NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

VLBA Antenna Memo Series No.16

Mauna Kea Maintenance Visit, March 22 - 27, 1999 - Trip Report

J. E. Thunborg
April 6, 1999

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

The Mauna Kea maintenance team consisted of S. Aragon, R. Gutierrez, S. Tenorio, S. Troy, J. Thunborg and P. Ulbricht. The team worked at the Mauna Kea antenna from March 22 to March 27, 1999. The Site techs B. Hancock and T. Sylvester also worked very long hours toward the completion of the scheduled tasks.

The Servo Safety Tests were performed by the site techs prior to the arrival of the maintenance team. Unfortunately, there was an ice storm on Mauna Kea the night before the maintenance team arrived. We spent a good part of the morning waiting for the road to clear. When we finally did arrive on site, we found an antenna that was coated with approximately ½ inch of sheet ice. Since the platforms and stairs were unsafe to work on because of this ice, the team unloaded the truck and performed the few tasks that could be accomplished without climbing the antenna. The freezing weather persisted until the third day when the ice finally melted enough that we could safely climb to the elevation platform.

A crack by the elevation axle on the encoder side was repaired. This crack was similar to the ones we found on most of the other antennas. An additional possible crack on a HVAC side counterweight support tube was identified but could not be repaired because of the rainy weather conditions. The site techs have been instructed to keep an eye on this crack and look for signs of propagation. All of the azimuth bearing races except the inside #2 drive bearing were rotated 180 degrees. Platform extensions were installed on the antenna.

A hydraulic wrench was used to loosen 16 pintle bearing bolts. Dial indicators were then placed on the bearing and the antenna was rotated. There was no measurable vertical runout.

The antenna paint was inspected and is documented in the paint report. The paint on the subreflector and some of the dish panels is in very poor shape.

The DiChroic panel and ellipsoid actuator were checked using a laser and mirrors. The actuator was operated several times and always repeated. The center brace on the DiChroic panel was found to be damaged. This may have allowed the DiChroic to "oil can" causing the dual calibration as seen by the software guys. The DiChroic panel was replaced.

Several details were left uncompleted because of the severe weather. These details and their required follow-ups are listed below.

1. The elevation hard stops were not installed. The stops were left on site and will be installed during the next tiger team visit.
2. Some paint on the elevation platform was removed to facilitate installation of the platform extensions. The paint needs to be touched up. The site techs will accomplish this task during scheduled maintenance periods.
3. The inside drive #2 bearing race was frozen in place and could not be rotated. No further action required.
4. The elevation bearing kick plates were welded in place but need touch up paint. The site techs will accomplish this task during maintenance periods. The site techs will accomplish this task during scheduled maintenance periods.
5. Need to install automatic drain valve in contempo A. The site techs will accomplish this task during scheduled maintenance periods.
6. The inside elevation bearing grease trays were not installed. The site techs can install these trays if they want them before the next tiger teams visit. These grease trays are not as necessary at Mauna Kea because the grease does not flow out of the bearings like it does at locations with warmer climates.
7. The bolts on the donut and quad legs, backup structure, gear sector and panels were not checked.
8. The elevation and pintle bearings were not greased. The site techs should be careful to put a little extra grease in these bearings during their next PM.
9. The ellipsoid cables need to be protected from UV radiation either by installing in conduit or by burying in the vertex cone insulation. A work order was submitted for this task.
10. The main reflector panels were not painted.
11. Insulation on the support tubes needs repair. Materials were left on location for the site techs. The site techs will accomplish this task during scheduled maintenance periods.
12. There were some small holes in the HVAC side elevation bearing platform that need repairing. This will be repaired during the next tiger team visit.
13. The winch pipe was not inspected to insure that it was not weakened during the previous hoist modifications.
14. There were some holes in the feed cone insulation that needs repair. The site techs will accomplish this task during scheduled maintenance periods.
15. The feed mounting hardware was only briefly inspected.
16. Elevation counterweight balance measurement was not performed. This should be accomplished during the next tiger team as the balance may have been adversely effected by the addition of the quad leg ice protection.
17. Water was pooling up on the structure above the azimuth wheels. Drain holes should be drilled in these pockets using a magnetic drill during the next tiger team visit.

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

1. Drive Motors - brakes, couplings, commutators and brushes. All of the spider couplings were replaced. Steve Tenorio reported that the site techs have kept the drive motors in "cherry" condition. A very good job by the site techs.
2. Servo system - Complete checkout per servo shop checklist.
3. Lightning protection - cables, straps and grounding.
4. Take Grease samples from elevation, azimuth and pintle bearings
5. Control building Contempo upgrade.
6. HVAC inspections per detailed checklist.
7. Utilities - Water, Sewer and Propane System (if exists)
8. FRM - per detailed checklist.
9. Subreflector.
10. Ellipsoid and DiChroic inspections

11. Quad legs and guy wires.
12. Anemometers
13. Swinging platform.
14. Elevation platform extensions.
15. Condenser platform toe guard.
16. Bearing Inspections - Azimuth, Pintle and Elevation.
17. Gearbox - Azimuth and Elevation. Elevation gearbox #1 was opened up and the internals were inspected. It was found to be in good condition.
18. Paint Inspection - Complete Hancock paint report.
19. Rail inspection and level measurement.
20. Antenna structure - Cracks, loose bolts
21. Antenna electrical inspections - Per detailed checklist
22. Station building electrical inspections - Per detailed checklist
23. Other electrical inspections - generator, weather station and ground.
24. Replaced pedestal room air conditioner
25. Check sensor cards.
26. Checked pintle bearing pocket flatness.

The following non-scheduled items were also completed.

