

**National Radio Astronomy Observatory**  
Socorro, NM

VLBA Antenna Memo Series #25

**North Liberty Maintenance Visit**  
April 14<sup>th</sup> through 19<sup>th</sup>, 2000  
Trip Report

Jim Ruff  
05/17/2000

**Attachments:** Azimuth rail survey, Servo trip report, Electronics trip report, and Task schedule.

The team consisted of Dave Alderman, Steve Aragon, Tom Baldwin, Ramon Gutierrez, Bob McGoldrick, Steve Troy and Jim Ruff. Site techs D.J. Beard and Mike Burgert assisted throughout.

Two azimuth bearings were replaced: Outer drive #1 And outer idler #2. The drive bearing showed severe thrust failure. (Figure 1) The idler bearing had pitting in its outer race. The outer races of the remaining azimuth bearings were rotated 180°. There were outer ring spacers in all eight azimuth pillowblocks. We left the spacers out of the pillowblocks in which bearings were replaced.



**Figure 1: Failed Azimuth Bearing**

An apex handrail was installed.

The elevation hoist drum switch was badly corroded and replaced. (Square D #2601AW2 is an acceptable substitute for OEM Furnas WR44.) A spare switch has been added to the container.

The pintle bearing pocket was inspected for flatness. Measured TIR was 0.0008”.

The pintle hatch cover was replaced with Lexan.

Elevation bearing grease catchers will be sent to the site techs for installation.

The INA bearing in the FRM was tested for excessive internal clearance. The clearance measured 0.004”.

The gearbox heaters were inspected. Three of the enclosure covers were very hard to remove, the fourth (inside elevation) could not be removed at all. The three thermostats we were able to inspect were severely corroded but appeared to function properly. (Figure 2) Weep holes were drilled in the three enclosures we opened. Three new heater assemblies (all that were available) were left at the site for replacement during the next gearbox oil change. In the future, we will drill weep holes in these enclosures and apply Nevr-Seez to the cover threads. Note that the Chromalox thermostat, costing \$180, can be replaced with Grainger #2E552 for \$30. A spare thermostat has been added to the container.



**Figure 2: Gearbox Heater**

The dichroic panel is delaminated in the corners. (Figure 3)



**Figure 3: Dichroic Panel**

The azimuth rail grout is failing in an area on the southwest side. (Figure 4) This should be monitored and repaired on the next tiger team visit, or sooner if warranted. See page 6 for more on the azimuth rail.



**Figure 4: Grout Failure**

The antenna structure paint was in good overall condition, but had flaked off in several areas. (Figures 5-11) The subreflector, feed cone, and main dish panels were stained black. (Figures 12-15)

Please refer to the attached task list for a complete list of what was done.



