

DECEMBER 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

DECEMBER PROGRESS REPORT

VLA PROGRAM

January 16, 1978

# NATIONAL RADIO ASTRONOMY OBSERVATORY

## MONTHLY PROGRESS REPORT

### VLA PROGRAM

DECEMBER 1977

#### SYSTEMS INTEGRATION DIVISION

The following astronomical observing programs were scheduled this month:

<u>Name</u>	<u>Affiliation</u>	<u>Program Code</u>	<u>Program Short Title</u>
DECEMBER 1-4			
R. M. Hjellming R. L. Brown	NRAO (VLA) NRAO (GB)	AH-2	Simultaneous observations of stellar objects at Green Bank and the VLA for instantaneous spectra.
DECEMBER 12-14			
R. C. Bignell E. R. Seaquist	NRAO (VLA) Toronto	AB-15	Mapping of the nuclear regions of three nearby spiral galaxies.
R. M. Hjellming D. M. Gibson	NRAO (VLA) NMIMT	AH-5	Periodic monitor of Cyg X-1.
DECEMBER 15-19			
Program AH-5 - same as above			
R. C. Bignell	NRAO (VLA)	AB-9	Mapping of 3C273.
R. M. Hjellming	NRAO (VLA)	AH-8	Search for radio emission from optically polarized soft x-ray emitters.
R. M. Hjellming N. R. Vandenberg	NRAO (VLA) NRAO (VLA)	AH-6	Study of nova shells.
E. B. Fomalont A. H. Bridle G. K. Miley	NRAO (GB) Queens University Leiden	AF-2	Observe nuclear components of sources with steep spectra.
A. R. Thompson	NRAO (VLA)	AT-2	Map of planetary nebula NGC 7662.
DECEMBER 27-29			
T. X. Thuan S. J. Goldstein	Virginia Virginia	AT-1	Detection of blue compact galaxies.

The array was scheduled for 274 hours of tests and observations (37% of the time). The downtime average for the month was 14%. There have been no changes in the location of operational antennas since last month's report.

#### ELECTRONICS DIVISION

A leak in the Air Products refrigerator cylinder assembly in Front-end 11 has required complete replacement of the refrigerator, with a subsequent delay in the construction of the unit. Front-end 11 should be ready for installation on an antenna in early January. Front-end 12 has undergone its first cooldown. The C.T.I. refrigerator in Front-end 13 has cooled successfully.

A program of retrofitting of Antenna Nos. 1 to 10 with the improvements and modifications designed over the past year was commenced in mid-December, and the first antenna was completed on schedule by the end of the month. This program includes modifications to improve the local oscillator stability and the general reliability of the electronics, and will be completed within the first half of the year. The addition of IF filtering at the antennas and spectral processing capacity will be made later.

The prototype F7 and F8 modules, which are designed to provide IF filtering at the antennas, were received from Charlottesville, and are undergoing laboratory testing as the month closes. Phase stability measurements on the test array have been extended to include the 18-21 cm band. The phase stability at 6 cm is close to satisfactory, and tests of the phase variation with temperature in the antenna vertex room show a coefficient of 2 to 3 degrees per degree centigrade at this wavelength. The 5 MHz master local oscillator for the entire system has been phase-locked to the rubidium time standard.

The 1978 electronics procurement is now under way and orders have been placed in many areas including all components required for the modems. Assembly of multilayer cards for the spectral processor is progressing and full production quantities of both custom integrated circuits are in the packaging and testing stage at Silicon Systems. The nitrogen supply system for pressurizing the waveguide has been completed and as the month ends final design details of waveguide windows and leakage monitoring procedures are being worked out.

#### COMPUTER DIVISION

Work is continuing on the software interface between the DEC-10 computer and the PDP-11 minicomputers. The 10-side interface now supports, in essentially final form, transmission of data from the 11 to the line printer spooler. Addition of other devices is expected to be fairly straightforward. Work is now concentrating on bringing the 11-side software interface up to an equivalent level of sophistication.

The revision of old programs coincident with the installation of the new command decoder is now nearly complete - the only exception is VISPLT, which is about 75% complete. Work has started on a program to implement the CLEAN algorithm on the new map format data.

