## VLB ARRAY MEMO No. 455

VLB ARRAY MEMD No. 455

NATIONAL RADIO ASTRONOMY OBSERVATORY

Socorro, NM

RFI SURVEY FOR THE VLBA

NORTH LIBERTY RADIO OBSERVATORY SITE

Iowa City, Iowa

April 1985

Jim Oty

The proposed VLBA location near Iowa City, Iowa was the subject of RFI survey number five. After a two and one half day trip to this location from Socorro, NM, the survey was started on Thursday, April 18 and completed on Friday, April 26.

The location for this survey was the North Liberty Radio Observatory (NLRO). This observatory is located about 10 miles north of Iowa City, near the town of North Liberty, and is the Physics and Astronomy Department bу operated of the University of Iowa. The RFI trailer was set up on NLRO property within 200 yards of the actual proposed VLBA location. Figure 1 is a drawing of the NLRO site with the proposed VLBA location The RFI marked. monitoring trailer was parked near the 60 foot telescope where power was availible. The survey was completed with no problems. Only a couple of power glitches during an electrical storm caused equipment shut down. All VLBA bands from 75 MHz. thru 11.2 GHz. were monitored.

The major interference problem encountered was a very strong TV Channel 32 signal in the 550 to 650 MHz. band. The power of this signal, at 584 MHz., was measured at 6.1 X  $10^{-7}$  watts/M $^2$ . Note that this is above the 1 percent compression threshold for the receiver (see Table II), but the special filter system being designed for the 680 - 640 MHz. receiver should sufficiently attenuate the RFI. This TV transmitter, a Waterloo, IA station, is located in Walker, IA about 40 miles north of NLRO. The power is listed as 5000 kW with an antenna hieght of 1851 feet. Other lower power TV signals were seen in this band with the next strongest being Channel 40 from Dubuque, IA.

One other potential interference signal was noted in the 2.15 to 2.35 GHz. band. This signal, a TV signal, at 2.156 GHz. was measured at 1 X  $10^{-8}$  watts/M<sup>2</sup> and is located north of NLRO, probably Cedar Rapids. This signal is at the low end of the VLBA band and is below the compression level given in Table II.

an attempt to find some shielding from the very strong TV In Channel 32 signal, a second location was looked at very briefly on the McBride Field Campus of the University of Iowa about one and a half miles from the NLRO site. This field campus is on land the Iowa River that is leased from the Corps of Engineers. along Figure 2 is a topographical map of the area. The elevation deference for various locations in this area is only 150 feet at the most so not much shielding can be expected. At the university field campus, a spot was located right on the river that was shielded to the north by a ridge about 100 feet high. It was impossible to get the RFI trailer down to this location because of recent rains so only the spectrum analyzer and plotter were

used. The first look from this low site indicated about 30 dB shielding, however this site was also surounded by trees. To carry the test further, two other sites were checked. One site on the ridge in the trees and one site on the ridge in the clear. From this data it seems reasonable that something in the neighborhood of 15 to 20 dB shielding can be expected at this location. The other factor not taken into account is the relative antenna hieght. The monitoring antenna was only 15 feet above the ground while the VLBA antenna will be about 90 feet.

This data is shown in plots 29 thru 32 at the end of Table I. Plot 29 is the baseline plot from the NLRO site. Plot 30 from the low spot on McBride Field Campus shows the 30 dB improvement. Plot 31 from the ridge but in the trees and plot 32 from the ridge clear of the trees show the 'local' Ch 32 strength and the shielding from the trees. These locations are marked on figure 2.

The horizon around the NLRO location was flat so no horizon elevation plot is included. The McBride Campus site was shielded from the north by about a 2 degree elevation.

The following comments are my observations:

73 MHz. to 75 MHz. TV Ch 4 and Ch 5 are not local so no problem. Signals between 75 MHz. and 76 MHz. are two-way communications.

300 MHz. to 350 MHz. Not much military air/ground activity in this area. One bothersome signal at 332 MHz.

550 MHz. to 650 MHz. Completely dominated by TV Ch 32. Most other UHF TV channels had signals. Some from as far away as 150 - 200 miles. Channel 37, 609 - 615 MHz., clear.

500 MHz. to 1 GHz. Again dominated by TV Ch 32.

<u>1.35 GHz. to 1.75 GHz.</u> Some low level signals throughout the band. Strong signal at 1.7 GHz. is a NLRO local oscillator. A few micro-wave signals above 1.73 GHz.

2.15 GHz. to 2.35 GHz. Strong TV signal at 2.154 GHz. This is a pay TV service from Cedar Rapids.

4.6 GHz. to 11.2 GHz. No signals.

Table I lists the plots included with this report. These are typical plots intended to show items of interest. Many other plots were generated and are on file.

