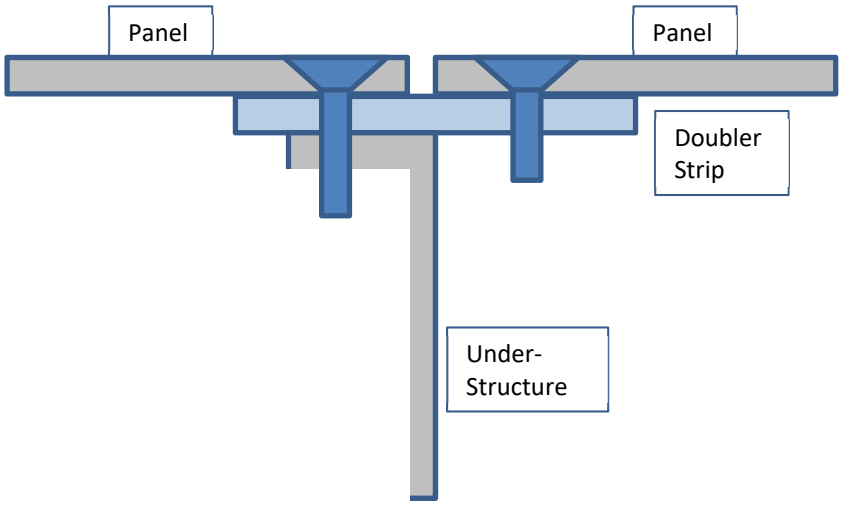

Figure 5: Panel and Under Structure with Doubler Strip

In one case the damage to the panel translated into the under-structure and the formed aluminum C was deformed. Using an adjustable wrench, hammers and a block of wood the C was straightened the best possible. There is about a 4 inch section that we didn't attach to the C to allow the panel to stay in the correct shape. The two panels are attached to the doubler-strip. (see Figure 6)

Figure 6: Doubler strip and Deformed Under-Structure

The rivets were painted white when installation was complete using white spray paint. The panels look very good. (see Figure 7)

Figure 7: New Installed Panels

It was found during a structural inspection that part of the antenna structure which creates an enclosed box using flat plates was bulged. (see Figure 8)

Figure 8: Bulged Plates

A 1/2 inch hole was drilled in the center of the bottom plate. A small amount of sludge came out and water drained out for 1 hour. The enclosed box was full of water and had frozen during colder weather which bulged the plates. The sludge is elevation gear moly grease lubricant and made a mess. It was decided that the long term solution would to drill and tap the bottom to 3/8 NPT thread and install a plug. The site techs will take a bucket up there once per month and drain it. Based on how much comes out will determine the long-term frequency for draining. (see Figure 9)

Figure 9: Boxed Area of Lower Structure

Overall the condition of the antenna is good. There is some rust but it is only surface scale. The techs would like to paint but they are nervous about the environmental constraints of this location. I believe they could use Zero-Rust or POR-15 and apply it with a brush. These paints are made to go over rust and seal it up. (see Figure 10)

Figure 10: Corrosion Examples

The sub-reflector on this antenna is in pretty rough shape. The fiberglass is exposed in a couple spots. (see Figure 11) Due to the environmental concerns about painting it may be best to refurbish the spare sub reflector at the VLA and swap it out. This would require hiring a crane locally and NRAO Technicians to align and calibrate the replacement. This refurbish and swap cycle could be used on all of the VLBA.

