

JANUARY 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

JANUARY PROJECT REPORT

VLA PROGRAM

FEBRUARY 18, 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

JANUARY 1977

SYSTEMS INTEGRATION DIVISION

The following observing sessions were conducted this month:

January 3-5 33 hours of interferometer test and calibration.

January 6-10 Program AH3, Hjellming (NRAO).
Search for radio emission from compact radio sources.
Program AH4, Hjellming (NRAO), Weisskopf, Novick (Columbia University).
Observations of Cygnus X-2.
85 hours of observations and interferometer test and calibration with 5 antennas.

January 17-19 38 hours of interferometer test and calibration.

January 21 6 hours of interferometer test and calibration.

January 24-26 Program A0-3, Owen, Spangler (NRAO).
Observation of AR LAC at all phases of the 1.98 day orbital period.
34 hours of observing with 3 antennas.

January 27-31 Program A0-3, Owen, Spangler (NRAO).
Observation of AR LAC at all phases of the 1.98 day orbital period.
Program A0-1, Owen, Porcas (NRAO).
Spectrum of strong millimeter sources.
Program AH5, Hjellming (NRAO), Gibson (NMIMT).
Periodic monitoring of CYG X-1.
80 hours of observing with 5 antennas.

At the end of the month Antennas #1 through #6 were located at stations DW8, BW8, DW3, CW8, DW2, and CW5. The maximum baseline was 5.2 km. Antennas #1 and #2 were outfitted for all bands. Antennas #3 to #5 were outfitted for 6, 2, and 1.3 cm. Antenna #6 was outfitted for 6 cm and undergoing single dish tests at 1.3 cm.

ELECTRONICS DIVISION

Antenna #6 was put into operation on the array on January 4, 1977. Antenna #7 is scheduled for operation in late February, but progress on the front-end has been held up by late delivery of parametric amplifiers.

A prototype of the new amplifiers was received from AIL. Problems were found in meeting the gain, noise temperature and pump power level specifications and a group of NRAO engineers will visit AIL in early February to resolve these problems.

In the feed area all antennas now have C-Band corrugated horn feeds. Requested for quotation for the K, Ku and L-Band horns have been issued and an option for C-Band feeds has been exercised for systems 11-15.

In the cryogenics area 3 compressors were retrofitted with stainless steel piping, leaving only 1 antenna still needing this modification. Representatives of Cryomech visited the Site on 4-6th January. They brought a new refrigerator for testing and tests made in the VLA Cryogenics Lab showed that the Cryomech system can meet VLA specifications. A Cryomech system is being run continuously in the lab to obtain reliability data. An RFQ has been issued for cryogenics systems 11-15. The front-end on Antenna #5 was found to have a helium leak from the refrigerator cylinder assembly into the vacuum dewar. The front-end was returned to the lab where it was found possible to replace the refrigerator cylinder and remount the front-end components on it with 10 hours work. If necessary, this type of repair could be carried out on an antenna.

Waveguide has been installed out to station BW8 covering 5.2 km of the west arm. Twenty millimeter waveguide connections from the manholes to the foundations are complete for 10 out of the 18 intervening stations. A measurement of the attenuation of the waveguide between CW5 and CW9, which was the section first installed, shows that the attenuation continues to increase at about the same average rate observed since August, 1975. However, the mean attenuation over the 5.2 km is well below the maximum tolerable level.

The redesigned local oscillator modules, L2 and L3, are being installed in Antennas #3 and #5, together with less extensively modified units. These antennas will be used for testing electronic modifications during the coming year. Investigation of remaining small phase instabilities in other modules is progressing, and work has started on improving the reliability of module F3, the 17-20 GHz L.O. used for observations at 2 and 1.3 cm wavelengths.

Modems have been completed and tested for antennas through #8, digital samplers for antennas through #9 and delay and multiplier cards for antennas through #8. Design of the IF units for the Spectral Processor is progressing. The second custom integrated circuit has now been through the preliminary design stages and a second design review meeting will occur at the beginning of February. Monitor and control modules for Antennas #7 to #10 are being assembled by a local company and are about 25% complete. Design of an improved Serial Line Controller to provide a backup unit is complete and assembly is about to commence. Construction by the Charlottesville group for antennas through #10 is essentially complete and the B and D racks for antennas through #10 were shipped from Charlottesville on January 28.