Table II has been expanded to include data from VLBA Electronics Memo 39, Table I. This data gives flux density required by an interfering signal that would result in a 1% comression in amplifiers.

## TABLE I NORTH LIBERTY RADIO OBSERVATORY Iowa City, Iowa

Plot Fi		Filter	filter	
#	Frequency	Fc/BW	Comments	
1	50 - 100 MHz	None	East.	
2	50 - 100 MHz	None	West.	
3	74 - 76 MHz	75/5%	East. Single plot showing noise floor.	
4	74 - 76 MHz	75/5%	West. Single plot showing noise floor.	
5	70 - 80 MHz	None	East. Note two signals between 75 and 76 MHz.	
6	70 - 80 MHz.	None	West. Same as plot 5.	
7	300 - 350 MHz	325/50	North. Signals are air/ground communications.	
8	300 - 350 MHz	325/50	South.	
9	550 - 650 MHz.	600/100	North. Single plot at reduced power showing strength of CH 32.	
10	550 - 650 MHz	600/100	North. Ch 32 completly saturated. Ch 40 from Dubuque, IA.	
11	550 - 650 MHz	600/100	East.	
12	500 - 1000 MHz	None	Quick look for signals in the VLBA IF band.	
13	1350 - 1550 MHz.	1500/1000	North.	
14	1350 - 1550 MHz.	1500/1000	South	
15	1550 - 1750 MHz.	1500/1000	North. 1.7 GHz. from NLRO local osc.	
16	1550 - 1750 MHz.	1500/1000	East. Local osc turned off.	

TABLE I (Cont.)

17 1300 - 1800 MHz. 1500/1000 Long term plot.

32

18 North. 2150 - 2350 MHz HP2000 Low end signal is pay TV. 19 2150 - 2350 MHz None. East. 20 4.6 - 4.8 GHz HP4000 Typical plot. 21 4.8 - 5.0 GHz HP4000 Typical plot. 22 5.0 - 5.2 GHz. HP4000 Typical plot. 23 5.9 - 6.4 GHz HP4000 Typical plot. 24 7.9 - 8.4 GHz. HF'6000 Typical plot. 25 8.4 - 8.9 GHz HP6000 Typical plot. 26 10.2 -10.7 GHz HP6000 Typical plot. 27 10.7 11.2 GHz HP6000 Typical plot. 28 550 - 650 MHz. 600/100 Baseline plot of CH 32 signal level fron NLRO. 30 550 - 650 MHz. 600/100 From low spot on McBride Field Campus. 31 550 - 650 MHz. 600/100 From ridge above 30 plot location. In the trees.

550 - 650 MHz. 600/100 From ridge above plot 30 location but clear of the trees.

## (6)

## TABLE II HARMFUL INTERFERENCE LEVELS

VLBA TUNNING RANGE	HARMFUL INTERFERENCE	RFI MEASURED THRESHOLD	FLUX DENSITY FOR 1% COMP.	
	(Note 1)	(Note 2 & 3)	(Note 4)	
50 - 100 MHz.	¥	-138 dBW/m^2	#	
310 - 340 MHz.	-151 dBW/m^2	-152 dBW/m^2	-72 dBW/m^2	
580 - 640 MHz.	-146 dBW/m^2	-140 dBW/m^2	-67 dBW/m^2	
1.35 - 1.75 GHz.	-135 dBW/m^2	-142 dBW/m^2	<b>~59 dBW/m</b> ^2	
2.175 - 2.425 GHz.	¥	-138 dBW/m^2	-55 dDW/m^2	
4.5 - 5.1 GHz.	-120 dBW/m^2	-132 dBW/m^2	-49 dBW/m^2	
4.99 - 5.0 GHz. (Sub-band)	-127 dBW/m^2	-130 dBW/m^2	-49 dBW/m^2	
5.9 - 6.4 GHz.	-120 dBW/m^2	-125 d9₩/m^2	-47 dBW/m^2	
9.0 – 9.8 GHz.	¥	-122 dBW/m^2	-44 dBW/m^2	
10.2 - 11.2 GHz.	-110 dBW/m^2	-115 dBW/m^2	-42 dBW/m^2	

Note 1: These levels, from VLB Array Memo No. 81, are increased by 10 dB since ground based RFI is likely to enter the antenna through 0 dBI sidelobes rather than the +10 dBI sidelobes assumed in Memo B1.

Note 2: These levels are threshold levels from Table I plots.

Note 3: These values may vary slightly from survey to survey because of minor equipment changes. Note 4: These levels are from VLBA Electronics Memo No. 39.

\* These frequency bands not included in memo 81. # These frequency bands not included in memo 39.























































