

JANUARY 1979

NATIONAL RADIO ASTRONOMY OBSERVATORY

JANUARY PROGRESS REPORT

VLA PROGRAM

FEBRUARY 15, 1979

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FEB 19 1979

# NATIONAL RADIO ASTRONOMY OBSERVATORY

## MONTHLY PROGRESS REPORT

### VLA PROGRAM

JANUARY 1979

#### SYSTEMS INTEGRATION DIVISION

The array was scheduled for 51 percent of the time; 32 percent went to astronomical programs and the remaining 19 percent to tests. The average downtime for the month was approximately 28 percent.

On January 19, Antenna 17 was moved to N8 on the North arm. This event marks the beginning of array observations employing antennas stationed on the North arm. The seventeen antennas currently outfitted with electronics are located at stations W8, W32, E1, W16, E2, W24, E4, W40, W48, E3, E8, E16, E12, W56, W64, E18, and N8. These stations are positioned approximately 0.48, 5.2, 0.08, 1.6, 0.05, 3.2, 0.15, 7.7, 10.5, 0.09, 0.48, 1.6, 0.97, 13.6, 17.2, 1.95, and 0.44 km respectively from the array center. Our longest astronomically usable baseline is approximately 18 km. The total number of operational antennas is 15 (1 through 15). Antennas 5 and 7 are presently decommissioned for electronic retrofits. Antennas 16 and 17 are in the shake-down stage. The test array consists of Antennas 3, 5, and 11.

#### ELECTRONICS DIVISION

In the front end area construction and testing on front end 18 was completed and the receiver was installed on the antenna. First fringes were obtained with Antenna 18 on 2 February. A stainless steel Dewar fabricated in the Green Bank machine shop has been received and will be used in the construction of front end 20. This Dewar exhibits a very high standard of workmanship and should help answer, in the long term, the question of whether or not stainless steel is superior to aluminum for constructing cryogenic vacuum vessels.

Further tests of the modifications to reduce RFI from modules F2 (up-converter pump) and F3 (17-20 GHz LO) have verified the value of the modifications. On Antennas 3 and 11, which have modified F2's and F3's, the 1400 MHz birdie produces 40 mJy in 1.5 MHz bandwidth, compared to 25 Jy on unmodified antennas. The strength of the 1450 MHz birdie is 63 mJy in 1.5 MHz bandwidths.

Redesign of the phase lock loop board in the L6 (2-4 GHz synthesizer) module has been completed. This redesign should improve the reliability of the lock and prevent the occurrence of spurious locks which are problems on some operational antennas.

Design of the new front end IF system (modules F4-F7-F8) is nearing completion. The designs for the F4 (frequency converter) and F7 (front end IF filter) have now been released for production. Testing of the prototype modules of the new spectral line baseband system (T3-T4-T5-T6) is continuing.

During the month the loss of the waveguide runs CW5 to CW9 and CW9 to BW6 were measured. It is one year since these losses were last measured. The losses were measured with the couplers between the two end stations left installed. When corrected for the known coupler loss, the waveguide loss did not show any deterioration over the measurements of a year ago.

The delay/multiplier system is now ready for spectral line operation. The necessary software for the delay/multiplier microprocessor has been completed and all recirculators have been successfully tested. Spectral line tests will start as soon as the necessary software is available for the FPS array processor and the Modcomps.

#### COMPUTER DIVISION

PDP-11/70 mapping software continues to improve. Maps up to 1024 on a side are supported, and work has begun on a CLEAN program using a slightly modified algorithm to best utilize the capabilities of the array processor.

Dicomed maps from the PDP-11/40 system continue to be improved. Radio images are now appropriately labeled; only a few more steps remain to allow publication-ready maps to be produced.

The new version of the ANTSQL program, intended to facilitate investigation of closure problems is now operational. When a little more is known about closure errors, a program to apply them to the data can easily be implemented.

