

**National Radio Astronomy Observatory  
Socorro, NM**

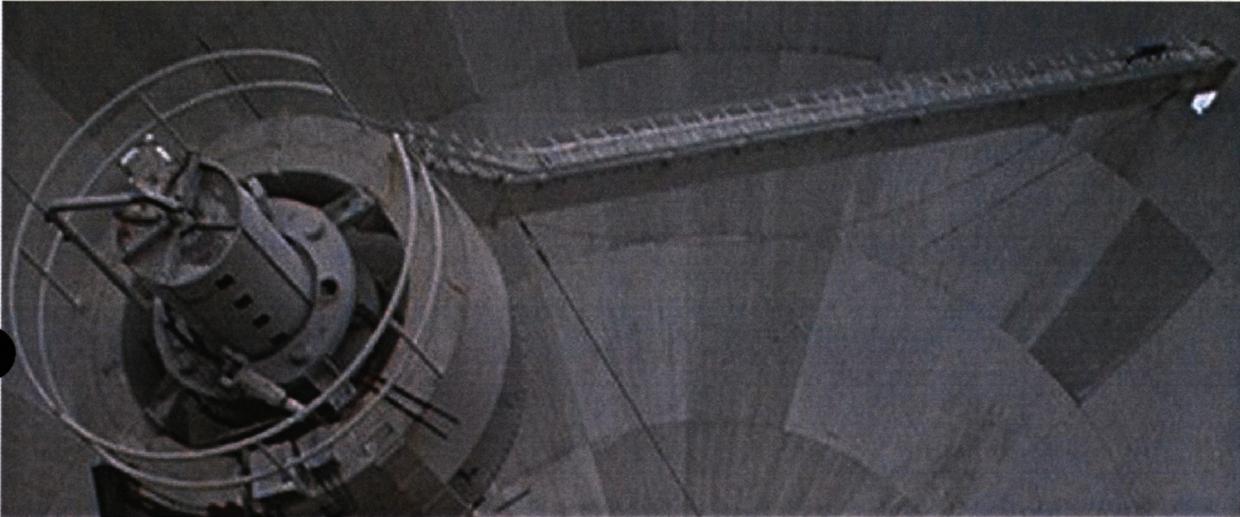
**VLBA Antenna Memo Series #41**

**Hancock Maintenance Visit  
June 3<sup>rd</sup> through 10<sup>th</sup>, 2002**

**Jim Ruff  
6/25/02**

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

**The team consisted of Steve Aragon, Ramon Gutierrez, Bob McGoldrick, Ken Lakies, Steve Troy and Jim Ruff. Site Techs Doug Whiton and Mark Alfero assisted throughout.**

