

**National Radio Astronomy Observatory
Socorro, NM**

VLBA Antenna Memo Series #40

**St Croix Maintenance Visit
April 8th through 25th, 2002**

**Jim Ruff
6/24/02**

Attachments: Azimuth Rail Survey, Servo Trip Report, Electronics Trip Report, Task Schedule

The team consisted of Steve Aragon, Ramon Gutierrez, Eric Carlowe, Tom Frost, Steve Troy and Jim Ruff. Site Techs Pete Allen and Taz Reed assisted throughout.



A quad leg ladder and Sellstrom fall arrest system were installed. (The handrail was installed previously.) The site techs were treated to a training session on use of the Sellstrom system and general fall protection. Note the corroded guy wires in the photo above.

The FRM INA bearing clearance measured 0.0015". The rusted second screw gearboxes were replaced.

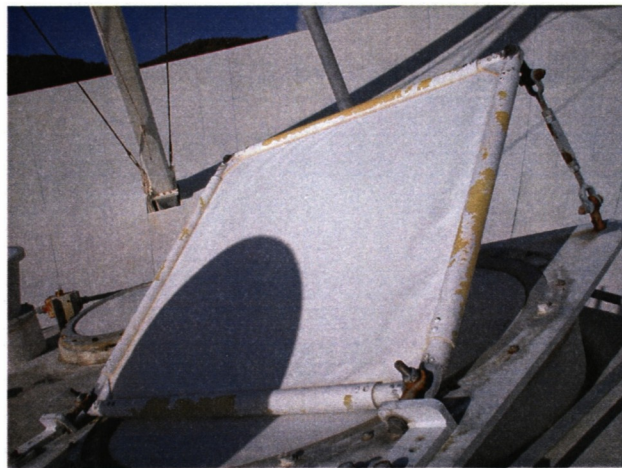
● Traces of metal were found in the grease from the tach side el bearing. The encoder side bearing was clean.

The azimuth bearings were inspected. No bearings needed replacing. The outer races had been rotated previously, so we didn't do it. Drive 1 is the new style axle.

Note the six arcmin vertical error on D2. This is four times the amount allowed by the spec. This can not be corrected without replacing the wheel assembly, as there is no shim under the pillowblocks. I recommend replacing this wheel on the next tiger team visit.

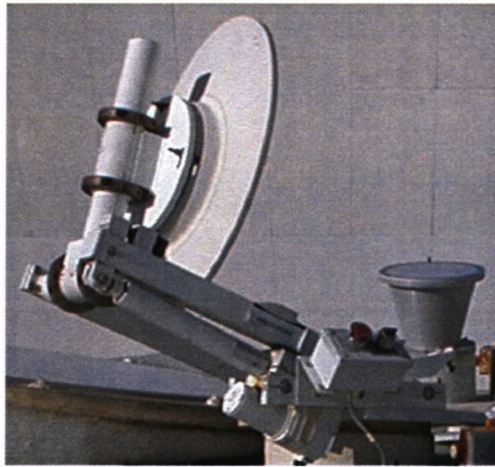
Az Bearing Grease Inspection				
	Drive 1 (new style)	Drive 2	I1	I2
Inner	OK	OK	some metal. races smooth.	no metal. gouge in outer ring. inner ring OK.
Outer	OK	OK	OK	OK

Drive Wheel Alignment			
Wheel #	Horizontal Error	Vertical Error	Radius Error
D1	0° 1' 20"	6' 11" (too flat)	0.13" (out)
D2	Not checked		



The dichroic panel is delaminating. (The frame was repainted after this picture was taken.)

So many items were left undone at the end of our scheduled stay that Ramon, Steve Aragon, and Eric decided to stay longer. They remained on site through April 25th. We appreciate their efforts.



The dish tipper looked fine.

The rails and rail clips on this antenna are rusting. The Vulkem has cracked to the point where it no longer keeps water away from the metal. In fact, it holds water in, facilitating rusting (if that's possible at STX!)



I did some experiments on ways to slow the deterioration. I scraped off the Vulkem in some bad areas and applied "Rust Cap" primer to the bare metal. Then I sprayed "Great Stuff" foam over half of the primed areas.