**Figure 5: Quad Leg**



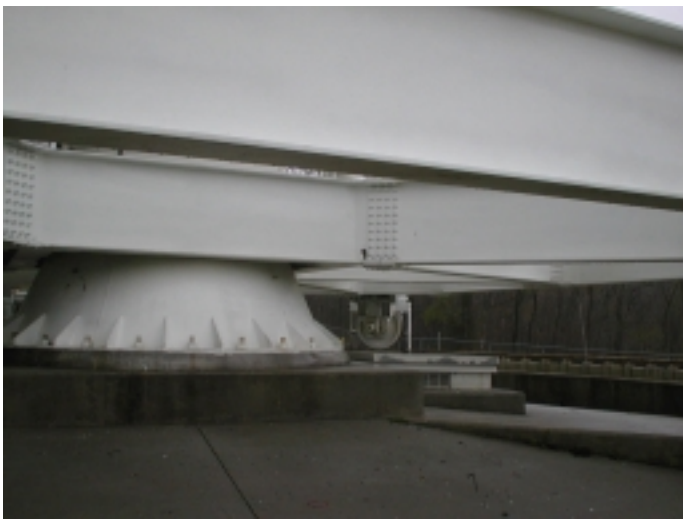
**Figure 8: Bull Gear**



**Figure 6: Pedestal Structure**



**Figure 9: Elevation Bearing Area**



**Figure 7: Pedestal Structure**



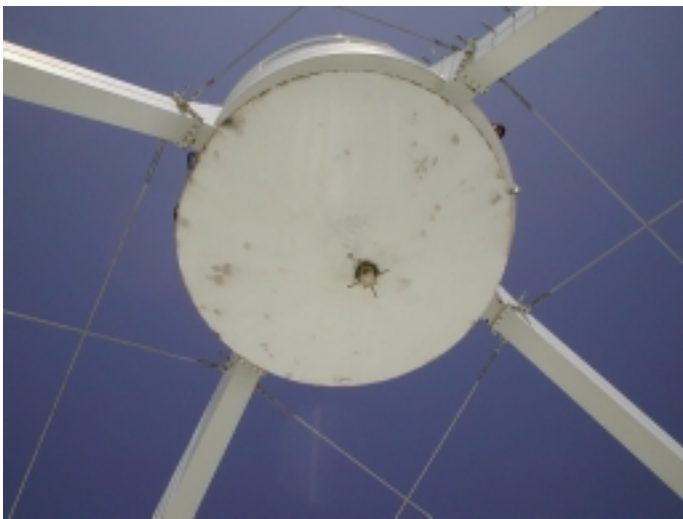
**Figure 10: Backup Structure**



**Figure 11: Elevation Axle Area**



**Figure 14: Main Dish**



**Figure 12: Subreflector**

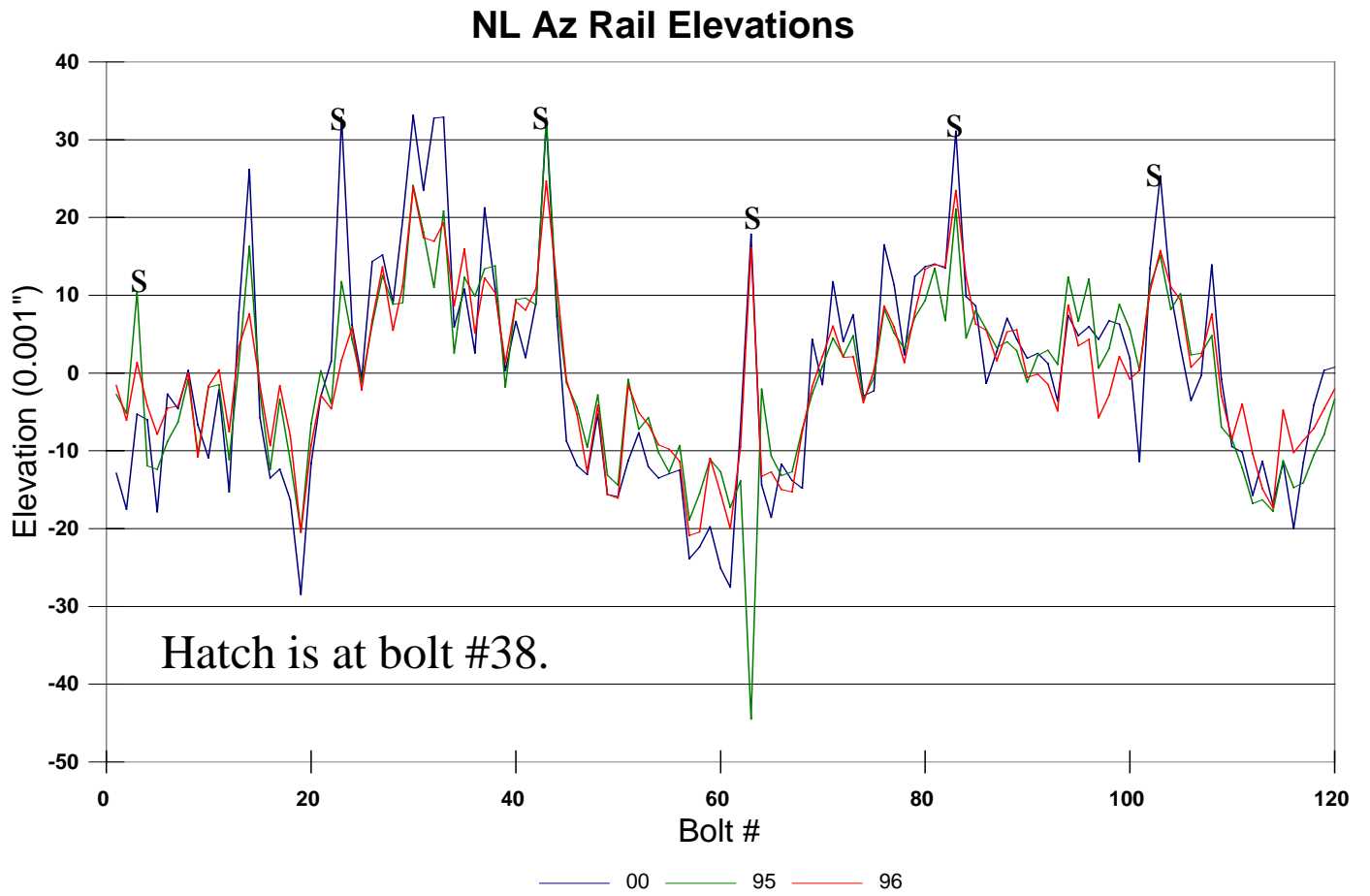


**Figure 15: Main Dish & Feed Cone**



**Figure 13: Feed Cone**

Note apparent grout failure at bolt #15. The splice at bolt #23 may also be failing. Other spots to check are bolts 30-35 and splices at 83 and 103.



N.L. Tiger Team

## **Servo Trip Report**

Dave Alderman

4/13/00

Travel to North Liberty site

4/14/00

Removed el e-stop, j-box, and warning horn for platform mod.

Replaced one motor j-box. (stainless steel)

Rotated races.

4/15/00

Replaced other three motor j-boxes

Started Servo PM

4/16/00

Finished j-boxes.

Replaced wheel bearing

4/17/00

Servo PM

Az #1 brushes needed to be replaced.

Az#2 commutator need to be dressed, brushes where serviceable.

Servo test.

4/18/00

Changed wheel bearing.

Greased el bearings.

Started picking up.

4/19/00

Greased az wheel bearings.

Greased pintle bearing.

Did counter weight test.

Finished servo test.

4/20/00

Travel from N.L. to San Acacia

May 12, 2000

To: P. Rhodes

From: Thomas Baldwin

Subject: North Liberty Maintenance Visit April 10 - April 20: Electronics Report

The overall condition of the North Liberty Station is very good. A tremendous amount of preventative maintenance was accomplished, and only a few minor problems were revealed during the North Liberty Maintenance Team visit. Many of the problems were corrected, but there are a few items that were left for the Station Technicians to correct.

Both Station Technicians were deeply involved with all maintenance activities during the visit. This was a tremendous help in completing all the planned work. Most of the completed work listed below involved the Station Technicians. They are aware of all the incomplete items listed below.

The Electronics Division members of the team were Bob McGoldrick and myself.

The following is a list of items inspected, repaired or to be repaired at North Liberty.

#### ACTIONS COMPLETED

1. The Electronics Inspection Sheet was completed. This is an FRM to Station Building electronic inspection.
