NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

VLBA Antenna Memo Series No. 75

St Croix Maintenance Trip Report
October 27 - November 14, 2008

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The St Croix antenna was in need of extensive maintenance. Therefore, a larger than normal maintenance team consisting of Sam Abeyta, Carl Cano, Ramon Gutierrez, Ken Lakies, Martin Lopez, Ray McFarlin, Phillip Sanchez, and Jon Thunborg traveled to St Croix to conduct the maintenance. The site technician, Greg Worrell, was also highly involved with this maintenance. Additional maintenance on the electronics was conducted by a separate team in March, 2008 and is documented by Eric Carlowe in "VLBA Antenna Memo No. 72."

Metal particles were found in the grease on the encoder side elevation bearing. Steel beams, struts and stiffeners were bolted or welded to the antenna to support the lifting jacks and reinforce the structure. The bearing was changed using the method used on the Fort Davis antenna described in "VLBA Antenna Memo Series No. 70", with the exception of 10 ton jacks located between the dish structure and the elevation bearing that were used to push the bearing from the housing. This method proved cleaner than torching out rollers so that the bearing could be pulled with the 100 ton jack as was done in Fort Davis.

The original bearing showed spalling on both sides of the inner ring center guide flange. This spalling is indicative of a fatigue type failure. Further analysis is needed to confirm whether the bearing was misaligned, axially loaded or improperly lubricated. A complete inspection of the bearing will be conducted after the bearing is shipped from St Croix to the VLA.

After the new bearing was installed, an improved design encoder mount and a refurbished encoder were mounted and aligned with the elevation axle.

The subreflector was removed and replaced with the refurbished subreflector (SN 07) from the Hancock, New Hampshire VLBA antenna. The new subreflector was initially installed in the same position and orientation as the original subreflector. A theodolite was placed on the elevation axle and aligned with the center punch points on the counterweight structure which are used to define the plane of the dish surface. When aligned with the dish surface, the theodolite pointed to a spot on the subreflector mirror 5/8 of an inch south of the mirror center. The autoreflected image produced while rotating the FRM was a 7/8" diameter circle with its center 9/16 of an inch to the east of the theodolite center. The antenna was pointed overnight and after analyzing the data, Dr. Vivek Dhawan instructed us to move the subreflector 8mm south. After observing overnight with the subreflector in this new position, Dr. Dhawan concluded that moving the subreflector 3mm west and 4 mm north would further improve the antenna performance. This move was accomplished moving the theodolite line of site point to its final position 3/16" west and ¼" south of the mirror center. The final autoreflected image while rotating the subreflector is a ¾" diameter circle centered ¼" to the east of the theodolite center.

Both azimuth wheel assemblies were replaced during the maintenance period. Azimuth drive # 1 was an old style wheel/axle assembly that was replaced as a preventative maintenance measure. Azimuth drive #2 was a new style wheel/axle assembly that had metal particles in the grease on the inside bearing. This assembly was installed in 2000. This wheel/axle assembly will be disassembled and inspected to establish the cause of the bearing failure.

The wheel/axle assemblies were installed and aligned to the following parameters. With the new wheel/axle assemblies installed, the antenna rotated smoothly without popping noises.

