



National Radio Astronomy Observatory

P.O. Box O, 1003 Lopezville Road, Socorro, New Mexico 87801-0387

Telephone: (505) 835-7000 Fax: (505) 835-7027

February 11, 2000

To: Recipients of VLBA Memos

From: Terry Cotter, Paul Harden

Subject: Plan for corrosion problems in electronic modules at St. Croix

History:

Recently, BBC sn 29 failed at St. Croix. This module was returned to the AOC for repair. Visual inspection of this module revealed severe corrosion and possibly some fungus growth within the module. The corrosion was mainly along the bottom edge of the filter board, and the power board closest to the bottom of the module. There was also some problems along one edge (the edge at the bottom of the module) of the M & C wire wrap board.. We have subsequently learned that several BBCs at SC have this problem. On sn 29 and 144, the corrosion caused a short circuit that burned a hole on the board and damaged a connector.

Discussion;

I have had some discussion with Paul Rhodes concerning this problems. Paul feels that the problem is an isolated event which was caused by the most recent hurricane. He believes that because the dehumidifier was shut down and the doors to the building were left open everything was soaked with salt spray. Paul believes that all we have to do is return the BBCs to the AOC and clean them up. The main reason Paul believes that we do not have a problem is because we have not seen it up until this time. I, however; believe that we have had and will continue corrosion problems due to the salt spray environment. I believe that the hurricane greatly magnified the problem and without the hurricane the problems would have eventually shown up. We have seen some evidence in the past of small white spots in the BBCs but we did not know what they were. A photograph showing some of the corrosion of BBC sn29 is show in Figure 1.

Analysis;

Paul Harden, after additional BBC failures, had all BBCs and the IF distributors returned to the AOC for inspection and repair. His report is included as Attachment # 1. He has provided BBC location, time of service at St. Croix and condition of each module returned. His report shows that the worst modules were near the center of the bin at the bottom of the rack. Since the heaviest corrosion was along the bottom edge of the circuit boards in the modules, I believe that salt water must have condensed inside the rack and dripped down initiating the heavy corrosion.

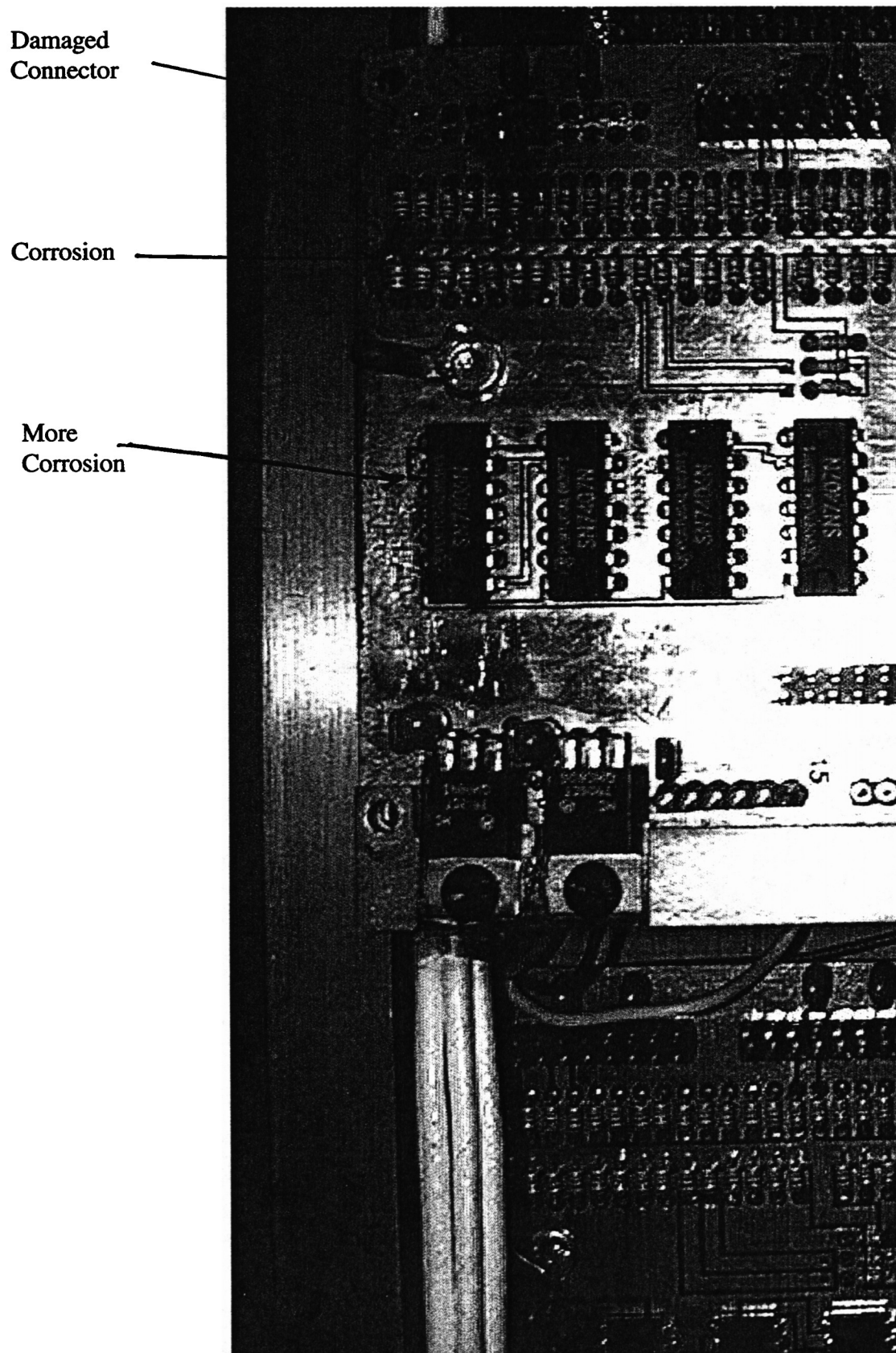
Paul Harden took some corroded hardware to Dr. Don Brandvold, a chemistry professor