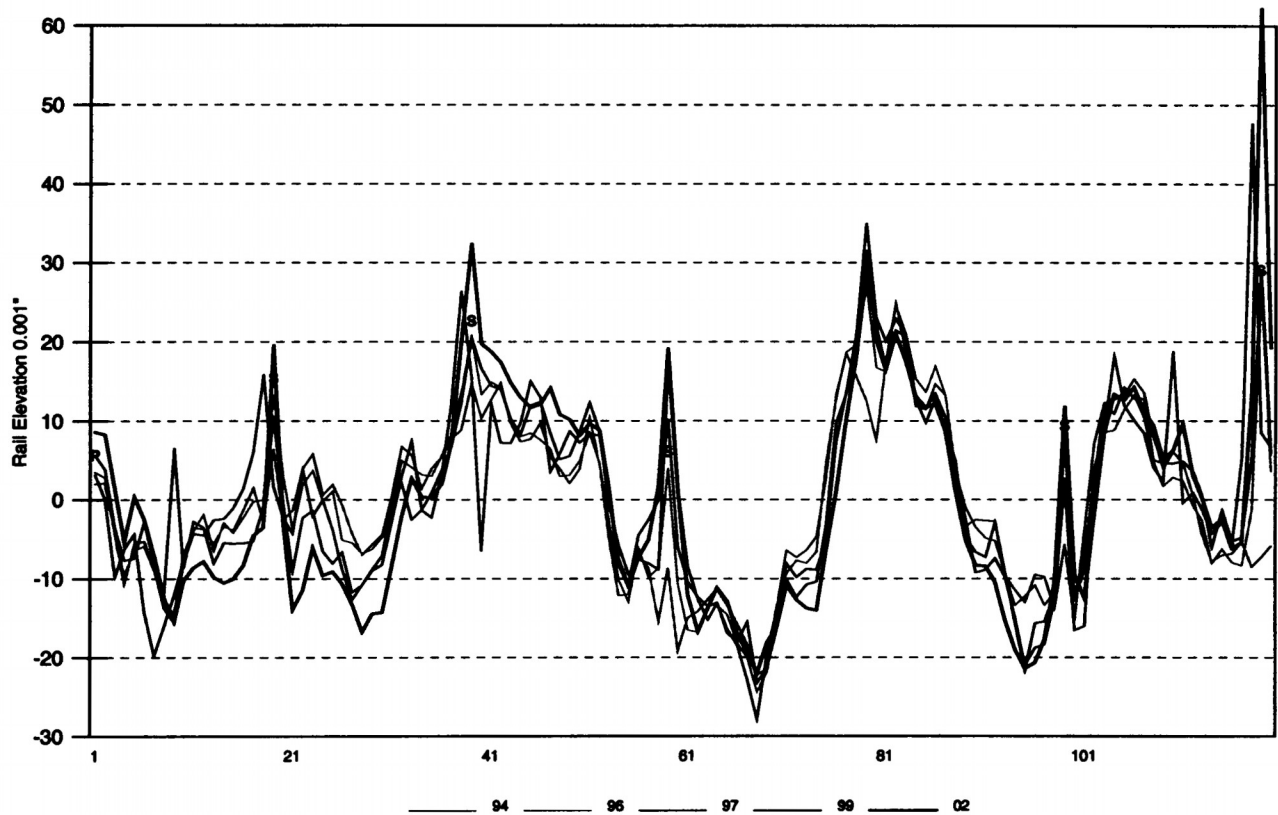


We need to monitor these patches, consider other alternatives, and decide how to proceed. I think we can wait a while before doing something, but the longer we wait, the more rust we'll have to deal with. In the mean time, the site techs are removing vulkem in their spare time.



If we decide to foam the rails, aluminum flashing should be placed over the foam.