Azimuth #1

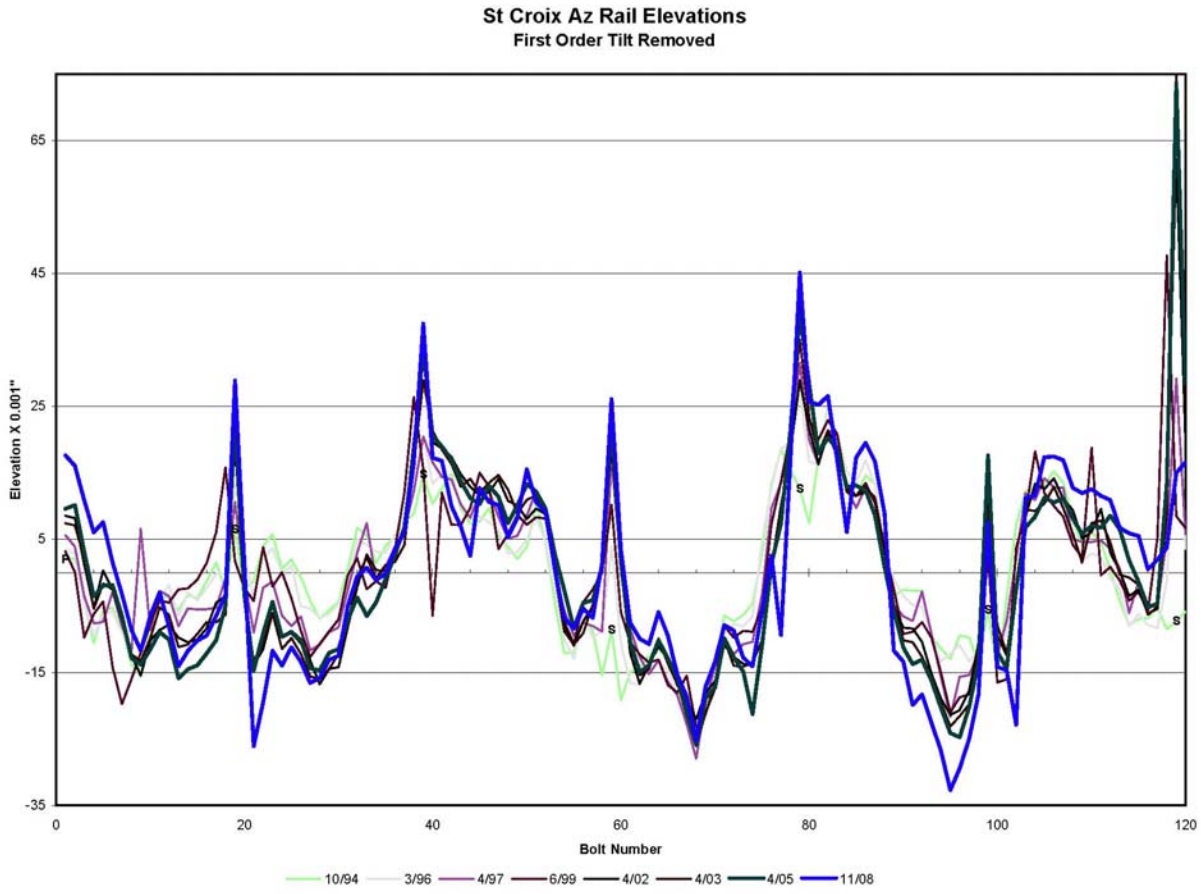
	Measured	**Specified**
Conic Radius	300.186”	300” ± ¼ “
Coupling Runout	0.0035 TIR	<0.005 TIR
Axle Vertical Slope	93.456°	93.440°” ± 0.023°
Axle Horizontal Error	0.023°	< 0.023°

Azimuth #2

	Measured	**Specified**
Conic Radius	300.155”	300” ± ¼ “
Coupling Runout	0.0025 TIR	<0.005 TIR
Axle Vertical Slope	93.437°	93.440°” ± 0.023°
Axle Horizontal Error	0.023°	< 0.023°

The maintenance team installed a HVAC platform extension. The platform extension was shipped to St Croix on an earlier maintenance visit but it was not installed due to time constraints. The original paint on the platform had begun to fail allowing the platform to rust even before it was installed. This afforded the opportunity to test a paint system. The platform was subsequently sand blasted to white metal using coarse grit copper slag (Black Beauty). The platform was then treated with hold tight and weathered outside for 2 days before a 2 - 4 mil DFT coat of organic zinc epoxy (Amercoat 68HS) was applied. Aluminum filled epoxy (Amerlock 400AL) was then applied at 4-6 mil DFT. The platform was then installed on the antenna. The welds were stripe coated by brush with Amerlock 400 AL. A final white finish coat of aliphatic acrylic polyurethane gloss (Benjamin Moore P-74) was applied at 1- 2 mil DFT.

Other badly corroded items such as the step and door shown above were replaced. The new items had paint systems similar to the one on the HVAC platform described above. A finish coat of Acrylic Polysiloxane (Amercoat PSX 1001) was used on the door.