2. DJ cleaned the supply air screen to room 103. The screen was clogged with dust.
3. Installed new RH sensor over the recorders for Contempo control of humidity.
4. Installed new thermistor under the Maser for Contempo temperature control.
5. Installed DDC communication cable from Contempo to room 103.
6. Removed sheet rock under the floor between 103 and 104 to improve supply airflow to room 104.
7. Completed B-rack modification for 3mm. I discovered drawing D58001K001 shows S11/S12 with opposite switch positions for the 3mm/2cm compared to the normal software settings. The switches are reversed and the drawings are now being changed. Also, the switches did not operate consistently, then the switch driver stopped responding to MCB commands. The switch driver was replaced. The cause of the switch driver failure is unknown at this time. Later, Bob McGoldrick and Mike Burgert found no LCP switched power from the 2cm. After troubleshooting, Mike found this to be caused by a long SMA center conductor and the problem was then fixed. I will have labels made for all B-rack connectors associated with the B-rack modification.
8. Installed two new feed heaters for 7mm and 3mm.
9. Tied down a 120v SO cord across Hoist platform.
10. Replaced Hoist Drum Switch. J. Ruff ordered a spare switch to keep in the container.
11. Installed Cable Strain Reliefs on all cables in the Cable Wrap.
12. IF and 500MHz LO cable loss from the B-rack to the Station Bulkhead was tested using the 500MHz LO. The loss at 500MHz for all five cables was 8dB. This is normal.
13. The dish anemometer roll pin stops were cracked. We replaced the roll pins with bolts. Also, Mike repaired a loose retaining bolt on one anemometer. All anemometer cups are dented, presumably by hail. I do not believe the functionality of the anemometers is affected and replacements are not planned.
14. Bob McGoldrick and Mike Burgert set up and checked all FE converter levels.
15. Bob McGoldrick made an extensive checkout of both recorders. Recorder 1 had speed shift problems caused by a worn dummy head, and periodic noise related error rates caused by wiring problems. The entire head assembly was replaced, and the recorder was calibrated and checked for speed shift problems. The capstan motor was replaced to correct a readback problem, and the idler was also replaced to correct an error rate problem.