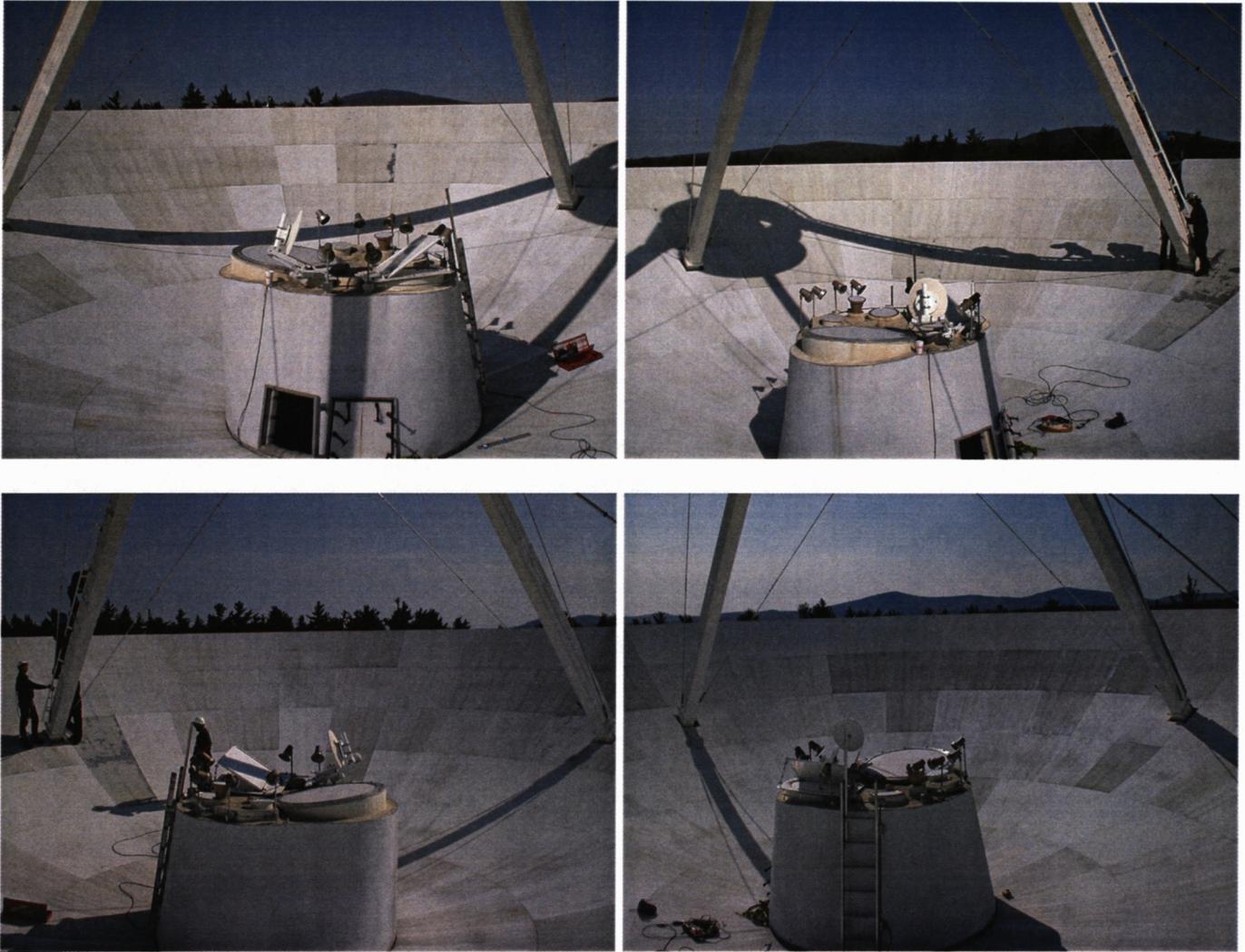


**An apex handrail, quad leg ladder and Sellstrom fall arrest system were installed. The site techs were treated to a training session on use of the Sellstrom system and general fall protection.**

**The elevation bull gear/pinion alignment was visually inspected and appears to be fine.**

**The stow pin was adjusted to ease installation.**

**Many of the panels on this antenna are losing their paint. The paint on these panels comes off down to bare metal with a shoe swipe. The panel next to the ladder had large bare spots due to extra traffic. The bare spots are slippery, so we swapped this panel with one from a less-traveled location. The next four photos show each quadrant of the dish. (These photos were taken before we swapped panels.)**



Antenna Surface Panels

El #1 was showing air in the oil lines. Careful searching failed to reveal the source until we replaced the pump, when the pipe leading out from the gearbox was found to be loose. The el bearing grease fittings were plugged, so we replaced them. (The only hint was the lack of any grease coming out after a lot of pumping. Always pump until you see grease come out!)

The azimuth bearings were inspected. One needed replacing. The outer races had been rotated previously, so we didn't do it.

<b>Az Bearing Grease Inspection</b>				
	Drive 1	Drive 2 (new style)	Tach side Idler	Other Idler
Inner	some flakes	some flakes	very fine flakes	clean
Outer	some metal & pitting	replaced	many flakes, no pitting	several small flakes