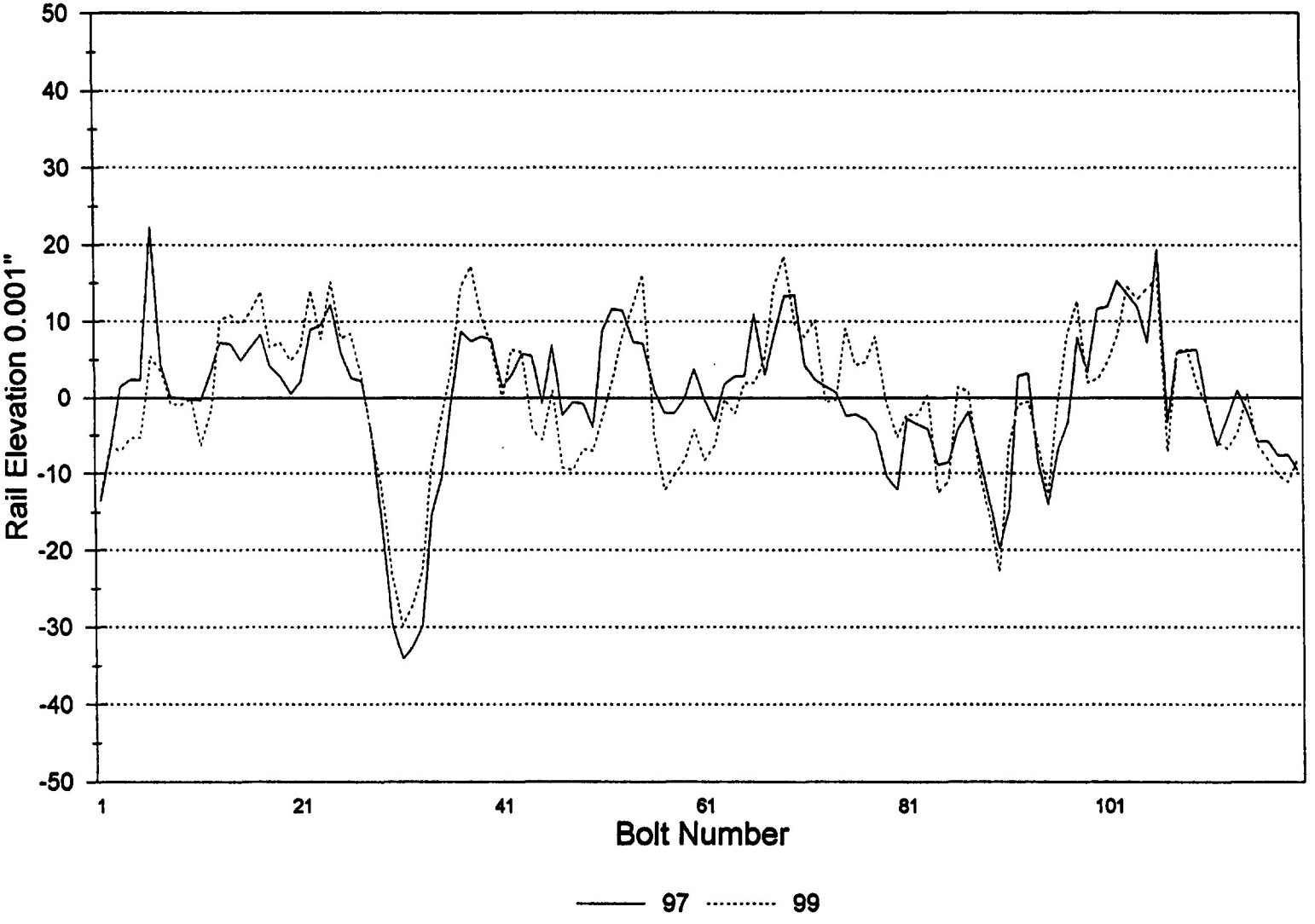
1. Sealed small J-boxes where smoke detector wires go though wall. Water was accumulating in the j-boxes.
2. Replaced Lovejoy couplings on all drive motors
3. Tightened cable wrap rollers
4. Replaced 6 cm feed window.
5. Install Internet Camera
6. Replaced the DiChroic reflector.
7. Repaired faulty ACU ESI board monitor test jack.
8. Repaired broken lightning protection ground cable.
9. Installed new batteries in maser.
10. Replaced D-Rack blower

The condition of the paint is as follows:

The lower backup structure shows very little rust but the second layer of paint is peeling like an onion. The first layer of paint seems to be holding up very well. Rust is beginning to leach through the paint on the counterweights. There are numerous 2-6 inch spots where the paint has chipped of the primary reflector backup structure. This is not a structural problem but it is not very aesthetic. The paint is peeled to the 50% level on 4 primary reflector panels and 10% peeled on 6 others. The paint on the subreflector is very thin. Because of this the subreflector is almost brown in appearance.

MK Azimuth Rail

Comparison 1997 to 1999



To: Jon Thunborg
Subject: Mauna Kea Maintenance Trip
From: Pete Ulbricht

Electronics Report

I worked with Steve Troy in the Station Building for the first two days. I removed the Mark II cables under the floor in rooms 103 and 104 to make room for the contempo temperature sensor to go through the bulkhead. I ran the Vertex Room DDC control cable down through the spare MCB cable and through the Room 103/104 bulkhead into Room 103. I mounted the humidity sensor and the temperature sensor and cabled them into the DDC controller on the modified Contempo. I then ran a control cable from the DDC into Room 103 to be tied into the computer to run PCTool for monitoring both the Contempo DDC and the Vertex Room DDC.

I replaced the D-Rack blower unit under the floor with a new unit equipped with tubes to allow lubrication of the bearings without removing and disassembling the unit.

I checked all the Junction Boxes in the building with the Infrared Thermometer and found loose conections in the Fire Alarm Box and the UPS Bypass Switch Box. I tightened all loose connections. I found an old phone number on the Chatterbox and had Tony reprogram it.

I checked out the Weather Station to use the tower to mount the video camera. The conduit under the Weather Station was filled with expanding foam, which made it impossible to run the cables from the camera to the monitor in the building. I decided to mount the camera out by the front gate. Steve Aragon welded two sections of pipe together and installed fittings at the top and bottom of the pole to run the cables from the camera inside the pipe and through some liquidtight conduit into a box next to the Transformer. We ran power and coax from there over to the building. The coax ran through existing conduit into the attic, through a bulkhead plate clamped to the RF screen, through the Room 100/103 bulkhead, and over to the monitor. We wired the power to the camera to a switch at the base of the camera pole. Bill Hancock installed the Snappy board into the PC.

Bill and I installed the new batteries in the Maser. I put two perforated panels under the Maser as per Steve Troy's instructions.

Steve Tenario and I traced a smoke detector problem to the vertex room bulkhead feedthru. We found two of the three boxes had water in them. We dried them out and sealed them with RTV.

I helped Steve Troy terminate wires in the Ped Room Air Conditioner installation.

I was concerned with the stiffness of the FRM mount. Although it ran smoothly, it was much harder to move in rotation with the brakes off than any of the other sites. We ran some tests on it, and found that it got a little better after running it from end to end several times. Bill had some data taken in 1995 which matched our results----so I don't think the stiffness or tightness of the FRM is a new thing. We may be dealing with a

temperature related problem.....once the unit is run and warmed up a little, it's performance seems to improve.

The Pintle Bearing Room was in pretty good shape. The rollers at the bottom of the cablewrap were loose. We left them a spare hatch cover.

I also left a spare anemometer cup to be installed when the ice stops forming.

Bill and Tony were a big help to the Maintenance Team during the week. They worked on many tasks with the team, and were always there to lend a hand.

interoffice MEMORANDUM

To: List

From: Steve Tenorio

Subject: Trip report VLBA Mauna Kea

Date: 20mar99

20mar99	Day # 1	Travel to L.A. from Alb.
21mar99	Day # 2	Travel from L.A. To Kona.
22mar99	Day # 3	Emptied container. Drilled holes in container and installed ramp. Completed drive cabinet pm. Checked power cabinets with I.R. Thermometer.
23mar99	Day # 4	Completed A.C.U. pm. Checked grounding system in ped. Room. Checked brake torque on motors. Tried to check current on gear Box heaters. Couldn't get current meter to work. Helped ant. Mechanics turn races on Az. Wheels.
24mar99	Day # 5	Completed Az. And El. Motor pm's. Helped ant. Mechanics install El. Platform extensions. Unwired el. Platform j-box, warning horn, And E-stop so we could remove old handrail.
25mar99	Day # 5	Started servo test. Found bad E.S.I. board. Monitor test jack wouldn't null, swapped E.S.I. board monitor jack worked fine. Tony repaired original E.S.I. board and I re-installed it. Moitor Worked fine.continued with servo test.
26mar99	Day # 6	Installed El. Platform j-box on new handrails. Rewired E-stop and warning horn. Helped Aragon check El. Gear box # 2. Measured