SC Azimuth Rail

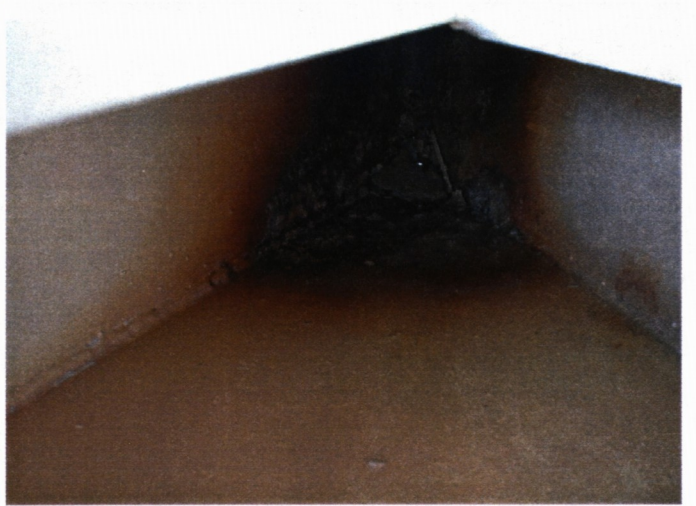


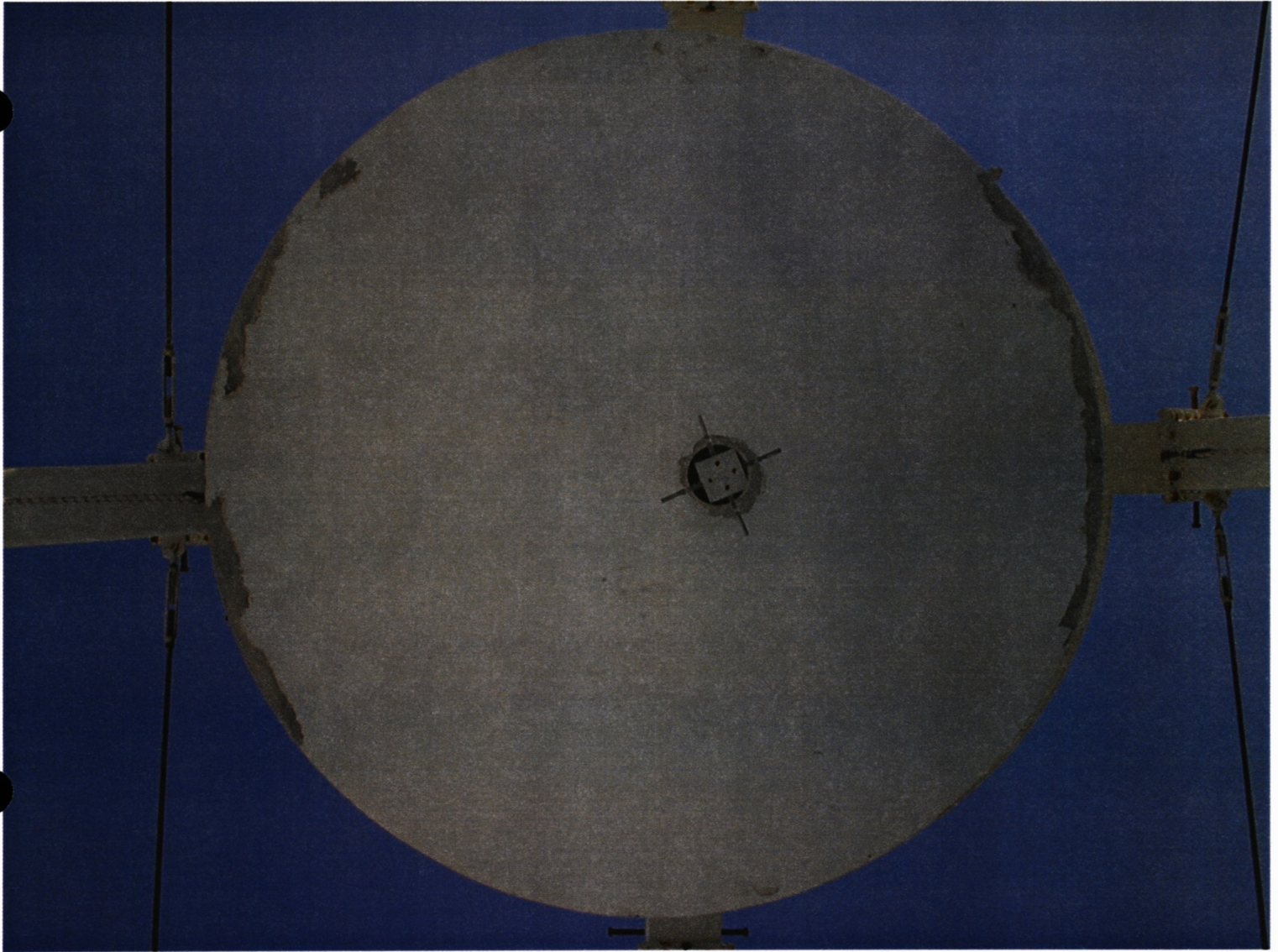
The SC rail has a first order tilt of nearly 0.3" peak-to-peak.

The splice at bolt #119 appears to be sinking over time. Similar behavior was seen at NL by the rail grout repair crew this year. It appears the rail is being slightly, slowly squashed at the splices. This should be repairable by shimming.

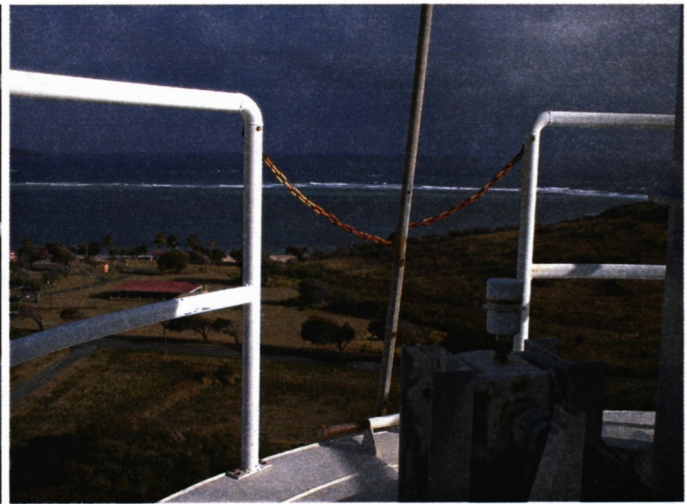
The painters appear to be doing an effective job, but rust is still evident.



