

NOVEMBER 1978

NATIONAL RADIO ASTRONOMY OBSERVATORY

NOVEMBER PROGRESS REPORT

VLA PROGRAM

DECEMBER 15, 1978

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NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

NOVEMBER 1978

SYSTEMS INTEGRATION DIVISION

The array was scheduled for 53 percent of the time; 44 percent went to astronomical programs and the remaining 9 percent to tests. The average downtime for the month was approximately 12 percent.

The sixteen antennas currently outfitted with electronics are located at stations DW8, BW8, DE1, CW8, DE2, BW6, DE4, AW5, AW6, DE3, DE8, CE8, CE6, AW7, CW5, and CE9. These stations are positioned approximately 0.5, 5.2, 0.08, 1.6, 0.04, 3.2, 0.1, 7.7, 10.5, 0.09, 0.5, 1.6, 1.0, 13.6, 0.7, and 1.9 km respectively from the array center. Our longest astronomically usable baseline is approximately 14.5 km. The total number of operational antennas is 13 (1 through 13). Antennas 5, 7, and 10 are presently decommissioned for electronic retrofits. Antennas 14, 15, and 16 are in the shakedown stage. The test array consists of Antennas 3, 5, and 11.

ELECTRONICS DIVISION

The electronics for Antenna 17 was completed during November and first fringes were obtained on December 4, 1978. This is the second antenna to be installed with the CTI's latest modification of their 1020 cryogenics system, the 1020 CP refrigerator and 1020 R compressor. Installation of CTI cryogenics on Antenna 10 to replace the Cryomech unit which had failed was in progress during the month, and final cool-down tests are being made as this report is prepared.

In the waveguide area, the final-design couplers have now been installed at all stations on the west arm out to AN8 at 17.2 km where the completed waveguide ends. A pressure monitor for this arm, which works on absolute pressure, is being tested and will shortly be connected to the computer monitoring system. Tests of the newly installed waveguide on the east arm show a mean attenuation of 1.01 dB per km at 50 GHz for the 3.36 km from BE6 to AE5. Tests of the cathodic protection system for the waveguide are being started.

A test observation using two antennas with the redesigned phase detectors for F2 and F3 modules mentioned in last month's report has confirmed the expected improvement. At 1400 MHz the level of the

interfering signal has been reduced by 24 dB and the dominant mechanism is no longer the harmonics of 200 MHz from F2 and F3 but the lower level harmonics of 50 MHz from equipment in rack B. Investigation of how to eliminate this latter effect is being started.

Tests on module F7 for the front end filter scheme have been completed and this module has been released for production. All of the required F7 filters are now on order. Progress is continuing on the new baseband modules (T3, T4, T5, and T6) for spectral line operation. The prototype T4, which contains the bandwidth selection filters, has been tested and resulting minor modifications to the circuit-board artwork are almost complete. A prototype of T6, the control module, is ready for testing, and components for prototypes of the two others are mostly on hand and being assembled.

The spectral processor has continued in use with no major problems since it was first brought into operation at the end of October. It has now replaced the old delay and multiplier system for all observations with the array. A start has been made on the software for the self-test of the correlator section and for spectral line operation. The possibility of self-test of the integrator section remains limited by the low level crosstalk, which is not sufficiently serious, however, to affect the basic system operation. In Charlottesville two sets of B- and D-Racks, for Antennas 19 and 20, and one A-Rack, for Antenna 23, have been completed ahead of schedule and will be shipped to the site in mid-December.

COMPUTER DIVISION

The PDP-11/70 mapping software works, and can make maps up to 1024 on a side. The mapmaking phase of the 1024 map takes approximately 15 minutes (exclusive of data select and sort phases). This can be dramatically reduced by the use of more of the core memory of the 11/70. DEC is expected, within the next year or so, to release software which will make this very much easier than it currently is. The programs are currently being connected into a system, so that a map can be made by typing a single command which will cause execution of all programs.