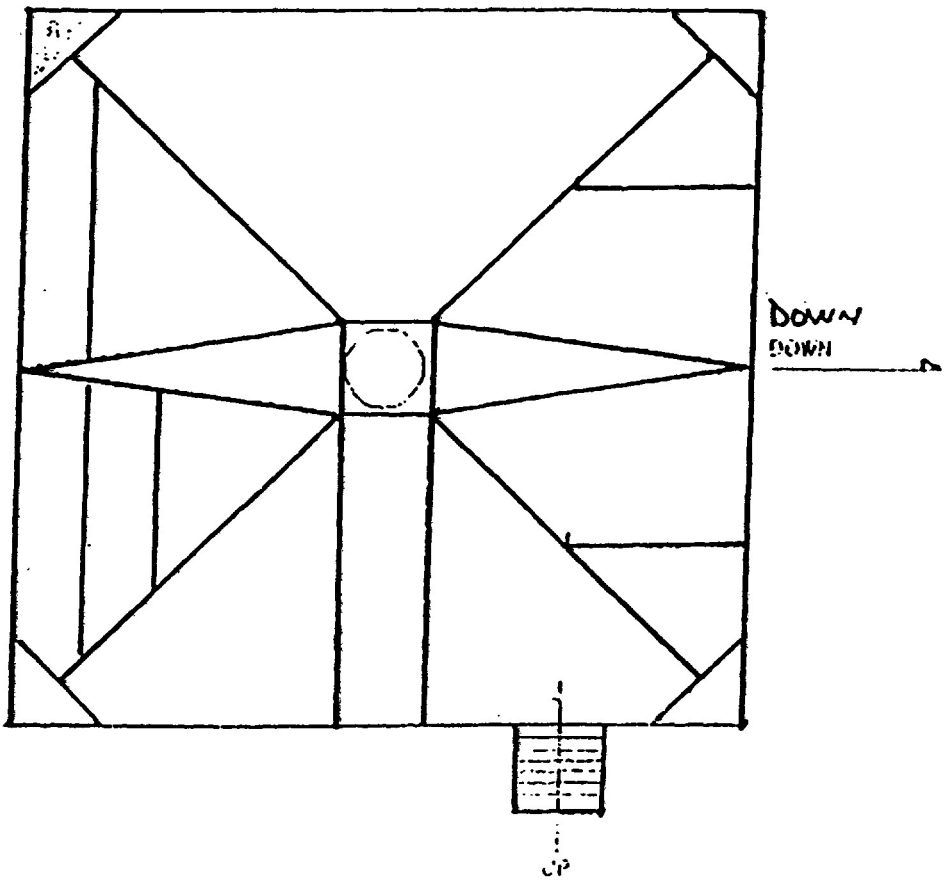
		El. Limits. Sealed Az. Motors and blowers with rtv. Checked Az. Limit switches and cable wrap. Tightened rollers and lubed them.
		Greased Az. Wheels.
27mar99	Day # 7	Helped ant. Mechanics fill El. # 2 gearbox with oil. Replaced ty-raps on El. Motors. Fixed broken grounding cable on Encoder platform. Helped Aragon install pedroom AC for Troy. Finished encoder -vs- synchro checks.
28mar99	Day # 8	Worked on smoke detector problem on antenna. Found water was getting into small j-boxes where smoke detector wires go through wall. Dried out j-boxes and sealed them with rtv. Helped load container.
29mar99	Day # 9	Traveled back to Alb.
30mar99	Day # 10	Continued travel back to Alb.

Conclusions:

The antenna in Mauna Kea is in real good shape. Bill and Tony are keeping up with everything as far as the servo system goes, no major problems.

AZIMUTH LEVEL PAINT CONDITIONS — HNT DATE:

VIEW FROM SKY PERFORMED BY:



THE SECOND COAT of PAINT is PEELING IN NUMEROUS PLACES. FIRST COAT SEEMS TO be holding up. SECOND COAT IS JUST PEELING LIKE AN ONION.

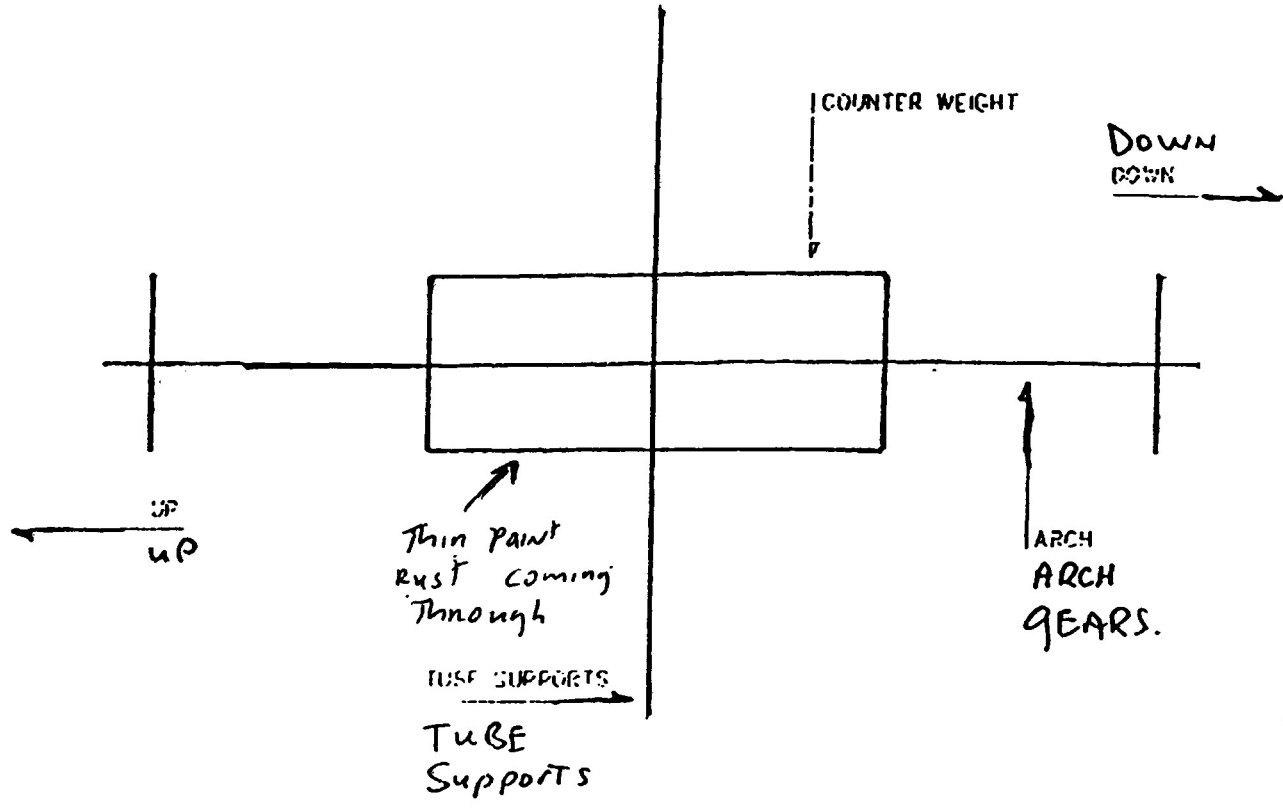
SYMBOL KEY
SURFACE AREA DEGRADATION
■ RUST □ NO RUST
SPLICE PLATE DEGRADATION
● RUST ○ NO RUST
WELDED SEAM DEGRADATION
RUST NO RUST
T=TOP, B=BOTTOM, S=SIDE
⚒ =PREVIOUSLY REPAIRED

COUNTERWEIGHT PAINT CONDITIONS

DATE:

VIEW-FROM-SKY-

PERFORMED BY:



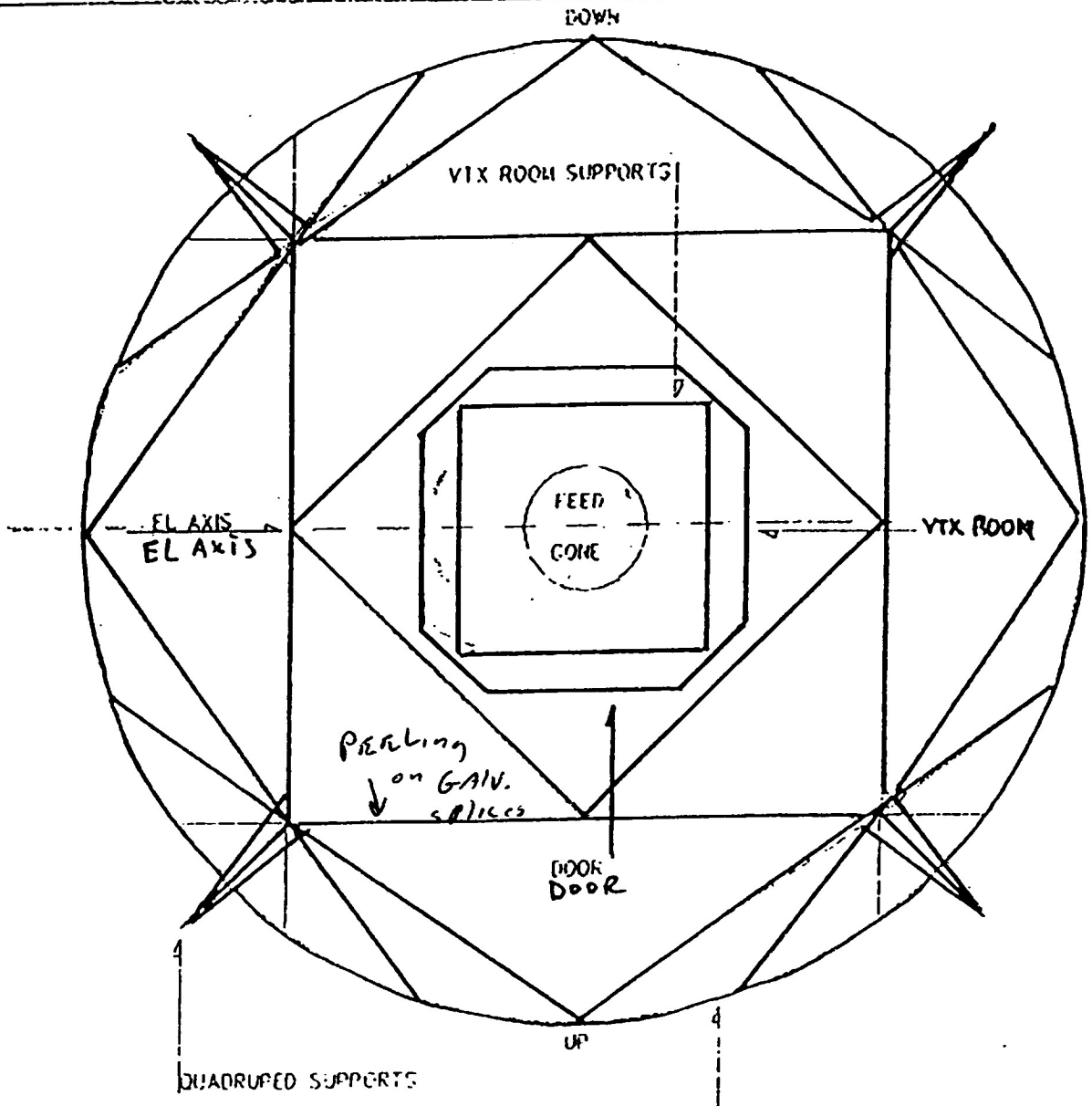
Counterweights very rusty.

Paint on elevation platform needs to be touched up after welding

SYMBOL KEY
SURFACE AREA DEGRADATION
■ RUST □ NO RUST
SPLICE PLATE DEGRADATION
● RUST ○ NO RUST
WELDED SEAM DEGRADATION
RUST NO RUST
T=TOP, B=BOTTOM, S=SIDE
✳ =PREVIOUSLY REPAIRED

VERTEX LEVEL PAINT CONDITIONS AS OF [illegible] DATE:

VIEW FROM SKY [illegible] PERFORMED BY:



PAINT on The CAVITIES is PEELING of GALVANIZED SPLICES

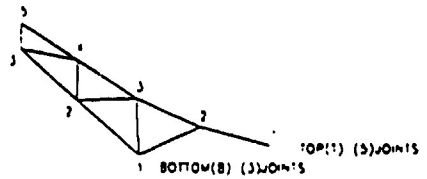
SYMBOL KEY

SURFACE AREA DEGRADATION
RUST NO RUST

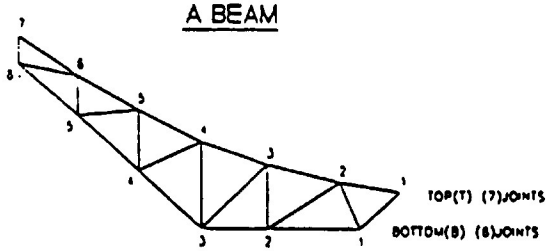
SPLICE PLATE DEGRADATION
RUST NO RUST

WELDED SEAM DEGRADATION
RUST NO RUST

T=TOP, B=BOTTOM, S=SIDE
X =PREVIOUSLY REPAIRED



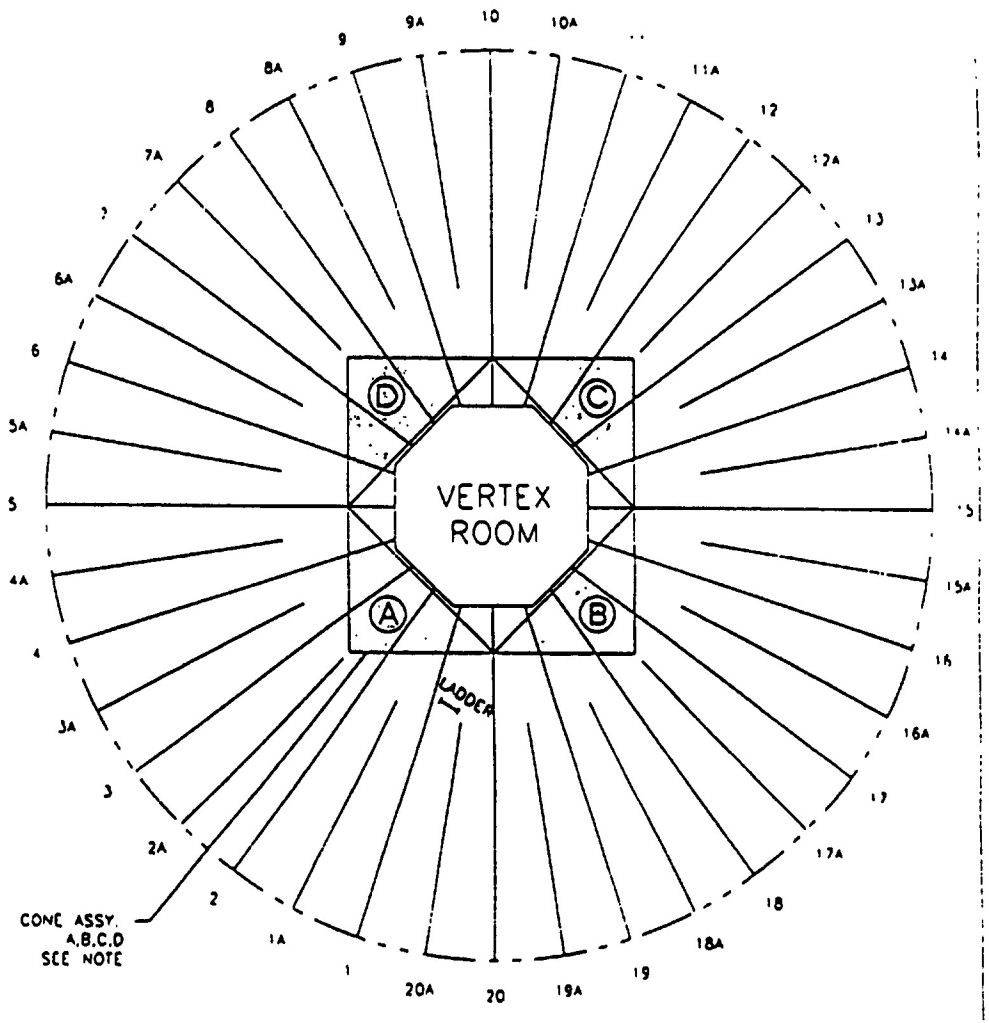
A BEAM



MAIN BEAM

JOINT LISTING REQUIRING REPAIR
(NOT INCLUSIVE)

Numerous 6" peels with Rust. Not structurally a problem but very ugly.



* ANGLE PEELING
** WF BEAM AROUND VERTEX TOUCHUP
*** SMALL RUST SPOTS

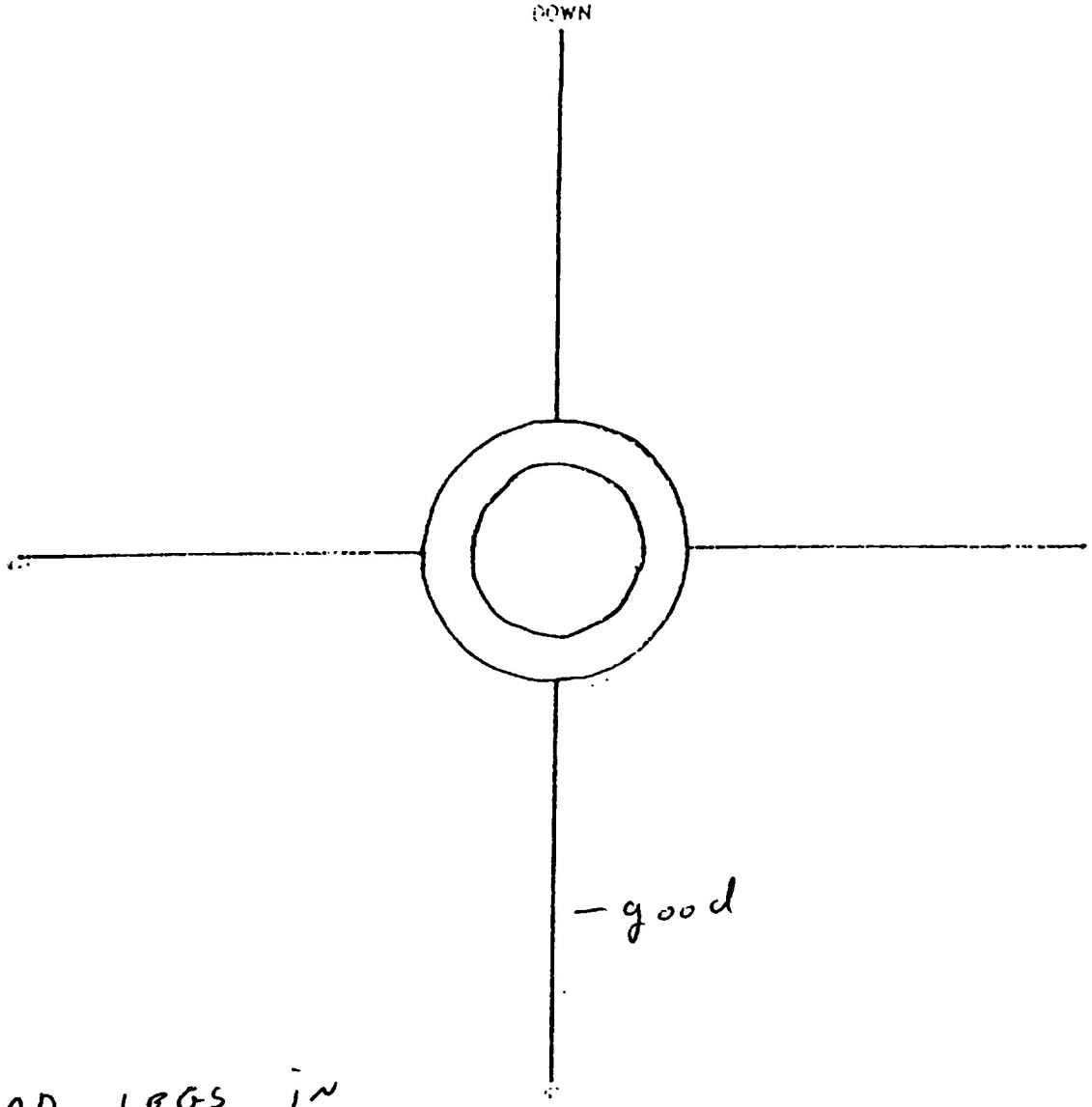
NOTE: INSPECT CONE ASSY INTERNALLY REPAIR/PAINT AS REQUIRED

ABFI VLBAPAII

NRAO	UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES MATERIAL FINISH	VLBA HANCOCK PAINT REPORT LOCATION OF DELAMINATIONS	NATIONAL RADIO ASTRONOMY OBSERVATORY C. GARCIA