The azimuth rail was measured. As can be seen in the chart above, a low spot was developing at bolt number 119. This spot was repaired by installing shims between the rail and the splice plate. These shims should be monitored on subsequent maintenance visits to ensure that they do not initiate corrosion under the rail. A 0.080" copper shim was placed directly below the splice. 0.050" and 0.025" shims were then placed on both sides of this shim, thereby, gradually tapering the shim under the rail.

The insulation that was removed during the painting project was replaced. Traditional Tiger Team tasks and inspections were completed. These included: Focus Rotation Mount PM and Flex Shaft replacement, Azimuth and Elevation Gearbox inspections and oil changes, and other items as described in the Tiger Team task list. Numerous electrical repairs and inspections were made. These are listed in Appendix A.

The boom lift cylinder, boom lift cylinder pins and basket cylinder pins were replaced on the Genie S-80 Manlift. These items were supplied by the manufacturer as part of a safety recall. This task was contracted to EM Solutions and was accomplished during the maintenance visit because the task required both a crane and a forklift. A crane and forklift were rented for this maintenance visit as they were needed to facilitate several of the tasks.

The inside portion of the truss structure under the dish was left unfinished during the 2007 painting due to time constraints. This part of the structure was primed with organic zinc epoxy and then coated with aluminum filled epoxy in 2007. During this visit, all of the bolts and places which showed signs of corrosion were stripe painted by brush with aluminum filled epoxy (Amerlock 400AL) before the final topcoat of Acylic Polysiloxane (PSX 1001) was applied. A small section of this structure was topcoated with aliphatic acrylic polyurethane gloss (Benjamin Moore P-74) in order to compare the performance of the two topcoats.

There is some rust staining on the bolt heads and nuts on the lower portions of the structure. However, this staining is not nearly as prevalent in the upper backup structure. The reason for this is that the backup structure had significantly more surface preparation and a more robust paint job than the remainder of the antenna. Since the corrosion was most prevalent and destructive on the upper backup structure, we focused our efforts on this part of the structure in 2007. This included more thorough surface preparation, the application of an organic zinc primer and additional paint application by brush at the connections. Another VLBA Antenna Memo focused entirely on the painting and paint system performance will be issued in the near future.

Locations that showed significant corrosion were repaired by needle scaling the existing rust and then applying aluminum filled epoxy by brush. The pictures below show some of these repair locations.

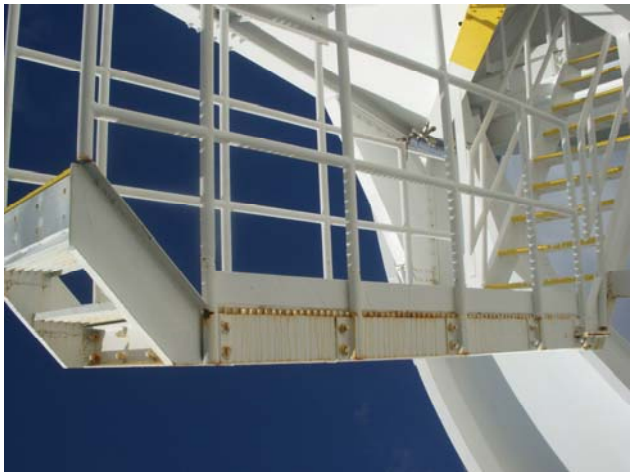
Shown above is the area where water gets trapped below the pintle bearing pocket.

Shown above is the structure where the dish structure is attached to the counterweight tubes.

Similar paint repairs were performed on the following areas:

1. The drive wheels, pillow blocks and flex couplings.
2. Areas where additional structure was welded to the antenna to facilitate the elevation bearing change.
3. Water traps on dish structure above the elevation bearing pillow blocks.
4. Swinging platform and swinging platform bolts.
5. Area where the counterweights attach to the dish by the vertex room.

Some of the rust stained bolt heads and nuts were also painted by brush to inhibit further corrosion. Additional stripe painting of bolt heads and nuts should be performed in the near future to deter further corrosion.



The elevation platform extensions and swinging platform have significant corrosion and will need to be replaced during a future maintenance visit. The hand rails on these parts of the structure are corroding from the inside out. A crane with at least 70 feet of stick will be needed to replace the swinging platform.

