NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

VLBA Antenna Memo Series No. 48

St. Croix Elevation Bearing Replacement - Trip Report

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Metal particles were found in the grease on the condenser side elevation bearing at St Croix. After carefully watching this bearing for several months, it was decided that the bearing needed to be replaced. Steve Aragon, Kelly Greene, Ramon Gutierrez, Phillip Sanchez and Jon Thunborg were dispatched to St Croix to replace the bearing with the capable help of site technicians Peter Allen and Tazewell Reed.

During the Las Alamos elevation bearing change, we experienced deflections in the antenna structure that were greater than were desired. Therefore, the finite element model was refined to better simulate the entire structure under the load path required for the bearing change. Using this model, it was found that installing the two struts shown in the photo in addition to the jack support beam, brace beam and anti-rotation pin that were installed in Las Alamos as described in VLBA antenna memo #29 significantly reduced both the stress and deflection of the structure.

It was not possible to gain access to a large press on the island of St. Croix, so instead of risking the possibility of not being able to remove the old bearing from the bearing pillow block, a new elevation pillow block was fabricated and installed with the new bearing.

The original bearing's inner ring center guide flange was fractured. According to engineers at Torrington Bearing, this kind of fracture is due to excessive thrust load on the bearing.

One possible reason for the excessive thrust load is the way the bearing was initially installed. The slots on the bearing pillow block and the slots on the elevation platform both go in the same direction. This allows for misalignment perpendicular to the axle. However it does not allow for misalignment along the axle. This means that great care must be used to position the bearing correctly on the axle to prevent thrust loads that could develop between the axle and the elevation bearing pillow block. During disassembly we found that the original bearing was positioned such that these thrust loads were present.

The thrust loads induced during assembly would have been alleviated if the slots on the pillow block went in a direction perpendicular to the slots in the elevation platform. A careful check of the AUI VLBA drawings showed that both the platform and the bearing pillow block were fabricated according to the drawings but the slots shown on the drawings were specified in the same direction. Since all of the VLBA antennas were built using these drawings, it is reasonable to believe that they all have the same problem. This is probably why the Las Alamos elevation bearing failed.

Dial indicators were positioned on the axle prior to lifting the dish to ensure that the dish was returned as close as possible to its original position. The dial indicators showed that the height of the axle after bearing replacement was within 0.005 inches of its starting position. The dial indicators showed that the dish might have moved perpendicular to the axle. We were unsure of this, as we had to hammer on the pillow block assembly for several hours to break it free from the platform and we thought we might have bumped the indicators during the extended hammering. The azimuth pointing offset changed by 3 minutes of arc after the bearing change thus indicating that the axle did indeed move.

Corrosion Notes:

During the St. Croix visit, the antenna structure was carefully inspected for signs of corrosion. The extent of the corrosion is documented in this report. There were several places where the amount of corrosion was disturbing.

This picture shows a hole that has corroded all the way through the quad leg of the antenna. The steel on this side of the quad leg has completely failed due to this corrosion. The reason that the corrosion is so bad on this part of the quad leg is that water runs down the inside of the quad leg and pools on an internal lip in the quad leg. This quad leg should be repaired during the next maintenance visit.

The walkway grating under the elevation platform has corroded to the point where it needs to be replaced during the next maintenance visit. The metal has corroded away so much that I was able to easily knock holes in the grating with a small hammer. The cable tray should also be replaced during the maintenance trip.

The major structural elements of the antenna were not severely corroded except for one of the beams that connect the dish to the elevation axle. Approximately 20% of the flange thickness has corroded away. This beam is in a pocket on the up side of the antenna where water collects. It will be very hard to drill a drain hole in this pocket. Therefore, the site techs should "Chem Prime" and paint these areas carefully.

The following table was developed after a visual inspection of the antenna. The estimated strengths are educated guesses. The actual extent of the corrosion cannot be known without additional testing.

LOCATION AND EXTENT OF CORROSION	Estimated Strength (% of New)
Azimuth Rail – Chem primed by site techs	100%
Rail Clips – Chem primed by site techs	95%
Rail Grout - very good condition	100%
Base of pintle tube- corrosion one side only	80%
36" I-Beams	98%
Grating under knuckle	40%
Cable tray under knuckle	40%
Knuckle- site techs need to insure drain holes are clear	95%
Elevation platform- catwalk brace boxes, corner gussets	30%
Structural tubes- looked good under insulation.	100%
Elevation pillow blocks	100%
Dish to Elevation Axle connections – upside beam flange corrosion described above	75%
Hoist rotating bar holder- completely rusted – fell off	0%
Winch gate- needs replacement	20%
Hoist Cable – re-head often as rust can weaken cable under weight.	80%
Vertex room attachment- some corrosion in water traps.	95%
Quad leg – severely rusted on sides that trap water	80%
Dish Structure – I-beam under 4th row of panels traps water on upside.	90%

CONCLUSIONS:

The antenna is in reasonable shape structurally. The rust is only severe in places that trap water. Drain holes have been drilled in most of these areas, but the damage already done is irreversible. It is my opinion that the structure is not going to fall over in the near future from excessive corrosion. However, the site techs need to be diligent in their efforts to identify areas that are being compromised by the rust. During the next Saint Croix maintenance visit, additional manpower should be utilized to repair and prevent damage to the telescope from corrosion.

Ramon Gutierrez suggested that we have the operator tip the antenna over the top before every observe file to dump the trapped water. This would alleviate most of the corrosion problems that occur above the elevation axle. I recommend that we implement this procedure if it is possible to do so.

Maintaining the paint system on this antenna is critical. It was very evident that in areas where the paint was compromised, corrosion started attacking the structure almost immediately. These areas will continue to rust even if painted over unless they are properly prepared before painting. Pete Allen has had very good results using a product called "Chem Prime" to slow the corrosion damage. The site techs should continue to use this product wherever possible.