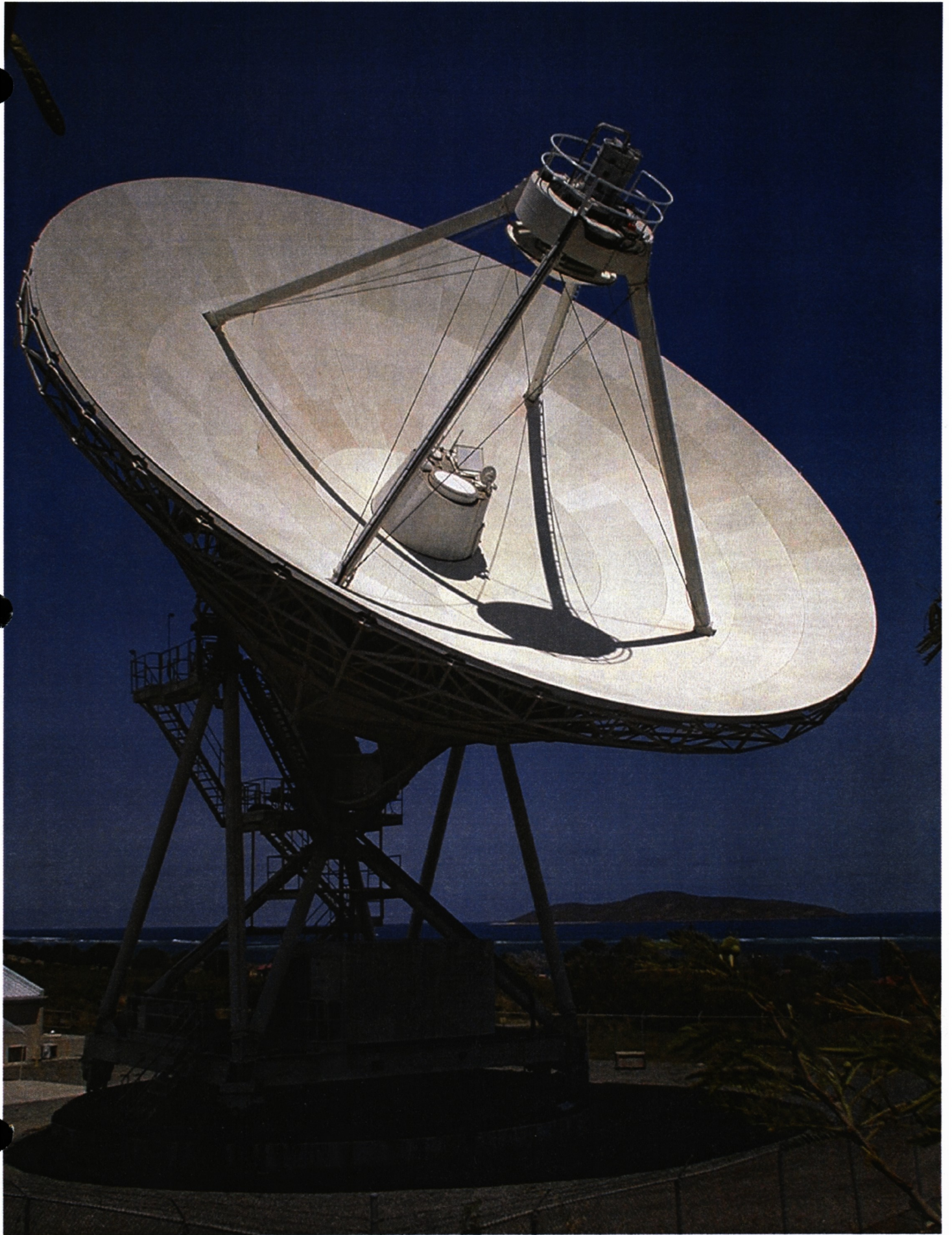




Some of the paint on the subreflector is peeling.



Some of the SR counterweight screws and the handrail chain were replaced.



St. Croix Tiger Team Trip Report
Servo Group
April 2002

Tue 9 APR 02- travel from ABQ to St. Croix

Wed 10 APR 02-

AZ/EL Encoder inspection & rust prevention treatment

encoder cards were corrosion free-installed corrosion inhibitor discs inside AZ/EL Encoders-applied ChemPrime & P'Blaster anti-corrosion treatment to Encoder access panels & surrounds.