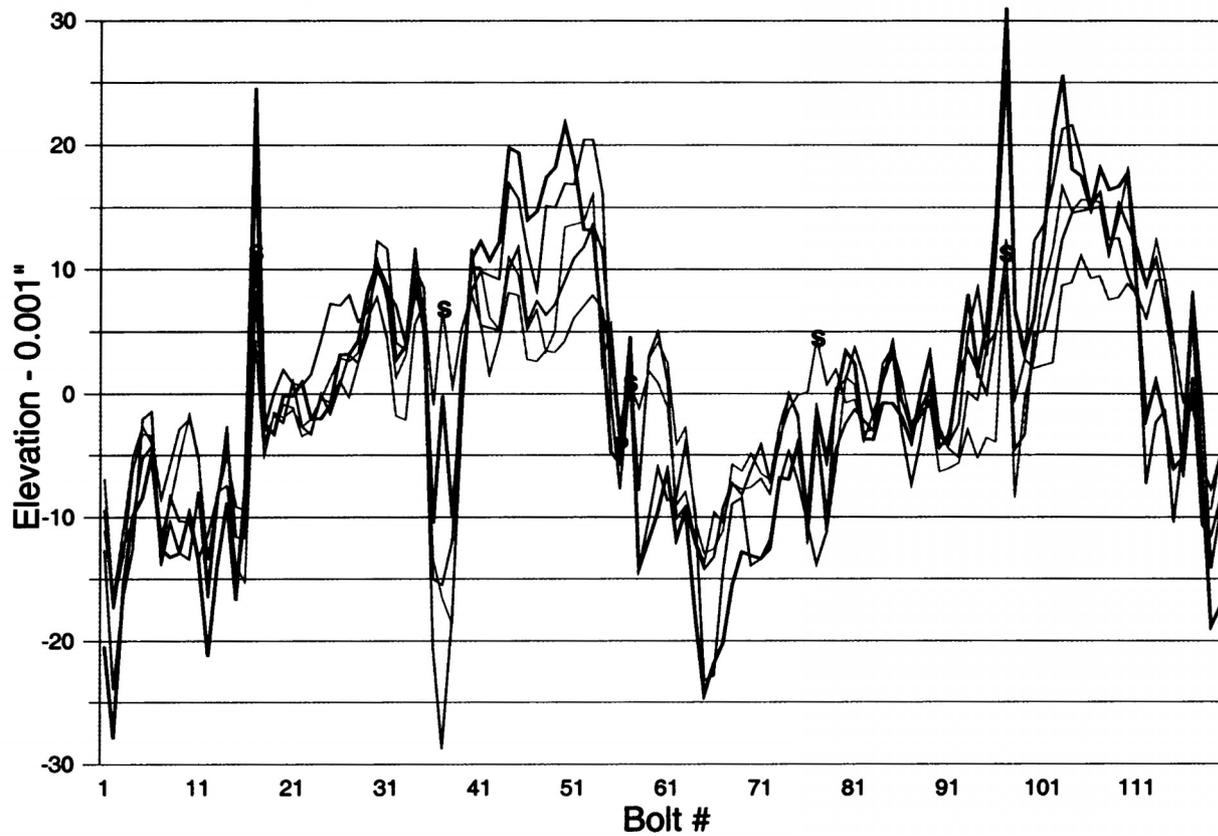
<b>Drive Wheel Alignment</b>			
Wheel #	Horizontal Error	Vertical Error	Radius Error
D1	0° 1' 31"	0° 0' 2"	0.24" (out)
D2	22"	0° 3' 16" (too flat)	0.17 out



The dichroic panel is in good condition.

The azimuth rail grout and Vulkem are in fairly good condition. We removed Vulkem and inspected the epoxy grout at all splices. The grout looked fine.

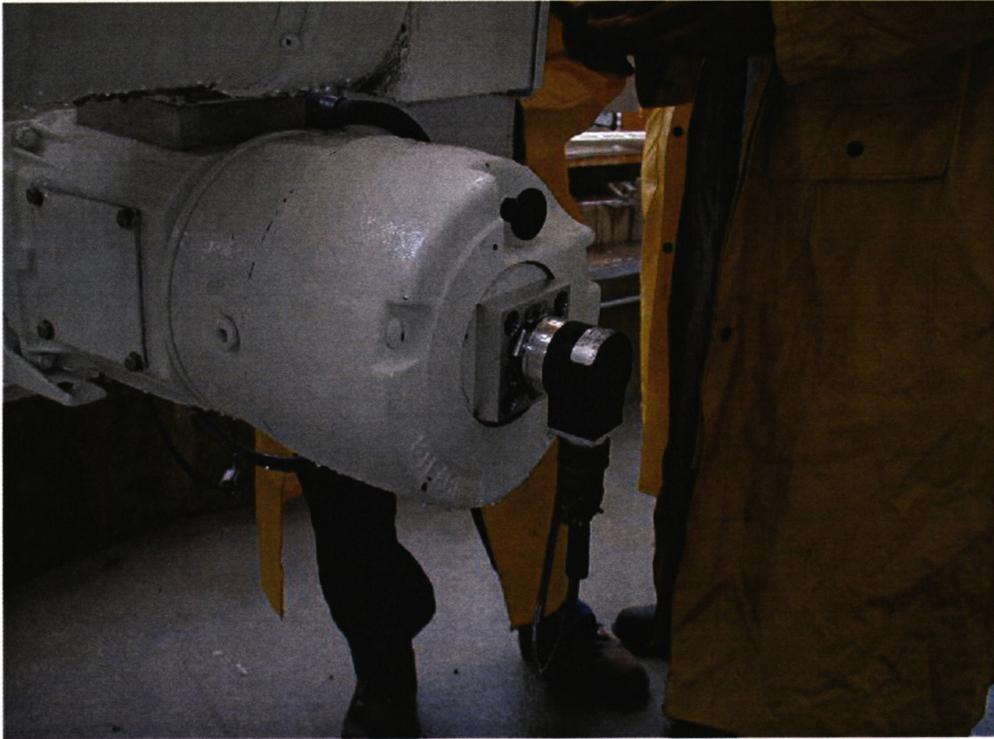
### Hancock Az Rail Elevations First Order Tilt Removed



