MARCH 1979

NATIONAL RADIO ASTRONOMY OBSERVATORY

MARCH PROGRESS REPORT

VLA PROGRAM

APRIL 12, 1979

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

MARCH 1979

SYSTEMS INTEGRATION DIVISION

The array was scheduled for 54 percent of the time; 42 percent went to astronomical programs and the remaining 12 percent to tests. The average downtime for the month was approximately 9 percent.

First fringes were obtained using Antenna 19 on March 21, 1979. The nineteen 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, N8, N4, and W12. 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, 0.44, 0.13, and 1.0 km respectively from the array center. Our longest astronomically usable baseline is approximately 18 km. Antenna 17 was declared operational on March 23, 1979 bringing the total number of operational antennas to 16 (1 through 15 and 17). Antennas 5, 7 and 9 are presently decommissioned for electronic retrofits. Antennas 16, 18 and 19 are in the shakedown stage. The test array consists of Antennas 3, 5 and 11.

ELECTRONICS DIVISION

During the month Antenna 19 obtained first fringes and the front end for Antenna 7 was reinstalled after having its Air Products cryogenic refrigerator replaced with a CTI system. Mechanical construction of front end 20 was completed and electrical testing began in preparation for installation on the antenna in April. The problem with the early AIL paramps mentioned in the February report has been investigated further. So far nine amplifiers have been found which have excessive passband ripple due to circulator performance degradation. It is known that AIL retrofitted five parametric amplifiers with new circulators for the Meudon Observatory free of charge. Discussion on this problem will be held with AIL in early April.

In the cryogenics area the front end from Antenna 9 has been brought into the lab to have its cryogenics replaced with a CTI system. An in-house built 5 HP compressor is ready to run. This machine, which was built as a training exercise for us, and also to provide a unit for laboratory testing, will be capable of running a 4^{o} k refrigerator if the VLA eventually goes to a maser front end.

A problem with the couplers in the 60 mm waveguide system has been identified. Because of incorrect bonding procedures by the manufacturer, there have now been three occasions on which the waveguide coupling, which

projects into the 60 mm waveguide, has come loose and fallen into the waveguide. To ensure that this does not happen in the operating system, all couplers presently installed will be removed for inspection and repaired if necessary.

A continuing problem with the digital monitor and control system is the problem of lost commands. Occasionally a few antennas fail to receive commands sent to them. This is particularly annoying when it occurs at the time of a frequency change, resulting in antennas remaining at the wrong frequency or having their subreflectors left in the wrong position. Considerable effort has been expended on isolating the problem but, because of its intermittent nature, little progress has been made. Investigations will continue as a high priority item.

During the month the delay-multiplier system was used for the first time in spectral line mode. For the preliminary tests the system was used to synthesize the bandpass responses for the three filter bandwidths currently available in the IF system: 50 MHz, 12 MHz, and 1.5 MHz. No attempt has yet been made to observe an astronomical spectral line. For the first time the self-test capability of the delay-multiplier system was used during actual observing. A new integrator rack has been completed and will be used to replace the original rack in early April. It is hoped that the different cabling techniques used on the second rack will eliminate the remaining cross-talk problems in the integrator.

The prototype of the new baseband system (modules T3, T4, T5, T6) was installed in the D rack of Antenna 5 and system tests were started. Solutions for several spurious-signal problems discovered during the testing have been found and are being implemented in the prototype system.

COMPUTER DIVISION

Additional features - source subtract and map center shift - have been installed in the PDP-11/70 map making system. Work has started on further enhancements, especially an input convolution and more flexible source subtract algorithm.

A version of CLEAN in the PDP-11/70 has progressed to the point where it operates but is still extremely unreliable and inconvenient.

A considerable effort was expended in some special purpose software to diagnose the "missing command problem" which has been plaguing us these many months.

The spectral line sorting system hardware (an 11/70 CPU and 13=12 + one spare Calcomp disk drives) has been delivered; work has started on bringing the system up.