An order has been placed for a communications line expander to support additional terminals in the Control Building and eventually a terminal in Socorro. (The latter requires additional equipment not yet ordered as well).

Further work on the software support for the micro-processors in the new correlator system is now waiting interface completion and definitions of the macrocode for the micro-processors. Work has started on the array processor program which will cause the new correlator to emulate the current interim correlator.

Work has been started on a software system which will permit readable and flexible listings of the data checker messages to be made.

#### ANTENNA DIVISION

##### Antenna No. 11

Mechanical outfitting was completed. Antenna was moved on December 20 to CW 5.

##### Antenna No. 12

Moved to maintenance foundation on December 20 and mechanical outfitting started.

##### Antenna Nos. 13 & 14

Awaiting mechanical and electronic outfitting.

##### Antenna No. 15

Accepted on December 7 from E-Systems and moved on December 13 to Station DW-6 to await outfitting.

##### Antenna No. 16

Pedestal and reflector mated on December 12 in the Assembly Building. Panel installation started.

#### Miscellaneous

At the end of December, seven azimuth bearings arrived on site leaving a balance of one remaining. This makes available on site or in E-Systems stock in Dallas all major items with the exception of panels and the antenna structure itself. Panel shipments are complete through Antenna No. 21.

#### SITE AND WYE DIVISION

##### Waveguide Installation

Waveguide installation was completed on the north arm with the exception of finish grading around three manholes. Trenching commenced on the west arm from CW-6 for approximately 400 feet. 20 mm was installed at DE-1, DE-3 and DE-4.

## PROJECT MANAGEMENT DIVISION

### Personnel

The personnel changes as of December 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	8	0	0	8
Antenna	14	0	0	14
Electronics	48	1	1	48*
Computer	14	0	1	13
Systems Integration	7	0	0	7
Project Management	<u>23</u>	<u>2</u>	<u>0</u>	<u>25**</u>
Total	114	3	2	115

\* Does not include one part-time person

\*\* Does not include three part-time people

### GENERAL

#### Davis-Bacon Wage Matter

The hearing before the Department of Labor Wage Appeals Board was postponed several times as the Department did not have travel money and was finally held on December 8, 1977. The members of the Board, particularly the Chairman, appeared to be sympathetic to the NRAO-NSF case and we are optimistic as to the outcome. We are ready to proceed with the necessary design work for a revised Phase IV construction package just as soon as a decision is published by the Wage Appeals Board. This is expected about the middle of January 1978.

#### Archaeological Site

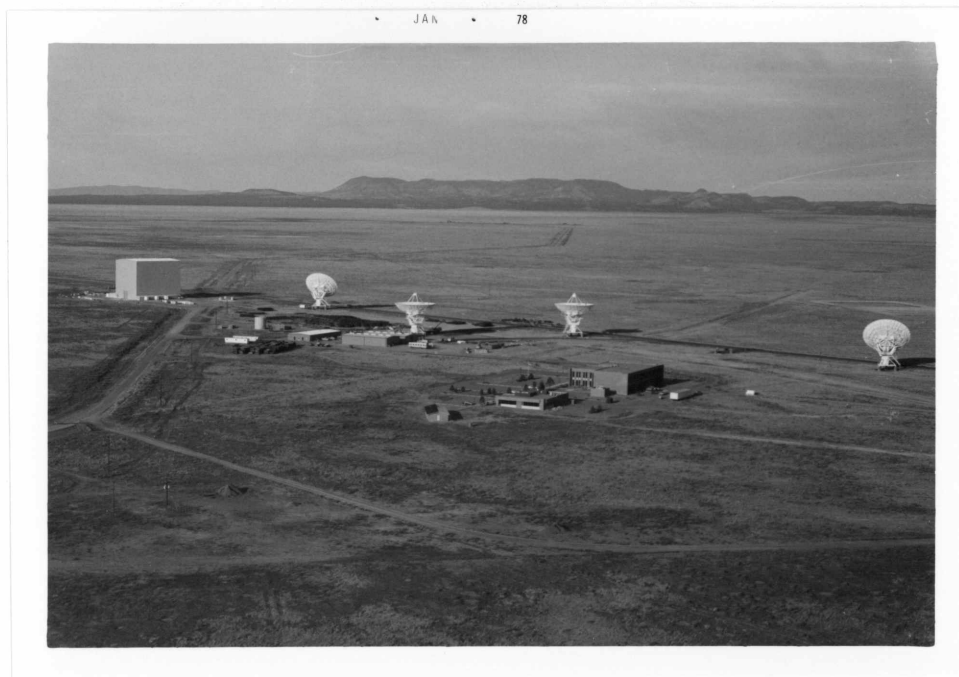
Upon approval of the modification to the subcontract with New Mexico State University covering the archaeological work, we requested the Corps of Engineers to notify Mr. Ake that we intended to start work on or about October 17, 1977. This was done on October 6, 1977 and resulted in Mr. Ake advising Dr. Bussey and the Regents of NMSU on October 11 that he would consider them to be in trespass on private property and liable to damages. On October 17 the CoE referred the matter to the Assistant U. S. Attorney, who then referred it to the Department of Justice in Washington for a decision. On November 8 the DoJ advised the U. S. Attorney in New Mexico to proceed to file a motion in the Albuquerque U. S. District Court to enforce possession. This was done on November 21. The Court