16. A complete Electrical System check out was completed with the exception of the Onan Transfer Switch and the Antenna Distribution Panels. Each bolt and screw was checked for tightness. Many connections were found to be loose. The Transfer Switch was repaired and checked earlier this year. The Servo Group checked the Antenna Distribution Panels.
17. The power cables in the Cable Wrap were beginning to chafe through the middle ring. Three anti-chafe rings were added.
18. The dates in the UPS logs were corrected.
19. Telephone numbers were corrected in the Chatterbox.
20. The generator still has the original ignition parts, and a freeze plug is starting to weep. NL will replace all ignition parts, clear debris from radiator, replace hoses, and replace all freeze plugs. Paul has a list of tune-up part that has been forwarded to NL.
19. The perimeter fence is covered with brush, trees, and vines in several areas. NL will remove the vegetation around fence.
21. The station driveway is getting very rough. NL will work on finding a way to fix the road.

#### SAFETY ITEMS TO BE ADDRESSED

1. Many cardboard boxes are stored on or next to the building HVAC system. NL will remove the cardboard boxes.
2. The gate restricting access to the Vertex Bridge does not have a latch. NL will add a clip to Vertex Bridge Gate and keep it closed when not in use. I provided a temporary clip.
3. Paint, oil, grease and other flammables are kept in two back rooms of the garage. NL will move all flammables, as much as possible, to the Hazmat Container located in one of the rooms. They will plumb the container vent outdoors.
4. Materials are being stored in front of the electrical panels in the garage. NL will keep the space in front electrical panels clear and free of materials to a minimum of three feet.
5. The safety markings on the antenna stairs and platforms are very faded. NL will repaint the orange safety markings.
6. NL uses a 120v-cheater cord to open the 7mm solenoid, but a proper connector is not attached. The Front End Group supplied NL with spare connectors, and NL will attach one of the connectors to the cheater cord.
7. DJ will install a spare circuit breaker in panel MP to fill a space that was left in the dead front.
8. An FM antenna is located on the side on the building roof. The antenna extends above the Lightning Rod. DJ will relocate the antenna so it is lower than the Lightning Rod.
9. NL needs a label for the building UPS Battery Disconnect that states 'Caution! Do Not Switch Under Load'. The battery disconnect is not load switchable. I will have labels made for all stations with a UPS Battery Disconnect.

#### PROBLEMS TO BE ADDRESSED

1. The AZ 1 Blower is starting to make bearing noises. The motor should be taken to a machine shop to replace the bearings.
2. AZ 2 Pump starting to vibrate slightly. This is not a concern at this time.
3. Three Gearbox Heaters are badly corroding. Three replacement heaters were left at NL for future replacement during the next oil change. NL will need to purchase a large pipe wrench to exchange the heaters. A replacement thermostat has been ordered and will be kept in the container.
4. The three main power cables in the cable wrap are badly cracking and splitting. The cables will have to be replaced in the future, possibly during the next maintenance trip. The deterioration is limited to the tight bends at the top and bottom of the cable wrap, but not within the cable wrap rings. If the cables

deteriorate further down the cable wrap, they will have to be replaced sooner. DJ and Mike will keep a close watch on the cables and reinsulate the sheath with rubber tape and electrical tape as needed. They will notify us if the sheath begins to split or crack in the cable wrap.

5. The AZ 1 Pump Motor 14/3 SJ cord is deteriorating. NL will replace the cord. 6. The 7mm receiver can not cool down without defeating the control system. The vacuum pump control must be bypassed to keep the pump running, and the vacuum solenoid must be bypassed to force the valve open overnight, and the receiver switched to cool. The receiver will not cool otherwise. I will send NL a modified control card to eliminate the problem.

7. The braided ground straps at the FRM are frayed. Ramon Gutierrez has sent new ground strap material to NL.

8. The Feed Cone roof insulation is getting soft and may cause leaks in the future. I suggested NL use Vulkem as a roofing material.

9. The Dichroic Panel appears 50% delaminated, although no problems have been seen by Operations. Peggy Perley is aware of the condition. No action is required at this time.

