NATIONAL RADIO ASTRONOMY OBSERVATORY

JUNE PROGRESS REPORT

VLA PROGRAM

July 11, 1979

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

JUNE 1979

SYSTEMS INTEGRATION DIVISION

The array was scheduled for 57 percent of the time; 42 percent went to astronomical programs and the remaining 15 percent to tests. The average downtime for the month was approximately 9.5 percent.

Antenna 21 was moved to W12 on June 11. Antenna 20 was moved to N2 on June 18. The twenty antennas currently outfitted with electronics are located at stations N14, W32, E1, W16, E2, W24, E4, W40, W48, E3, E8, E16, E12, W56, W64, E18, W8, N4, N6, and N2. These stations are positioned approximately 1.14, 5.22, 0.08, 1.59, 0.04, 3.19, 0.15, 7.66, 10.47, 0.09, 0.48, 1.59, 0.97, 13.64, 17.16, 1.95, 0.48, 0.15, 0.27, and 0.05 km respectively from the array center. Our longest astronomically usable baseline is approximately 18 km. Antenna 1 was removed from service for cryo and AIL paramps retrofits on June 18 and will be unavailable for observations indefinitely. Antennas 1, 5 and 9 are currently unavailable for observation. Antennas 19 and 20 are in the shakedown stage. The test array consists of Antennas 3 and 11.

ELECTRONICS DIVISION

During the month circular polarizers were installed on all L-band (18-21 cm) feeds. Initial astronomical tests at 1385 MHz, 1480 MHz and 1685 MHz indicate acceptable performance with respect to on-axis instrumental polarization. Typical on-axis baseline instrumentals at the three frequencies are in the 1% to 2% range. No measurements have as yet been made of the off-axis performance of the circularly polarized L-band feeds.

In the front end area problems with AIL parametric amplifiers are now having a serious impact on the front end construction schedule. There are essentially three current problems with AIL paramps and it is worthwhile to review them at this time. The first problem, which has been mentioned in the March, April and May Progress Reports, is the demagnetization of the magnets in the circulators of the first 12 paramps supplied by AIL. This problem has been resolved by issuing a contract to AIL to replace all of these old style circulators with new style circulators which do not demagnetize. Ten of these old style paramps have been returned to AIL for the circulator change and the other two are still functioning satisfactorily in Antenna 8. The second problem, which was mentioned in the May Progress Report, is that AIL is several months late on their delivery schedule for paramps fabricated under the current build contract. They have been unable to obtain sufficient

numbers of varactors having the correct capacitance parameters from the three suppliers GHZ, Alpha and Microwave Associates. At the time of writing this report AIL are hopeful that a recently delivered batch of Alpha varactors will be satisfactory, but this has not yet been demonstrated. The final problem, which has arisen during the last month, is that three of the eight paramps delivered under the current build contract have failed by developing an over-coupled passband response after two cooldowns during front end construction. The cause of these failures has not yet been determined. The effect of these paramp problems has been to delay the front end construction schedule. Front end 20 had to be installed on the antenna with a paramp that was slightly out of specification, front end 21 is now two months behind schedule and construction of front ends 22 and 23 is halted awaiting paramps. As a note of optimism it is worth noting that, except for the cirulator demagnetization problem, the AIL paramps have been reliable once a front end has been completed and put into operation on an antenna. With 13 antennas operating for a total of approximately 10^6 paramp hours, only one paramp has had to be replaced because of failure (excluding the circulator demagnetization design flaw).

Assuming that the paramp problems take several more months to resolve, the most straightforward way of working around the problem is to leave the paramps out of the front end and to make up the missing gain with a low-noise room temperature GaAs Fet. System temperatures of about 100 K at L-band 200 K at C-band and 700 K at Ku- and K-band can be obtained in this way using a very good GaAs Fet amplifier with a 1.7 dB noise figure. These system temperatures will make an antenna usable until paramps are available. Another possibility is to use cryogenically cooled GaAs Fets in place of the paramps. However, given the current state of cryo-fet development, it seems unlikely that this is a useful solution at this time. RFP's for room temperature and cryogenically cooled GaAs Fets are being sent out.

The front end for Antenna 12 was reinstalled after having its cryogenics retrofitted with the CTI system.

A major development during the month was the first use of two antennas in true spectral line mode. Antennas 3 and 11 now have one IF complete with the spectral line baseband system. All band-pass responses between 50 MHz (8 channels) and 200 kHz (256 channels) were synthesized and observations were made of the OH maser W3OH. The tests showed that several changes are needed in the on-line spectral line software.

Finally, during the month, the loss of the 14.6 km of waveguide on the east arm was measured and found acceptable. At 50 GHz the average loss over 14.6 km is 1.08 dB/km.