issued a "Writ of Assistance" and an "Order for Writ of Assistance" on December 6. Mr. Ake filed an objection on December 8 and the U. S. Judge called a hearing on December 9, at which he allowed the writ to stand. On December 13 the CoE formally notified NRAO that we were clear to proceed with the exploration.

We have since been in touch with Mr. Ake, who is satisfied and gave us permission to use his ranch roads for access to the site. Due to year-end vacation and scheduling problems, NMSU will not be able to start the excavation until the latter part of January.

#### Access Road to the VLA Site

All preliminary subgrade and base pavement of the 1.5 mile approach road to the VLA Site has now been completed by the New Mexico State Highway Department. The Department has not yet agreed to pave the remaining 0.4 mile of access road. This matter should be on the Highway Commissioners' agenda for their January 19 meeting.



p12-77-1

Site of Building Complex looking West



p12-77-2

Aerial View of Southwest Arm of Array



12/31/77

VLA PROGRAM  
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

NUMBER P.O. SUBCONTRACT	VENDOR	ITEM DESCRIPTION	DATE PLACED	DOLLAR AMOUNT	DELIVERY DATE	CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED
VLA-5	BWH/CVA Joint Venture	E/A Title I and II	6/11/73	\$ 1,039,064		Title I - Completed Title II - Completed Title III - Work in conjunction with VLA-149 is complete.
VLA-6	E-Systems, Inc.	28 Radio Telescopes	10/18/73	\$ 21,256,850		Amendment #21 approved by NSF in amount of \$3,125,083.
VLA-29	Sterling-Detroit	Focusing Feed Mounts for Antennas 17 thru 22	6/17/74	\$ 734,760		Delivery on progress.
VLA-70 P.O. 52322, C.O. #5	Sumitomo Electric USA, Inc.	3000 pieces of wave- guide - 3000 each coupling sleeves	1/27/75	\$ 2,885,126		Delivery completed by 12/31/78.
VLA-179 P.O. S-01046	AIL Division of Cutler-Hammer	Parametric Amplifiers	4/29/76	\$ 134,920		Delivery in progress.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 206,375	2/28/78	Delivery will be completed on 2/28/78.
P.O. S-02998	AIL Division of Cutler-Hammer	Upconverters	12/15/76	\$ 62,623	2/28/78	Five pieces have been received; six are on back order. Delivery will be completed by 2/28/78.
P.O. S-01742	Digital Equipment Corporation	Maintenance on DEC-10 System	1/07/77	\$ 102,312	12/31/77	Maintenance is performed daily at VLA Site. Approximately \$102,312 was spent effective 12/31/77.
VLA-234	E-Systems, Inc.	Design Review of Transporter	2/17/77	\$ 37,253	6/30/77	Subcontractor began design review on 3/25/77. Work is approximately 98% complete.
VLA-256	New Mexico State University	Archaeological Excavation	9/20/77	\$ 107,000	7/01/77	Work to start latter part of January '78.

