VLBA Electronics Memo No. 137

Interoffice

National Radio Astronomy Observatory

New Mexico
September 20, 1993

To: Recipients of VLBA Memos

From: Paul Rhodes

Subject: VLBA Lightning Damage Reports - 1993

Attached are the VLBA Lightning Damage reports for North Liberty and Kitt Peak.

Interoffice

National Radio Astronomy Observatory
Socorro, New Mexico

September 13, 1993

To: VLBA Memo Series
From: Jack Meadows and D.J. Beard
Subject: Lightning Damage Report for North Liberty

On Monday, August 9, 1993 the North Liberty VLBA Site was struck by a multiple lightning strike. The strike was known to be multiple because both Site Technicians were on duty and witnessed the event. The lightning hit the antenna and induced enough static discharge to take out electronic circuits in the Antenna, Vertex and Pedestal Rooms. Also the
Weather Station, The Main Control Building, and circuits at the Telephone Company Office located 30 miles from the site.

Conditions that existed immediately following the strike:

1. The Antenna had been stowed for about 30 minutes and was in the standby mode.
2. Antenna - UPS was in the not ready state, no power output.
   The Fire alarm trouble alarm was sounding.
   Critical and non-critical power shunt tripped.

After resetting the breakers and getting the UPS back up, the following conditions were found at the antenna:

1. 4 - 100 amp servo fuses were blown.
2. Focus-Rotation system failure.
3. ACU low temperature & wind warnings.
4. Servo control cards damaged.
5. Wind warning system failure.
6. Ped utility interface failure.
7. Ped fire alarm damaged.

Station Building Equipment.

The computer room (103) smelled like burning electronic components, there was no response from the terminal and we were unable to reboot the Station Computer.

The 4 wire lease line for Internet communications was down. After receiving replacement cards from the AOC we were able to get the station computer back up and functioning. We determined that the following items possibly needed repair:

2cm receiver and it's F117 module.
F118 UHF Receiver Interface and the UHF receiver
1cm Serial Interface Bus
Weather station digital card and the Weather station conditioner board
East antenna edge wind anemometer
Pedestal Room & Building . J-Boxes
FRM second screw sensor

Repairs and Replacements:

Station Computer:

It seems as though the strike entered the main computer by way of the RS-232 cable and went through the Motorola VME- 701 I\O Transition Module and then into the VME-050 System Controller Module. The VME-050 Module was very hot and smelled like a burning resistor. The computer rebooted normally after replacing the 050 Module but we checked all of the VME modules for any visual damage.

Utility Interface Modules:

The Pedestal Utility Module was replaced with a new one sent from the AOC. As of this moment the module has not been checked out at the DCS lab. The Building Utility Module was repaired on site and needed IC's B1, B2, B6, B7, B11, and B12 replaced. These IC's are the monitor interface channels and include 74LS86 and 74LS173 which are vulnerable to static discharges.

ACU:

The problems with the ACU turned out to be inputs to the ACU. The low temperature & wind warnings could be eliminated by removing the Blue cable marked W37 which has a DB-9 connector and plugs into J7 on the back of the ACU. After removing this cable the jumper plug-in was inserted and all of the warnings went away.

AZ & EL Servo Cabinet:
Even though the antenna was in standby, we still lost 4 servo fuses on the AZ side. One of the servo drive cards also had to be replaced. It rained so hard that the blower motor sucked water in through it's filter and blew water into the AZ drive electrical motor and saturated it. We had to remove the power and take out the motor brushes and use the heat gun to dry out the motor before testing it.

Weather Station:

A digital card was replaced with one sent from the AOC. The DCS lab found that IC 5A (74LS374) was bad. The A3 Conditioner board needed IC's U11 (7406) & U8 (LM319) replaced. These are the wind warning and low temperature IC's.

Pedestal Room & Building J-Boxes:

Repairing the weather station didn't cancel the low temperature & wind warnings to the ACU. As it turns out there are back to back zener diodes located under each set of terminals in the Pedestal Room and Building J-Boxes. We finally just checked all of them in each J-Box and found 10 that were bad.

Pedestal Room J-Box Terminal Connections: 2-5-7-14-17-43-55
Building J-Box Terminal Connections: 10-29-31

Antenna Mounted Wind Warning System

We replaced the Wind Warning Module in the ACU rack with one shipped from the AOC. The DCS lab replaced IC's: A6 & A10 - (LM339), and A2 (74LS04). The east anemometer photo-detector was replaced and the system was re-calibrated for 35 & 55 MPH. When this module is not working, there will be wind warning messages sent to the ACU also.