COMPUTER DIVISION

The Versatec hard-copy peripheral for the new graphics terminal on the DEC-10 has been received. The terminal itself should be received at the beginning of July.

As an attempt to alleviate the DEC-10 disc storage capacity problem, there is now a procedure available to save data files on the Century discs attached to the PDP-11/70 (sorter) computer.

The work on on-line software for the spectral line system is progressing. A rather important 256 channel spectrum for one IF channel displayed on the on-line printer is the latest achievement.

ANTENNA DIVISION

Work of the Antenna Division at the end of month stood as follows:

Antenna No. 21

Mechanical outfitting completed and on June 11 the antenna was moved to station CW6 for electronic installation and initial operation.

Antennas No. 22 & 23

Awaiting mechanical outfitting.

Antenna No. 24

Moved to maintenance pad on June 11 and mechanical outfitting started. Focusing feed mount installed with crane as it was not available for installation in building as normally installed. Stairway, wallways and cryogenic platform installed.

Antenna No. 25

Panel alignment completed on June 6 with a measured RMS of 0.0105 inches. Antenna moved to master pad on June 12 for final alignment, servo installation and checkout and final inspection. Servo tests completed on June 25 with azimuth and elevation natural frequencies of 2.59 and 2.33 Hz respectively. The antenna was accepted on June 28, which is 6 days behind the schedule adopted in June, 1976.

Antenna No. 26

Pedestal assembly started on June 13. At end of month reflector assembly approximately 90% complete and pedestal assembly completed through yoke arms. Elevation wheel installed ready for gear alignment.

Antenna No. 27

Trial assembly of reflector completed, first shipment on site. Trial assembly of pedestal completed, ready for dismantling. Trial assembly of yoke arms and elevation wheel underway.

Miscellaneous

Antenna 20 moved from station CW5 to station DN2 on June 19.

SITE AND WYE DIVISION

Waveguide Installation

Installed approximately 2032 feet of waveguide, set to line and grade and backfilled between BN6 and BN7. Trenched 3800 feet on North arm.

Phase IV

Overall completion 85%. Track work on the West arm is still 96% complete with small modifications required before final acceptance. Track work on the East arm is partially complete to 1000 feet from AE7. First lift of ballast has been placed to 1000 feet past AE6. Round Place Construction is 99% complete with the earthwork. Subgrade preparation is complete and is ready for trackage. All antenna foundations are 100% complete. Electric work is still 85% complete.

Phase V

Overall completion 6%. Mountain States, the dirt work subcontractor, has completed 95% of the excavation work on the North arm and has completed the subgrade prep work to Highway 60. He has started clearing and grubbing on the West arm.

PROJECT MANAGEMENT

General

Land Acquisition: The Land Commission held its second hearing June 25th in Albuquerque, but refused to accept any additional testimony from the Government. The U. S. Attorney will file a Memorandum Brief to the Commission on July 5th and then await the Commission's Report and Recommendations.

Procurement: There has been no improvement in the parametric amplifier supply situation. We are continuing to do all we can to expedite the AIL Division of Cutler Hammer but to date they have been unable to find a satisfactory source of diodes which will stand up under cryogenic temperature cycling.

New Mexico Gross Receipts Tax: The final judgement in favor of the U. S. Government (VLA) was appealed by the State on June 15, 1979.

Personnel

The personnel changes as of June 30, 1979 are as follows:

Division	Budgeted 12/79 Level	5/31/79 Level	Additions	Reductions	6/30/79 Level
Site & Wye	9	9	0	0	9*
Antenna	17	14	0	0	14
Electronics	54	55	0	1	54*
Operations Management	3	3	0	0	3
Computer	14	12	0	0	12
Array Operations	11	9	0	0	9*
Program Management	28	27	1	1	27**
TOTAL	136	129	1	2	128

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

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-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 CO. #7	Sumitomo Electric USA, Inc.	3000 pieces of waveguide and 3900 pieces of coupling sleeves.	11/03/78	$ 3,215,847	7/31/79; 10/31/79; and 1/31/80	Next 1000 pieces of waveguide and coupling sleeves to arrive Oakland port by 7/31/79.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	$ 206,375	5/31/79	Complete except for 468 each of Item 4.
VLA-256	New Mexico State University	Archaeological Excavation	9/20/77	$ 107,000	2/20/79 Completion	$80,633 invoiced thru 12/31/78 Final reports expected by 7/79.
P.O. S-07990	AIL Division Cutler-Hammer	Parametric Amplifiers	9/21/78	$ 197,600	Complete by 1/21/80	4 received. No additional delivery information available at this time.
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	RLC has received 700 diodes to allow them to proceed with filter production.
P.O. S-08535	RF Systems, Inc.	Ku and K Band Feed Horns	12/14/78	$ 71,554	5/15/79	Complete.
P.O. S-08558	Allen Avionics	L.C. Filters	1/08/79	$ 69,500	Complete by 7/31/79.	