On January 3, 1977 Henry Richards joined the VLA electronics group as engineer for the Local Oscillator System.

COMPUTER DIVISION

During January, the MODCOMP program was modified to handle one-of-a-kind devices (currently, only the weather station) in a more logical fashion, and an improved system for detecting antenna position servo oscillations was installed.

An obscure software error caused loss of data on the Antenna 1-Antenna 2 baseline during the observing session of January 17-19. Two of the MODCOMPS, "Boss" and "Monty", have been brought up to current revision levels by MODCOMP service; the remaining two will be done the first week in February. This is necessary so that we may upgrade our computers to Model II/45 as planned and so that we may run new releases of the software systems.

The new correlator data structure for the DEC-10 was implemented in January. There are currently available preliminary versions of programs to list and to plot its contents. The SYNLIST program, which averages and lists the MODCOMP output tape appears to be approaching a stable version.

The MODCOMP fixed head disk interface is now operating sufficiently well that work may start on implementing the software to make it a DEC system device.

Work has begun on making the monitor log data available to the DEC-10 programs which manipulate correlator data.

The addition of a hard copy device to the Tektronics graphic CRT has made it much more useful for obtaining plots of both correlator data and monitor log data.

ANTENNA DIVISION

Antenna No. 7

Mechanical outfitting completed and antenna moved on January 10 to station DW9. Antenna will be returned to station CW5 for installation of electronics upon completion of testing of Antenna #6.

Antenna No. 8

Moved on January 13 to maintenance pad for outfitting. Compressor platform, cable trays and handrail were installed. Electrical installation is in progress.

Antenna No. 9

Panel setting completed on January 19 with measured rms of 0.012 inches. Antenna moved on January 24 to Master pad for final alignment. Servo installation started on January 31, 1977.

Antenna No. 10

Started assembly of pedestal on January 20, 1977. At end of month, pedestal was assembled to yoke arms. Reflector is approximately 80% complete.

First parts of Antenna #11 were received on Site January 17, 1977 with arrival of the surface panels. On January 19 two truck loads of miscellaneous mechanical and structural parts for Antenna #11 were received from the E-Systems warehouse in Dallas. Receipt of the first structural parts for the antenna is anticipated in late February. Trial assembly of Antenna #11 is presently in progress in Hobbs, New Mexico. Inspection of gear segments and azimuth bearing and gear were performed at the manufacturer's plants in late January.

SITE AND WYE

Subcontract VLA-149; Wye Construction; Burn Construction Company, Inc., \$3,001,176

All trackage has been completed on all arms. Maintenance Vehicle Spur Line is complete and being used.

This contract is estimated at 99.6% complete.

Subcontract VLA-167; Paul D. Goar Construction; \$165,228

The lean-to structural steel and siding was delivered to the Site and installation will commence after installation of the generators.

Waveguide

The lead-in sections to the Control Building for the north and east arms have been completed.

Work on the test section (waveguide installed inside on a 6" diameter PVC pipe sleeve) between antenna foundations CN7 and CN8 has commenced.

PROJECT MANAGEMENT

In the month of January 1977, 225 purchase orders and subcontracts were placed at a total price of \$373,425.00.

Personnel

The personnel changes as of January 31, 1977 are as follows:

<u>Division</u>	<u>Previous Level</u>	<u>Additions</u>	<u>Reductions</u>	<u>Current Level</u>
Site and Wye	6	1	0	7
Antenna	10	2	0	12
Electronics	43	1	2	42*
Computer	14	1	0	15
Systems Integration	4	0	0	4
Project Management	<u>26</u>	<u>2</u>	<u>1</u>	<u>27**</u>
Total	103	7	3	107