10. The 13cm and 4cm desiccants appear wet. This may have occurred when the Dry Air System failed. NL will replace or dry the desiccant.

11. Corrosion was found on the Generator Battery. NL will clean the battery.

12. I noticed the receivers are all connected to the correct vacuum, but the 7mm and 1cm are on the wrong helium line. This does not create an operational problem. No action is required at this time.

13. Cryogenic Compressor A has a bad Supply Gauge. Rudy Latasa will send NL a new gauge, and NL will get instructions from Rudy

## North Liberty VLBA Tiger Team Maintenance Schedule

Item	Notes
<b>SERVO</b>	
<b>SAFETY TESTS</b>	
X MULTIPLE FAULT STATUS	
X MANUAL MODES TEST	
X INDIVIDUAL FAULT STATUS	
X REMOTE BOX TESTS	
<b>AZ Travel Limit Switch Tests</b>	
X AZ Clockwise tests	
X AZ Counter-Clockwise tests	
<b>EL Travel Limit Test</b>	
X Elevation up tests	
X Elevation down tests	
<b>BRAKE HOLDING-TORQUE TESTS</b>	
<b>Motor Inspections</b>	
X Motor and Tach Couplings	
X Replace j-boxes w/stainless steel boxes	
X Commutator & Brush Inspection	
<b>Detailed Test</b>	
X System and Axis Faults	
X Motor Fault Status	
X Measure EL Velocity	
EL counterweight balance measurements	
X Measure AZ Velocity	
X Record 1st Limits EL/AZ	
<b>Recordings</b>	
<b>EL System Response Test</b>	
X Implement test setup	
X Calculate acceleration	
X Locked rotor resonance, AZ/EL	
<b>AZ System Response Test</b>	
X Implement test setup	
X Calculate acceleration	
X Locked rotor resonance, AZ/EL	
<b>AZ Position Loop Tests</b>	
X Small signal step response	
X Large signal step response	
X Single motor step response	
<b>EL Position Loop Tests</b>	
X Small signal step response	
X Large signal step response	
X Single motor step response	
<b>Auto Modes Test</b>	
X Check stow commands	
X Synchro feedback operation	
X Test AUI COMM DEAD	
<b>Servo PM</b>	
X ACU PM	
X INSPECT ANTENNA POWER PANELS	
X INSPECT GEARBOX HEATERS	
	T-Stats corroded. Bring spares. Left 3 complete units for installation @ next oil change.

	<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>HVAC PM AND UPGRADE</b>	
	<b>Contempo Unit B(2) Upgrade</b>	
X	Reclaim refrigerant from unit	
X	Install refrigerant valves	
X	Evacuate and recharge system	
X	Install DDC	
X	Install SCR's and Controllers	
X	Install sensors	
X	Install enunciator interface	
X	Calibrate sensors and SCR controllers	
	<b>HVAC/Plumbing PM &amp; Inspections</b>	
	<b>Control Building Contempo Sys</b>	
X	Repair leak in contempo valve	
X	PM/inspect indoor units	
X	PM/inspect outdoor units	Need to protect outdoor refrigerant lines from ice & snow sliding off the roof.
X	System operational checkout	
	<b>Lab A/C Unit</b>	
X	PM/inspect indoor unit	
X	PM/inspect outdoor unit	
X	System operational checkout	
X	Water & sewer PM/inspection	Need a 3 ft square slab around well casing.
	<b>Propane System PM</b>	
N	Replace schedule 80 spec pipe	Needs to be done.
N	Check for hydrostatic relief valve	Needs to be done. Steve Troy will send a valve.
X	Contempo ops/maint training	
X	VR sys ops/maint training	
X	Lab A/C ops/maint training	
	<b>Vertex Room A/C Upgrade</b>	
X	Replace Pedroom A/C	
X	Reclaim refrigerant from system	
X	Install head pressure control valve	
X	Remove existing evaporative coil	
X	Install new coil assembly	
X	Evacuate and recharge system	
NA	Air flow measurements & adjustments	
	<b>Vertex Room A/C</b>	
X	PM/inspect condensor unit	
X	PM/inspect air handler	
X	System operational checkout	
	<b>ANTENNA MECHANICAL</b>	
	<b>MECHANICAL TEAM 1</b>	
X	FRM 2-year PM	
X	FRM - INA bearing check	Slop < 0.002". Rotation force 25# CW, 30# CCW.
X	Install apex guardrail	
	<b>Subrefector</b>	
X	Check for peeling, delamination	
X	Check spider bolts, backside,etc	
X	Check Donut Bolts	
	<b>Feeds &amp; Dichroic</b>	