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
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-08423	Rimo Manufacturing, Inc.	C Band Horns	11/17/78	$ 36,600	Complete by 10/01/79	On schedule.
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-345	G. C. Dean	Labor Hour (Waveguide installation)	3/19/79	$ 170,000	One Year Completing 3/18/80	
VLA-346	Wm. A. Smith Contracting Co., Inc.	Phase V Construction	4/26/79	$2,820,000	June, 1980	
P.O. S-09818	Dataram Corp.	Very Large Memory	5/22/79	$ 161,625	8/15/79	
P.O. S-09849	BWH/CVA Joint Venture	A/E Service Phase V	5/16/79	$ 39,000	June, 1980	

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-08645	DEC	Computer Maintenance	1/08/79	$ 90,063	CY '79	Monthly expenditure rate estimated at $7,500.
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	99% Complete.
VLA-344 P.O.S-08595	Wheeler Construction Co.	Crushed Stone	1/08/79	$ 668,660	Complete by 4/01/80	
P.O. S-08230	Structures, Inc.	Feed Support Structures	10/23/78	$ 26,855	Remaining 2 units to ship week of 7/15/79.	

NATIONAL RADIO ASTRONOMY OBERVATORY

VERY LARGE ARRAY

STATUS AS OF JUNE 30, 1979

CY - 79

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/WYE	5,356,050	113,697	629,139	3,695	625,444	4,214,620	4,843,759	512,291
12000	ANTENNA	1,549,000	27,944	421,422	23	421,399	861,057	1,282,479	266,521
13000	ELECTRONICS	2,764,000	237,345	1,066,878	27,788	1,039,090	994,072	2,060,950	- 703,050
14000	COMPUTER	1,392,000	21,254	74,811	---	74,811	393,421	468,232	923,768
17000	PROGRAM MANAGEMENT	120,000	8,598	57,703	---	57,703	2,136	59,839	60,161
18000	COMMON COSTS	487,752	36,596	223,571	---	223,571	14,025	237,596	250,156
19000	CONTINGENCY	504,004	---	---	---	---	---	---	504,004
	TOTAL PROGRAM	12,172,806	445,434	2,473,524	31,506	2,442,018	6,479,331	8,952,855	3,219,951

Note: Project allocation consists of $11,500,000 in new funding, $7,752 in Common Cost commitments carried forward, and $665,054 in prior years funds. A portion of the prior year funds were re-allocated in February, 1979.

NATIONAL RADIO ASTRONOMY OBSERVATORY

VERY LARGE ARRAY

STATUS AS OF JUNE 30, 1979

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/WYE	24,541,144	114,710	19,203,462	7,226,663	11,976,800	4,827,389	24,030,851	510,293
12000	ANTENNA	22,600,391	28,047	20,195,656	11,783,289	8,412,367	2,126,340	22,321,996	278,395
13000	ELECTRONICS	16,947,720	293,615	14,817,123	6,880,997	7,936,126	1,419,833	16,236,956	710,764
14000	COMPUTER	5,126,512	21,254	3,788,626	2,529,107	1,259,519	413,313	4,201,939	924,573
16000	SYSTEMS INTEGRATION	201,022	---	201,022	179,370	21,652	---	201,022	---
17000	PROGRAM MANAGEMENT	1,905,296	8,598	1,842,561	1,676,390	166,171	2,574	1,845,135	60,161
18000	COMMON COST	1,723,100	36,596	1,458,919	1,235,347	223,571	14,025	1,472,944	250,156
19000	CONTINGENCY/RESERVE	504,004	---	---	---	---	---	---	504,004
	SUB TOTAL	73,549,189	502,820	61,507,369	31,511,163	29,996,206	8,803,474	70,310,843	3,238,346
30000	RETIREMENTS	(10,820)	---	(10,820)	(10,820)	---	---	(10,820)	---
	TOTAL PROGRAM	73,538,369	502,820	61,496,549	31,500,343	29,996,206	8,803,474	70,300,023	3,238,346

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 $11,480,000 available.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLA PROGRAM

FINANCIAL STATUS REPORT
(in thousands)

As of: June 30, 1979

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	(A)	Allocation to Date (C)				Outlook (B)			
Item	Program Ceiling	Allocated	Expended and Committed	Allocated Balance	Un-allocated Balance	Estimate to Complete	Estimate Total	(Over) Under Ceiling	Notes
Site and Wye	27,860	24,541	24,031	510	3,319	2,936	26,967	893	
Antennas	20,400	22,600	22,322	278	(2,200)	377	22,699	(2,299)	
Electronics	17,000	16,948	16,237	711	52	1,435	17,672	(672)	
Computer	4,850	5,127	4,202	925	(277)	1,517	5,719	(869)	
Systems Integration	400	201	201	-	199	-	201	199	
Program Management	2,650	1,905	1,845	60	745	360	2,205	445	
Common Cost	-	1,723	1,473	250	(1,723)	634	2,107	(2,107)	
Subtotal	73,160	73,045	70,311	2,734	115	7,259	77,570	(4,410)	
Contingency	2,840	504	-	504	2,336	1,000	1,000	1,840	
TOTAL	76,000	73,549	70,311	3,238	2,451	8,259	78,570	(2,570)	

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.