AZ/EL Motor Inspections

AZ1 has bad grease channel casting & has excess grease inside motor housing-will be replaced

AZ2 commutator needs cleaning with soft stone

EL1 commutator needs cleaning with soft stone

EL2 has grooved commutator & badly rusted motor housing-will be replaced

NPL Data Converter PM

completed-no problems found

Thu 11 APR 02

ACU PM

replaced burnt-out indicators with LEDs-replaced power switch and AZ current/velocity switch-installed spare switch in chassis adjusted motor current scaling on ESI Interface bd to provide correct readbacks to computer monitor system

AZ1 Motor

replaced motor and leaking gearbox seal

EL2 Motor

disconnected motor cables in preparation for motor replacement

Fri 12 APR 02

Drive Cabinet PM

started PM's

EL2 Motor

started motor replacement-after 5 futile attempts to mate motor to mounting adapter it was discovered that motor has an oversize flange-the AntMechs had to grind down adapter plate to fit

Sat 13 APR 02

EL2 Motor

finished motor wiring & checkout

Drive Cabinet

finished PM's

AZ/EL Motor Brake Torque Tests

performed brake torque tests-all brakes within specs

Antenna Structural Lightning Protection

inspected lightning cables for integrity-all OK

Limit Switch inspection

AZ/EL limit switches inspected for integrity & correct operation

Sun 14 APR 02

AZ/EL Motor Commutators

conducted training session with Site Techs on proper cleaning methods

Servo Response Test

started Servo Response tests-3/4 way done begin having AZ1 problems; was indicating both +/- current flow when system in

Standby: R & R AZ1 SCR control card, fixed problem.

ACU Auto bd had defective registers R02, R05 for EL; R & R Auto bd, fixed problem; reloaded correct station parameters.

Performed current readback calibration procedures on ESI Interface bd.

mon 15 APR 02

Servo Response Tests

finished response tests; Servo System performance is within acceptable specs

AZ Wheel Inspection

Assisted with wheel inspections

Rust Prevention

cleaned up AZ/EL blowers as best as possible & applied corrosion inhibitor; AZ2 & EL1 both will need replacement

soon: will have Warehouse ship new fan wheel covers to be replaced by Site Techs

Tues 16 APR 02-travel from STX to ABQ

June 24, 2002

To: Paul Rhodes, Jim Ruff

From: Eric Carlowe

Subject: SCVLBA Maintenance Visit, April 7 thru April 26.

A tremendous amount of maintenance was accomplished. The site technicians, Pete Allen and Tazewell Reed assisted tirelessly in all areas of maintenance during the visit. Many problems were found and corrected but, some were left for the site techs to complete when they receive parts. This being my 1st maintenance visit, I preformed most of the electronics maintenance checkout and assisted in all other areas of maintenance when my help was needed. The following is a list of items that were inspected, repaired and need repaired.

FRM/FEED CONE ITEMS COMPLETED

1. Electronic inspection of frm j-boxes. All enclosures had no signs of moisture.
2. Installed new acrylic casting, brass flanges and resolver couplings on focus motor.
3. Control cable strain reliefs are rusting away. All were replaced with metal ty wraps.
4. Both rotation motors had their backlash readjusted. Pete was trained on this.
5. Pete was also trained on the FRM pm and replaced 1 bellows boot.
6. All 4 FRM turnbuckles were replaced. Ramon trained me on this procedure.
7. Feed cone inspection, insulation was in good condition except it was full of moisture.
8. Ellipsoid reflector power/control cable was reattached to feed cone and secured with screws.

FRM/FEED CONE ITEMS TO BE COMPLETED

1. FRM power/control cables connectors are corroding. Gary Duff is working on replacements.
2. Apex upside lightning rod is broken off. Parts will be sent for replacement.
3. FRM tube hatch cover is broken off. Parts will be sent for replacement if necessary.
4. West rotation motor encoder failed on the last day. Resolver cables were swapped with the East motor temporarily and a new West motor was sent and later installed by site technicians. The new motor needs stainless ty wire for the pinion gear, which I have sent.
5. Feed heater conduit/wire will be pulled off by site techs. Since it has been disconnected.

VERTEX/PED/ELEVATION ITEMS COMPLETED

1. The bottom of the RFI power bulkhead filter was badly rusted and the terminals were badly corroded. Water was leaking in around a FC heater conduit. The feed heater conduit/wire was removed and the bulkhead hole sealed. RFI filter and lugs were cleaned up and dressed with rust inhibitor and no corrode paste.
2. Ran 1 new condenser control cable through power bulkhead to DDC and terminated.
3. Replaced 2 HVAC cables in the elevation cable wrap and reassembled with metal ty wraps.
4. 3 RG214 type N IF/RF connectors pulled out of the bulkhead. They were replaced and a supply of connectors were left for site techs to replace as needed.
5. Replaced 11 bulkhead feed thru disk bolts with stainless bolts. Site techs will monitor the rest.
6. Went through all FE setups and set converter levels with Pete and Tazewell.
7. Shut down and purged all FE'S with site techs. On start up the 1cm cold head failed and it was replaced. Also the 6cm cold head power supply failed and it was replaced.
8. The AZ#2 gear box heater feed thru was broken off and allowing moisture to seep into the ped room. It was disconnected, the feed thru repaired and reconnected.
9. FRM logic was incorrectly wired to non-critical power. Logic was rewired to UPS power.
10. The UPS by pass switch was incorrectly labeled, this was corrected.
11. UPS panel breakers, ACU, FRM, ENCODER where mislabeled, this was corrected.
12. Ped room emergency stop failed. It was temporarily jumperd at the servo drive cabinet until a new cable was pulled and the stop was repaired
13. Shrink boot on 3 cannon connectors were badly deteriorated. These were resealed with silicon.
14. El #2 motor was replaced. New motor to be refitted with the right conduit and stainless j-box before installation. Steve Aragon helped out by grinding mounting flange for proper alignment to gearbox. Site techs were trained on Elevation motor replacement and installation and proper use of the portable motor hoist built by Steve Aragon.
15. All ty wraps for CRYO lines were replaced with metal type and flex lines were inspected.