— 99 — 96 — 95 — 94 — 02

The first order tilt amplitude is 0.018"

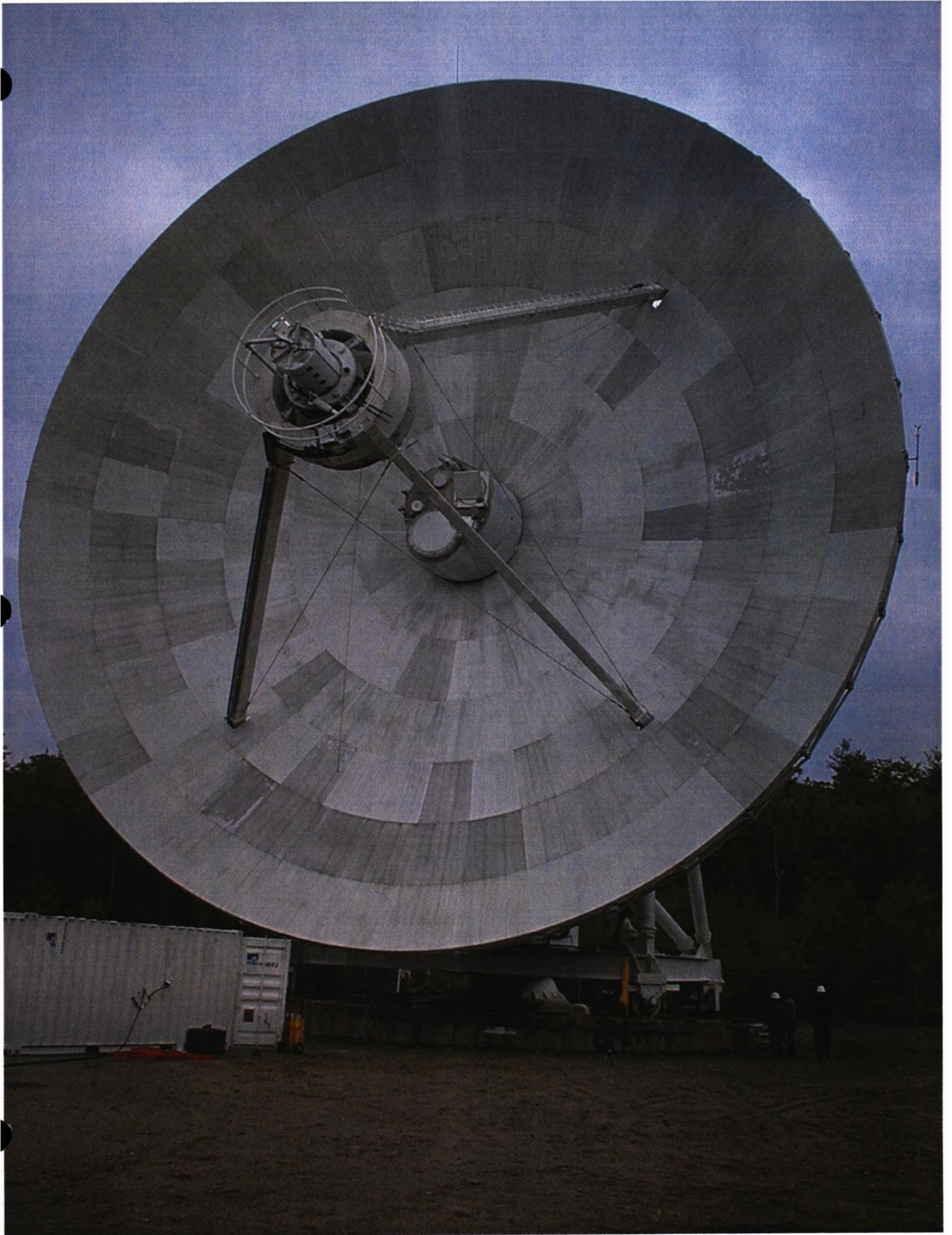
We replaced the azimuth tachs with encoder-based tach generators developed by Doug Whiton. The new design appeared to work fine electrically, but we were unable to get the encoders properly aligned on the motor shafts. There was too much slop in the clamping collars. So the encoders wobbled as the motors turned, until one broke off after about an hour in service. We then put the tachs back on.