X	Inspect feeds, mounts, htrs, etc	
X	Check dichroic reflector, check panel	dichroic delaminated about 30%
	<b>Quad-Legs Guy Wires Etc..</b>	
X	Inspect guywires & turnbuckles	
X	Inspect quadleg flange bolts	
	<b>Lightning Protection/Anemometer</b>	
X	Inspt mounts/chk operation	
	<b>Bull/Pinion Gears</b>	
X	Inspt bull/pinion gears	
X	Lub El brgs, bull gears as req	
X	Check stow pin fit	
	<b>ANT. MECHANICS Cont.</b>	
	<b>Pintle Bearing</b>	
X	Inspect seals, check pocket level & for loose bolts	0.0008 TIR Replaced pintle hatch cover w/ Lexan.
X	Lubricate bearing as needed	
X	Close gap in pintle grease catcher	
	<b>AZ Rail Inspection</b>	
X	Inspect ant foundation	Bad grout - SW side
X	Inspect for rail movement	
X	Inspect joint bars & clips	
X	Move ant, chk rail movement	
X	Rail level measurements	
	<b>Dish Surface &amp; Panels</b>	
X	Inspect panels, check distortion, shifting, etc	
X	Spot check panel bolts-looseness	
R	Repaint panel where needed	
	<b>Structural</b>	
X	Install EL hard stops	
X	Check ant structural bolts	
X	Inspect ant structural welds	
X	Inspt ant backup/lower struct	
X	Inspect EL axle	
	<b>MECHANICAL TEAM 2</b>	
	<b>Elevation/Hoist/Swing Platform Work</b>	
X	Instl hoist safety mods, checkout winch, etc	Replaced winch drum switch, Furnas WR44
X	Checkout swinging platform	
X	Extend EL motor platforms	
X	Instl condensor platform toe guard	
	<b>EL Bearing Inspection</b>	
X	Inspect EL bearings internals	
X	Inspect EL bearings lip seals	
X	Clean off excess grease	
	Install El bearing grease trays	Sent to NL for site techs to do.
	<b>EL Motors &amp; Gearboxes</b>	
X	Inspect pmps, seals, couplings	
X	Weep gearbox heater enclosures	
	<b>AZ Wheels &amp; Bearings</b>	
X	Pressure wash gearboxes	
X	Rotate outer races on Az wheel bearings	Replaced outer brgs D1 & I2. D2 outer & I2 inner show slight pitting. I1 & D2 have double spacers.
X	Check wheel to struct clearances	
X	Determine wheel radial	
X	Check axle bolt tightness	
X	Pillow block brgs-open & clean	
X	Lubricate & check grease	

**AZ Motors & Gearboxes**

- X Inspect pumps, seals, couplings
- X Weep gearbox heater enclosures

**Paint & Insulation Inspection**

- X Inspect ant paint and report
- X Inspect & repair ant insulation as needed

**ELECTRONICS**

**Station Building Inspections**

- X Rm 100 - Check electrical, UPS and test operation
- X Rm 103 - Chatter/supervisory boxes, alarms, etc.
- X Rm 104 - Bulkhead, underfloor, maser, etc
- X Check tools, test equip, manuals, wtr sys, UIS, etc
- NA Install protective cover over maser

**Outside Building and Misc. Inspections**

- 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.

**Antenna Maintenance & Inspections**

- X Inspect Cryo sensor card upgrade
- X Activate & test feed heaters
- X Apex/FRM inspections
- X Feedcone/Receiver system inspections
- NA Replace receivers that have faulty sensors
- X Vertex Room/Racks & cable inspections
- X B-rack modification for 3mm receiver
- X Vertex to pintle bearing inspection
- X Install cable wrap strain reliefs
- X Inspect pintle bearing rm bulkhead, cablewrap, etc.
- X Inspect pedroom UPS, FRM controller, dry air sys, etc.
- X Install electrical breaker for air comp & hydraulic wrench

**FINAL INSPECTIONS**

- X Spot check critical PM's
- X Review problems areas with Site Techs
- X Site Inspections for Oversights
- X Station Startup Verification Tests

Key:

- X Completed
- N Needs to be done
- R Remove from schedule
- NA Not applicable