NATIONAL RADIO ASTRONOMY OBSERVATORY

Socorro, New Mexico

VLBA Antenna Memo Series No.22

Hancock, New Hampshire- Maintenance Visit, June 22 - 28, 1999 - Trip Report

J. E. Thunborg September 2, 1999

Attachments: Azimuth Rail Level Survey, Scrvo Trip Report, Electronics Trip Report, Paint Report, Task Schedule

The Hancock maintenance team consisted of S. Aragon, R. Gutierrez, S. Tenorio, S. Troy, J. Thunborg and P. Ulbricht. The team worked at the Hancock antenna from August 16 - 22, 1999. The Site techs M. Alfero and D. Whiton also worked toward the completion of the scheduled tasks.

All of the azimuth bearing races were rotated 180 degrees. Both Az#1 drive bearings and the Az#2 outside idler bearing had slightly pitted sections on the outer bearing races. These bearings were not changed and will probably last a few more years, since the outer races were rotated. These bearings should be scheduled for change during the next Hancock maintenance visit in 3 years.

A hydraulic wrench was used to loosen 18 pintle-bearing bolts. Dial indicators were then placed on the bearing and the antenna was rotated. The measured vertical runout was 0.003".

The paint on the antenna was in excellent condition except on the panels, subreflector and a few small areas.

The following items were tested/inspected and repaired if needed. A more detailed list/schedule is attached to this document.

- 1. Extend elevation platforms providing additional access to drive motors.
- 2. Add toe boards to elevation axle platform.
- 3. Install elevation hard stops.
- 4. Install elevation bearing grease trays.
- 5. Measure pintle bearing pocket flatness.
- 6. Bearing Inspections/grease samples Azimuth, Pintle and Elevation
- 7. Rotate azimuth bearing outer races.
- 8. Gearbox inspections Azimuth and Elevation
- 9. FRM inspection/PM per detailed checklist.
- 10. Subreflector inspection.
- 11. Feeds and DiChroic reflector inspection
- 12. Quad leg and guy wire inspection.
- 13. Antenna structure Cracks, tighten loose bolts, repair insulation.
- 14. Bull and pinion gears lubricate and tighten bolts.
- 15. Swinging platform and hoist inspections.
- 16. Detailed corrosion inspection.

- 17. Paint Inspection Complete Hancock Paint report.
- 18. Rail inspection and level measurement.
- 19. Drive Motor Inspections/PM brakes, couplings, commutators and brushes
- 20. Servo system Complete checkout per servo shop checklist.
- 21. Lightning protection inspection/repair- cables, straps and grounding.
- 22. Replace ped room A/C
- 23. Control building Contempo upgrade.
- 24. HVAC inspections per detailed checklist.
- 25. Utilities Water, Sewer and Propane System
- 26. Vertex room HVAC repairs/mods.
- 27. Anemometer inspection/repair.
- 28. Antenna electrical inspections Per detailed checklist
- 29. Station building electrical inspections Per detailed checklist
- 30. Other electrical Inspections- Generator, Weather Station and Grounds.
- 31. Checkout fire alarm.
- 32. Add internet site camera
- 33. Replaced Ped room A/C unit with a Marvaire Unit.
- 34. 3mm modifications to B-rack

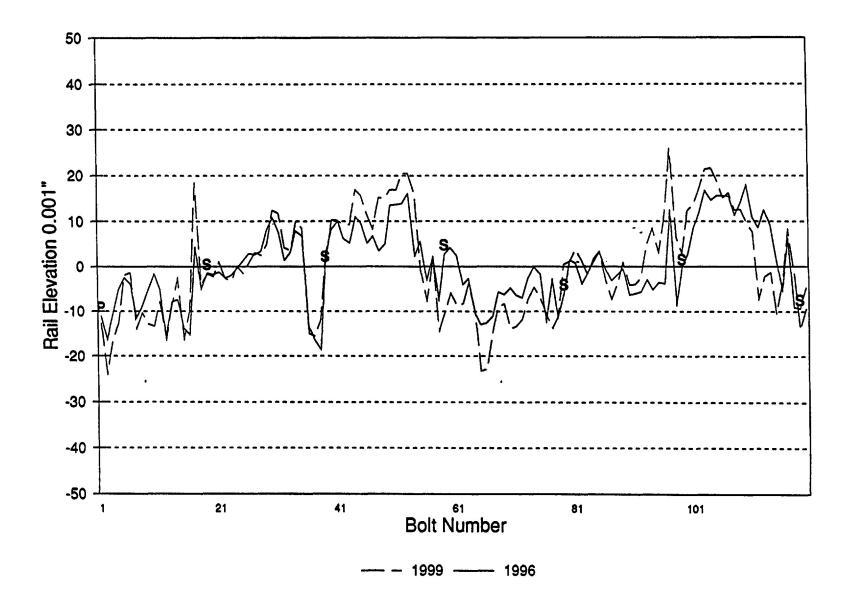
The following non-scheduled items were also completed.