The Dicomed film writer has been interfaced to the IMPS data base, and can make grey scale or pseudocolor images of the maps. Work has started on adding coordinate lines and labels to these images. The latter may be lengthy - a software character generator must be made to work (Dicomed provided a skeleton routine, but it will take quite a lot of our own programming to make it go).

Work has started on a few of the on-line developments for the spectral line system. Highest priority is to have a system to let us see a spectrum plot in real time (10 second averaged data).

We are ordering a new small Modcomp which will, primarily, take the task of handling the terminals from MONTY. MONTY will have his hands full with 27 antennas of DCS data, and the 10% of his time spent handling the CRT terminals was projected to be intolerable.

ANTENNA DIVISION

Antenna No. 17

Moved on November 1, 1978 to Station CW6 for electronic installation and initial operation.

Antenna No. 18

Mechanical outfitting complete with exception of minor amount of touch-up painting.

Antenna Nos. 19 and 20

Awaiting mechanical outfitting.

Antenna No. 21

Reflector mated to pedestal assembly on November 6, 1978. Surface panels installed and aligned and surface RMS measured on November 27 as of 0.0105 inches. Feed legs installed and aligned. Elevation gear and gear boxes aligned and kirk sited. At end of month, antenna was ready for move to master pad for servo installation and final alignment.

Antenna No. 22

Reflector assembly started in rear of assembly building on November 9, 1978. Pedestal frame on site ready for start of assembly.

Miscellaneous

Surface panels through Antenna 27 on Site. Antenna 16 moved to Station CE9 on November 1, 1978.

SITE AND WYE DIVISION

Waveguide Installation

Trenched approximately 7,800 feet east arm and installed approximately 5,100 feet of waveguide, 5,200 feet set to line and grade and backfilled. Completed 60 mm and 20 mm waveguide installation at AW8.

Phase IV

Pacific Railroad Constructors have completed trackage to AW7 and have completed approximately 95% of the trackage work to AW8.

Round Place Construction has completed 100% of the clearing and grubbing work to AE8 and has completed 100% of the excavation work between CE9 and BE9, as well as 65% of the excavation work between BE9 and AE8. Trackage subbase removal and recompaction work is in progress and is 50% complete. Antenna foundation concrete tie beams have been poured at BN5, BN6, and BN8. All antenna umbilical cords have been fabricated and delivered.

PROJECT MANAGEMENT

General

Arizona Railroad Co. is continuing the take up of 4500 feet of railroad trackage at Fort Huachuca, Arizona and shipments are being received at the Site.

During November the procurement activity has centered around exercising a number of options on major subcontracts thus utilizing the \$3.5 million in advanced 1979 funding, initiating procurement actions for the early part of 1979 and completing the 1978 purchasing requirements. In all, some \$4.3 million in procurement activity has been commenced or completed this month. In a number of instances, it has been possible to place orders for quantities to complete the requirements for the program. This has allowed price advantage to be taken of larger quantities and elimination of potential inflation.

Bids were received on the second antenna transporter. Arrangements were made to meet with the bidders early in December in order to evaluate their capabilities and also to conduct price negotiations.

Phase IV Construction: On November 30, 1978 the General Accounting Office denied the Burn Construction Company, Inc. Request for Reconsideration and affirmed their previous decision in favor of NSF-NRAO.

New Mexico Gross Receipts Tax: On October 26, 1978 two attorneys from the New Mexico Department of Taxation and Finance and experts from the U. S. Department of Justice visited the Site to observe the movement of an antenna.

VLA Land Acquisition: During the period November 28, 29, December 1 the Commission was appointed by the U. S. District Court to consider the Ake-Taylor-Dunlap request for additional compensation for the land taken for the VLA. It is expected that the Commission will visit the Site before making their recommendations to the Judge.