at New Mexico Tech, for further analysis. Dr. Brandvold's analysis showed that sodium chloride was the primary chemical found in the corroded areas of the circuit boards. Dr. Brandvold also found some sulfates on the boards. He said that the sulfates possibly (due to the volcanic activity in the area) appeared to have caused some pitting on the boards accelerating the corrosion due to the salt. Dr. Brandvold believes that the excessive corrosion we have found at this time is more event related to the hurricane and not a long term corrosion problem. He believes a simple coating on the boards should provide all the protection we need.

Plans and Conclusion;

I believe that the modules at St Croix need to have all exposed circuit boards (ie boards that are not in an enclosed housing) conformal coated. We are going to replace the boards that are heavily damaged and thoroughly clean all of the other exposed boards. We are then going to conformal coat these boards and initiate a program which will insure that St. Croix has modules with conformal coated boards. The problems faced here may not be indicative of long term corrosion but these modules will need to function for a long time and coating the boards is an easy and cheap solution.

Figure 1. Damaged Board in BBC sn 29



ATTACHMENT #1

SALT CORROSION PROBLEM AT VLBA ST. CROIX

VLBA IF-LO MODULES

Jan. 26, 2000
Paul Harden

FAILURE HISTORY

- 12-6-1999 BBC S/N 29 (SLOT 5) failed at SC - no LSB output power
12-7-1999 BBC S/N 134 shipped to SC as replacement
12-12-1999 BBC S/N 134 installed in BBC slot 5.
1-6-2000 BBC S/N 29 arrived from St. Croix. No LSB output power due to no +12V or switching commands to LSB AGC amplifiers.
1-7-2000 Began troubleshooting the SWITCH DRIVER BOARD. Discovered heavy corrosion on bottom 1-inch of board that encased 8 resistors, dissolved 3 traces and ~1/8 in. of ground plane, caused short across +12V trace (burned through board) and melted connector to LSB AGC sub-assembly. Some corrosion on Digital Board, but no failure. There are no built spares of the SWITCH DRIVER BOARD.
1-8-2000 Began building a replacement SWITCH DRIVER BOARD (C. Wang).
1-13-2000 VLBA MAINT. DAY. Herb at SC inspected several BBC's, for which 2 showed signs of corrosion, and 2 failed upon reinstalling after inspection. Halted further BBC inspections. Decided to send SC six (6) BBC's over next few days and 2 IF DISTRIBUTORS, with all existing modules to be returned to AOC for inspection/repair.