QUADRUPED PAINT CONDITIONS DATE

VIEW FROM SKY PERFORMED BY

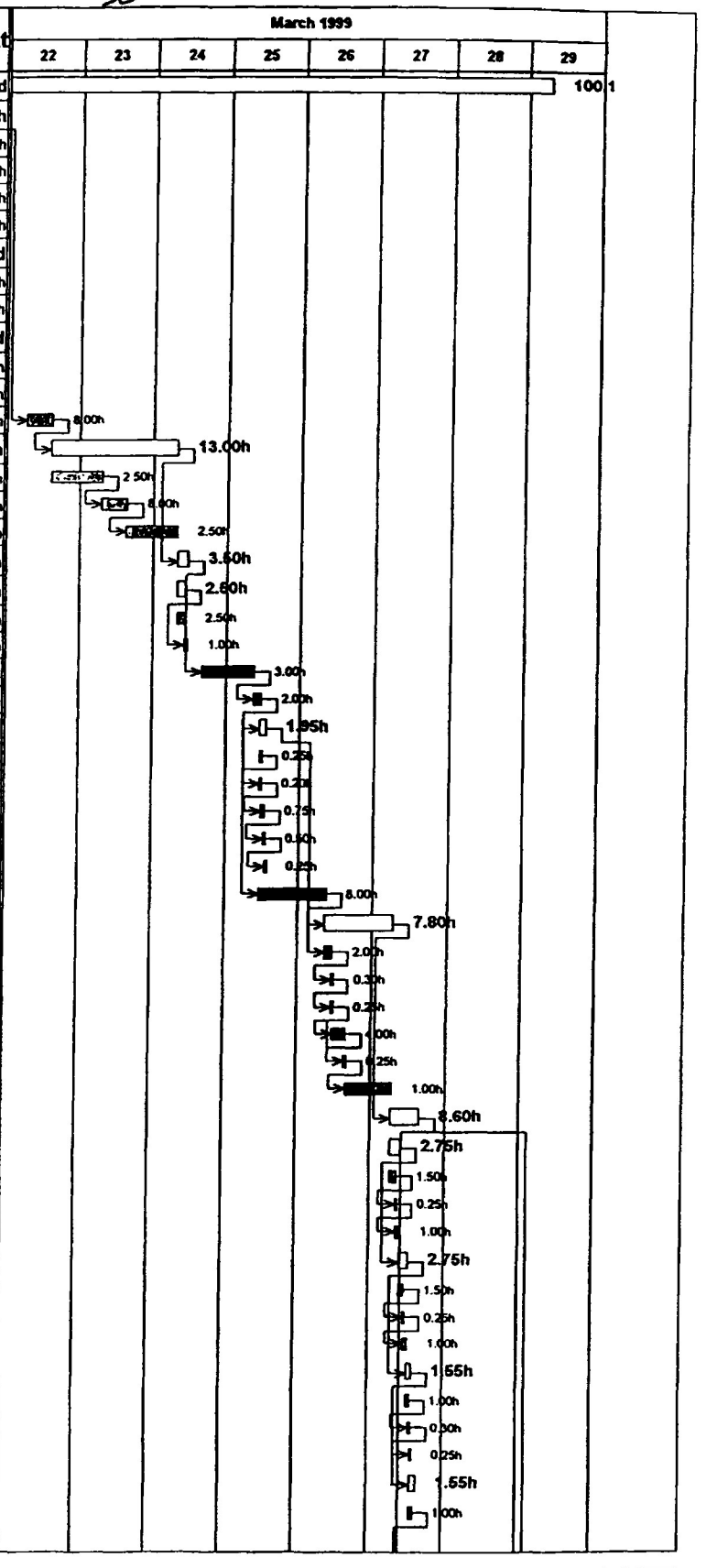


QUAD LEGS IN good condition.

KEY
SURFACE AREA DEGRADATION
PLATE DEGRADATION
BOTTOM, SIDES
PREVIOUSLY REPAIRED

1999 VLBA Tiger Team Maintenance
Task Listing for MK, ~~AR~~ SC, HN

Task Name	Resources	Durat
SERVO		10.02d
SAFETY TESTS	Site T 1, Site T 2	2.00h
MULTIPLE FAULT STATUS		0.10h
MANUAL MODES TEST		0.20h
INDIVIDUAL FAULT STATUS		0.20h
REMOTE BOX TESTS		0.50h
AZ Travel Limit Switch Tests		0.05d
AZ Clockwise tests		0.25h
AZ Counter-Clockwise tests		0.25h
EL Travel Limit Test		0.05d
Elevation up tests		0.25h
Elevation down tests		0.25h
BRAKE HOLDING-TORQUE TESTS	Servo T, Site T 1	8.00h
Motor Inspections	Servo T, Site T 1	13.00h
Motor and Tach Couplings		2.50h
Drive motors wiring orientation		8.00h
Commutator & Brush Inspection		2.50h
Servo PM	Servo T, Site T 2	3.50h
Drive Cabinet PM		2.50h
Rewire Lockout Switch		2.50h
ACU PM		1.00h
INSPECT ANTENNA POWER PANELS	Servo T, Site T 2	3.00h
INSPECT GEARBOX HEATERS	Servo T, Site T 2	2.00h
Lightning Grounding	Servo T, Site T 2	1.95h
EL Bearing Ground Cables		0.25h
EL Motor Platform to Pintle Turret		0.20h
Pedestal Room Grounding		0.75h
AZ Wheel Ground Straps		0.50h
Pintle Bearing Room Grounding		0.25h
EL encoder inspection		8.00h
Detailed Test	Servo T, Site T 1	7.80h
System and Axis Faults		2.00h
Motor Fault Status		0.30h
Measure EL Velocity		0.25h
EL counterweight balance measurements		4.00h
Measure AZ Velocity		0.25h
Record 1st Limits EL/AZ		1.00h
Recordings	Servo T	8.60h
EL System Response Test		0.28d
Implement test setup		1.50h
Calculate acceleration		0.25h
Locked rotor resonance, AZ/EL		0.10d
AZ System Response Test		0.28d
Implement test setup		1.50h
Calculate acceleration		0.25h
Locked rotor resonance, AZ/EL		0.10d
AZ Position Loop Tests		0.16d
Small signal step response		1.00h
Large signal step response		0.30h
Single motor step response		0.25h
EL Position Loop Tests		0.16d
Small signal step response		1.00h

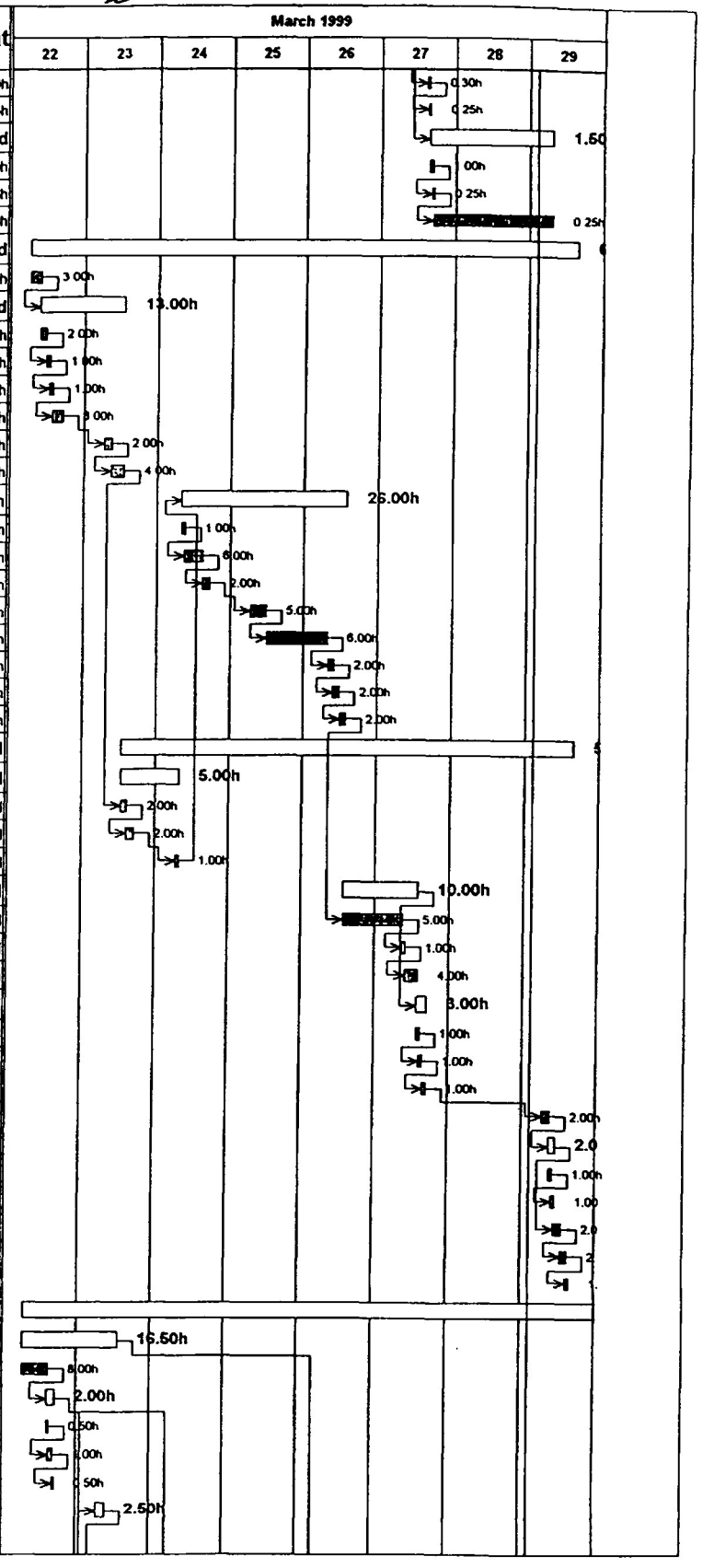


Milestone △ Summary

Fixed Delay — — — Slack .....