* Includes one temporary person

**Includes two part-time people

VLA PROJECT
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

<u>NUMBER P.O. SUBCONTRACT</u>	<u>VENDOR</u>	<u>ITEM DESCRIPTION</u>	<u>DATE PLACED</u>	<u>DOLLAR AMOUNT</u>	<u>DELIVERY DATE</u>	<u>CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED</u>
VLA-5	BWH/CVR Joint Venture	E/A Title I and II	6/11/73	\$ 1,039,064		Title I - Completed Title II - Completed Title III - Work in progress in conjunction with VLA-149 and preparation of bid documents for Phase IV construction. Fixed price plus reimbursables.
VLA-6	E-Systems, Inc.	28 Radio Telescopes	10/18/73	\$ 18,131,767	3/01/77	NRAO has taken possession of Antenna Nos. 1 through 8. Antenna #9 is on schedule. Amendment 19 for Antennas 11-20 has been accepted by E-Systems.
VLA-29	Sterling-Detroit Co.	Focusing Feed Mounts	11/03/76	\$ 524,032	8/01/77	Delivery is on schedule for Antennas 11 through 16.
VLA-53	R. F. System	K and Ku Band Feed Horns	1/26/76	\$ 109,168	11/15/76	All but two Ku Band Horns received. Two Ku Bands shipped 1/31/77.
VLA-70 P.O. 52322	Sumitomo Electric USA, Inc.	5373 pieces of waveguide 5185 each coupling sleeves	1/27/75	\$ 1,801,827	1/15/77	4313 pieces of waveguide and 4380 coupling sleeves have been received. First shipment under C.O. No. 4 is due in April 1977.
VLA-149	Burn Construction Co., Inc.	Site Construction Phase III	9/25/76	\$ 3,001,176	10/25/76	Work is Approx. 99.6% complete.
P.O. 53880	N. M. Tech.	Labor Hour Contract	9/01/75	\$ 15,000	8/31/76	Approx. \$12,653 spent effective 1/31/77
VLA-167	Paul D. Goar Construction Co.	Prefab Metal Maintenance and Warehouse Bldgs.	1/06/76	\$ 165,228	3/30/77	Amendment No. 1 issued for construction of Lean-to type addition to maintenance building. Work on addition is progressing on schedule.
VLA-174	Lawrence Hefner	Provide Labor and Equipment	1/26/76	\$ 80,000	2/28/77	Approx. \$70,751 spent effective 1/31/77.

VLA PROJECT
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

<u>NUMBER P.O. SUBCONTRACT</u>	<u>VENDOR</u>	<u>ITEM DESCRIPTION</u>	<u>DATE PLACED</u>	<u>DOLLAR AMOUNT</u>	<u>DELIVERY DATE</u>	<u>CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED</u>
VLA-179 P.O. S-01046	AIL Div. of Cutler Hammer	Parametric Amplifiers	4/29/76	\$ 62,320	10/12/76	Vender has had trouble meeting specifications. Problems appear to have been resolved and delivery should be complete by 3/31/77.
P.O. S01946	Industrial Design Engineering Assoc.	Labor Hour Contract for Temporary Draftsman	7/21/76	\$ 19,000	1/26/77	Draftsman is working in drafting section at 2015 Ivy Rd., Charlottesville, Va. \$9,382 spent effective 1/31/77.
P.O. S-01984	J. J. Gustincic Consulting Engr.	Consultant Agreement	8/02/76	\$ 4,000	12/31/76	Consultant on K, Ku and C Band Horn. \$600 spent effective 1/31/77.
VLA-211 P.O. S-02412 P.O. S-02524	Executone Systems of New Mexico Inc.	VLA Wye Comm. System	10/05/76	\$ 72,980.83	3/30/77	Installation was completed December 1976 on all antennas that have been delivered and all cable has been installed.
VLA-227	Fairmont Railway Motors, Inc.	Motor Vehicle for operation on RR Track and Ground	10/15/76	\$ 10,430.40	1/31/77	Unit will be shipped 2/08/77.
VLA-229 P.O. S-02717	Digital Equipment Corp.	128K words of Main Memory and two Data Channels	11/30/76	\$ 83,760	1/30/77 3/31/77	Delivery is on schedule for 128K words of memory. Delivery of data channels will be 6/30/77.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 164,000	3/21/77 6/30/77	Delivery is on schedule.
P.O. S-02998	AIL Div. Cutler Hammer	Upconverters	12/15/76	\$ 62,623	6/15/77 to 8/15/77	Delivery is on schedule.
P.O. S-01742	Digital Equipment Corp.	Maintenance on DEC-10 System	1/07/77	\$ 67,560	6/30/77	Maintenance is performed daily at VLA Site.
VLA-240 P.O. S-03093	Eagle Picher In- dustries, Inc.	Fabricated Metal Parts	1/07/77	\$ 67,092	4/17/77	Delivery is on schedule.
P.O. S-0336	Modular Computer Systems, Inc.	Host Computer for Array Processor	1/28/77	\$ 62,075	4/30/77	Delivery is on schedule.