Various improvements to the IMPS image display system have been begun. This system has now been assigned interim status; it will eventually be replaced by a system which is now starting to be developed by the Charlottesville programming group. IMPS will, however, be developed a bit more to be usable for visiting observers (it currently requires a bit of an adept to get data into the system).

Work has been started on an interim spectral line system which will be adequate to handle instrumental investigations and some astronomical problems.

#### ANTENNA DIVISION

The antenna division fabrication assembly and outfitting reached the following completion status at the end of January:

##### Antenna No. 19

Mechanical outfitting approximately 80% complete. Walkways and platforms installed, subreflector and support tube installed, waveguide installed, electrical junction boxes and interior cabling completed. The remaining items to be completed consist of feed leg cable trays and cabling, subreflector alignment and touch-up painting.

Antenna No. 20

Awaiting mechanical alignment.

Antenna No. 21

Moved on January 16 to DN5 to wait mechanical outfitting.

Antenna No. 22

Reflector assembly mated to pedestal on January 11. Panel installation and alignment completed on January 25 with an rms of 0.0098 inches. On January 31 the antenna was moved to the Master pad for final alignment, servo installation and servo testing.

Antenna No. 23

At the end of the month, reflector assembly was approximately 25% complete. The pedestal frame, tubes and bearings, support housing as well as reflector parts on site.

Miscellaneous

Antenna 17 was moved on January 9 to station DN8- first operating antenna on the North arm.

SITE AND WYE DIVISION

Waveguide Installation

Installed approximately 1680 feet of waveguide, 4700 feet set to line and grade and backfilled. Completed 20 mm waveguide installation at DN7. Zinc ribbon installation is complete to E27 manhole.

Phase IV

Track work on the West arm is still 98% complete with small modifications required before final acceptance. Track work has started on the East arm and is partially complete to BE7. Round Place Construction has suspended all earthwork due to the inclement weather. Antenna foundation concrete tie beams have been poured at BE5, BE6, and BE7.

PROJECT MANAGEMENT

General

Approximately 300 tons of railroad track has been transferred to the VLA Program from Eglin AFB. A contract has been let for its transport to the Site.

Advanced notice has been sent to the Commerce Business Daily for IFB 346 Phase V construction which is in preparation.

Personnel

The personnel changes as of January 31, 1979 are as follows:

Division	Budgeted 12/79 Level	12/31/78 Level	Additions	Reductions	1/31/79 Level
Site & Wye	9	9	0	0	9*
Antenna	17	15	0	0	15
Electronics	53	50	1	2	49**
Operations Management	3	3	0	0	3
Computer	15	12	1	0	13
Array Operations	11	9	2	2	9***
Program Management	28	26	3	2	27****
Totals	136	124	7	6	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



p2-79-1

View to North - Control Building foreground  
Office-Library to Left



p2-79-2

West Arm of Array

1/31/79

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 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. #6 C.O. #7	Sumitomo Electric USA, Inc.	1060 pieces of waveguide 3000 pieces of waveguide and 3900 pieces of coupling sleeves	9/27/78 11/03/78	\$ 3,215,847	4/30/79; 7/31/79; 10/31/79; and 1/31/80	Next 1060 pieces to arrive Oak- land port by 4/30/79.
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	\$80,633 invoiced thru 12/31/78 Final reports due 2/20/79.
P.O. S-04886	AIL Division Cutler- Hammer	Parametric Upconverters	9/23/77	\$ 79,702		One unit still due. Promise of 2/28/79.
P.O. S-07990	AIL Division Cutler- Hammer	Parametric Amplifiers	9/21/78	\$ 197,600	Complete by 1/21/80	2 received. On schedule.
P.O. S-08085	AIL Division Cutler- Hammer	Parametric Upconverters	10/23/78	\$ 102,525	4/13/79 thru 8/13/79	
P.O. S-08510	RLC Electronics, Inc.	Switch filter assemblies and filters	12/12/78	\$ 193,943	Start 4/3/79	
P.O. S-08535	RF Systems, Inc.	Ku and K Band Feed Horns	12/14/78	\$ 71,554	4/15/79	
P.O. S-08557	Federated Metals Corp.	Diamond Line Zinc Ribbon	12/8/78	\$ 59,412	2/02/79	192 of 194 received. 2 promised 2/28/79.
P.O. S-08558	Allen Avionics	L.C. Filters	1/08/79	\$ 67,040	Complete by 6/30/79	