1999 VLBA Tiger Team Maintenance
Task Listing for MK, ~~NL~~ SC, HN

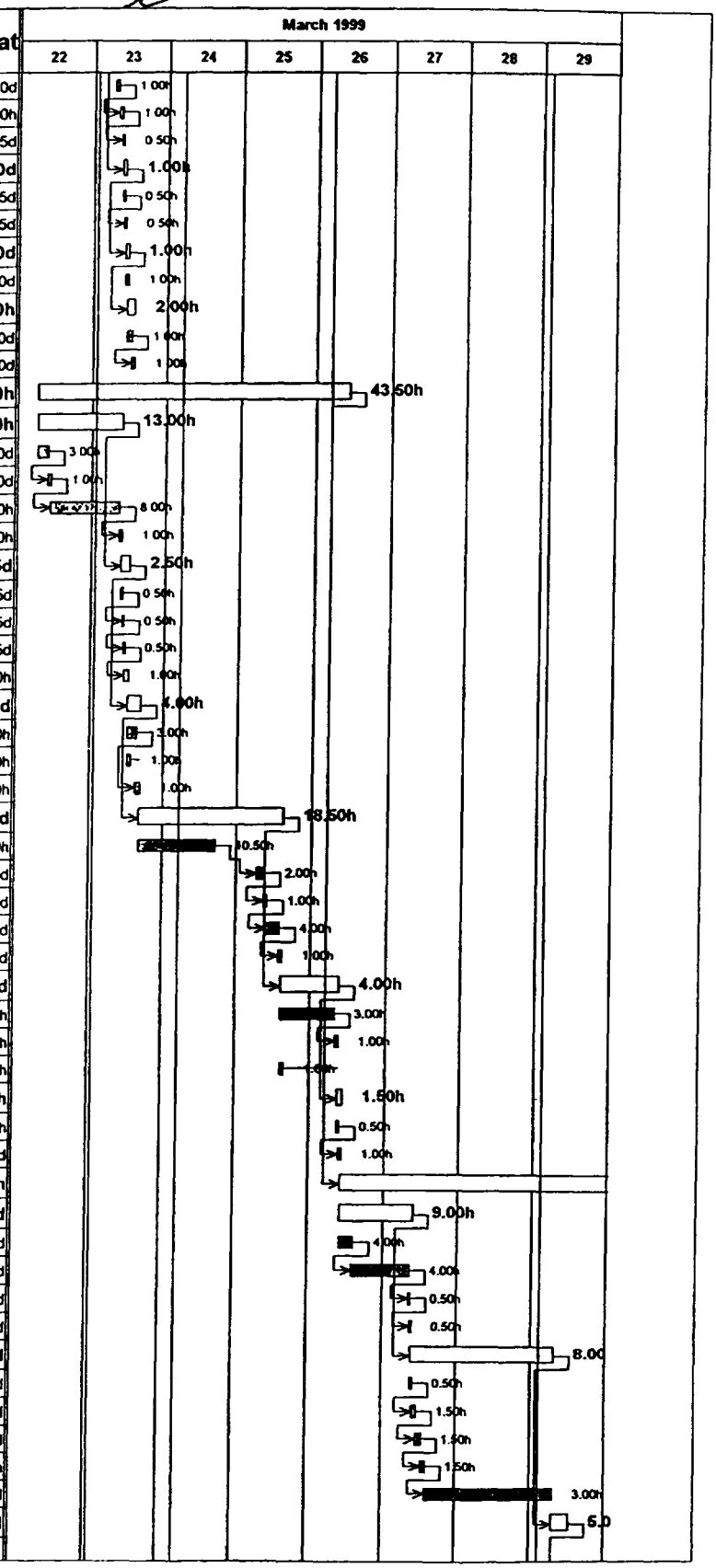
Task Name	Resources	Durat
Large signal step response		0.30h
Single motor step response		0.25h
Auto Modes Test	**Servo T, Site T 1,**	**0.16d**
Check stow commands		1.00h
Synchro feedback operation		0.25h
Test AUI COMM DEAD		0.25h
HVAC PM AND UPGRADE	**HVAC T**	**6.90d**
Check or replace Pedroom A/C		3.00h
Vertex Room A/C Upgrade		**1.30d**
Reclaim refrigerant from system		2.00h
Install head pressure control valve		1.00h
Remove existing evaporative coil		1.00h
Install new coil assembly		3.00h
Evacuate and recharge system		2.00h
Air flow measurements & adjustments		4.00h
Contempo Unit B(2) Upgrade		**26.00h**
Reclaim refrigerant from unit		1.00h
Install refrigerant valves		6.00h
Evacuate and recharge system		2.00h
Install DDC		5.00h
Install SCR's and Controllers		6.00h
Install sensors		2.00h
Install enuciator interface		2.00h
Caliibrate sensors and SCR controllers		2.00h
HVAC/Plumbing PM & Inspections		**5.30d**
Vertex Room A/C		**0.50d**
PM/inspect condensor unit		0.20d
PM/inspect air handler		0.20d
System operational checkout		0.10d
Control Building Contempo Sys	**Site T 1**	**1.00d**
PM/inspect indoor units		0.50d
PM/inspect outdoor units		0.10d
System operational checkout		4.00h
Lab A/C Unit	**Site T 1**	**0.30d**
PM/inspect indoor unit		0.10d
PM/inspect outdoor unit		0.10d
System operational checkout		0.10d
Water & sewer PM/inspection	HVAC T, Site T 2	0.20d
Propane System PM	**HVAC T, Site T 2**	**0.20d**
Check for schedule 80 spec pipe		1.00h
Check for hydrostatic relief valve		1.00h
Contempo ops/maint training	HVAC T, Site T 1, Site	0.20d
VR sys ops/maint training	HVAC T, Site T 1, Site	0.20d
Lab A/C ops/maint training	HVAC T, Site T 1, Site	0.10d
ANTENNA MECHANICAL		**7.95d**
MECHANICAL TEAM 1	**Ant M 1, Site T 1**	**16.50h**
FRM Inspection/PM		8.00h
Subrefector		**0.20d**
Check for peeling, delamination		0.50h
Check spider bolts, backside,etc		0.10d
Check Donut Bolts		0.50h
Feeds & Dichroic		**0.25d**



Milestone △ Summary
Fixed Delay — — — Slack .....