- 1. Repaired pintle bearing Grease tray.
- 2. Repaired winch post.
- 3. Replaced Lovejoy couplings on all drive motors
- 4. Adjusted cable wrap to allow additional clearance.
- 5. Repaired leak in ped room cable feedthroughs
- 6. Repaired feedcone insulation
- 7. Replaced lovejoy couplings
- 8. Installed offset Stainless steel J-boxes on drive motors.
- 9. Found & repaired a leak in the suction line located in Vertex room.
- 10. Replaced oil saturated HVAC tube insulation in Vertex.
- 11. Repaired Refrigerant leak in Building A/C condensing unit.
- 12. Installed 2 feed heaters.

Several details were left uncompleted. These details and their required follow-ups are listed below. .

- 1. Inspected Propane piping & found that it is Sch. 40 pipe instead of Sch.80. Steve Troy asked Doug to get a quote to replace the piping to determine if we should have it done locally or on our next visit, depending on cost.
- 2. The panel bolts were only spot checked in order to preserve the paint.

HN Azimuth Rail Measured 8/20/99



To: List

From: Steve Tenorio

Subject: Trip report VLBA HANCOCK

Date: 24 AUG 99

14aug99 Day #1 Travel from San Antohio N.M. to Alb. N.M..

15aug99 Day #2 Travel from Alb. N.M. to Keen N.H.

16aug99 Day #3 Rewired Az. #2 tach. Cable, Az # 1 and Az. #2 E-stop cables, and Az.stairway E-stop. Started replacing Az. Motor j-boxes.

17aug99 Day#4 Completed installation of Az. Motor j-boxes. Replaced El. Motor jboxes. Completed Drive Cabinet pm. Checked grounding in ped. Room. Completed ACU. and Data Converter pm. Cleaned and seated Az. Brushes. Checked El. Brushes.

18aug99 Day#5 Rewired El. E-stop to new platform extention. Mounted warning horn to El. Platform j-box. Ty-wrapped El platform cables. Completed electrical checks in ped. Room. Check current on gear box heaters. Completed servo test.

19aug99 Day#6 Helped antenna mechanics with hardstops. Replaced motor blower filters. Changed motor coupling spiders on Az. And El. Motors. Sealed motors and motor blowers with rtv to try and stop pollen problem. Helped S. Troy replace ped. Room A/C. Painted blower motors. Helped mechanics paint welds.

20aug99 Day#7 Cleaned up ped. Room and replaced electrical panel covers. Checked lighting protection on antenna. Helped J. Thunborg shoot rail. Checked Az. Cable wrap and limits. Checked El. Cable wrap and limits. Helped grease El. Bearing.

21aug99 Day#8 Ty-wrapped cables into drive cabinet. Helped ant. Mech. Grease pintal bearing. RTVed leak in ped. Room. Adjusted bracket on cable wrap for Pete. Cleaned up antenna and loaded container.

22aug99 Day#9 Traveled back from Keen N.H. to San Antonio N.M.

Conclusion: Hancock site is in real good shape. One suggestion is that the blower filters be changed from the metal type to the paper type.

FROM: Pete Ulbricht

SUBJECT: Hancock Maintenance Trip

The Maintenance Visit to Hancock was from August 15-22, 1999. The site was in very good condition. It was evident that the site personnel take pride in maintaining their facility.

I installed the 3mm modifications to the B-Rack which included relocating S11 and S12. With the exception of North Liberty, all sites should have this change completed. I found several discrepancies comparing the drawings with the locations of cables feeding the back of the B-Rack. Although none of the changes affected the operation of the Electronics, I corrected them to match the schematics for future reference. The P-Band cables were cross-polarized at the back of the B-Rack. I could not find a reason for this (second cross). The labels on the cables are from the original outfitting and the frontend has not been changed. Operations has not had any complaints with it's operation, so I left it as I found it.