Focus-Rotation Mount

The S102 (apex interface) lost IC's D6,D11 (74LS14), E20,F20 (74LS165), B25 (74LS30), U1,U2,U3, (7406). The F-R servo amps lost C-MOS flatpack chips on the pc-boards and all three were replaced with new ones sent from the AOC. The DCS lab replaced U356 (4050), U174 (4050), and U101 (MC68705) in the Rotation Amplifiers. The IC U27 (R/D converter) in the Focus Amplifier were also replaced. The second screw sensor was also lost and had to be replaced. This problem didn't show up until it was possible to move the FRM.

2cm Receiver:

Although it was thought that the F117 or FET bias cards were the problem, it turned out that the 2cm receiver had to be replaced because all test indicated that the FET's were bad.

UHF Receiver:

The UHF receiver was removed from the barrel after it's associated F117 & F118 modules were replaced. The damage was thought to be limited to zener diodes used to protect the input/output lines. They were replaced with MOV's and several loose terminals were soldered. After the Front End group checked out the receiver, it was determined that it suffered internal damage had to be replaced. This will be done as soon as one is available.

F117 Receiver Monitor & Control Modules:

The 1cm, UHF, & 2cm F117 modules were replaced.

Pedestal Room Antenna Fire Alarm:

The pc-board had transistors blown off the board and burned resistors. The board was replaced with one sent from the VLA. Smoke detectors were also ordered but were not

needed. The pc-board made the electrical breakers shunt trip and the shunt trip relay had to be removed in order to service the fire alarm. The report we received from the Servo group said that the pc-board suffered a lot of damage.

4-Wire Leased Line:

The 4 wire leased line communication was lost and the Telephone Co. was called in to test the line. Even though we lost our portable telephone from the lightning strike, nothing else at the site was damaged. However, the Telephone Co. lost a plug-in card at their office which is 30 miles away.

We have yet to find any physical evidence of a direct hit from the lightning strike. A check of the antenna grounding system showed everything to be normal.

Jack Meadows & D.J. Beard

NATIONAL RADIO ASTRONOMY OBSERVATORY
Tucson, Arizona

TO: Paul Rhodes

FROM: Dewey Ross

DATE: August 31, 1993

SUBJECT: Hilary's Wrath (i.e., Storm Damage)

The chatter box called ~1940 MST 1993-Aug-28 saying "Power is off." Highway 386 showed evidence of heavy rain and high winds. (Rocks in road —had to move some to proceed; tree branches and debris in road, also.)

Upon arrival at this site, I found the outside light "on" and the generator running. Transfer switch DID NOT have "emerg" lamp lighted. Checked generator output breaker, O.K. Checked transfer switch to make sure it was seated, O.K. "Emer" light on transfer switch came "on," but was dim and pulsating as were the lights for Room 100. ("Emerg" stopped pulsating and stayed "on.")

Measured transfer switch voltages: Gen In = Normal; Gen Out = Normal, Commercial In: A = 49V, B = 208V, C = 208V. Called Henry Marquez, commercial power on and normal at summit and MDM. Called TOUA to send out crew. TOUA found blown fuse on Phase "A" at pole in picnic area before the power goes underground. Power was restored ~2330 MST.

Cryo Compressor "A" front panel switch was off. Reset and ~10 mins. later found it to be "off" again. Reset, same situation. After ~10 mins. checked voltage, O.K.; checked contactor, O.K. Reset front panel switch and compressor stayed on.

Reset all receivers to "cool." Reset all synth. (#2 would not reset until removed and re-seated). Unable to communicate with weather station; cycled power, O.K., except that ±12 volts and +5 monitor voltage did not read proper values. (Found TO-5 can on 12 volt power supply oozing gunk. GPS and Maser, O.K.) Checked Ped Room, found non-critical main breaker tripped.

All receivers were cooling when I left site, however, the 6 cm and 7mm did not cool. Monday morning we heated, purged and started cooling ~1245 MST.

Found blown 6¼ Amp fuse in building air handler. Replaced; air handler, O.K.

Talked to KPNO and they said there was severe lightning along with the rain and high winds.

Just for the record, this storm was the remnants of tropical storm, "Hilary."

DER/nlc