



NATIONAL RADIO ASTRONOMY OBSERVATORY

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October 29, 1987

Donald W. Brown
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Ref: VLA-GDSCC Telemetry Array Project

Dear Mr. Brown:

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

Sincerely yours,

Bill Brundage

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

WDB/pl

cc: W/Report

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NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA-GDSCC TELEMETRY ARRAY PROJECT

VLA-JPL VOYAGER 2 AT NEPTUNE

QUARTERLY STATUS REPORT

JULY - SEPTEMBER 1987

Prepared by:

William D. Brundage

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Approved by:

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SUMMARY

During this third quarter of 1987, JPL and VLA continued testing all antennas operating at X-band. NRAO continued procuring materials and constructing front-ends and receivers for installation in 1987 thru March 1988. Three more antennas became operational at X-band, for a total of 14. The VLA Implementation Plan was finalized and issued this quarter. JPL and NASA considered additional funding for replacing critical VLA power cables in 1988.

FEEDS

VLA received the last eight production feed horns from JPL. We now have all 28 feeds plus one spare.

The antenna group installed support towers and feed horns during overhaul of three antennas this quarter.

COOLED FRONT-ENDS

The Central Development Laboratory (CDL) delivered four more front-ends (#20 thru #23) to the VLA this quarter. One further front-end (#24) awaits shipment and two more near completion. We have all parts on hand for the completion of the remaining front-ends (total of 30) by the end of 1987.

The latest receivers use GE HEMTs and have a typical $T_r \leq 13$ K.

RECEIVER SYSTEM

The front-end (FE), cryogenics (CRYO), local oscillator (LO), and digital control system (DCS) groups completed and installed the eleventh thru fourteenth production receiver systems this quarter. A production HEMT cooled-front-end and Rack-F replaced the last of the two developmental FET front-end systems. The upgraded VLA receiver front-ends in Rack-A, which contains the new bandswitches, must be installed before an X-band receiver becomes operational. Now the front-end and cryo groups install an upgraded Rack-A with the X-band installation or before.

The DCS group began construction of Analog Sum #2 this quarter and completed testing of Analog Sum #1.

The LO group placed permanent mountings for the 108 IF bandpass filters and are ready to install the remaining 81 filters when provided by JPL.

NEW ON-LINE SYSTEM

JPL concurred on the Implementation Plan for the new VLA On-line System, and VLA issued it in September as Computer Division Memo No. 177, "Voyager Considerations for the VLA On-line System".

The Plan focused on aspects of software and hardware. It included items on schedule, reliability, testing, autophasing, and operations.

The new system continued operating this quarter in a parallel monitoring mode. The new system will take control of the array in early November. The old system hardware will be removed in early January. VLA and JPL continued using the new display of X-band front-end monitor data, which will evolve according to users' needs.

JPL provided, via the DSN Telos Software Support contract, a computer programmer to assist with software development. He started in August and will continue into February.

TESTS

In each month of July, August, and September, 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. Simulations of the current autophasing algorithm on normal synthesis array data demonstrated that autophasing robustness in removing atmospheric phase fluctuations is independent of baseline length, provided delay between phase data acquisition and application of phase corrections is sufficiently short.

JPL also measured the performance of up to thirteen 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.

POWER GENERATION

JPL and VLA continued installing 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. The electrical contractor began work in September. System testing will begin in May 1988.

SCHEDULE

The twelfth, thirteenth, and fourteenth X-band systems became operational this quarter. All of them utilize lower noise HEMT amplifiers. We expect sixteen antennas to be operational at X-band by the end of next quarter. The schedule has a total of 20 operational antennas by mid 1988, and all 28 by the end of 1988.

The VLA Implementation Plan contains summarized schedules for the X-band system installation, back-up cryo-compressor installation, analog sum and switch construction, new on-line system implementation, power generation system implementation, power cable replacement, and array configuration.

RELIABILITY

Following the Reliability Review No. 1 , VLA continued to monitor downtime statistics and explore possible mitigations. We will issue another review by March 1988.

Several CTI 22 cryogenic refrigerators in the cooled front-ends had failed after only 3000 hours running time. Since early 1987, VLA replaces carbon bushings in all refrigerators with polyamide bushings of Envex or Vespel, expecting to extend the MTBF. Two units with scotch-yokes of VLA design continued extended testing with no associated failures. Several units will be equipped with displacer couplings of VLA design. Experience so far with these modifications indicates improved MBTF.

Concerns continued this quarter about reliability of on-site power distribution cables feeding the arms of the wye. The National Science Foundation (NSF) has not yet responded to the VLA report on the problem, which included a cable replacement schedule and cost estimate. NRAO-VLA funding in 1987 only allowed adding a redundant cable between the site switch-gear and the Control Building. JPL and NASA will consider special funding so that VLA can complete cable replacement by December 1988, at least to the end of the C-array, which will be used during most of the Voyager telemetry reception in 1989.

FUNDS

Spending by CDL and VLA is on schedule relative to the revised budgetary estimate and funding schedule, which is (in \$k):

FY	1985	1986	1987	1988	1989	TOTAL
	891	1977	1712	1114	610	6304

In order to complete the receiver installation on the VLA by the end of 1988, NRAO has requested that NASA transfer to NSF either the full \$1114k for FY 1988 in FY Quarter 1 (October 1987), or \$709k in FY Quarter 1 plus \$135k in each of FY Quarters 2, 3, and 4.

A fiscal statement for the project from inception thru 1987 September 30 follows. It includes total expenditures and commitments (E&C), and balance. Total allocations equal total funds. In addition it shows estimated E&C at calendar year end, and estimated balance at year end.

SUMMARY FISCAL STATEMENT IN \$k
INCEPTION THRU DATE

VLA-VOYAGER

DATE: 1987 SEPTEMBER 30	ALLOCATION IT Dec87 \$k	E&C ITD \$k	BALANCE ITD \$k	Est E&C IT Dec87 \$k	Est BAL IT Dec87 \$k
<u>VERY LARGE ARRAY</u>					
WAGES	520	458	62	520	0
BENEFITS	141	118	23	141	0
COMMON COSTS	494	432	62	494	0
TRAVEL	60	29	31	53	7
OFFICE LAB ADDITIONS	28	27	1	28	0
2 DEV'L RECEIVERS	157	157	0	157	0
CRYOGENICS & VACUUM	51	59	-8	54	-3
CRYD COMPRESSORS	161	169	-8	170	-9
RCVR INSTALLATION M & S	461	427	34	461	0
EQUIPMENT (TEST & TOOLS)	115	56	59	115	0
JPL DONATED EQUIP	326	326	0	326	0
BACKUP ON-LINE COMPUTER	250	255	-5	255	-5
RELIABILITY IMPROVEMENTS	5	9	-4	5	0
POWER GENERATION	73	71	2	73	0
CONTINGENCY	10	0	10	0	10
VLA TOTAL	2852	2595	256	2852	0
<u>CENTRAL DEVELOPMENT LABORATORY</u>					
WAGES	654	536	118	654	0
BENEFITS	207	140	67	207	0
COMMON COSTS	423	348	75	423	0
TRAVEL	36	19	17	19	17
MATERIALS & SERVICES	455	411	44	411	44
EQUIPMENT (TEST & TOOLS)	279	340	-61	340	-61
CDL TOTAL	2054	1792	262	2054	0
VOYAGER TOTAL	4906	4388	518	4906	0
NASA FUNDS	4580				
JPL DONATED EQUIP	326				
TOTAL FUNDS	4906				
BALANCE = TOT FUND - VGR TOT	0				

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