I installed 2 feedheaters and repositioned the existing ones to better utilize the heat. I ran new cables from the Vertex Room DDC Smart Controller down through the spare MCB cable to the building and into room 103. I also ran cables for the Contempo DDC controller including; a temperature sensor under the floor in room 104 under the Maser, a humidity sensor mounted through a ceiling tile in room 103, and a RS-232 cable into room 103 to an A-B switch so the site techs can check the controllers from the PC using PCTool software. Mark and Doug installed the new SCSI hard drive into the Station VME Computer.

I checked all the J-boxes in the Station Building with the IR thermometer for hot spots----only found one "warm" one. I tightened the connection. I checked all the IF cables, the 500Mhz, and the 100 Mhz with the TDR and found them to be very good. The power loss from the Vertex Room to the station building was consistent from cable to cable at about 7.8 db.

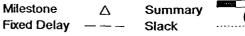
I installed the video camera at the top of the Weatherstation Tower and cabled it into the Station building using the underground conduit. We had to remove a connector and pull out the fiberoptic cables before pulling the new cables in with the existing cables. We included an RS232 cable at the request of the site techs. Doug and Mark tied it into the existing RS232 cable, W-115 and installed a connector out at the Weatherstation to connect to the laptop computer.

I completed a top-to-bottom inspection of the antenna. The azimuth cablewrap bothered me a little. At one spot during the rotation, the arm supporting one end of the spring assembly was so close to the phenolic tray that my credit card would not slide between the two. The arm had no adjustment. Steve Aragon and Ramon Gutierrez were able to redrill and raise the arm to give a margin of safety to it's operation.

Task Name	Resources	Durat		T		·				
		[]	16	17	18	19	20	21	22	23
SERVO		10.84d		r			1		108.40h	
SAFETY TESTS	Site T 1, Site T	2.00h						1		
MULTIPLE FAULT STATUS		0 10h		l .		1	1	1	1	
MANUAL MODES TEST		0.20h		1	1		Į	1	[1
INDIVIDUAL FAULT STATUS		0.20h					f		1	Í
REMOTE BOX TESTS		0.50h								
AZ Travel Limit Switch Tests		0.05d								
AZ Clockwise lests		0.25h							1	
AZ Counter-Clockwise tests		0.25h						1	1	ł
EL Travel Limit Test		0.05d							l I	[
Elevation up tests		0.25h	1					1	1	
Elevation down tests		0.25h							1	}
BRAKE HOLDING-TORQUE TESTS	Servo T, Site T 1	8.00h		00n						[
Motor Inspections	Servo T, Site T	13.00h	لہے		13.d	0h				
Motor and Tach Couplings		2.50h		2.50					1	
Drive motors wiring orientation		8.00h	-1	5	son					
Commutator & Brush Inspection		2.50h		Ģ	2.50					
Servo PM	Servo T, Site T	-3.50h			L-0-3.6	оь				
	361 VO 1, SILE 1				L-2.6					
Drive Cabinet PM	·	2.50h								
Rewire Lockout Switch		2.50h			2.50					
ACUPM	····-	1.00h			1.00	1		i		
INSPECT ANTENNA POWER PANELS	Servo T, Site T 2	3.00h			ر تے	on				
INSPECT GEARBOX HEATERS	Servo T, Site T 2	2.00h				00h	. 1			
Lightning Grounding	Servo T, Site T	1.95h		ł	⋗	1.9 \$	h			
EL Bearing Ground Cables		0.25h		1	느ㅋ	25h		j		
EL Motor Platform to Pintle Turret		0.20h			*	20h				
Pedestal Room Grounding		0.75h			>	0.75				
AZ Wheel Ground Straps		0.50h	{			×_0.50€				
Pintle Bearing Room Grounding		0.25h	1		-	≫l 0.25	1		1	
EL encoder inspection		8.00h				ه الع	on			
Replace W39 cable - AZ stair e-stop to drive cabinet		1.00h	1		1	₩	an			
Replace W43 cable - AZ#2 e-stop to drive cabinet		1.00h					xon		1	
Replace W39 cable - AZ#2 motor j-box to drive cabinet		1.00h		}		See	1.00			
Detailed Test	Servo T, Site T	7.80h						BOh		
System and Axis Faults	·	2.00h				jL,	200			
Motor Fault Status		0.30h		1		1	5-0.30			
Measure EL Velocity	[[0.25h	[[]	5-02h		1	[
EL counterweight balance measurements		4 00h			ļ			n		
Measure AZ Velocity		0.25h					5	an I	1	
Record 1st Limits EL/AZ		1.00h	1	1						l
Recordings	Servo T	8.60h		[لتستر		ion	
					1		7		1	
EL System Response Test		0.28d		{		ł		₽""	`	
implement lest setup		1.50h				1	الط،	or I	1	
Calculate acceleration		0.25h		1		l		D ^{0.25}	l l	[
Locked rotor resonance, AZ/EL		0 10d					11	1.004		
AZ System Response Test		0.28d					ļ,	2.15	h	
Implement test setup		1.50h						1.50	1	
Calculate acceleration		0.25h	ļ	ļ				102h		1
Locked rotor resonance, AZ/EL		0.10d					()	30 1.00 n	1	