**The subreflector is stained.**

The paint is fairly good, but there are many areas where rust appears to be bleeding through. There are also some large areas where newer paint is peeling off of older paint.





**From:** Ken Lakies

**Subject:** Trip Report To HN

**Date:** 06/12/02

Date                      Day Number                      Action

03June02    Day #1                      Travel from ABQ to HN

04June02    Day #2                      Helped with Safety Fall Arrest Install on Apex Quad Leg, Apex Safety Rail. Also performed AZ & EL brake torque test. Both El brakes failed with less than 36lbs. Installed Stow Pin, had to remove Shims to engage the unit. Started Drive Cab PM

05June02    Day#3                      Continued Drive Cab. PM, Pulled Az #2 motor(metric) and replaced with rebuilt unit. Fixed miss wire on field of AZ#2, Cleaned commutator on #1AZ & reseated brushes. Pulled brake covers on El #1&2, found grease in brake and both index blocks were loose and the back pads had slipped behind the index block.

06June02    Day#4                      Removed/cleaned both El brakes. Helped with AZ wheel bearing replacement. Showed site tech about brakes and how to adjust air gap and make sure of index block placement. During heavy rain continued Pedroom PM

07June02    Day#5                      Pulled newly installed AZ#2 tach and installed new tach system. Finished interface card modification(site tech Doug completed this task), together we made scope measurements while running #1 motor. Note: we powered the new tach with the 24v from the motor J-Box(Pin14 & Grnd), all worked as expected. Turned off #1 and drove the antenna with #2 and new tach system. All worked well. Then proceeded to make the changeover to #1 motor. Completed in the PM, but failed to see signal on the scope test, found miss wire of 24vdc for the new tach, fixed and all worked. Noted the new tachs "wobbled" while in use. Started Servo test with new system in place.

08June02    Day#6                      Started early to complete the Servo test before the group arrived to work. Completed test around 8:30-9:00am Helped move (swap)panels,

Page # 2

Changed El#1 coupling spyder and observed # 2 coupling spyder to be OK but cracked. Helped check Wheel alignment. While assisting with that task the new tach on AZ#2 #made some noise. Ran Elevation to seat-in Brushes of Motor #2, recleaned both armatures

09June02    Day#7                      Replaced #2 (EL) coupling spyder, found Az #2 encoder coupling to be broken. Replaced both AZ "new tachs" with original Tachs, remodified the AZ interface PCB. Assisted Mechanics with Greasing of El-AZ bearings and varied other tasks.

10June02    Day#8                      Assisted with the height recording of the track, cleaned wheel bearings and removed excess grease. Helped repacked the container and cleaned the office. After all was packed we left site about 1:00pm for Albany.

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**Conclusions:** HN looks good and is well maintained in most areas, we all had to explain several different items to pay attention to in more detail. The site techs were shown what to look for and how to correct the small problems we found.

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To: Jim Ruff  
Subject: Hancock Tiger Ream Report  
From: Bob McGoldrick  
Date: 25 June 2002

The Hancock Station is well maintained, and, in spite of rainy weather, a considerable amount of maintenance was completed by the Tiger Team in conjunction with the Site Techs, Doug Whiton and Mark Alfero. The members of the Tiger Team were Jim Ruff (PE Engineer in charge), Ramon Gutierrez, Ken Lakies, Steve Aragon, Steve Troy, and Bob McGoldrick.

The Site Techs leave little to find fault with around the station as is evidenced with their replace as you go attitude concerning station maintenance and upkeep. Many improvements and maintenance issues were corrected, but some items were left for the Site Techs to correct.