Personnel

The personnel changes as of November 30, 1978 are as follows:

<u>Division</u>	<u>12/1978</u>	<u>10/31 Level</u>	<u>Additions</u>	<u>Reductions</u>	<u>11/31 Level</u>
Site and Wye	9	9	0	0	9*
Antenna	15	14	1	0	15
Electronics	54	51	0	0	51**
Computer	16	15	0	0	15
Systems Integration	9	8	0	0	8***
Project Management	<u>27</u>	<u>27</u>	<u>0</u>	<u>0</u>	<u>27****</u>
Total	130	124	1	0	125

* Does not include one part-time employee
** Does not include one part-time employee
*** Does not include one part-time employee
**** Does not include three part-time employees

VLA PROGRAM
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 Amend. #12	BWH/CVA Joint Venture	E/A Title I and II	6/11/73	\$ 1,090,684		Title I -Completed Title II -Completed Title III -Completed Title IV -VLA-325 Supervision
VLA-6 Amend. #21	E-Systems, Inc.	28 Radio telescopes	10/18/73	\$ 18,156,054		Delivery in Progress.
VLA-29 Amend. #5	Sterling-Detroit	Focusing Feed Mounts thru Antenna 28 plus spares	6/17/74	\$ 1,002,380		Delivery in Progress. (Mounts for Antennas 23-28 complete by 7/13/79. Amend. #5 issued 11/9/78.
VLA-70 P.O. 52322, C.O. #5 C.O. #6 C.O. #7	Sumitomo Electric USA, Inc.	3000 pieces of waveguide 3000 each coupling sleeves 1060 pieces of waveguide 3000 pieces of waveguide and 3900 pieces of coupling sleeves.	1/27/75 9/27/78 11/03/78	\$ 3,215,847	12/31/78; 4/30/79; 7/31/79; 10/31/79; and 1/31/80.	2000 pieces received. Next 1000 to arrive Oakland port by 12/31/78.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 206,375	9/15/78	Complete except for 468 each of Item 4.
VLA-256	New Mexico State University	Archaeological Exca- vation	9/20/77	\$ 107,000	2/20/79 Completion	\$76,332 invoiced thru 9/30/78. Final reports due 2/20/79.
P.O. S-07698	New Mexico Institute of Mining and Tech.	Cost Reimbursement Blanket Order		\$ 3,000	12/31/78	Follow on to P.O. S-04400.
P.O. S-04886	AIL Division Cutler- Hammer	Parametric Upconverters	9/23/77	\$ 79,702		Nine units still due. Promise of 3 each - 12/3/78 3 each - 12/15/78 3 each - 1/19/79.

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MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

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P.O. S-07990	AIL Division Cutler-Hammer	Parametric Amplifiers	9/21/78	\$ 197,600	Complete by 1/21/80	
P.O. S-08085	AIL Division Cutler-Hammer	Parametric Upconverters	10/23/78	\$ 102,525	4/13/79 thru 8/13/79	
VLA-277 P.O. S-05376 Amend. #4	Wheeler Construction Co.	Crushed Stone		\$ 659,328	Complete by 2/1/79	
P.O. S-05814	DEC	Computer Maintenance	1/30/78	\$ 84,742	Cy '78	Monthly expenditure rate estimated at \$7,000.
VLA-294 P.O. S-05722 Amend. #1	Hughes A/C Co.	Gunn Diode Oscillators	8/30/78	\$ 48,805	12/07/78	
VLA-295 P.O. S-05746 Amend. #2	Spacekom, Inc.	Channel 2 thru 8 Mixers	1/10/78	\$ 100,500	Complete	
VLA-316	Midstate Cartage	Labor-Hour	3/28/78	\$ 150,000	Completed by 3/27/79	Total expenditure thru 11/4/78 is \$119,082.
P.O. S-06827 Amend. #2	C.T.I. Cryogenics	Cryocooler	5/23/78	\$ 239,760	2/15/80	Delivery late. Two units received
VLA-321	Allen Avionics	L.C. Filters	7/18/78	\$ 2,400	Complete	Total with all options is \$74,220; First option date is 01/01/79.
VLA-322 P.O. S-07436	Dicomed Corp.	Color Image Recorder	8/02/78	\$ 86,887	Complete	