The software for making grayscale or color images on the Dicomed film writer has been reworked for greater efficiency, speeding it up by a factor of three.

We have installed the latest version of the TOPS-10 operating system in the DEC-10. We have reevaluated our program history/security requirements and have modified the system to one believed more secure.

We have tentative agreement on an image interchange tape format with Charlottesville and Kitt Peak. We will also circulate this standard to Westerbork and try to get agreement on a universal standard for astronomy.

ANTENNA DIVISION

Status of work of the Antenna Division reached the following stages at the end of March.

Antenna No. 20

Mechanical outfitting continued on maintenance foundation and is approximately 90% complete.

Antenna No. 21

Antenna is awaiting mechanical outfitting.

Antenna No. 22

Moved from Master foundation to station CE7 on February 15 to await mechanical outfitting.

Antenna No. 23

Panel installation, feed log installation and final panel alignment completed. Panel installation rms of 0.011 inches was achieved. On March 19, the antenna was moved to the Master foundation for Servo installation and check-out, final alignment and final inspection.

Antenna No. 24

Pedestal assembled through yoke and alidade and elevation wheel. Reflector approximately 80% complete in rear of assembly building.

Antenna No. 25

Trial assembly in progress at Hobbs.

SITE AND WYE DIVISION

Waveguide Installation

Installed approximately 2080 feet of waveguide, and set to line and grade and backfilled at AE5 and BE7. Completed 20 mm waveguide installation at CE5 and DN2. Completed zinc ribbon installation from Highway 78 to BE9, approximately 2200 feet.

Phase IV

Overall completion at 72%. 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 BE9. First lift of ballast has been placed to BE8. Round Place Construction has commenced excavation work between BE9 and AE5. Subgrade preparation is complete to AE5 and is ready for trackage. All antenna foundation concrete tie beams have been poured, along with foundation pedestals at AW9, BE5 and BN5.

Phase V - Site and Wye Construction

On March 27, 1979 construction bids were received covering the balance of the wye railroad and utility construction work. Results of the bids were:

Wm. A. Smith Contracting	$2,820,000
Burn Construction Co.	2,896,000
Transit Products, Inc.	3,084,387
Pacific Railroad Constructors	3,190,000
Peter Kiewit Sons' Co.	3,270,000
Engineers Estimate	$3,099,803

On March 28, 1979 a TWX was received from the Burn Construction Co. protesting an award to Smith. This protest was rejected by AUI on March 29th. AUI has not heard of any additional action by Burn. The contract will be submitted to the NSF for approval early in April.

PROJECT MANAGEMENT

General

The Washington legal firm of Steptoe & Johnson submitted its legal opinion concerning the labor provisions of AUI Subcontract VLA-345 on March 15th. This opinion fully supported the actions taken by AUI as to the labor classifications and wage scales included in the labor-hour subcontract for the waveguide installation. Formal NSF approval of the subcontract was received March 16th.

Land Acquisitions

To date no action has been taken by the Commission, appointed by Federal Judge Bratton to recommend a value for the VLA land taken.

New Mexico Gross Receipts Tax

The trial was held April 2, 1979 before U. S. Judge Santiago Campos in Santa Fe. Upon conclusion, Judge Campos rendered judgement in favor of

the U. S. Government and against the State Bureau of Revenue and Taxation. He instructed the State to return the $127,000 paid under protest and not to assess additional taxes against E-Systems Inc. This eliminates a potential liability against NSF funds by $600,000 to $680,000.

Land Right-of-Way from the U. S. Bureau of Land Management

Back in May, 1974, the Corps of Engineers prepared a Land Withdrawal Document for over 840 acres of BLM land required for the VLA. No action was taken by the Department of Interior until January 25, 1979 when they advised the Corps of Engineers that a withdrawal would not be issued. BLM now wants to permit the land use under a right-of-way grant. The Corps is preparing the necessary documentation which must be executed by the Director of the National Science Foundation. It is not known what problems the BLM will create prior to issuance of the right-of-way grant but they will be formidable.