VLA PROJECT
PROCUREMENT ACTIVITIES INITIATED

<u>RFP NUMBER</u>	<u>ITEM DESCRIPTION</u>	<u>ESTIMATED COST</u>	<u>ISSUE DATE</u>	<u>BID DUE DATE</u>	<u>SUBMISSION TO NSF DATE</u>	<u>AWARD DATE</u>	<u>CURRENT STATUS</u>
VLA-5	Amendment No. 11 for inspection of Site Construction	\$ 49,086	-----	-----	10/28/76	-----	Amendment No. 11 is being held until contract for Site construction Phase IV is awarded
VLA-149	Amendment No. 6 for earthwork and 8.1 miles of RR Track	\$536,000	-----	-----	12/13/76	-----	Awaiting approval from NSF.
VLA-234	Design Review of Transport Vehicle	\$ 38,363	9/28/76	11/01/76	1/26/77	2/15/77	Awaiting approval from NSF.
VLA-244	High-Speed Array Processors	\$175,000	11/11/76	12/17/76	1/24/77	-----	Awaiting approval from NSF.
VLA-245	Standby Power Source	\$ 70,000	11/19/76	12/13/76	1/30/76	1/15/77	Order awarded for alternate 1 Phase I of Specification.
VLA-247	Two Meter Flexible Waveguide	\$ 45,000	12/07/76	1/06/77	1/31/77	1/31/77	Two proposals are being evaluated.
VLA-251	Multilayer Printed Circuit Boards	\$ 65,000	1/11/77	2/08/77	2/28/77	3/15/77	Proposals solicited from 12 companies.
VLA-252	Cryogenic Refrigeration System	\$ 88,000	1/25/77	1/25/77	3/15/77	3/31/77	Proposals solicited from 3 companies.
VLA-254	L-Band Horns	\$108,000	1/25/77	2/25/77	3/15/77	3/31/77	Proposals solicited from 7 companies.
VLA-255	Host Computer for Array Processor	\$135,000	1/27/77	2/11/77	2/28/77	3/15/77	Proposals solicited from 2 companies.

CY - 1977

VERY LARGE ARRAY

STATUS AS OF JANUARY 31, 1977

	<u>ALLOCATION</u>	<u>EXPENDED MONTHLY</u>	<u>TOTAL EXPENDED</u>	<u>TRANSFER TO FIXED ASSETS</u>	<u>BALANCE CONSTRUCTION IN PROGRESS</u>	<u>TOTAL COMMITTED</u>	<u>TOTAL EXPENDED & COMMITTED</u>	<u>BALANCE</u>	<u>OUTSTANDING OBLIGATIONS PENDING</u>	<u>NET BALANCE</u>
SITE AND WYE	2,488,000	14,876	21,983	2,871	19,112	384,212	406,195	2,081,805	56,573	2,025,232
ANTENNAS	3,908,000	64,191	124,307	---	124,307	3,477,862	3,602,169	305,831	208,937	96,894
ELECTRONICS	3,633,000	119,295	221,432	800	220,632	794,140	1,015,572	2,617,428	704,446	1,912,982
COMPUTER	1,020,000	20,354	20,354	---	20,354	92,513	112,867	907,133	334,534	572,599
SYSTEMS INTEGRATION	82,000	2,461	2,461	---	2,461	64	2,525	79,475	43,351	36,124
PROJECT MANAGEMENT	100,000	7,558	7,558	---	7,558	35	7,593	92,407	79,008	13,399
CONTINGENCY/RESERVE	578,000	---	---	---	---	---	---	578,000	---	578,000
COMMON COST	691,000	42,704	42,704	---	42,704	18,317	61,021	629,979	629,979	---
TOTAL VLA	12,500,000	271,439	440,799	3,671	437,128	4,767,143	5,207,942	7,292,058	2,056,828	5,235,230

This report does not reflect allocation of uncommitted carry-over of \$464,151 from CY-1976 funds totalling \$17,086,000.