Printed: 8/3/99 Page 1

•



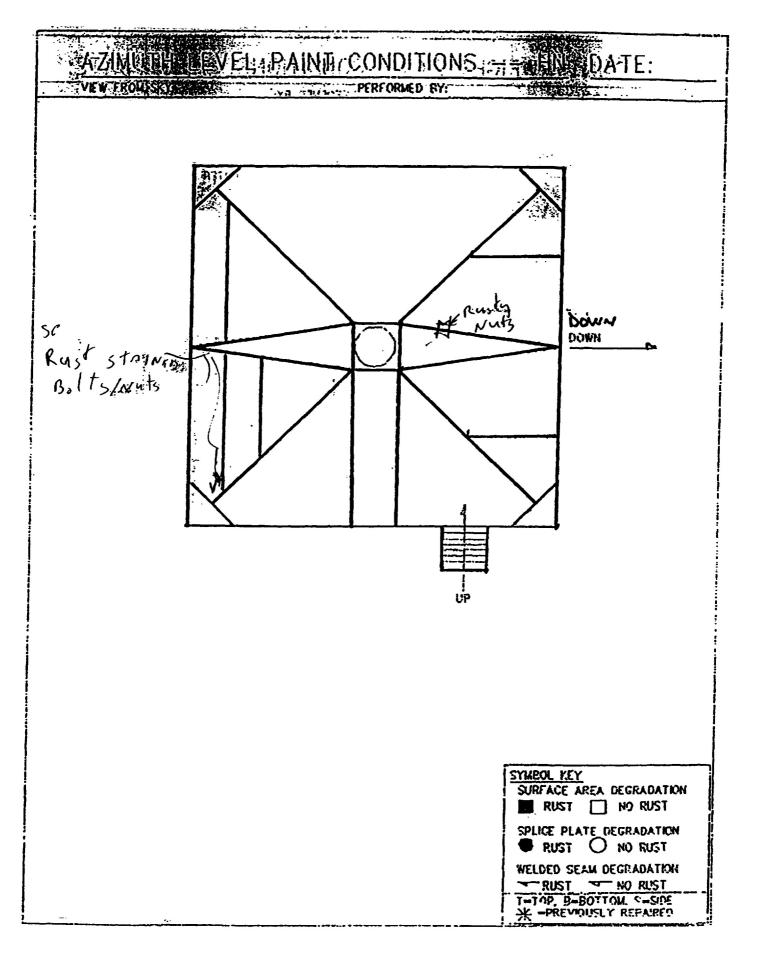
SERVO E10	.0R84dA0R	F4dET	<u> </u>	1			1 -	1-			
			16	17	18	19	20	21		23	24
Single motor step response		0.25h	4		1				0.5h		
EL Position Loop Tests		0.16d		}		1		140	1 56h		1
Small signal step response		1.00h							⊐ ¹pon		
Large signal step response		0.30h							- 1		
Single motor step response		0.25h							0,256		1
Auto Modes Test	Servo T, Site T	0.15d						┥┝┛	1.50h		
Check stow commands		1.00h									
Synchro feedback operation		0.25h						1	⊐¢²≫∖	1	
Test AUI COMM DEAD		0.25h						\	0.25h		
HVAC PM AND UPGRADE	HVAC T	7.10d		· · · ·	1		·				71 71
Replace Pedroom A/C		5.00h	<u>5.0</u>	Dh							
Vertex Room A/C Upgrade		1.30d	۶ <u>–</u>		13.00h						1
Reclaim refrigerant from system		2.00h	₽_2	poh							
Install head pressure control valve		1.00h	54-1	oon							
Remove existing evaporative coil		1.00h	जित्त	.00h		1					
Install new coil assembly		3.00h	5	3.0	ափ				1		ł
Evacuate and recharge system		2.00h		5-2	opn	1	1				1
Air flow measurements & adjustments		4.00h		5	econ						
Contempo Unit B(2) Upgrade		26.00h			100			e.qoh	1	1	
Reclaim refrigerant from unit		1.00h			- Fi	oph			1		
Install refrigerant valves		6.00h			5	1 .00h					
Evacuate and recharge system		2.00h	1				*				
install DOC		5.00h				5	bon				
Install SCR's and Controllers		6.00h				G	- 6.00				
install sensors		2.00h	1				5-20				
Install enuciator interface		2.00h					5-2	On			
Caliibrate sensors and SCR controllers		2.00h						001			
HVAC/Plumbing PM & Inspections		5.30d			L	I					63.0
						och					
Vertex Room A/C		0.50d			200	T		1			
PM/inspect condensor unit		0.20d	1	ר וויי	h _ .				1		
PWinspect air handler		0.20d				1					i
System operational checkout		0.10d				ſ					
Control Building Contempo Sys	Site T 1	1.00d						┶╌┟╌	1 ^{0.00h}	1 1	
PM/inspect indoor units		0.50d					9	°Ch	opn	1 1	
PM/inspect outdoor units		0.10d						""	, don		
System operational checkout		4.00h						4	1.00h		
Lab A/C Unit	Site T 1	0:30d						- HAC		3.00	h
PM/inspect indoor unit		0.10d	1			1 1		- F-	1.00h		
PM/inspect outdoor unit		0.10d								1.00	
System operational checkout		0.10d								51 1.00	
Water & sewer PM/inspection	HVAC T, Site T 2	0.20d	1				1			20	.
Propane System PM	HVAC T, Site T	0.20d	1							50 -20	Oh
Check for schedule 80 spec pipe		1.00h							1	1 Fia	、
Check for hydrostatic relief valve		1.00h								51 100	n
Contempo ops/maint training	HVAC T, Site T 1,	0.201	1							20	on l
VR sys ops/maint training	HVAC T, Site T 1,	0.20d									DOh
Lab A/C ops/maint training	HVAC T, Site T 1,	0.10d					1		1	1 - 4	1.00
NTENNA MECHANICAL		5.70d						\mathbf{h}	7.00h		
MECHANICAL TEAM 1	Ant M 1, Site T	19.00h			9.00h		1				
· · · · · · · · · · · · · · · · · · ·	Puic M 1, Site 1										1
FRM Inspection/PM - replace 2nd screw shaft								1			
Subrefector		0.20d	ԿԵղես	00h				1		1 1	
Check for peeling, delamination		0.50h	Ьф	r				1	1	1	