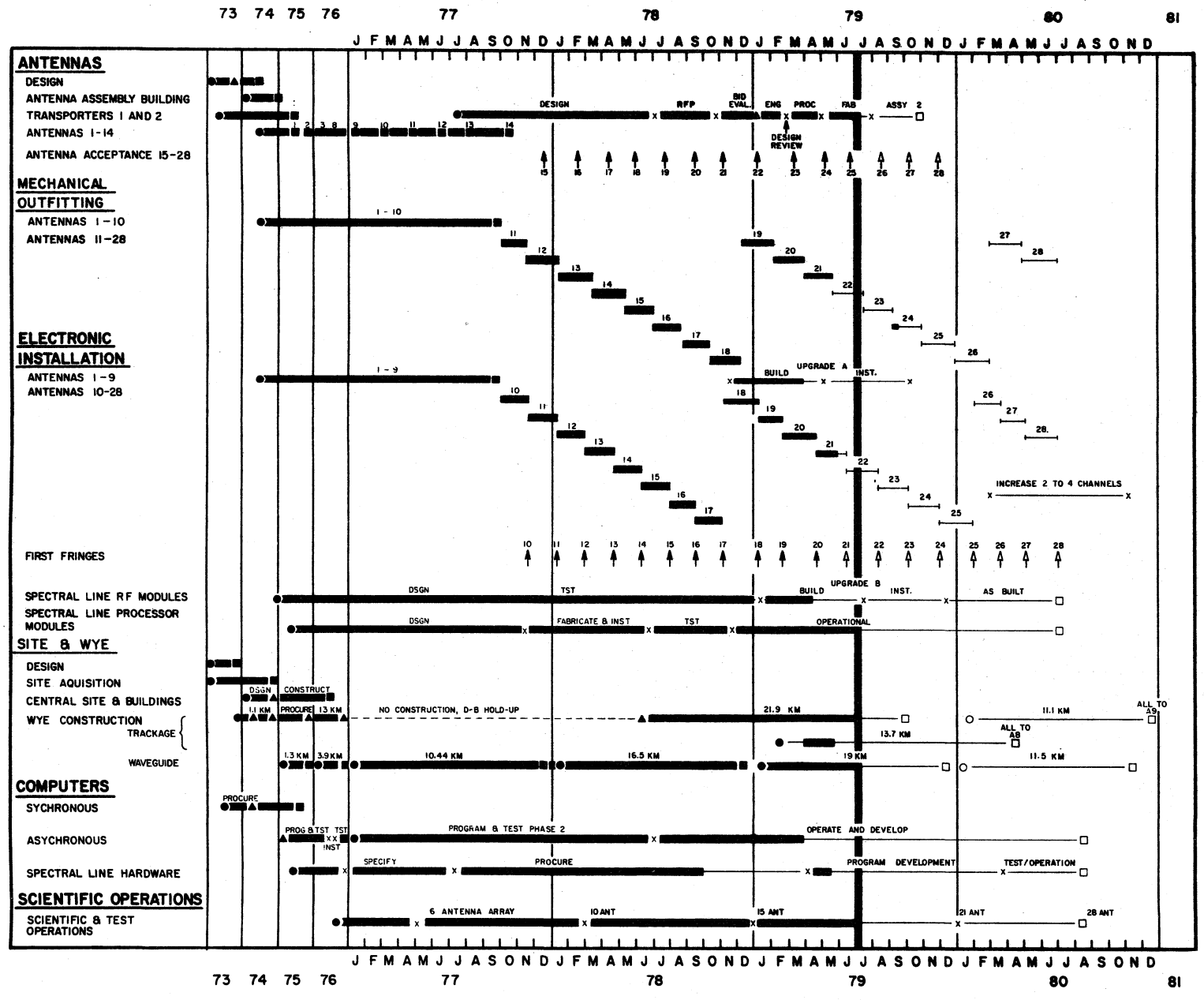
(B) Estimate to complete is as of March 1979 and it excludes $172K for airstrip. Escalation included for future years for Site/Wye work (8%); NRAO labor (6%); and certain electronic elements (8%). Antenna estimate is based upon the existing contract costs for fabrication of the antennas.

(C) Includes $11,500K of CY-79 Funding.

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA ACTIVITY SCHEDULE

UPDATE DATE: 6/29/79



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