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-277 P.O. S-05376 Amend. #4	Wheeler Construction Co.	Crushed Stone		\$ 659,328	Complete by 2/01/79	Complete.
P.O. S-08645	DEC	Computer Maintenance	1/08/79	\$ 90,063	CY'79	Monthly expenditure rate estimated at \$7,500.
VLA-316 Amend. #1	Midstate Cartage	Labor-Hour	3/28/78 12/28/78	\$ 175,000	Complete by 3/27/79	Total expenditure thru 12/31/78 is \$143,050.
P.O. S-06827 Amend. #2	C.T.I. Cryogenics	Cryocooler	5/23/78	\$ 239,760	2/15/80	
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 C.O. #1	California Computer Products, Inc.	Data Storage Subsystem	11/12/78 12/18/78	\$ 221,190	2/01/79	
VLA-340 P.O. S-08227 C.O. #1	Digital Equipment Corp.	Computer System	11/06/78 12/08/78	\$ 102,977	2/09/79	
VLA-344 P.O. S-08595	Wheeler Construction Co.	Crushed Stone	1/08/79	\$ 668,660	Complete by 4/01/80	
P.O. S-06084 C.O. #1	Structures, Inc.	Walkways & Platforms	9/27/78	\$ 33,740	Complete by 3/15/79	
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-08230	Structures, Inc.	Feed Support Structures	10/23/78	\$ 26,855	Complete by 6/01/79	
P.O. S-08269	Superior Electric Co.	Motors & Translators	10/26/78	\$ 30,643	1/29/79	Most deliveries on schedule. Com- plete by 3/2/79.

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
P.O. S-08329	Contact Systems, Inc.	Various Wiring Modules	10/31/78 1/19/79	\$ 30,486	Complete by 9/30/79	
P.O. S-06387 Amend. #2	Milliflect	Subreflectors	10/23/78	\$ 61,200	Complete by 8/01/79	
P.O. S-08422	Rimo Manufacturing, Inc.	L Band Horns	12/7/78	\$ 71,190	Complete by 9/1/79	
P.O. S-08423	Rimo Manufacturing, Inc.	C Band Horns	11/17/78	\$ 36,600	Complete by 10/01/79	
P.O. S-08443	Avantek, Inc.	Transistor Ampli- fiers	11/17/78	\$ 23,636	Complete by 4/15/79	
VLA-323	Logemann Bros.	Transporter	1/17/79	\$ 788,758	1/17/80	
P.O. S-08684	A & K Railroad Materials, Inc.	Wood Cross Ties	1/17/79	\$ 375,000	Complete by 10/79	
P.O. S-08685	Standard Pipeprotection	Coating of Waveguides	2/2/79	\$ 61,793	Complete by 2/15/80	

## VLA PROGRAM

1/31/79

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-345	G. C. Dean (Labor Hour)	\$170,000			1/10/79	Estimate 2/28/79	

NATIONAL RADIO ASTRONOMY OBSERVATORY  
VLA PROGRAM

FINANCIAL STATUS REPORT  
(in thousands)