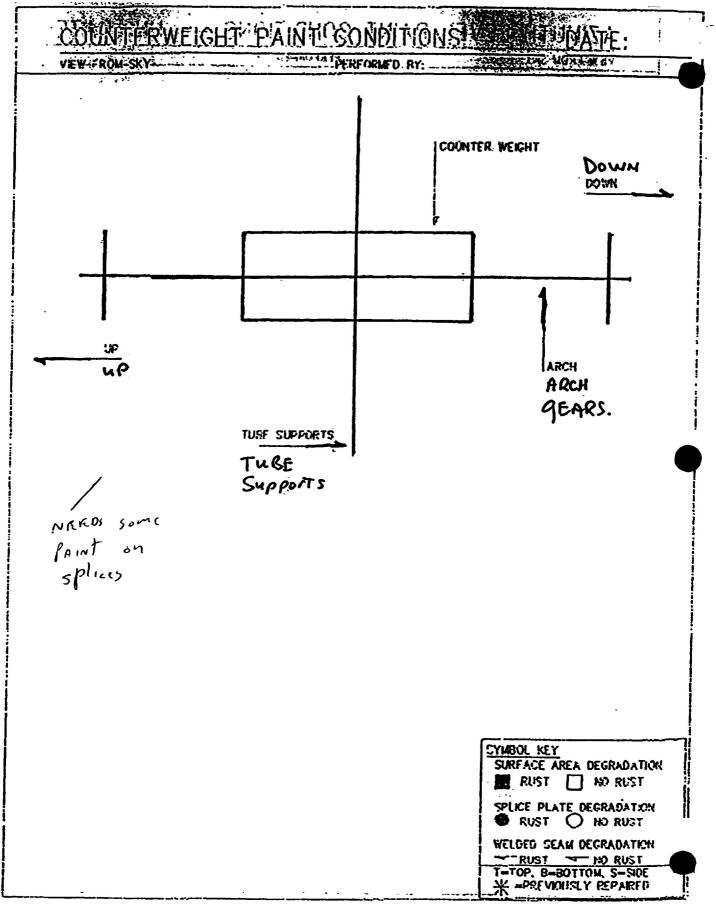
SERVO E10	.0R84dA0R	F4dET	16	17	T	18	19	Augus		21	22	23	
Obertanides baha bertaide st		0.10d		abot			1-"	-+	4	<u> </u>	+- <u>"</u> -		24
Check spider bolts, backside,etc		0.50h		I									1
Check Donut Bolts		0.50d		LA_	6.00	h						}	
Feeds & Dichroic		0.10d		17	.00							ł	1
Inspect leads, mounts, htrs, etc Replace Q-band feedhorn window		1.00h									ł	1	
Remove 3mm receiver		1.00h											
Repair dichroic reflector, check panel		2.00h		H	2.00						1		
Quad-Legs Guy Wires Etc		0.10d			1.00	h				1	1		1
Inspect guywires & tumbuckies		0.054			0.101					Ì	1	1	1
Inspect quadleg flange boits		0.05d			0.500		ļ						
Lightning Protection/Anemometer	+	0.10d		14.	1 00	h							
Inspt mounts/chk operation	- · · · · · · · · · · ·	0.10d			1,000						1		ļ
Bull/Pinion Gears		2.00h			2.0	Oh	1	1			}	1	}
Inspt but/pinion gears		0 10d		.	- 100		1				1		
Lub El brgs, bull gears as req		0.10d		115			1			1	1	{	}
MECHANICAL TEAM 2	Ant M 2, Team	46.50h	· · · · ·	41-	1		1	┵╌┑	46.0) Sah	1		
	Fuir m 2, ream			Ц,	3 00	h.	T	T	T	1	1		
Elevation/Hoist/Swing Platform Work	-{	13.00h	<u> </u>	TH.			1	1	1	1	1	1	1
Instit hoist safety mods, checkout winch, etc		0.30d	<u> </u>							1	1	(
Checkout swinging platform		0.10d 8.00h	יי רא ר קיינאר		00			1		1	1	. 1	
Extend EL motor platforms	· { · · · · · · · · · · · · · · · · · ·	1.00h		ΠEΨ"			[1			{		
Insti condensor platform toe guard	CH. TO	1			2 5.06								
EL Bearing Inspection	Site T 2	0.25d		12	T		5			}	<u> </u>		
Inspect EL bearings internals	<u> </u>	0.05d		HE.	T				1				
Inspect EL bearings lip seals	+	0.05d		E	T			1		1			
Clean off excess grease	+	1.00h	1	H.	T.			1					
