



# NATIONAL RADIO ASTRONOMY OBSERVATORY

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August 6, 1987

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JPL/CALTECH  
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REF: VLA-GDSCC Telemetry Array Project

Dear Mr. Brown:

Here is the Quarterly Status Report for April-June, 1987. I leave to you the distribution of copies within JPL.

Sincerely yours,

*William D. Brundage*

William D. Brundage  
VLA-Voyager Preparation  
Manager and Project Engineer

WDB/sb

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NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA-GDSCC TELEMETRY ARRAY PROJECT

VLA-JPL VOYAGER 2 AT NEPTUNE

QUARTERLY STATUS REPORT

APRIL - JUNE 1987

Prepared by:

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During this second quarter of 1987, JPL and VLA staff continued testing the antennas operating at X-band. NRAO continued procuring materials and constructing front-ends and receivers for installation in 1987 and 1988.

#### CDL

The Central Development Laboratory delivered seven more front-ends (#13 thru #19) to the VLA this quarter. Parts are on hand for the completion of the remaining front-ends by the end of 1987.

Further improvements occurred recently due to the incorporation of HEMT'S obtained via the JPL/NASA supported contract with GE. The latest receivers now have a typical  $T_r \leq 13$  K, an improvement of at least 3 K over the Fujitsu HEMT's and older GE HEMT's. It is likely that some of the early receivers with Fujitsu HEMT's will be retrofitted with new GE HEMT's to improve system sensitivity before the Neptune flyby during August 1989.

#### TESTS

In April, May, and June, JPL used four to eight hours of array test time to examine the phase stability of the "phased-up" array as a function of signal-to-noise ratio (SNR) and the gain and integration parameters in the autophasing algorithm. JPL also measured the performance of the nine and ten X-band antennas in pointing at radio sources, in tracking the Voyager 2 spacecraft in a phased-up array, in aperture efficiency, and in system noise temperature at low elevation angles. In June, JPL tested telemetry reception from Voyager 2 at a data rate of 7200 bps.

#### SCHEDULE

The ninth and tenth X-band system became operational this quarter. We expect thirteen antennas to be operational at X-band by the end of next quarter, with twelve of them utilizing lower noise HEMT amplifiers. The schedule has a total of 15 operational antennas (all with HEMTs) by the end of 1987, 20 by mid 1988, and all 28 by the end of 1988.

The VLA Implementation Plan, being drafted now, will be issued next quarter.

#### FEEDS

VLA received eight production feeds from JPL. We expect the remaining 8 feeds next quarter.

## RECEIVER SYSTEM

VLA completed the tenth thru twelfth production receiver systems this quarter. A production HEMT cooled-front-end and Rack-F replaced one of the two developmental FET front-end systems. The second developmental front-end and feed will be replaced next quarter. The upgraded VLA receiver front-ends in Rack-A, which contains the new bandswitches, must be installed before an X-band receiver becomes operational. Antenna #26 will get its band-switches next quarter. All future antenna installations will include an upgraded Rack-A with or before the X-band installation. Starting in July, upgraded Rack-A's will be installed in antennas at 4 week intervals so that all 28 antennas will operate at X-band by the end of 1988.

Construction of production Analog Sum #1 finished this quarter and testing began.

VLA ordered materials for permanent mounting of the 108 IF bandpass filters and installation will begin next quarter.

## NEW ON-LINE SYSTEM

In May, JPL commented on the draft Implementation Plan for the new VLA On-line System which was issued last quarter. Concerns focused on aspects of software, including schedule, reliability, testing, autophasing, and operational items. VLA continues to develop the plan with JPL, and expects to complete the final plan next quarter.

The new system began operating this quarter in a parallel monitoring mode. VLA and JPL began using the new display of X-band front-end monitor data, which will evolve according to users needs.

## ELECTRIC POWER GENERATION

The power line monitor provided more data on voltage sags, spikes and dropouts on the VLA power source (Socorro Electric Cooperative). JPL and VLA began installation of the on-site diesel electric power generation system which will substitute for commercial power during telemetry reception in 1989. The two 1400 kW generators, exhaust system, and building are in place. System testing will begin in May 1988.