As of: January 31, 1979

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Item	(A)	Allocation to Date			Un-allocated Balance	(B)	Outlook	(C)	Notes
	Original Program Ceiling	Allocated	Expended and Committed	Allocated Balance		Estimate to Complete	Estimate Total	(Over) Under Ceiling	
Site and Wye	27,860	24,187	21,555	2,632	3,673	5,512	27,067	793	
Antennas	20,400	22,625	21,458	1,167	(2,225)	1,266	22,724	(2,324)	
Electronics	17,000	16,913	14,983	1,930	87	2,657	17,640	(640)	
Computer	4,850	5,500	3,755	1,745	(650)	2,427	6,182	(1,332)	
Systems Integration	400	201	201	-	199	-	201	199	
Program Management	2,650	1,900	1,795	105	750	307	2,102	548	
Common Cost	-	1,723	1,275	448	(1,723)	839	2,114	(2,114)	
Subtotal	73,160	73,049	65,022	8,027	111	13,008	78,030	(4,870)	
Contingency	2,840	500	-	500	2,340	1,000	1,000	1,840	
TOTAL	76,000	73,549	65,022	8,527	2,451	14,008	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. Allocated and Expended includes \$11K in assets which were retired in prior years.

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

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

NATIONAL RADIO ASTRONOMY OBSERVATORY  
 VERY LARGE ARRAY  
 STATUS AS OF JANUARY 31, 1979  
 CY - 1979

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	4,631,000	9,836	25,572	3,695	21,877	2,308,071	2,333,643	2,297,357
12000	ANTENNA	1,536,000	11,880	34,799	---	34,799	371,374	406,173	1,129,827
13000	ELECTRONICS	2,651,000	52,560	97,406	545	96,861	702,089	799,495	1,851,505
14000	COMPUTER	1,587,000	9,053	9,053	---	9,053	11,736	20,789	1,566,211
17000	PROGRAM MANAGEMENT	115,000	9,764	9,764	---	9,764	---	9,764	105,236
18000	COMMON COST	487,752	28,563	28,563	---	28,563	10,651	39,214	448,538
19000	CONTINGENCY/RESERVE	500,000	---	---	---	---	---	---	500,000
	TOTAL PROGRAM	11,507,752	121,656	205,157	4,240	200,917	3,403,921	3,609,078	7,898,674

Note: Project allocation consists of \$11,500,000 in new funding plus \$7,752 in prior year commitments carried forward in Common Costs. As of January 31, 1979, \$9,375,000 of the CY-79 funds had been made available by the NSF. The remaining balance of \$2,125,000 has not been released.

NATIONAL RADIO ASTRONOMY OBSERVATORY  
VERY LARGE ARRAY

STATUS AS OF JANUARY 31, 1979

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	24,186,825	105,345	17,259,894	7,218,687	10,041,207	4,294,893	21,554,787	2,632,038
12000	ANTENNA	22,625,337	342,176	19,646,206	11,769,102	7,877,104	1,811,358	21,457,564	1,167,773
13000	ELECTRONICS	16,912,591	66,171	13,421,236	6,848,259	6,572,977	1,561,979	14,983,215	1,929,376
14000	COMPUTER	5,499,578	9,904	3,418,319	2,503,607	914,712	336,981	3,755,300	1,744,278
16000	SYSTEMS INTEGRATION	201,294	(9,261)	201,015	179,370	21,645	7	201,022	272
17000	PROGRAM MANAGEMENT	1,900,465	10,327	1,794,187	1,676,391	117,796	875	1,795,062	105,403
18000	COMMON COST	1,723,099	28,563	1,263,910	1,235,347	28,563	10,651	1,274,561	448,538
19000	CONTINGENCY/RESERVE	500,000	---	---	---	---	---	---	500,000
	SUB TOTAL	73,549,189	553,225	57,004,767	31,430,763	25,574,004	8,016,744	65,021,511	8,527,678
30000	RETIREMENTS	(10,820)	---	(10,820)	(10,820)	---	---	(10,820)	---
	TOTAL PROGRAM	73,538,369	553,225	56,993,947	31,419,943	25,574,004	8,016,744	65,010,691	8,527,678