Install El bearing grease trays	Site T 2	0.50d			Ξ.	- 6.00	5			1			
EL. Motors & Gearboxes	Sherz	<u> </u>]			[
Internal gear inspection	+	4.00h			11			1			1		
Exchange drive motors	<u>}</u>	1.00h			Ш.	1.00			1				
Inspect pmps, seals, couplings	Ant MA Site T	1.85d	[15			8.50h	{				
AZ Wheels & Bearings	Ant M 1, Site T	10.50h	Í									1	- 1
Rotate outer races on Az wheel bearings	<u> </u>	0.20d	1	11	1		GL.	I					{
Check wheel to struct clearances	1	0.10d		11			æ.	I				1	j
Check ade bolt tightness Pillow block brgs-open & clean	·{·····	0.400	1				d	T				1	}
Lubricate & tale sample as req	<u> </u>	0.10d	1	11	1		្រុ	100					
AZ Motors & Gearboxes	Site T 2	0.40d		11			-ئا -	Ξ.	udos.			1	1
	JACTI	-3.00h	1		1	- {			.00				
Internal gear inspection		1.00h				- 1					1	1	
Inspect pumps, seals, couplings Install grease fitting on #2 motor bearing	· · · · · · · · · · · · · · · · · · ·	1.00h		11		1	b		TI				
Paint & Insulation Inspection	Site T 2	3.50h		11		1	-	The I	3 50				
	Sile 1 2		1	11				-			1		
Inspect ant paint and report	<u></u>	0.50h	1	11	1	1		L S	300		1	1	1
Inspect & repair ant insulation as needed	A-142 Cit- 7	3.00h		11-	1				Т	[000	1	
ANT. MECHANICS Cont.	Ant M 2, Site T	38.00h	ļ						71	┘┦	.00h		1
Pintle Bearing	 	0.60d			Γr	Pe.6	011					}	1
inspect seals, check pocket level & for loose bolts	ł	2.00h			1]2.00				ļ		1	1
Repair grout under bearing	{	3 00h			1 P	□ ""	•					1	
Lubricate bearing as needed	├ ────┤	0.05d		{		⊐°≸				1	1	1	
Take grease samples as needed	I	0.05d		1		0.50				- 1	- 1		1
AZ Rail Inspection		b08.0			4	L	8.0	un			1		
Inspect ant foundation		0.05d				₽° ₽	1					1	
Inspect for rail movement		0 15d		ł	14	6	h l			1		1	