VERTEX/ PED/ELEVATION ITEMS TO BE COMPLETED

1. Vertex room 2 non-critical receptacle covers were broken. Site techs will replace.
2. A 28 volt power supply simpson meter in the A-rack is broken. Doug Scott will send replacement.

3. Floor tiles in the VTX rm are coming up. Suggest removing tiles and paint floor with no slip paint
4. The 20cm FE has a bad vacuum valve and needs replaced. I sent a rebuild kit from cryo.
5. Many of the ped rm feed thru's are rusting away and should be watched closely by site techs.

PINTLE/AZ PLATFORM/CABLE WRAP ITEMS COMPLETED

1. Top of pintle rm cable feed thru/strain relief severely rusted. Site techs used scaling hammers to chip all the heavy rust away and coated it with rust inhibitor. Techs will check it regularly.
2. Cryo compressors housings are rusting away and should be replaced. Site techs keep sealing holes with bondo as needed.
3. 3 so power cables at the top of the pintle rm were beginning to kink. Guards were installed and properly secured to cables.
4. The pintle bearing grease catcher had a gap that was allowing grease to fall on the pintle rm floor. Steve Aragon repaired the gap. Tazewell cleaned out of the catcher and the grease of the floor.
5. Swapped an inside leaf to an outside leaf on the IF cable wrap and replace the button screws.
6. AZ#2 motor was replaced and the site techs were trained on this procedure. It was noticed that the gearbox seal was leaking. Tom Frost had a spare so I replaced it.

PINTLE/AZ PLATFORM/CABLE WRAP ITEMS TO BE COMPLETED

1. 3 servo control cables in the cable wrap at the 1st and 2nd rings are beginning to chaff. I have sent a sheet of teflon and hose clamps for the site techs to install.
2. Cryo compressor housings should be replaced. I will talk to cryo to find out if this is possible.
3. Cryo compressors contactor lugs were beginning to rust off. I sent replacements to be changed out by the site techs as needed.

WEATHER STATION ITEMS COMPLETED

1. The weather station analog card traces were badly corroded. This card was replaced
2. The weather station tower ground cable insulation had sloughed off and was badly corroded. This was replaced and secured with metal ty wraps.
3. Weather station pm was performed with the site techs.

WEATHER STATION ITEMS TO BE COMPLETED

1. Weather station enclosure is badly rusted and should be replaced. Site techs are currently repairing enclosure with fiberglass.
2. The upper section of the weather station tower is rusting from the inside out and should be replaced with a new section. I will work with Gary on a replacement tower section.
3. The wea station enclosure filter needs replaced. Gary and Pete will try to acquire a new one that does a better job of removing salt from inside the enclosure.

STATION BIULDING ITEMS COMPLETED

1. A broken ground strap on the rm 104 RS 232 port was found broken, this was repaired
2. Four chairs from the previous site techs were stored in rm 104. These were removed.
3. An ethernet hub and cables were found under the floor of rm 104; this was disconnected and removed from the baulk head.
4. 2 RG223 non-terminated cables were removed from the rm 104 baulk head.
5. A metal rack full of old NRAO PC's was removed from rm 104 and sent back to the AOC.
6. The site techs were shown how to oil the D-Rack fan.
7. An explanation of the chatter box operation and VME reboot was provided to Pete and all chatter box parameters were checked and corrected.
8. The VT 102 had failed. A new one was sent from the AOC and installed.
9. Removed 3 non-terminated cables from under rm 103's floor.
10. A cut cable was hanging from rm 103's ceiling. It was traced back to contempo #2 and removed.
11. The station VME was found incorrectly installed in the communication rack without a cover. I remounted VME in rack with cover and had Steve Aragon cut a new mounting plate for the VME. The hey tech printer was installed and rack wiring redone.
12. Rm 103's plenum temp sensor was located in the wrong spot. This was corrected.
13. 6 floor tiles were obstructing the main contempo's output to the plenum. These were removed and properly stored in rm 102.