#### ACTION COMPLETED

1. The Electronics Inspection Sheet was completed.
2. Ramon Gutierrez, Steve Aragon, Bob McGoldrick, Mark Alfero, and Ken Lakies removed the old bolt-ladder on the apex leg, installed a new safer ladder in its place, and also installed the new fall arrest rail on the ladder; Ramón Gutierrez installed the apex safety rail also. Jim Ruff trained the site techs on the new system.
3. Steve Troy did the HVAC upgrades in the station building and pedestal room.
4. Strain reliefs for all cables needing strain relief in the Cable Wrap were checked and adjusted as needed.
5. Bob McGoldrick cleaned/decontaminated the cable wrap and all the rings in the pintel bearing room; Ring three through ring six are missing some of the heavy duty plastic chafing rings; twenty two chafing rings are needed. The steel plate that the grounding lugs are attached to that is installed on the pintel bearing room floor is very rusted; the site techs are aware of this.
6. The site is quite damp and the lower pintel bearing floor can get damp; there is some corrosion on some electrical boxes next to the ladder to the floor; the site techs are aware of the problem, and they do monitor it.
7. Bob McGoldrick inspected both site Tape Recorders and looked at some Recorder Test results to determine if any major work would be needed; The recorders are maintained well and the system runs fine.
8. Jim Ruff replaced the dish anemometer roll pin blocks with replacement blocks and new bolts rather than roll pins; He had the machine shop modify old blocks prior to the visit, and plans to take the old blocks back for modification prior to the next trip.
9. Bob McGoldrick checked the generator out and found it to be up to par with the rest of the station; hoses, wires, filters, and switches were in good condition.
10. Tie wraps from Az motors to the Apex were replaced as needed; the cable run from the bottom of the quadruped leg to the Apex showed no sign of any tie wrap problems at the time. There was some corrosion inside the "critical power" filter mounted on the inside of the Vertex room feedthrough; it looks like at some time in the past that the HVAC feedthrough lines just above the enclosed filter may have leaked because there is a tale tail sign of corrosion associated with that union; it was cleaned as best as possible at that time. The site techs are aware of this.
11. Ken Lakies replaced one Az motor, and replaced brushes and holders where necessary.

12. Doug Whiton and Ken Lakies installed the new servo tachometers on the Azmith motors, and Ken lakies reported very good result, however one of the tachometers broke in what is perceived as a mechanical vibration/resonance between the antenna and the tachometer; it is likely that the tachometer isn't stout enough for this particular application without some redesign by the manufacturer or some redesign of the isolation between the tachometer and the motor, or as Jim Ruff stated, "a Hall effect device."
13. The Weather Station PM was completed, noting that the tower cable crank handle spring was marginal, but I could not ascertain if it was a real problem.
14. The Fire Alarm System was tested successfully for the Station Building, but the Pedestal Room smoke detector wasn't functioning at the time so we were unable to test the Fire Alarm System for the Antenna.
15. Mark Alfero and Bob McGoldrick repaired the perimeter fence in one section where plowing places much snow along its base and popping the fence stays.
16. Jim Ruff, Ramon Gutierrez, Mark Alfero, and Bob McGoldrick transposed two panels in the dish for safety reasons; the panel to the right of the quadruped leg with the ladder was replaced by the fifth panel in the same row while it was put in the latter's position. The aforementioned panel was missing much paint and it was slick.
17. Bob McGoldrick and Doug Whiton installed the new acrylic casting on the focus motors along with the new couplers.

#### **ACTIONS TO BE COMPLETED**

1. The Antenna Fire Alarm system needs to be tested as soon as the smoke detector can be repaired or replaced. (Doug Whiton has notified me that this has been repaired and the Annual PM has been completed.)
2. Further research is needed to ascertain just what to do about the new tachometers or to investigate the "Hall effect" type.
3. The Antenna paint needs further testing to ascertain just how to remove it for a new application; Jim Ruff did preliminary work on the existing paint that indicates that it will probably come off fairly easily
4. Chafe rings for rings three through six on the cable wrap need to be replaced; twenty two are needed; the site techs are aware of this. The grounding lug plate on the Pintel bearing Room floor should be monitored for further deterioration and replace if needed.