VLA PROGRAM  
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

NUMBER P.O. SUBCONTRACT	VENDOR	ITEM DESCRIPTION	DATE PLACED	DOLLAR AMOUNT	DELIVERY DATE	CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED
VLA-258	Midstate Cartage Co.	Labor-Hour Subcontract	3/28/77	\$ 195,000	3/27/78	Approximately \$126,100 was spent effective 12/31/77.
P.O. S-04382	Industrial Design Engr. Assoc.	Temporary Draftsman		\$ 8,000	12/31/77	Approximately \$7,500 spent effective 12/31/77.
P.O. S-04400	New Mexico Institute of Mining and Tech.	Labor-Hour Contract		\$ 10,000	8/31/77	Approximately \$2,725 spent effective 12/31/77.
P.O. S-04738	AIL Division Cutler-Hammer	Parametric Amplifiers	10/14/77	\$ 102,900	5/03/78	Vendor will furnish firm delivery schedule by 1/16/78.
P.O. S-04886	AIL Division Cutler-Hammer	Parametric Upconverters	9/23/77	\$ 79,702	7/15/78	Order has been accepted by AIL and work is in progress and on schedule.
P.O. S-05002	Modular Computer Systems	Back up Synchronous Computer System	10/17/77	\$ 95,383.20	1/02/78	Delivery is on schedule.
VLA-277 P.O. S-05376	Wheeler Construction Co.	Crushed Stone	11/3/77	\$ 292,600	3/8/78	Work in Progress.
VLA-283 P.O. S-05136	Fujikura Cable Works Ltd.	20 mm Waveguide		\$ 168,756	4/30/78	Order placed 11/4/77.
P.O. S-05428	Digital Equipment Corporation	Equipment to Expand Graphics Display Systems	11/15/77	\$ 61,953	5/15/78	Delivery scheduled for completion on 5/15/78.
P.O. S-05841	DEC	Computer Maintenance		\$ 86,630	Cy '78	To NSF for approval 12/28/77. (Continuation of Services previously preformed under P.O. S-01742).

## VLA PROGRAM

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 Site Construction	\$ 49,086	-----	-----	10/28/76	-----	Amendment No. 11 is being held until contract for Site Construction Phase IV is awarded.
VLA-278	Rail Take Up	\$ 325,000	10/20/77	11/19/77	12/01/77	1/16/78	Proposals received; Amendments requested; revised proposals being evaluated.
VLA-291	Fabricated Metal Parts	\$ 60,000	10/20/77	11/10/77	11/30/77	12/15/77	Proposals received from four companies. Submitted to NSF for approval 1/5/78.
VLA-293	Bins and Brackets	\$ 41,738	10/20/77	11/10/77	11/30/77	11/29/77	50% delivery by 1/31/78; Balance by 2/28/78.
VLA-295	Mixers, Spec. #A13440N9B and drawings #C13440P22A	\$ 55,200	10/27/77	11/18/77	12/14/77	1/10/78	NSF approval requested 12/14/77. NSF approved 12/30/77.
VLA-304	Prefab Motel & Office Building	\$ 103,000	12/5/77	12/19/77	12/28/77		NSF approved 1/12/78. Two bids received.

VERY LARGE ARRAY  
STATUS AS OF DEC. 31, 1977  
TOTAL CY-77

<u>PROJECT NUMBER</u>	<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 &amp; COMMITTED</u>	<u>NET BALANCE</u>
11000 SITE AND WYE	2,822,883	249,841	1,276,187	43,835	1,232,352	1,075,674	2,351,861	471,022
12000 ANTENNA	4,134,500	1,568,013	4,089,219	4,478	4,084,741	14,084	4,103,303	31,197
13000 ELECTRONICS	3,835,500	325,213	3,040,371	27,491	3,012,880	249,533	3,289,904	545,596
14000 COMPUTER	1,053,000	101,826	610,500	762	609,738	177,826	788,326	264,674
16000 SYSTEMS INTEGRATION	67,000	5,112	51,876	216	51,660	502	52,378	14,622
17000 PROGRAM MANAGEMENT	105,700	8,732	101,518	-0-	101,518	163	101,681	4,019
18000 COMMON COST	691,000	80,502	643,694	-0-	643,694	17,830	661,524	29,476
19000 CONTINGENCY/RESERVE	364,189	-0-	-0-	-0-	-0-	-0-	-0-	364,189
20000 CY-78 FUNDING	7,200,000	329,438	337,130	-0-	337,130	4,025,462	4,362,592	2,837,408
 TOTAL PROGRAM	 20,273,772	 2,668,677	 10,150,495	 76,782	 10,073,713	 5,561,074	 15,711,569	 4,562,203

Notes: (A) Project allocation does not include the following amounts which were withheld by the NSF: 1) \$293,000 for the Army Corp. of Eng; 2) \$15,700 for the ECAC Study; 3) \$15,111 for the NSF Ad Hoc Advisory Panel.