GROUNDS/GENERATOR ITEMS

1. Outside the perimeter fence the weeds and grass had just been mowed by a contractor and looked great. Inside of the fence the weeds need some attention. Pete was making an effort to control them with a weed eater. I later learned the weed-spraying contractor had not visited in a while. Pete is looking into a new spraying contractor.
2. A quick inspection of the generators because of time constraints produced nothing. Tom Baldwin had done an inspection and some maintenance approximately 1 year before. Pete changed the oil on the 75KW, oil that we had brought from the VLA. Just to note thought, Pete and Tazewell were doing a great job with corrosion control on both generators.

SERVO

SAFETY TESTS		Recordings										
MULTIPLE FAULT STATUS (done by site techs)		EL System Response Test										
MANUAL MODES TEST (done by site techs)		Implement test setup										
INDIVIDUAL FAULT STATUS (done by site techs)		Calculate acceleration										
REMOTE BOX TESTS (done by site techs)		Locked rotor resonance, AZ/EL										
AZ Travel Limit Switch Tests (done by site techs)		AZ System Response Test										
AZ Clockwise tests (done by site techs)		Implement test setup										
AZ Counter-Clockwise tests (done by site techs)		Calculate acceleration										
EL Travel Limit Test (done by site techs)		Locked rotor resonance, AZ/EL										
Elevation up tests (done by site techs)		AZ Position Loop Tests										
Elevation down tests (done by site techs)		Small signal step response										
BRAKE HOLDING-TORQUE TESTS		Large signal step response										
<table border="1"> <thead> <tr> <th colspan="2">Brake Holding Torques (ft-lbs)</th> </tr> </thead> <tbody> <tr> <td>Az 1</td> <td>78</td> </tr> <tr> <td>Az 2</td> <td>76</td> </tr> <tr> <td>El 1</td> <td>80</td> </tr> <tr> <td>El 2</td> <td>83</td> </tr> </tbody> </table>		Brake Holding Torques (ft-lbs)		Az 1	78	Az 2	76	El 1	80	El 2	83	Single motor step response
		Brake Holding Torques (ft-lbs)										
		Az 1	78									
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		EL Position Loop Tests										
		Small signal step response										
		Large signal step response										
		Single motor step response										
		Auto Modes Test										
		Check stow commands										
		Synchro feedback operation										
		Test AUI COMM DEAD										
Motor Inspections												
Motor and Tach Couplings												
Commutator & Brush Inspection												
ACU PM												
Servo PM												
Lightning Grounding												
EL Bearing Ground Cables												
EL Motor Platform to Pintle Turret												
Pedestal Room Grounding												
AZ Wheel Ground Straps												
Pintle Bearing Room Grounding												
Detailed Test												
System and Axis Faults												
Motor Fault Status												
Measure EL Velocity												
Measure AZ Velocity												
Record 1st Limits EL/AZ												

HVAC

Antenna		Control Building	
	Pedestal room A/C inspection		Building A/C System
	Provide Site Techs w/manual and hold Q&A session		Perform operational checks
			Inspect indoor & outdoor units
	Vertex Room A/C		Correct deficiencies as needed.
X	Inspect air handler		Stand-By Contempo
X	Replace condenser unit		Indoor Unit
X	inspect lines & bulkhead fittings	X	Install primary unit interface relay board
	Repair/replace damaged line insulation	X	Instal Hoffman SCR's
X	Replace any suspect bulkhead fitting	X	Install auxillary terminal block
X	Evacuate & place unit back in service	X	Replace V-belt & adjust pully to maximum
X	Install ROC & set to (C1, set 135, Dif.30)	X	Perform operational checks
X	Check PCtool to DDC connection @ computer		Condensing Unit
	Make hard copy of program parameters	X	Inspect for leaks & clean oil
	Check programing, save program file to disk.	X	Inspect electrical connections
	Hold Q&A session w/ Site Tech's	X	Perform operational checks
			Primary Contempo
			Indoor Unit
		X	Install auxillary terminal block
		X	Install utility interface auxillary switch & cable
		X	Install wiring to stand-by unit
		X	Install upgraded interface
		X	Install UPS transformer & cable to DDC
		na	Replace control transformers
		na	Replace humidity sensor
			Condensing Unit
		X	Inspect for leaks & clean oil
		X	Inspect electrical connections
		X	Peform operational checks
		X	Check PCtool to DDC connection at computer
			Make hard copy of program parameters
			Check program & save program file to disk
			Schedule and perform hard test of emergency power interface for both Contempo units.
			Hold Q&A session w/ Site Tech's
			Review site documentation with site techs
			Inspect site utilities
			Water supply & distribution
			Propane system
			Sewer/septic system
	VTX Air Handler: Air switch was bypassed. Reconnected and adjusted		Standby - bad comp relay & contactor wiring.
	No bulkhead fitting used to pass tubing through.		Primary-pressure switch for cond. stuck closed