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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-325	Pacific Railroad Constructors, Inc.	Phase IV Construction	6/23/78	\$ 2,916,080	9/16/79	Work progressing satisfactorily.
VLA-326 P.O. S-08191	California Computer Products, Inc.	Data Storage Subsystem	11/12/78	\$ 159,784	1/12/79	
VLA-340 P.O. S-08227	Digital Equipment Corp.	Computer System	11/6/78	\$ 101,938	2/09/79	
P.O. S-08269	Superior Electric Co.	Motors & Translators	10/26/78	\$ 30,643	1/29/79	
P.O. S-08222	Structures, Inc.	Transition & Towers for K, Ku and C-Band Horns, L Band Towers.	10/19/78	\$ 23,955	Complete by 6/01/79	
P.O. S-06084 C.O. #1	Structures, Inc.	Walkways & Platforms	9/27/78	\$ 33,740	Complete by 3/15/79	
P.O. S-08230	Structures, Inc.	Feed Support Structures	10/23/78	\$ 26,855	Complete by 6/01/79	
P.O. S-06387 Amend. #2	Milliflect	Subreflectors	10/23/78	\$ 61,200	Complete by 8/01/79	
P.O. S-08329	Contact Systems, Inc.	Various Wiring Modules	10/31/78	\$ 19,709	Complete by 7/19/79	
P.O. S-08423	Rimo Manufacturing, Inc.	C Band Horns	11/17/78	\$ 36,600	Complete by 10/1/79	
P.O. S-08422	Rimo Manufacturing, Inc.	L Band Horns	12/7/78	\$ 71,190	Complete by 9/1/79	
P.O. S-08443	Avantek, Inc.	Transistor Ampli- fiers	11/17/78	\$ 23,636	Complete by 4/15/79	

VLA PROGRAM

PROCUREMENT ACTIVITIES INITIATED

<u>RFP NUMBER</u>	<u>ITEM DESCRIPTION</u>	<u>ESTIMATED COST</u>	<u>ISSUE DATE</u>	<u>PROPOSAL/BID DUE DATE</u>	<u>SUBMISSION TO NSF DATE</u>	<u>AWARD DATE</u>	<u>CURRENT STATUS</u>
VLA-316 Amend. #2	Midstate Cartage	\$ 25,000			12/07/78	Estimate 12/22/78	Adding \$25,000 to existing subcontract.
VLA-323	Transporter		08/09/78	10/31/78	Estimate 12/22/78	Estimate 01/12/79	Two quotations received. Negotiations with both companies completed 12/08/78.
VLA-326 P.O. S-08191 C.O. #1	California Computer Products, Inc.	\$ 61,406			12/04/78	Estimate 12/19/78	Additional equipment to expand Synchronous Computer System for interface to the Sorting System.
VLA-340 P.O. S-08227 C.O. #1	Digital Equip. Corp.	\$ 1,038			11/22/78	12/08/78	Additional equipment.
VLA-344	Crushed Stone	\$700,000	11/14/78	12/01/78	Estimate 12/15/78	Estimate 12/29/78	Quotations being evaluated.
P.O. S-08510	Switch Filter Assemblies and Filters	\$193,943			12/01/78	12/12/78	
P.O. S-08535	Ku and K Band Feed Horns	\$ 71,554			12/07/78	Estimate 12/22/78	
P.O. S-08557	Diamond Line Zinc	\$ 59,412			12/07/78	12/08/78	