VERY LARGE ARRAY  
STATUS AS OF DEC. 31, 1977

TOTAL PROGRAM

<u>PROJECT NUMBER</u>		<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 &amp; COMMITTED</u>	<u>NET BALANCE</u>
11000	SITE AND WYE	14,470,109	254,946	12,901,814	3,682,381	9,219,433	1,102,376	14,004,190	465,919
12000	ANTENNA	17,359,976	1,568,013	17,314,171	10,247,506	7,066,665	14,607	17,328,778	31,198
13000	ELECTRONICS	10,923,863	328,613	10,122,205	3,217,105	6,905,100	275,473	10,397,678	526,185
14000	COMPUTER	3,447,207	101,826	2,998,834	1,374,200	1,624,634	183,692	3,182,526	264,681
16000	SYSTEMS INTEGRATION	193,019	5,112	178,842	138,639	40,203	543	179,385	13,634
17000	PROGRAM MANAGEMENT	1,683,712	12,307	1,677,042	1,566,933	110,109	5,067	1,682,109	1,603
18000	COMMON COST	691,000	80,502	643,694	-0-	643,694	17,830	661,524	29,476
19000	CONTINGENCY/RESERVE	407,303	-0-	-0-	-0-	-0-	-0-	-0-	407,303
20000	CY-78 FUNDING	7,200,000	329,438	337,130	-0-	337,130	4,025,462	4,362,592	2,837,408
TOTAL PROGRAM		56,376,189	2,680,757	46,173,732	20,226,764	25,946,968	5,625,050	51,798,782	4,577,407

Notes: (A) Project allocation does not include the following amounts which were withheld by the NSF: 1) \$293,000 for the Army Corp. of Eng; 2) \$15,700 for the ECAC Study; 3) \$15,111 for the NSF Ad Hoc Advisory Panel.

NATIONAL RADIO ASTRONOMY OBSERVATORY  
VLA PROGRAM

FINANCIAL STATUS REPORT  
(in thousands)

As of: December 31, 1977

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Item	(A) 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	14,470	14,004	466	13,390	13,099	27,103	757	
Antennas	20,400	17,360	17,329	31	3,040	4,786	22,115	(1,715)	
Electronics	17,000	10,924	10,398	526	6,076	6,827	17,225	(225)	
Computer	4,850	3,447	3,183	264	1,403	2,415	5,598	(748)	
Systems Integration	400	193	179	14	207	26	205	195	
Program Management	2,650	1,684	1,682	2	966	421	2,103	547	
Common Cost	-	691	662	29	(691)	1,299	1,961	(1,961)	
Subtotal	73,160	48,769	47,437	1,332	24,391	28,873	76,310	(3,150)	
Contingency	2,840	407	---	407	2,433	1,733	1,733	1,107	
TOTAL	76,000	49,176	47,437	1,739	26,824	30,606	78,043	(2,043)	

- Notes: (A) Includes \$293K for site acquisition, \$15.7K for ECAC Study, and \$15.1K for NSF Ad Hoc Advisory Panel  
 (B) Estimate to complete is as of August, 1977, and it excludes \$268K for airstrip  
 (C) Estimate to complete includes an escalation factor of 6% for Site/Wye work, NRAO labor, minor antenna equipment items, and certain electronic equipment. No future escalation has been included for computer purchased equipment.  
 (D) The antenna estimate includes \$596K for Transporter #2.  
 (E) The above statement does not reflect the \$7,200K for CY-78 program plan received on Amendment No. 29 to NSF-AST-74-13427 (formerly NSF C-780).

# NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

UPDATE DATE: 12/15/77