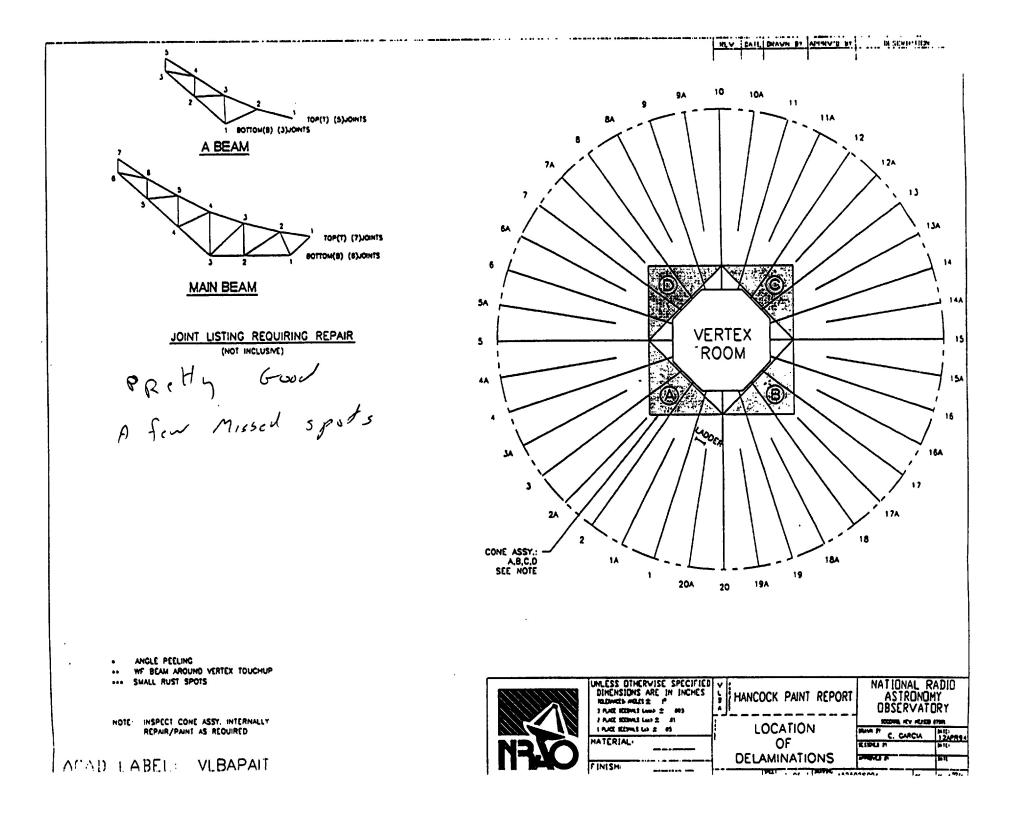
Printed: 8/3/99 Page 3



SERVO E10	.0R84dA0R	F4dET			· · · ·	1	August 19	1		- -	
			16	17	18	19	20	21	22	23	24
Inspect joint bars & clips	-l	0 150				t son	1			1	1
Move ant, chk rail movement		1.50h			•	1.40n	1		1		
Rail level measurements	l	0 30d				3.0					
Dish Surface & Panels	Site T 1, Site T	1.00d				1 ×	┰╼╧┚ᡃ⁰	por		1	
Inspect panels, check distortion, shifting, etc		0.20d			l	_ _2	ሞ서		[[1
Check all panel bolts-looseness	L	0 30d		1	1		aloch 🛛		1	1	
Repaint panel where needed		5 00h				, San	5.00				
Structural	Ant M 1, Site T	1.40d	1				5		14.00h		
Install EL hard stops		8.00h				1			×		
Check ant structural bolts		2.00h	1		1	([20	xh		
Inspect ant structural welds		0.20d		1				4-12	dan 🛛		
Inspt ant backup/lower struct	1	0.200						∮ ∎ :	zban		
ELECTRONICS	Elect T	59.90h				· · · · ·			59.90h		
Antenna Maintenance & Inspections	1	37.25h		<u> </u>	[]	<u></u> 3	7.25h		1		
Cryo sensor card upgrade		1.00d		ban					{		
Install feed heaters	+	4,00h	կ	4.0	pn i				1		ļ
Apex/FRM inspections	Site T 2	5.25h	ľ	5	.25h						1
Feedcone/Receiver system inspections		3.75h	ł	Ģ	3.7			1	l	į	(
	+	1.00h	1		Ģ.				[
Replace receivers that have faulty sensors	<u> </u>										
Vertex Room/Racks & cable inspections	<u> </u>	2.50h									
B-rack modification for 3mm receiver		3.00h					. [
Vertex to pintle bearing inspection	<u> </u>	3.50h									
Inspect pintle bearing m bulkhead, cablewrap, etc.		1,75h	{			721	×				
Inspect pedroom UPS, FRM controller, dry air sys, et	<u> </u>	2.50h	1			1_1		1			
Station Building Inspections		10.25h	4			<u>لم</u>	יים	.25h			