NATIONAL RADIO ASTRONOMY OBSERVATORY
VERY LARGE ARRAY
STATUS AS OF NOVEMBER 30, 1978
CY-1978

<u>PROJECT NUMBER</u>	<u>DESCRIPTION</u>	<u>ALLOCATION</u>	<u>EXPENDED MONTHLY</u>	<u>TOTAL EXPENDED</u>	<u>TRANSFER TO FIXED ASSETS</u>	<u>BALANCE CONSTRUCT. IN PROGRESS</u>	<u>TOTAL COMMITTED</u>	<u>TOTAL EXPENDED & COMMITTED</u>	<u>NET BALANCE</u>
11000	SITE AND WYE	5,273,000	579,852	2,269,021	16,211	2,252,810	2,919,567	5,188,588	84,412
12000	ANTENNA	3,762,000	226,577	1,441,944	13,920	1,428,024	2,264,223	3,706,167	55,833
13000	ELECTRONICS	3,897,000	248,314	2,566,976	46,610	2,520,366	705,456	3,272,432	624,568
14000	COMPUTER	740,000	13,286	226,831	50	226,781	265,713	492,544	247,456
16000	SYSTEMS INTEGRATION	23,000	4,534	23,439	1,133	22,306	200	23,639	(639)
17000	PROGRAM MANAGEMENT	109,000	8,464	98,736	4,926	93,810	128	98,864	10,136
18000	COMMON COSTS	605,527	45,640	511,807	---	511,807	14,261	526,068	79,459
19000	CONTINGENCY	325,832	---	---	---	---	---	---	325,832
TOTAL PROGRAM		14,735,359	1,126,667	7,138,754	82,850	7,055,904	6,169,548	13,308,302	1,427,057

Notes: Project allocation consists of \$12,873,000 in new funding plus \$1,862,359 in prior year funds re-allocated in CY-1978. In May, 1978, \$82,000 in allocation transferred from Contingency to Site and Wye for Cryogenic facility. As of June 30, 1978, CY-78 funds were re-allocated to reflect revised estimates plus new funds received. In June, 1978, \$200,000 in new funds were made available under Amendment No. 32. In addition, \$18,000 of the \$20,000 in funds withheld under Amendment No. 30 were made available with the remaining \$2,000 being used for the NSF Ad Hoc Advisory Panel. In September, 1978, \$175,000 in new funds were made available under Amendment No. 33 and \$160,000 in allocation was transferred from the Computer Div. to Site/Wye for additional waveguide procurement.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VERY LARGE ARRAY
STATUS AS OF NOVEMBER 30, 1978
TOTAL PROGRAM

PROJECT NUMBER	DESCRIPTION	ALLOCATION	EXPENDED MONTHLY	TOTAL EXPENDED	TRANSFER TO FIXED ASSETS	BALANCE CONSTRUCT. IN PROGRESS	TOTAL COMMITTED	TOTAL EXPENDED & COMMITTED	NET BALANCE
11000	SITE AND WYE	19,219,179	1,017,284	16,177,643	7,145,562	9,032,081	2,957,123	19,134,766	84,413
12000	ANTENNA	21,089,362	226,577	18,768,807	10,246,405	8,522,402	2,264,721	21,033,528	55,834
13000	ELECTRONICS	14,264,613	250,110	12,927,216	2,874,846	10,052,370	712,829	13,640,045	624,568
14000	COMPUTER	3,912,578	13,286	3,398,604	1,363,608	2,034,996	266,518	3,665,122	247,456
16000	SYSTEMS INTEGRATION	201,294	4,533	201,690	127,269	74,421	243	201,933	(639)
17000	PROGRAM MANAGEMENT	1,787,110	8,464	1,772,576	1,574,631	197,945	4,398	1,776,974	10,136
18000	COMMON COST	1,249,221	45,640	1,155,500	643,693	511,807	14,261	1,169,761	79,460
19000	CONTINGENCY / RESERVE	325,832	---	---	---	---	---	---	325,832
20000	CY-79 FUNDING	3,700,000	4,441	4,441	---	4,441	1,813,569	1,818,010	1,881,990
	SUB TOTAL	65,749,189	1,570,335	54,406,477	23,976,014	30,430,463	8,033,662	62,440,139	3,309,050
	RETIREMENTS	(5,045)	---	(5,045)	(5,045)	---	---	(5,045)	---
		<u>65,744,144</u>	<u>1,570,335</u>	<u>54,401,432</u>	<u>23,970,969</u>	<u>30,430,463</u>	<u>8,033,662</u>	<u>62,435,094</u>	<u>3,309,050</u>

Notes: 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) \$17,111 for the NSF Hoc Advisory Panel.