## RELIABILITY

Following the Reliability Review No. 1, VLA continued to monitor downtime statistics and explore possible mitigations. We will continue periodic reviews. To help achieve the goal of 98% availability and 4 hour mean-time-to-recover, VLA ordered a backup on-line computer, as recommended by JPL, with funds NASA transferred to NSF-NRAO-VLA. It was installed this quarter.

Several CTI 22 cryogenic refrigerators in operational antennas have failed after only 3000 hours running time. VLA replaced carbon bushings in all refrigerators with polyamide bushings of Envex or Vespel expecting to extend the MTBF to at least 8 months. Two units with scotch-yokes of VLA design continued extended testing with no failures. Experience so far this year indicates much improved MBTF.

Concerns continued this quarter about reliability of on-site power distribution with 3 additional failures of buried cables feeding the arms of the wye. NSF has not yet responded to the VLA report on the problem, which included a cable replacement schedule and cost estimate. NRAO-VLA operations funding in 1987 only allowed adding a redundant cable between the site switch-gear and the Control Building. It was installed in June.

## FUNDS

Spending by CDL and VLA is on schedule. Projections show negative balances before the ends of 1988 and 1989. Total funding for VLA in the Management Plan is inadequate to complete the receiver system because benefits, overhead, receiver construction costs, and reliability goals are higher than originally planned.

In March, VLA submitted to JPL an amendment to the revised budgetary estimate and funding schedule. The JPL Implementation Plan for VLA Power Generation requires additional funds to support construction by VLA. The amendment estimated VLA needs total additional funds of

\$303k for 1987,  
\$206k for 1988, and  
\$262k for 1989, for \$771k total.

In June, NSF received an additional \$303k in funds, so VLA began ordering materials and cryo-refrigerators to get back on the construction schedule.

A fiscal statement for the project from inception thru 1987 June 30 follows. It includes total expenditures and commitments (E&C), and balance. Total allocations equal total funds which include the additional \$303k. In addition it shows estimated E&C at year end, and estimated balance at year end.

DESCRIPTION	ALLOCATION	E&C	BALANCE	Est E&C	Est BAL
B7 Jun 30	IT Dec87	ITD	ITD	IT Dec87	IT Dec87
	\$k	\$k	\$k	\$k	\$k
<u>VERY LARGE ARRAY:</u>					
WAGES	520	393	127	520	0
BENEFITS	141	99	42	141	0
COMMON COSTS	494	373	121	494	0
TRAVEL	60	25	35	60	0
OFFICE LAB ADDITIONS	28	27	1	28	0
2 DEV'L RECEIVERS	157	157	0	157	0
CRYOGENICS & VACUUM	51	51	-0	51	0
CRYD COMPRESSORS	161	21	140	161	0
RCVR INSTALLATION M & S	461	418	43	461	0
EQUIPMENT (TEST & TOOLS)	115	53	62	115	0
JPL DONATED EQUIP	325	326	-0	325	0
BACKUP ON-LINE COMPUTER	250	255	-5	250	0
RELIABILITY IMPROVEMENTS	5	0	5	5	0
POWER GENERATION	73	57	16	73	0
CONTINGENCY	10	0	10	10	0
VLA TOTAL	2851	2254	597	2851	0
<u>CENTRAL DEVELOPMENT LABORATORY</u>					
WAGES	654	476	178	654	0
BENEFITS	207	123	84	207	0
COMMON COSTS	423	310	113	423	0
TRAVEL	36	18	18	36	0
MATERIALS & SERVICES	455	404	51	421	34
EQUIPMENT (TEST & TOOLS)	279	313	-34	313	-34
CDL TOTAL	2054	1644	410	2054	0
VOYAGER TOTAL	4905	3898	1007	4905	0
NASA FUNDS	4580				
JPL DONATED EQUIP	325				
TOTAL FUNDS	4905				
BALANCE =TOT FUNDS - VGR TOT	0				

E&C = EXPENDED & COMMITTED  
IT = INCEPTION THRU  
ITD = INCEPTION THRU DATE  
Est = Estimated