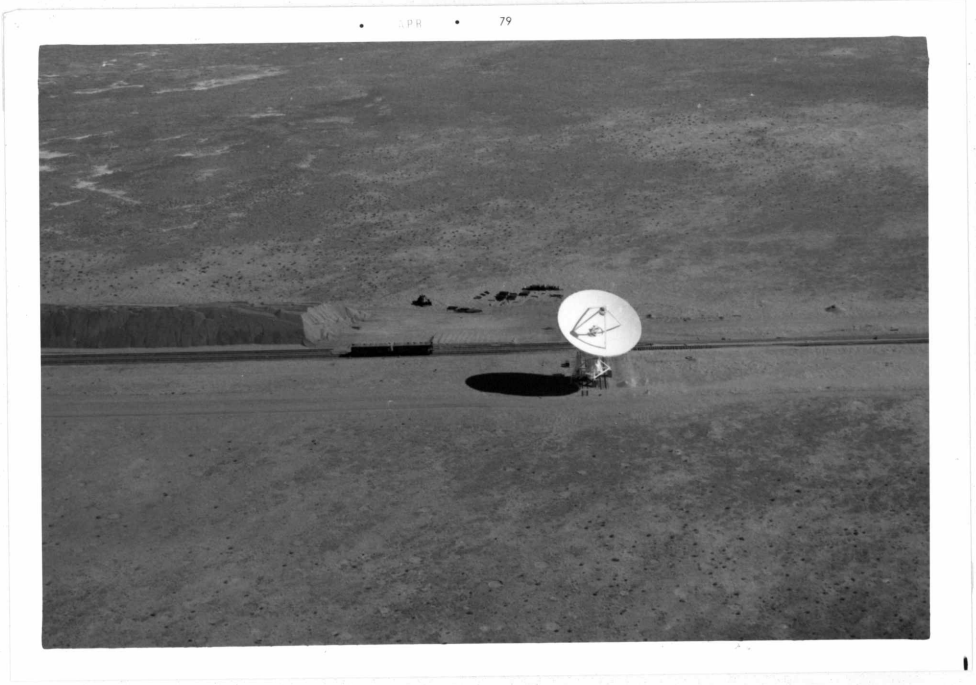
Personnel

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

Division	Budgeted 12/79 Level	2/28/79 Level	Additions	Reductions	3/31/79 Level
Site & Wye	9	9	1	1	9*
Antenna	17	14	0	1	13
Electronics	55	50	3	1	52**
Operations Management	3	3	0	0	3
Computer	14	12	0	0	12
Array Operations	11	9	0	0	9***
Program Management	28	27	0	0	27****
Totals	136	124	4	3	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

p3-79-1 Aerial View of East Arm Construction



p-3-79-2 Aerial View Hopper Cars at Ballast Storage Area
East Arm of Array

3/31/79

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 Oakland port by 4/30/79.
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 due 2/20/79.
P.O. S-07990	AIL Division Cutler-Hammer	Parametric Amplifiers	9/21/78	$ 197,600	Complete by 1/21/80	2 received. 2 in transit.
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-08558	Allen Avionics	L.C. Filters	1/08/79	$ 69,500	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
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	Final expenditure of $174,658.19.
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	Partial quantities received.
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	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-06084 C.O. #1	Structures, Inc.	Walkways & Platforms	9/27/78	$ 33,740	Complete	
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	L-Band Towers complete.
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	Estimate completion by 4/30/79.