Appendix A

St. Croix VLBA Tiger Team Electronics Maintenance Oct-Nov 2008

1. Feed cone housing seals around feeds and RFI seal near dish panels were recaulked and feed housing was repainted with elastomeric to stop water leak in vertex rm.
2. Recaulked inside vertex room RFI seal of Feed housing to stop water leak.
3. 7mm receiver feed had water in it caused by leaking feed window seal. Dropped receiver and about a quart of water was released. Removed water from feed and resealed feed window.
4. ACU had an intermittent EL Down Limit Fault. It would just flash on and off of the ACU display. Troubleshot to Drive Cabinet interface board by swapping boards with AZ and problem changed to AZ CCW limit intermittent fault. – Replaced interface board.
5. Installed new winch motor power cable. Removed old cable. Used man lift to tie cables in the wire tray. Wired and installed winch switch and wired to winch motor.
6. Installed FRM AC outlet cable. Added a J-box where cable was cut by water blasters. Also wired up AC outlet at EL bearing platform and mounted outlet to side of EL bearing support.
7. Installed new power cables for Antenna lighting and replaced 3 J-boxes. Wired to lights.
8. Installed new Ped room E-stop box and replaced cable.
9. Installed new EL motor platform E-stop box.
10. Replaced 7mm cryo refrigerator that was running 30K on second stage.
11. Patched holes in lower feed cone (with foam, then sealed with elastomeric caulk. Housing holes caused by water blasters.
12. Removed old caulk on top of the feed cone and around feeds. Recaulked with elastomeric caulk. Painted over twice with elastomeric.
13. Found seized up fan motor on secondary Contempo condenser. Replaced fan motor.
14. Found secondary Contempo compressor was not cooling. Refrigerant level appeared low. Called contractor to add R-22.- Advised Gregg to run backup once a month on double maintenance days to prevent condenser fan from seizing up.
15. Replaced 6cm cryo refrigerator for running warm on second stage.
16. Replaced AZ#1 and AZ#2 SCR cards to help with the blowing fuses problem.

17. Replaced 2cm cryo refrigerator for running warm on second stage.

18. Replaced 1cm cryo refrigerator for running warm on second stage.

19. East anemometer hardware stop was broken. Found U-bolt had broken. Replaced U-bolt and aligned stop.

20. West Anemometer cable was chaffing. Rerouted cable and fixed insulation on cable.

21. EL #2 J-box had water inside. Found Blower motor J-box had a CGB plug that was leaking. Sealed all cable CGB's to J-boxes with silicone.

22. Found IF cables on cable wrap were chaffing when antenna was near CCW limit. Repositioned cables where they go up the fork and taped insulation and tie strapped.

23. Found water in AZ#1 J-box. Sealed all cable CGB's with silicone on newly replaced motor

24. Found water in AZ#2 –J-ox. Sealed all cable CGB's with silicone.

25. Found water in EL#1 J-box. Sealed all cable CGB's with silicone on newly replaced motor.

26. Found water in both Apex FRM J-boxes. Sealed all cable CGB's with silicone and replaced desiccant. Advised Greg to recheck J-boxes after a rain storm and if water is still penetrating J-boxes then maybe we should think about adding a dry air line to them? J-box does not have a drain hole in it but because of the highly corrosive atmosphere in St. Croix was not sure if this would make matters worse so did not add one.

27. Compressor A failure. – Found bad phase relay that supplies coil voltage to contactor.- Replaced with spare on site. Cryo sent new solid state phase detector replays for replacement.

28. Spare compressor failure. Troubleshot to bad breaker (ON/Off) switch but also has a chattering phase relay. Called cryo for parts. Cryo sent new phase detector relays. Installed new solid state relay but Greg still needs to replace the breaker switch.

29. Spare compressor #2 failure. Troubleshot to bad breaker (On/Off) switch. Ray replaced with spare but it too is flakey. Greg needs to replace the switch when new ones arrive. Advised Greg not to use switch to turn off unit and instead use the disconnect switch as the breaker switches break often when used as a ON/OFF switch.

30. Building UPS Liebert went to bypass and indicator D was lit with a 2 second beep every 4 seconds. Called Liebert and they recommended replacement because this indicated a PFC (power factor correction) failure. But he also suggested powering down and restarting. After the shutdown and power up UPS had no errors. Tech believes it will most likely happen again though. Greg needs to call Liebert during a weekday to see if we can replace any parts to repair instead of replacing the whole UPS.