ANTENNA MECHANICS																			
Apex Safety		El Bearings																	
x	Install new ladder & fall arrest system		Inspect EL bearings lip seals																
x	Fall Protection training (sign-in sheet)		Clean off excess grease																
FRM		x	Install El bearing grease trays (done previously)																
x	2-year PM (adjusted rotn pinion backlash)		Grease																
x	INA bearing check		<table border="1"> <tr> <th colspan="3">El Bearing Grease Inspection</th> </tr> <tr> <td>Encoder Side</td> <td colspan="2">ok</td> </tr> <tr> <td>Tach side</td> <td colspan="2">minute metal</td> </tr> </table>		El Bearing Grease Inspection			Encoder Side	ok		Tach side	minute metal							
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x	Replace bevel gearboxes																		
x	Install INA zirks (replaced existing ones)																		
x	Replace FRM turnbuckles																		
FRM INA Bearing Check		Az Bearings																	
50# pull on primary side		x	Open, clean & inspect pillowblocks																
Pr'y Travel: 0.0005			Az Bearing Grease Inspection/Bearing Replacement																
Sec'y Travel: -0.0005			<table border="1"> <tr> <td></td> <th>Inner</th> <th>Outer</th> </tr> <tr> <td>D1</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>D2</td> <td>OK</td> <td>OK</td> </tr> <tr> <td>I1</td> <td>some metal. races good</td> <td>no metal. gouge in outer ring. inner ring ok.</td> </tr> <tr> <td>I2</td> <td>OK</td> <td>OK</td> </tr> </table>			Inner	Outer	D1	OK	OK	D2	OK	OK	I1	some metal. races good	no metal. gouge in outer ring. inner ring ok.	I2	OK	OK
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I2	OK	OK																	
50# pull on secondary side																			
Pr'y Travel: -0.001																			
Sec'y Travel: 0.0005																			
Subrefactor																			
x	Check for peeling, delamination (edges peeled)																		
x	Check cover (reinstalled)																		
Quad Legs, Guy Wires Etc..																			
x	Inspect guywires & turnbuckles			D1 is the new design. Grease inspection only)															
x	Inspect quadleg flange bolts	x	Rotate outer races (done previously)																
Anemometer		x	Close pillowblocks and grease																
x	Inspt mounts/chk operation		Az Wheels																
x	Install Baldwin bracket parts	x	Check wheel to struct clearances																
Feeds & Dichroic Replace hardware as reqd		x	Check axle bolt tightness																
x	Inspect feeds, mounts, heaters, etc.		AZ wheel radii and alignment																
x	Check dish tipper			<table border="1"> <tr> <td></td> <th>D1</th> <th>D2</th> </tr> <tr> <td>Horiz. Error</td> <td>-</td> <td>1' 20"</td> </tr> <tr> <td>Vert. Error</td> <td>-</td> <td>6' 11" (flat)</td> </tr> <tr> <td>Radius</td> <td>-</td> <td>300.13</td> </tr> </table>		D1	D2	Horiz. Error	-	1' 20"	Vert. Error	-	6' 11" (flat)	Radius	-	300.13			
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x	Check Dichroic reflector																		
x	Check feedcone exterior																		
x	Replace hatch latches as req'd (none)																		
Dish Surface & Panels																			
x	Inspect for damaged panels		Az Motors & Gearboxes																
x	Spot check panel bolts-looseness	x	Inspect pumps, seals & couplings																
Elevation/Hoist/Swing Platform		no	Check gearbox heater enclosures																
	Instl hoist safety mods (done previously)	x	Replace Az #1 motor																
x	Checkout swinging platform		Paint & Insulation Inspection																
	Instl condensor platform toe guard(done previous)	x	Inspect ant paint and report																
x	Drill weep holes - stair corner bracing		Inspect & repair ant insulation as needed																
Structural			Pintle Bearing																
x	Spot check structural bolts	x	Inspect seals																
x	Inspect structural welds		Check pocket level (done previously)																
x	Inspt ant backup/lower struct	x	Check for loose bolts																
x	Inspect EL axle for cracks	x	Lubricate																
El Bull and Pinion Gears			Close gap in grease catcher (done previously)																
x	Inspt bull/pinion gears		Az Rail Inspection																
x	Lub bull gear as req	x	Inspect ant foundation, grout and Vulkem vulkem crack																
x	Check stow pin (needed modification)	x	Inspect for excessive rail movement (see plot)																
El Motors & Gearboxes		x	Inspect joint bars & clips rusty clips? (yes)																
x	Inspect pumps, seals & couplings	x	Rail level measurements																
no	Check gearbox heater enclosures	x	Check for popping wheel none																
x	Replace El #2 motor																		
		15																	
x	fixed overhead light in container	x	Re-installed SR cover																