BBC 30 sent to SC
1-14-2000 BBC S/N 7 sent to SC.
Pulled 4 BBC's from VLBA rack to checkout, minor tuning and send to St. Croix Mon. 1-17
1-17-2000 BBC S/N 10 }
S/N 41 } Shipped to VLBA SC
S/N 91 }
1-18-2000 BBC S/N 20 }
IF DISTRIBUTOR S/N 4 } Shipped to VLBA SC
S/N 7 }
1-25-2000 Modules from SC arrived
IF DISTRIBUTOR S/N 9 BBC's S/N 106
S/N 41 S/N 31
S/N 113
S/N 144
S/N 10*
S/N 132
*BBC S/N 10 returned as defective; VCO did not lockup at SC

VLBA SC MODULE HISTORY

MODULE STATUS IN DEC. 1999

BBC S/N	DATE INSTALLED	BBC SLOT NO.	TIME IN SERVICE	CONDITION
S/N 121	JAN. 96	1	4 yrs.	Clean
S/N 106	JAN 96	2	4 yrs.	Slight "film" & discoloration
S/N 126	JUN 95	3	4½ yrs.	? (still installed SC)
S/N 85	DEC 95	4	4 yrs.	? (still installed SC)
*S/N 29	FEB 97	5	3 yrs.	DAMAGED/FAILED from corrosion
S/N 144	NOV 95	6	4 yrs.	Heavy corrosion, board damage
*S/N 113	DEC 98	7	1 yr.	Heavy corrosion, board damage
S/N 132	DEC 95	8	4 yrs.	Slight "film" & discoloration
IF DISTRIBUTOR S/N 31			~4 yrs.	Clean, slight discoloration
S/N 9			~4 yrs.	Mild corrosion

*SN 29 replaced BBC SN 97 2-97
BBC SN 97 → KP 7-97

*SN 113 replaced BBC SN 134 12-98
BBC SN 134 → SC 1-2000

*Might be worth inspecting these BBC's from VLBA SC for corrosion.

IF DIST. #1	IF DIST. #2	BBC #1	BBC #2	BBC #3	BBC #4
SN 9	SN 31	SN 121	SN 106	SN 126	SN 85
BLANK	BLANK	BBC #5 SN 29	BBC #6 SN 144	BBC #7 SN 113	BBC #8 SN 132

KEY:

 Some corrosion

 Heavy, damaging corrosion

VLBA SC MODULE HISTORY

MODULE STATUS ON 1-26-2000

Shipped to SC JAN. 2000

Date	BBC SN		Returned to AOC	SN	Condition	Status on 1-26-00
1-18-00	SN 20	→	1	SN 121	clean	Tested OK → SPARE
1-17-00	SN 41	→	2	SN 106	slight film & discoloration	In repair
			(SN 126)	3		
			(SN 85)	4		
12-7-99	SN 134	→	5	SN 29	Heavy corrosion, failed	In repair
1-14-00	SN 7	→	6	SN 144	Heavy corrosion	In repair
1-17-00	SN 91	→	7	SN 113	Heavy corrosion	In repair
1-11-00	SN 30	→	8	SN 132	Slight "film" & discoloration	In repair
IF DISTRIBUTORS (T121)						
1-17-00	SN 4	→	1	SN 31	Clean	Awaiting testing
1-17-00	SN 7	→	2	SN 9	Mild corrosion	In repair

CURRENT
CONFIGURATION

IF DIST. #1	IF DIST. #2	BBC #1	BBC #2	BBC #3	BBC #4
SN 4	SN 7	SN 20	SN 41	SN 126	SN 85
BLANK		BBC #5	BBC #6	BBC #7	BBC #8
		SN 134	SN 7	SN 91	SN 30