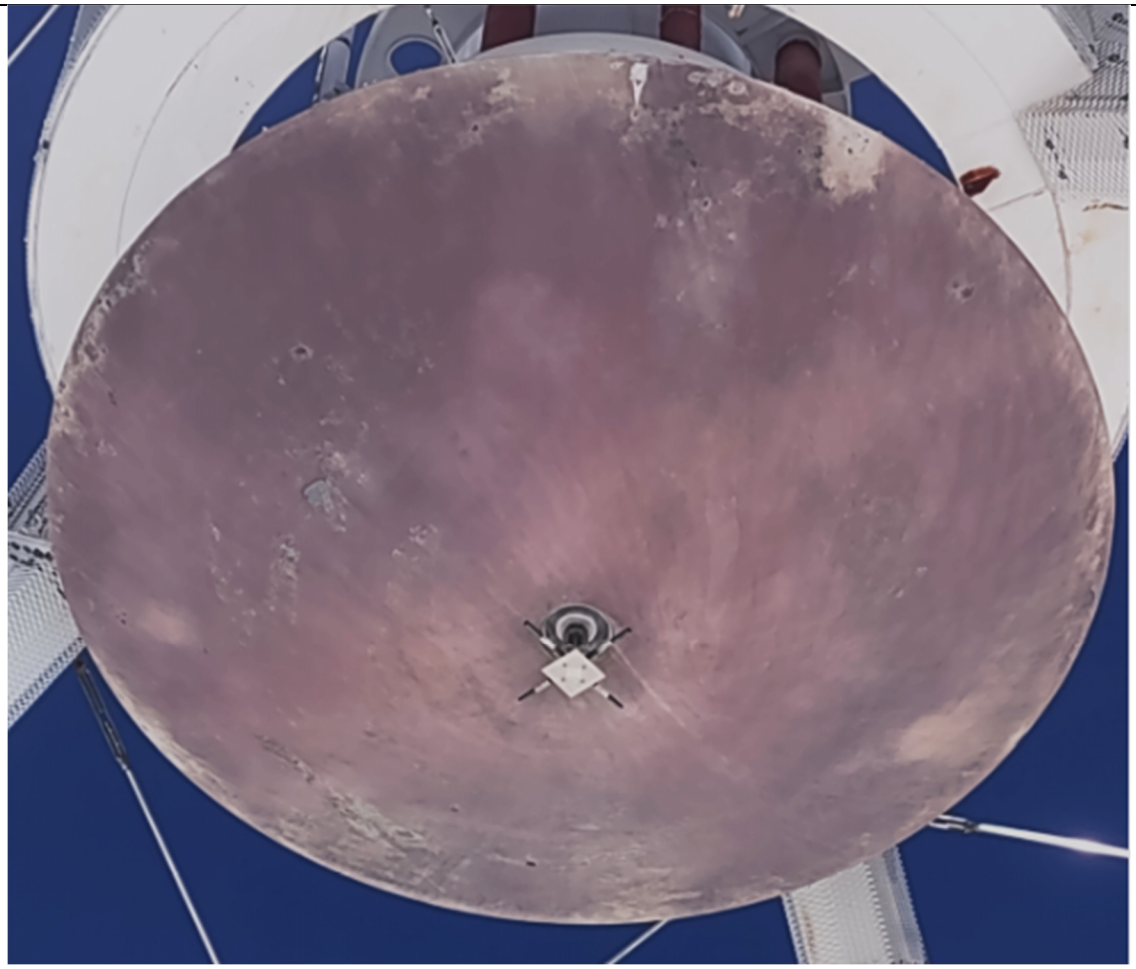

Figure 11: Sub-Reflector Condition

The grout around the pintle bearing lower housing was cracked and separated. The loose material was removed down to solid and replaced with some new quick setting grout/mortar. (see Figure 12)

Figure 12: Mortar Fix Around Lower Pintle Bearing Structure

4. Trip Conclusion

Due to the harsh weather conditions this antenna gets damaged after ice storms. It is on its second dichroic panel this year. The dish panel replacement went better and faster than expected by the Antenna Mechanics. The enclosed box in the structure needs to be inspected closely at the other sites and possibly drained. Some big decisions need to be made about sub-reflector and if what we have is good enough. Many other service activities were done during this visit associated with the typical Tiger Team and are not documented here. These site techs should be commended for their house keeping and continuing to keep this antenna running.