In May, 1978, \$82,000 in allocation transferred from Contingency to Site and Wye for Cryogenic facility.

As of June 30, 1978, CY-78 funds were re-allocated to reflect revised estimates plus new funds received.

In June, 1978, \$200,000 in new funds were made available under Amendment No. 32. In addition, \$18,000 of the \$20,000 in funds withheld under Amendment No. 30 were made available with the remaining \$2,000 being used for the NSF Ad Hoc Advisory Panel.

In September, 1978, \$175,000 in new funds were made available under Amendment No. 33. As of October 31, 1978, the NSF advanced \$3,700,000 in CY-79 funds. Retirements includes five items which were disposed of in prior years.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLA PROGRAM

FINANCIAL STATUS REPORT
(in thousands)

As of: November 30, 1978

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Item	(A) Original Program Ceiling	Allocation to Date			Un- allocated Balance	Outlook		
		Allocated	Expended and Committed	Allocated Balance		Estimate to Complete	Estimate Total	(Over) Under Ceiling
Site and Wye	27,860	19,219	19,135	84	8,641	7,932	27,067	793
Antennas	20,400	21,089	21,033	56	(689)	1,691	22,724	(2,324)
Electronics	17,000	14,265	13,640	625	2,735	4,000	17,640	(640)
Computer	4,850	3,913	3,665	248	937	2,517	6,182	(1,332)
Systems Integration	400	201	202	(1)	199	(1)	201	199
Program Management	2,650	1,787	1,777	10	863	325	2,102	548
Common Cost	-	1,249	1,170	79	(1,249)	944	2,114	(2,114)
Subtotal	73,160	61,723	60,622	1,101	11,437	17,408	78,030	(4,870)
Contingency	2,840	326	-	326	2,514	1,000	1,000	1,840
TOTAL	76,000 (A)	62,049	60,622	1,427	13,951	18,408	79,030	(3,030)

NOTES: (A) Includes \$293K for site acquisition, \$15.7K for ECAC Study, and \$17.1K for NSF Ad Hoc Advisory Panel.

(B) Estimate to complete is as of November 1978 and it excludes \$172K for airstrip.

(C) Escalation included for future years for Site/Wye work (8%); NRAO labor (6%); and certain electronic elements (8%). Antenna estimate is based upon the existing contract costs for fabrication of the antennas.

(D) The antenna estimate includes \$800K for transporter No. 2.