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
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 Amplifiers	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-345	G. C. Dean	Labor Hour (Waveguide installation)	3/19/79	$ 170,000	One Year Completing 3/18/80	

VLA PROGRAM

3/31/79

PROCUREMENT ACTIVITIES INITIATED

RFP NUMBER	ITEM DESCRIPTION	ESTIMATED COST	ISSUE DATE	PROPOSAL/BID DUE DATE	SUBMISSION TO NSF DATE	AWARD DATE	CURRENT STATUS
VLA-346	Phase V Construction	Actual $2,820,000	2/19/79	3/27/79	4/09/79	Estimate 4/27/79	

NATIONAL RADIO ASTRONOMY OBSERVATORY
VERY LARGE ARRAY
STATUS AS OF MARCH 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	5,356,050	76,923	219,988	3,695	216,293	2,188,441	2,408,429	2,947,621
12000	ANTENNA	1,549,000	30,035	211,546	23	211,523	1,025,861	1,237,407	311,593
13000	ELECTRONICS	2,764,000	155,989	398,581	3,020	395,561	839,193	1,237,774	1,526,226
14000	COMPUTER	1,392,000	9,165	34,799	---	34,799	40,626	75,425	1,316,575
17000	PROGRAM MANAGEMENT	120,000	10,014	29,170	---	29,170	176	29,346	90,654
18000	COMMON COSTS	487,752	42,891	107,428	---	107,428	18,444	125,872	361,880
19000	CONTINGENCY	504,004	---	---	---	---	---	---	504,004
	TOTAL PROGRAM	12,172,806	325,017	1,001,512	6,738	994,774	4,112,741	5,114,253	7,058,553

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 MARCH 31, 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	324,135	17,955,400	7,223,325	10,732,075	3,638,965	21,594,365	2,946,779
12000	ANTENNA	22,600,391	77,895	19,885,006	11,783,289	8,101,717	2,403,702	22,288,708	311,683
13000	ELECTRONICS	16,947,720	232,573	13,894,493	6,850,784	7,043,709	1,525,513	15,420,006	1,527,714
14000	COMPUTER	5,126,512	313,701	3,748,614	2,503,607	1,245,007	60,518	3,809,132	1,317,380
16000	SYSTEMS INTEGRATION	201,022	---	201,022	179,370	21,652	---	201,022	---
17000	PROGRAM MANAGEMENT	1,905,296	10,014	1,813,592	1,676,390	137,202	1,051	1,814,643	90,653
18000	COMMON COST	1,723,100	42,891	1,342,776	1,235,347	107,429	18,444	1,361,220	361,880
19000	CONTINGENCY/RESERVE	504,004	---	---	---	---	---	---	504,004
	SUB TOTAL	73,549,189	1,001,209	58,840,903	31,452,112	27,388,791	7,648,193	66,489,096	7,060,093
30000	RETIREMENTS	(10,820)	---	(10,820)	(10,820)	---	---	(10,820)	---
	TOTAL PROGRAM	73,538,369	1,001,209	58,830,083	31,441,292	27,388,791	7,648,193	66,478,276	7,060,093

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 PROGRAM

FINANCIAL STATUS REPORT
(in thousands)

As of: March 31, 1979

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Allocation to Date (D)				Outlook			
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	21,594	2,947	3,319	5,373	26,967	893	
Antennas	20,400	22,600	22,289	311	(2,200)	410	22,699	(2,299)	
Electronics	17,000	16,948	15,420	1,528	52	2,252	17,672	(672)	
Computer	4,850	5,127	3,809	1,318	(277)	1,910	5,719	(869)	
Systems Integration	400	201	201	-	199	-	201	199	
Program Management	2,650	1,905	1,815	90	745	390	2,205	445	
Common Cost	-	1,723	1,361	362	(1,723)	746	2,107	(2,107)	
Subtotal	73,160	73,045	66,489	6,556	115	11,081	77,570	(4,410)	
Contingency	2,840	504	-	504	2,336	1,000	1,000	1,840	
TOTAL	76,000	73,549	66,489	7,060	2,451	12,081	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.