TOTAL PROJECT
VERY LARGE ARRAY
STATUS AS OF JANUARY 31, 1977

	<u>ALLOCATION</u>	<u>EXPENDED MONTHLY</u>	<u>TOTAL EXPENDED</u>	<u>TRANSFER TO FIXED ASSETS</u>	<u>BALANCE CONSTRUCTION IN PROGRESS</u>	<u>TOTAL COMMITTED</u>	<u>TOTAL EXPENDED & COMMITTED</u>	<u>BALANCE</u>	<u>OUTSTANDING OBLIGATIONS PENDING</u>	<u>NET BALANCE</u>
SITE AND WYE	14,320,406	228,155	11,553,397	2,968,161	8,585,236	499,040	12,052,437	2,267,969	56,573	2,211,396
ANTENNA	17,138,344	62,344	10,427,330	2,436,519	7,990,811	6,400,613	16,827,943	310,401	208,937	101,464
ELECTRONICS	10,912,934	100,054	7,059,764	403,711	6,656,053	1,019,080	8,078,844	2,834,090	704,446	2,129,644
COMPUTER	3,548,589	19,777	2,383,557	396,901	1,986,656	124,061	2,507,618	1,040,971	334,534	706,437
SYSTEMS INTEGRATION	221,000	2,590	127,626	12,614	115,012	934	128,560	92,440	43,351	49,089
PROJECT MANAGEMENT	1,688,961	(7,611)	1,568,456	141,283	1,427,173	24,468	1,592,924	96,037	79,008	17,029
CONTINGENCY/RESERVE	680,066	---	---	---	---	---	---	680,066	---	680,066
COMMON COST	691,000	42,704	42,704	---	42,704	18,317	61,021	629,979	629,979	---
TOTAL VLA	49,201,300 ⁽¹⁾	448,013	33,162,834	6,359,189	26,803,645	8,086,513	41,249,347	7,951,953	2,056,828	5,895,125

(1) Total Project allocation does not include \$283,000 withheld by NSF for Army Corp. of Engineers, \$15,700 for ECAC Study. \$50,000 withheld by NSF on Amendment #24 to C-780 is included in the total allocation.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLA PROGRAM

FINANCIAL STATUS REPORT
(in thousands)

As of: January 31, 1977

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Item	Program Ceiling	Allocation to Date			Un-allocated Balance	Outlook			Notes
		Allocated	Expended and Committed	Allocated Balance		Estimate to Complete	Estimate Total	(Over) Under Ceiling	
Site and Wye	27,860	14,320	12,052	2,268	13,540	14,727	26,779	1,081	(6)
Antennas	20,400	17,138	16,828	310	3,262	5,038	21,866	(1,466)	
Electronics	17,000	10,913	8,079	2,834	6,087	9,075	17,154	(154)	
Computer	4,850	3,549	2,508	1,041	1,301	3,018	5,526	(676)	
Systems Integration	400	221	128	93	179	133	261	139	
Program Management	2,650	1,689	1,593	96	961	375	1,968	682	
Common Cost	-	691	61	630	(691)	2,010	2,071	(2,071)	
Subtotal	73,160	48,521	41,249	7,272	24,639	34,376	75,625	(2,465)	
Contingency	2,840	680	-	680	2,160	2,527	2,527	313	
TOTAL	76,000 ⁽¹⁾	49,201 ⁽²⁾	41,249	7,952	26,799	36,903	78,152 ⁽⁴⁾	(2,152)	

Notes: (1) Includes estimate of \$293K for site acquisition and \$15.7K for ECAC Study withheld by NSF. Total

(2) Allocation includes \$50K withheld by NSF on Amendment 24 to Contract C-780.

(3) Basic Estimate is that of August 1976.

(4) Estimate excludes the Airstrip: \$268K.

(5) Escalation included for future years at 6% for Site/Wye work, National Radio Astronomy Observatory labor, minor antenna equipment items and certain electronic equipment. No future escalation has been included for computer purchased equipment.

(6) Includes \$525,000 for Transporter #2.

Explanation to Accompanying Statement

Column (2) - Project Ceiling: Original estimates

Column (3) - Allocated: Funded by NSF and included in total funds provided in Contract C-780.

Column (4) - Expended and Committed: Actual cash paid out and orders written and accepted by vendors.

Column (5) - Allocated Balance: Column 3 less Column 4. (Current funds available for expenditure and commitment.)

Column (6) - Unallocated Balance: Column 2 less Column 3. (Funds due from NSF to fund the total project as originally estimated.)