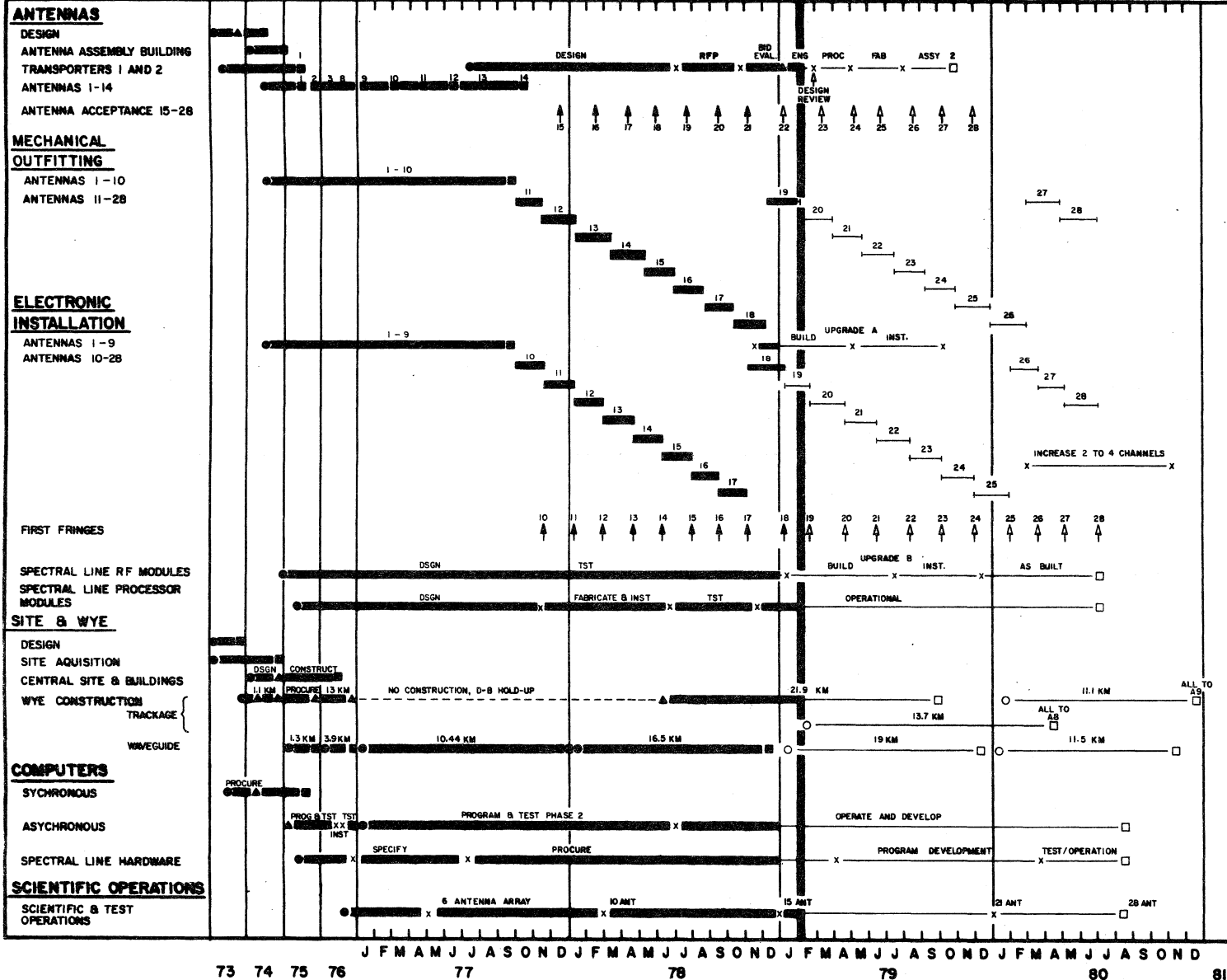
Note: Project allocation excludes \$325,811 withheld and paid directly to other agencies by the NSF in prior years.

Project allocation includes \$11,500,000 for CY-79 funding. Of this amount, the NSF has made \$9,375,000 available.

# NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

UPDATE DATE: 2/1/79

73 74 75 76 77 78 79 80 81  
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D



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	
○ 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