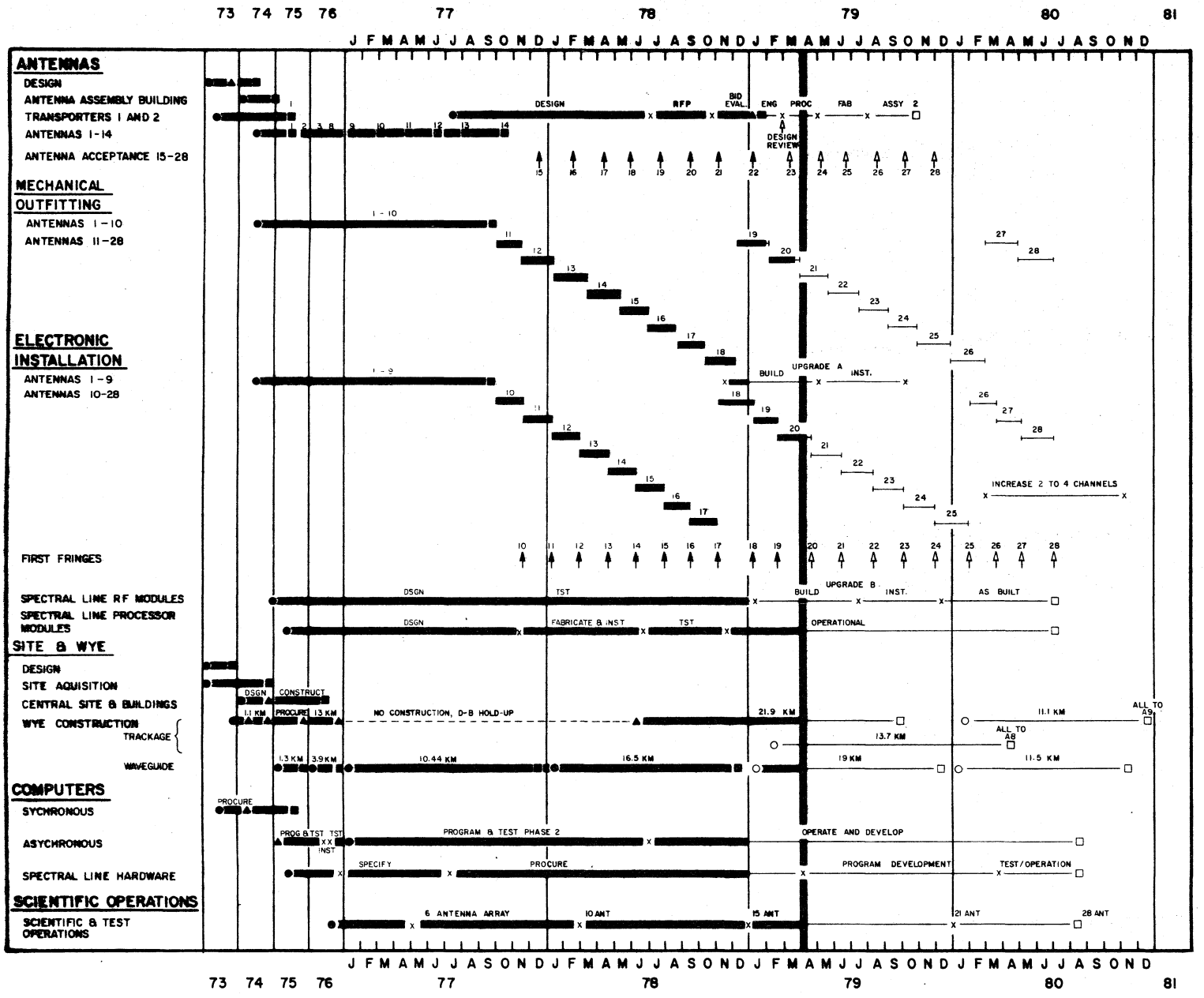
(C) The antenna estimate includes $800K for transporter No. 2.

(D) Includes $11,500,000 of CY-79 Funding.

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA ACTIVITY SCHEDULE

UPDATE DATE: 4/2/79



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

○ 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