Column (7) - Estimate to Complete: Original estimate updated to take into account current or known costs.

Column (8) - Estimated Total: Column 4 plus Column 7.

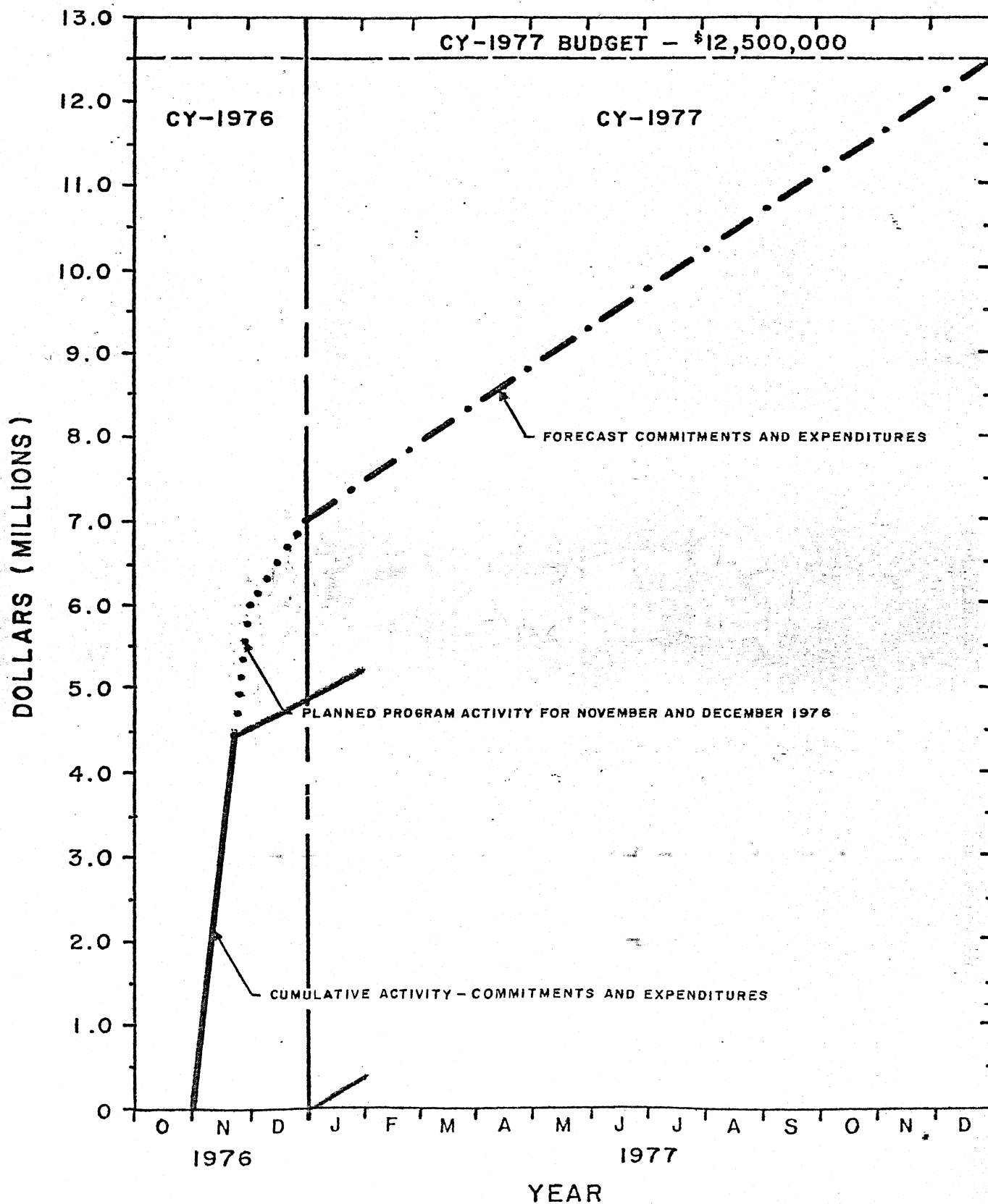
Column (9) - (Over) Under: Column 2 less Column 8.

VLA-NRAO

PROGRAM REPORT

EXPENDITURES AND COMMITMENTS

CY-1977 CUMULATIVE ACTIVITY



NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

11/15/76

UPDATE DATE: 2/1/77