31. 150KW generator governor shaft to injection pump is sticky. The trouble seemed mechanical as there was one spot in the lever swing that was sticky. This caused RPM and generated frequency fluctuations that could only be steadied if you held the governor shaft from moving, then it would stay good on it's on. Called contractor and they advised flushing the pump with diesel fuel or injector cleaner to get rid of gunk in the injection system. If this doesn't work he believes the distributor pump needs to be rebuilt. Greg needs to flush the pump to see if this will work.

32. Replaced all filters and changed oil on 150KW generator.

33. 75KW generator over due for PM. Plug wire insulation chewed on by rats. Spark plugs need changing. Replaced all filters, spark plugs and plug wires.

34. FRM rotation appears to have greater friction (drag) near both limits. In CW direction the rotation slows down about C500 and struggles slowly to F200. In CCW direction the rotation slows down at about 2500 and struggles to 0A00. Releasing the breaks at the troubled spots showed that the rotation moved freely so now think this is in the programming of the S101. Operations have not reported any problems using FRM so this may be a non-issue. FYI only.

35. Ellipsoid actuator rusty. Still functions normally. Removed rust, sanded and painted.

36. Ellipsoid manual switch is inop. Needs replacement. – Part on order

37. Vertex room phone is inop. Disconnected by Telephone Company when troubleshooting a short. Gregg found water in the phone. Phone now dry. Reconnected wires in Ped room. Phone works now.

38. Outside temp sensor reading 100 degrees. Replaced and aligned.

39. A-Rack temp sensor reading high. Aligned several times but wouldn't hold true. Replaced and aligned.

40. All receiver vacuum levels needed aligning. Aligned all receivers.

41. AZ#1 Oil pump power J- box FULL of water. Cleaned out rust, dried and resealed. Replaced supply cable with correct size gauged wire.

42. AZ#2 Oil pump power J-box FULL of water. Cleaned out rust, dried and resealed. Replace supply cable with correct size gauged wire.

43. AZ#1 and AZ#2 oil pump cable has too big of wire #10 for terminals to fit to terminal strip in J-boxes. Causing terminal strip separators to break increasing chance of shorting. – replaced both cables with #14 and replaced AZ#1 terminal strip that had broken separators in J-box.

44. AZ#1 new motor replacement had a shorted brake heater wire to break housing. Brake heaters not needed at SC so it was disconnected and taped off.

45. AZ#1 new motor had wrong blower motor installed for 208 3 phase power. Used old blower motor.

46. EL #1 replacement motor had a shorted brake coil. Replaced with old brake actuator.

47. Remote Box has an intermittent enable. Open in cable. Pulling on cable allows motors to be used. Gregg rewired remote box cutting about a foot of cable off.

48. AZ #2 Armature #1 bolt broke from wood block. Replaced with old AZ armature block terminal.

49. Weather station cabinet rusting in bottom edges from water leakage. Sealed around cable CTV's and air breather. Sanded rusted area and painted.

50. Weather station transmitter temp display LED chip has burnt out sections on 2 chips. Need replacement chips. Greg needs to order and replace.

51. Weather station hand crank slips when lowering tower. Opened gear box and greased gears with sure-tac. Slipping was being caused by resistance on the gears because they were very rusted.

52. Vertex HVAC line insulation is coming apart. Replaced pipe insulation and taped with foil.

53. Ran wire for Dish aircraft warning lights. J-box at Dish lights need a gasket and new CGB. Also need to replace photo switch J-box and connect cables.- Ran out of time left for Greg.

54. Replaced the "ramp" resister on the new interface board with a 5.1meg. (was a 2.7meg)

55. Changed gear box oil in El and AZ gear boxes. Wrong oil was picked up. ISO 86 instead of ISO 46. Looked up specs and the only difference appeared to be that 86 had a little higher viscosity to it. John Thornburg said to go ahead and use the 86.

56. AZ # 1 and EL #1 gear box oil filters had seized up turning handles. Was able to loosen them by turning then with a wrench and spraying "loosening oil" on the handle shaft at the entrance to the filter. Advised Greg to turn filters more frequently to prevent them from seizing up.