1999 VLBA Tiger Team Maintenance
Task Listing for MK, ~~BR~~ SC, HN

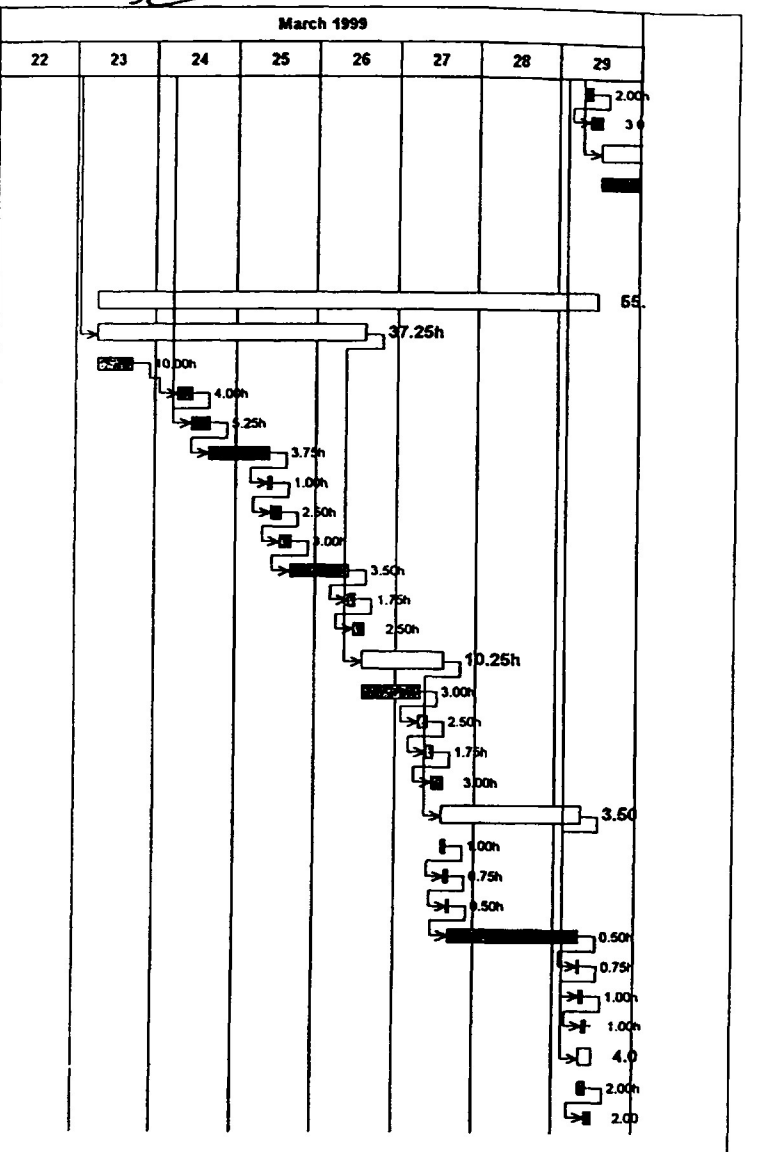
Task Name	Resources	Durat
Inspect feeds,mounts,htrs,etc		0 10d
Replace C-band feedhorn window		1.00h
Inspt dichroic reflectr, panel		0 05d
Quad-Legs Guy Wires Etc..		**0.10d**
Inspect guywires & turnbuckles		0.05d
Inspect quadleg flange bolts		0.05d
Lightning Protection/Anemometer		**0.10d**
Inspt mounts/chk operation		0 10d
Bull/Pinion Gears		**2.00h**
Inspt bull/pinion gears		0.10d
Lub El brgs, bull gears as req		0.10d
MECHANICAL TEAM 2	**Ant M 2, Team L**	**43.50h**
Elevation/Hoist/Swing Platform Work		**13.00h**
Instl hoist safety mods, checkout winch, etc		0.30d
Checkout swinging platform		0.10d
Extend EL motor platform		8.00h
Instl condensor platform toe guard		1.00h
EL Bearing Inspection	**Site T 2**	**0.25d**
Inspect EL bearings internals		0.05d
Inspect EL bearings lip seals		0.05d
Clean off excess grease		0.05d
Install El bearing grease trays		1.00h
EL Motors & Gearboxes	**Site T 2**	**0.40d**
Internal gear inspection		3.00h
Exchange drive motors		1.00h
Inspect pmps, seals, couplings		1 00h
AZ Wheels & Bearings	**Ant M 1, Site T 2,**	**1.85d**
Rotate outer races on Az wheel bearings		10.50h
Check wheel to struct clearances		0.20d
Check axle bolt tightness		0.10d
Pillow block brgs-open & clean		0.40d
Lubricate & take sample as req		0.10d
AZ Motors & Gearboxes	**Site T 2**	**0.40d**
Internal gear inspection		3.00h
Inspect pumps, seals, couplings		1.00h
Install grease fitting on #2 motor bearing		1.00h
Paint & Insulation Inspection	**Site T 2**	**1.50h**
Inspect ant paint and report		0.50h
Inspect ant insulation		0.10d
ANT. MECHANICS	**Ant M 1, Ant M 2**	**36.00h**
Pintle Bearing		**0.90d**
Instl grease catcher and zurcs		0.40d
Inspect seals, check pocket level & for loose bolts		0.40d
Lubricate bearing as needed		0.05d
Take grease samples as needed		0.05d
AZ Rail Inspection		**0.80d**
Inspect ant foundation		0.05d
Inspect for rail movement		0.15d
Inspect joint bars & clips		0.15d
Move ant, chk rail movement		1.50h
Rail level measurements		0.30d
Dish Surface & Panels	**Site T 1, Site T 2**	**0.50d**



Milestone △ Summary
Fixed Delay — — — Slack .....

1999 VLBA Tiger Team Maintenance
Task Listing for MK, ~~NL~~ SC, HN

Task Name	Resources	Durat
Check distortion, shifting, etc		0.20d
Check all panel bolts-looseness		0.30d
Structural	**Site T 1, Site T 2**	**1.40d**
Install EL hard stops		8.00h
Check ant structural bolts		2.00h
Inspect ant structural welds		0.20d
Inspt ant backup/lower struct		0.20d
ELECTRONICS	**Elect. T**	**55.00h**
Antenna Maintenance & Inspections		**37.25h**
Cryo sensor card upgrade		1.00d
Install feed heaters		4.00h
Apex/FRM inspections	Site T 2	5.25h
Feedcone/Receiver system inspections		3.75h
Replace receivers that have faulty sensors		1.00h
Vertex Room/Racks & cable inspections		2.50h
B-rack modification for 3mm receiver		3.00h
Vertex to pintle bearing inspection		3.50h
Inspect pintle bearing rm bulkhead, cablewrap, etc.		1.75h
Inspect pedroom UPS, FRM controller, dry air sys, et		2.50h
Station Building Inspections		**10.25h**
Rm 100 - Check electrical, UPS and test operation		3.00h
Rm 103 - Chatter/supervisory boxes, alarms, etc		2.50h
Rm 104 - Bulkhead, underfloor, maser, etc		1.75h
Check tools, test equip, manuals, wtr sys, UIS, etc		3.00h
Outside Building and Misc. Inspections		**3.50h**
Run and inspect site generator		1.00h
Inspect weather station		0.75h
Check gates. fence, signs, grounds, etc		0.50h
Inspect lightning protection for antenna & bldg		0.50h
Check safety items/hazmat storage, etc.		0.75h
Spot check critical PM's		1.00h
Review problems areas with Site Techs		1.00h
FINAL INSPECTIONS	**Elect. T, Site T 1,**	**4.00h**
Site Inspections for Oversights		2.00h
Station Startup Verification Tests		2.00h



Milestone △ Summary
Fixed Delay — — — Slack .....