Rm 100 - Check electrical, UPS and test operation		3.00h	1		1		3.001				1
Rm 103 - Chatter/supervisory boxes, alarms, etc.		2.50h					250				1
Rm 104 - Butichead, underfloor, maser, etc		1,75h	}			1	거니까				
Check tools, test equip, manuals, wir sys, UIS, etc		3.00h					4∎ 3 Þ	≫n			
Outside Building and Misc. Inspections		3.50h			ł		ч <u>с</u>	3.50	h		
Run and inspect site generator		1.00h	1	ĺ	1			on	1		
Inspect weather station		0.75h		ł			5-1-1	54			
Check gates. fence, signs, grounds, etc		0.50h					54-10	io	5		
Inspect lightning protection for antenna & bldg		0.50h						0.50			
Check safety items/hazmat storage, etc.		0.75h					L C	0.75			l
Spot check critical PM's		1.00h					10	1.00			
Review problems areas with Site Techs		1.00h					- 11		.		
FINAL INSPECTIONS	Elect. T, Site T	3.00h				1		50	.00h		
		2.00h			1	1			Don	1	1
Site Inspections for Oversights Station Startup Verification Tests		1 00h							.00h		
inted: 8/3/99 age 4						Milestor Fixed D		Δ		mmary	







1	SCY. INTO PROVIDE ATTACK BY RECEIPTION
•	
	, A,
	2 2
3 2 1 BOTTOM(8) (6)JOHTS	1 BOTTOM(8) (3),JORITS
MAIN BEAM	A BEAM

MAIN BEAM

. .

٠

	JOINT L	ISTING RE (NOT INCL	EQUIRIN JSIVE)	G REPAIR	{
BEAM #	BOTTOM	TOP	.BEAM #	BOTTOM	TOP
1			. 11		
1A			11A		
2			12		
2A			12A		
3			13		
3A			13A		
4			14		
4A			14A		
5			15		•
5A			15A		
6			16		
[•] 6A			16A		
7			17		
7A		·	17A		
8			18		
8A			18A		
9			19		
9A			19A		
10			20		
10A			20A		

ANGLE PEELING *

WF BEAM AROUND VERTEX TOUCHUP **

*** SMALL RUST SPOTS

	ANTENNA PAINT REPORT	NATIONAL RADIO ASTRONOMY DBSERVATORY		
		WORKSHEET		
	FB45H		anne ber	

ACAD LABEL: VLBAPAIT