**SERVO**

SAFETY TESTS		Recordings											
x	MULTIPLE FAULT STATUS	x	EL System Response Test										
x	MANUAL MODES TEST	x	Implement test setup										
x	INDIVIDUAL FAULT STATUS	x	Calculate acceleration										
x	REMOTE BOX TESTS	x	Locked rotor resonance, AZ/EL										
x	AZ Travel Limit Switch Tests	x	AZ System Response Test										
x	AZ Clockwise tests	x	Implement test setup										
x	AZ Counter-Clockwise tests	x	Calculate acceleration										
x	EL Travel Limit Test	x	Locked rotor resonance, AZ/EL										
x	Elevation up tests	x	AZ Position Loop Tests										
x	Elevation down tests	x	Small signal step response										
<b>BRAKE HOLDING-TORQUE TESTS</b>		x	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>70-74</td> </tr> <tr> <td>Az 2</td> <td>78-80</td> </tr> <tr> <td>El 1</td> <td>fixed - 80+</td> </tr> <tr> <td>El 2</td> <td>fixed - 80+</td> </tr> </tbody> </table>		Brake Holding Torques (ft-lbs)		Az 1	70-74	Az 2	78-80	El 1	fixed - 80+	El 2	fixed - 80+	x	Single motor step response
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x	EL Position Loop Tests												
x	Small signal step response												
x	Large signal step response												
x	Single motor step response												
		<b>Auto Modes Test</b>											
		x	Check stow commands										
			Synchro feedback operation										
			Test AUI COMM DEAD										
<b>Motor Inspections</b>													
x	Motor and Tach Couplings												
x	Commutator & Brush Inspection												
	Install stainless j boxes on drive motors (4)												
	ACU PM												
<b>Servo PM</b>													
<b>Lightning Grounding</b>													
x	EL Bearing Ground Cables												
x	EL Motor Platform to Pintle Turret												
x	Pedestal Room Grounding												
x	AZ Wheel Ground Straps												
x	Pintle Bearing Room Grounding												
<b>Detailed Test</b>													
x	System and Axis Faults												
x	Motor Fault Status												
x	Measure EL Velocity												
x	<b>Measure AZ Velocity</b>												
x	<b>Record 1st Limits EL</b>												
x	<b>Record 1st Limits AZ</b>												
x	<b>El Encoder Inspection</b>												
x	<b>Az Encoder Inspection</b>												
	<i>Note that the site tech had just completed the servo system safety test on 5/28/02.</i>	11											

**HVAC**

<b>Antenna</b>		<b>Control Building</b>	
x	Pedestal room A/C inspection		Building A/C System
x	Provide Site Techs w/manual and hold Q&A ses	x	Perform operational checks
		x	Inspect indoor & outdoor units
		x	Correct deficiencies as needed.
<b>Vertex Room A/C</b>			Stand-By Contempo
x	Inspect air handler		Indoor Unit
x	Inspect condenser unit		Install primary unit interface relay board
x	inspect lines & bulkhead fittings	x	Instal Hoffman SCR's
x	Repair/replace damaged line insulation	x	Install auxillary terminal block
x	Replace any suspect bulkhead fitting	x	Replace V-belt & adjust pully to maximum
	<del>Evacuate &amp; place unit back in service</del>	x	Perform operational checks
x	Install ROC & set to (C1, set 135, Dif.30)	x	Condensing Unit
x	Check PCtool to DDC connection @ computer	x	Inspect for leaks & clean oil
x	Make hard copy of program parameters	x	Inspect electrical connections
x	Check proگرام, save program file to disk.	x	Perform operational checks
x	Hold Q&A session w/ Site Tech's		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
			<del>Replace control transformers</del>
			<del>Replace humidity sensor</del>
			Condensing Unit
		x	Inspect for leaks & clean oil
		x	Inspect electrical connections
		x	Peform operational checks
		x	Check PCtool to DDC connection at computer
		x	Make hard copy of program parameters
		x	Check program & save program file to disk
		x	Schedule and perform hard test of emergency power interface for both Contempo units.
		x	Hold Q&A session w/ Site Tech's
		x	Review site documentation with site techs
			Inspect site utilities
		x	Water supply & distribution
		x	Propane system
		x	Sewer/septic system