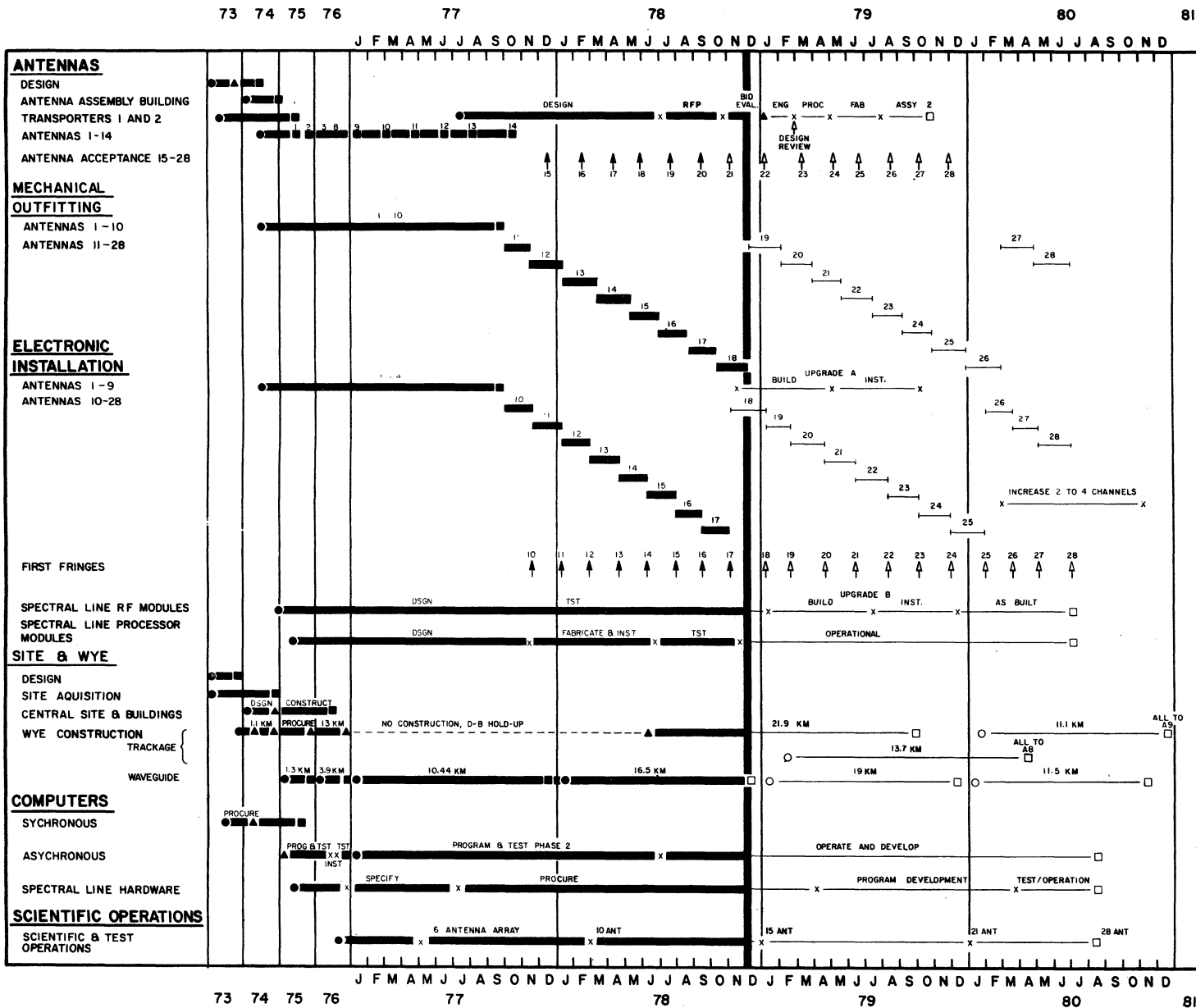
(E) Allocated includes new funds received from the NSF in the amounts of \$200K on Amendment No. 32 and \$175K on Amendment No. 33.

(F) The above statement does not reflect the \$3,700K advanced by the NSF for CY 1979 commitments and expenditures on Amendment No. 34 dated October 31, 1978.

(G) Allocated and Expended includes \$5K in assets which were retired in prior years.

NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

UPDATE DATE: 12/1/78



TASKS	
UPGRADE A	RECEIVER FRONT-END FILTERS, MODULES F4, F7, F8. INSTALL 5 ANT/MO. (25 MODULES)
UPGRADE B	SPECTRAL LINE IF MODULES T3, T4, T5, T6. INSTALL 4 SYSTEMS (24 MODULES) PER MONTH.
INCREASE 2 TO 4 CHANNELS	ADDITIONAL MODULES OF ABOVE TYPES. TOTAL 224. INSTALL 36 PER MONTH.

ABBREVIATIONS	
DSGN - DESIGN	TST - TEST
LAB - LABORATORY	PRELM - PRELIMINARY
INST - INSTALL	OPNS - OPERATIONS
ANT - ANTENNA(S)	

SYMBOLS	
O START OF A PHASE	△ CONTRACT AWARD
X END OF AN ACTIVITY	□ END OF A PHASE
↑ SCHEDULED	↑ COMPLETED

REV. NO.	REV DATE	DESCRIPTION
1	12/1/78	UPDATE PROGRAM PLAN