**ANTENNA MECHANICS**

<b>Apex Safety</b>		<b>EI Bearings</b>																			
x	Install new ladder & fall arrest system	x	Inspect EL bearings lip seals																		
x	Install apex guardrail	x	Clean off excess grease																		
x	Fall Protection training (sign-in sheet)		<del>Install EI bearing grease trays</del>																		
<b>FRM</b>		x	Grease (replaced 4 plugged fittings)																		
x	2-year PM	<table border="1"> <tr> <th colspan="2">EI Bearing Grease Inspection</th> </tr> <tr> <td>Encoder Side</td> <td>some metal flakes</td> </tr> <tr> <td>Tach side</td> <td>clean</td> </tr> </table>		EI Bearing Grease Inspection		Encoder Side	some metal flakes	Tach side	clean												
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		x	Open, clean & inspect pillowblocks																		
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x	Install INA zirks	Rotate outer races (done previously)																			
<b>Subrefector</b>		<b>Az Wheels</b>																			
x	Check for peeling, delamination (discolored)	x	Check wheel to struct clearances																		
x	Check cover		Check axle bolt tightness																		
<b>Quad Legs, Guy Wires Etc..</b>		<table border="1"> <tr> <th colspan="3">AZ wheel radii and alignment</th> </tr> <tr> <td></td> <th>D1</th> <th>D2</th> </tr> <tr> <td>Horiz. Error</td> <td>1' 31"</td> <td>22"</td> </tr> <tr> <td>Vert. Error</td> <td>0' 2"</td> <td>3' 16" (flat)</td> </tr> <tr> <td>Radius</td> <td>0.24" out</td> <td>0.17" out</td> </tr> </table>		AZ wheel radii and alignment				D1	D2	Horiz. Error	1' 31"	22"	Vert. Error	0' 2"	3' 16" (flat)	Radius	0.24" out	0.17" out			
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x	Inspect guywires & turnbuckles	<b>Az Motors &amp; Gearboxes</b>																			
x	Inspect quadleg flange bolts	x	Inspect pumps, seals & couplings																		
<b>Anemometer</b>		x	g-box htr encl's (A1 & E2 clean. E1 & A2 rusty. Drilled E1)																		
x	Inspt mounts/chk operation	<b>Paint &amp; Insulation Inspection</b>																			
x	Install Baldwin bracket parts	x	Inspect ant paint and report																		
<b>Feeds &amp; Dichroic</b>		x	Inspect & repair ant insulation as needed																		
x	Inspect feeds, mounts, heaters, etc.	<b>Pintle Bearing</b>																			
x	Check dish tipper	x	Inspect seals																		
x	Check Dichroic reflector		Check pocket level (done previously)																		
x	Check feedcone exterior	x	Check for loose bolts																		
x	Replace hatch latches as req'd	x	Lubricate																		
<b>Dish Surface &amp; Panels</b>			Close gap in grease catcher (done previously)																		
x	Inspect for damaged panels (extensive peeling)	<b>Az Rail Inspection</b>																			
x	Spot check panel bolts-looseness	x	Inspect ant foundation, grout and Vulkem																		
<b>Elevation/Hoist/Swing Platform</b>		x	Inspect for excessive rail movement																		
x	Instl hoist safety mods	x	Inspect joint bars & clips																		
x	Checkout swinging platform	x	Rail level measurements																		
x	Instl condensor platform toe guard	x	Check for popping wheel (none)																		
<b>Structural</b>																					
x	Spot check structural bolts	<b>Swap az #2 motor</b>																			
x	Inspect structural welds	<b>Replace lovejoys</b>																			
x	Inspt ant backup/lower struct	<b>Check bubbles in EI #1 oil lines (bubbles were due to loose suction pipe at grbx. Replaced pump anyway)</b>																			
x	Inspect EL axle for cracks	<b>Check EI bull gear/pinion alignment</b>																			
<b>EI Bull and Pinion Gears</b>																					
x	Inspt bull/pinion gears																				
x	Lub bull gear as req																				
x	Check stow pin (adjusted shims)																				
<b>EI Motors &amp; Gearboxes</b>																					
x	Inspect pumps, seals & couplings																				
x	Check gearbox heater enclosures																				
no	Open & inspect az #1 gearbox																				
no	Open & inspect ei #1 gearbox																				
x	test panel paint removal techniques (loose paint wipes off easily)																				

<b>ELECTRONICS</b>		
	<b>Antenna Maintenance &amp; Inspections</b>	
x	Apex/FRM inspections	
x	Feedcone/Receiver system inspections	
x	Activate & test feed heaters	
x	Vertex Room/Racks & cable inspections	
x	Vertex to pintle bearing inspection	
x	Replace tie wraps on antenna cabling with metal type	
x	Install cable wrap strain reliefs	
x	Inspect pintle bearing rm bulkhead, cablewrap, etc.	
x	Inspect pedroom UPS, FRM controller, dry air sys, etc.	
	Install breaker for air comp & hydraulic wrench <i>(Didn't do. No breaker)</i>	
	<b>Station Building Inspections</b>	
x	100 - Check electrical, UPS and test operation	
x	103 - Chatter/supervisory boxes, alarms, etc.	
x	104 - Bulkhead, underfloor, maser, etc	
x	Check tools, test equip, manuals, wtr sys, UIS, etc	
	<b>Outside Building and Misc. Inspections</b>	
x	Run and inspect site generator	
x	Inspect weather station	
x	Check gates, fence, signs, grounds, etc	
x	Inspect lightning protection for antenna & bldg	
x	Check safety items/hazmat storage, etc.	
<b>FINAL INSPECTIONS</b>		
x	Spot check critical PM's	
x	Review problem areas with site tech's	
x	Site Inspections for Oversights	
x	Site clean-up	
x	Contact VLBA Operations for Station Startup Verification Tests	