

AUGUST 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

AUGUST PROGRESS REPORT

VLA PROGRAM

September 16, 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

AUGUST 1977

SYSTEMS INTEGRATION DIVISION

During this month there were four scheduled observing sessions.

- August 4-8                      This session included two programs. Balick, Heckman, and Sullivan (all from U. Washington) observed 150 normal galaxies searching for nuclear components. Hjellming (NRAO) and Gibson (NMIMT) continued with program AH5, the periodic monitoring of Cygnus X-1.
- August 15-17                    This session also included two programs. Gibson (NMIMT) ran program AG1 searching for radio emission from single late-type sub-giant stars. Hjellming and Gibson also continued with program AH5.
- August 18-22                    This session contained five observing programs. Hjellming and Gibson continued with AH5. Spangler, Brown, Marscher (NRAO) and Cotton (MIT) ran program AS4, observing the variable radio source 0402+160. Owen (NRAO) and Gibson (NMIMT) ran program AO4, observing several late-type binary stars. Purton (York U., Canada), Feldman (H.I. of Astrophysics, Canada) and Seaquist (Toronto) ran program AP1 searching for radio emission from the star HM Sagittarius. Program AB9, Bignell (NRAO) involved the mapping of quasar 3C273.
- August 25-29                    Hjellming and Gibson continued with program AH5. Wardle and Potash (Brandeis) ran program AW1 measuring linear polarization of 51 quasars.

During this period Antenna #8 was moved to station AW5. This now gives a maximum baseline of 7.66 km. Good data was obtained from this new baseline resulting in Antenna #8 being declared fully operational. Antennas #7 and #9 are awaiting completion of efficiency measurements before being declared operational.

L. R. D'Addario and D. Bagri continued with development and testing of the new L. O. modules in Antennas #3 and #5, using these antennas occasionally as a second subarray for test measurements.

Francis (Frank) Hart joined the operations group as the fifth array operator, and is currently undergoing training.

The average percentage of antenna downtime for the month continues to be rather high at 45.5% although the last session was significantly improved with a downtime of only 4.87%.

#### ELECTRONICS DIVISION

Delivery of the new production run of L-Band feeds has started and an L-Band feed has been installed on Antenna #8. The front end for Antenna #10 is complete and delivery of AIL paramps for front end 11 is now due in mid-September. During August considerable effort was expended on understanding and improving the L-Band RFI problem on Antenna #5. The shielding of the L2 and L3 modules in the B Rack reduced the level of most spurious signals in the front end by approximately 30 dB. This should be adequate for observations. The present goal requires all spurious signals in the front end to be below the RMS noise in a bandwidth of 1 KHz in 1 hour of integration. To reach this goal the isolation between the A and B Racks on Antenna #5 must be improved by a further 30 dB for most of the spurious signals.

A special cryogenic dewar has been constructed for the purpose of tuning parametric amplifiers when they are cold. This dewar will allow the repair and retuning of Comtech and AIL paramps to be done at the VLA Site.

In the cryogenics area Cryomech refrigerators in front ends 7 and 10 are now running satisfactorily. All antennas up to Antenna #9 now have cryogenic compressors which have been retrofitted to have new agglomerators, orifices instead of capillary tube oil returns, and improved piping layouts.

Tests on a newly completed section of waveguide between BW8 and AW5 showed good attenuation values: 1.35 to 1.1 dB per km from 40 to 60 GHz. This section was put into use when Antenna #8 was moved out to AW5 and first fringes were obtained over a 7.2 km baseline on August 25. Re-measurement of the 1.24 km section from CW5 to CW9, the first section to be installed on the wye, showed no change in attenuation since the previous check two months earlier. Waveguide installation on the East arm is now in progress in preparation for bringing Antenna #10 into operation in early November, shortly after the delivery of the next B and D Racks from Charlottesville. Tests with the electronic waveguide 'mouse' to investigate its response in more detail are in progress.

In the monitor and control subsystem, tests of the second serial line controller were commenced. The modified data set design has been satisfactorily tested and assembly of new units is in progress. Several improvements are also being made in the various test units for the monitor and control system, including the facility for the test microprocessor to interact with Rack B either directly or through Rack D. For the spectral line system, prototypes of all the high speed cards have been tested satisfactorily, and the full production quantities of the memory cards have been received.

The new design of L17 module has been installed and tested in the master local oscillator. A shielded design for the L2 and L3 local oscillator modules has been developed, and will be incorporated in the build of retrofit

units now in progress in Charlottesville. Progress continues on modifications to increase the reliability of the F3 module which produces the local oscillator signal for the two highest frequency bands. A new harmonic mixer with lower responses to unwanted sidebands on the 600 MHz reference has been designed, and problems in the phase detector board have been corrected.

Production by the Charlottesville group is progressing very well. Shipment of B and D Racks for Antennas #11 and #12 is scheduled for October 27.

#### COMPUTER DIVISION

The new map making program for the DEC-10 computer is now in operation. Work is continuing to provide the support software to make this system sufficiently complete to replace the old "INTMAP" system, which has support difficulties (i.e., some new features are not being implemented in this system). The empirical gain calibration part of the system is now working reasonably well, although minor difficulties must yet be overcome.

The PDP 11/70 host for the array processing system has been delivered, except for the device connecting it to the DEC-10 and for a loan of a tape drive which will be used for initial software development.

A study of truncation effects in a large Fourier transform (pertinent to the design of a large digital map making system) has been completed.

Some graphics routines have been developed using the array processor which has temporarily been connected to the graphics system pending the delivery of its proper host. These routines were done primarily to familiarize ourselves with the capabilities of the array processor.

#### ANTENNA DIVISION

##### Antenna No. 10

Mechanical outfitting on maintenance pad continued and approached completion at end of month.

##### Antennas No. 11 and 12

Previously accepted by AUI, awaiting mechanical and electronic outfitting.

##### Antenna No. 13

Panel Alignment completed on August 9 with an RMS of 0.010 inches. On August 10 antenna was moved to Master Pad for final alignment, finish painting, acceptance testing and servo installation and checkout. Servo testing was completed on August 24 with a resonant frequency of 2.3 Hz in rocking mode and 2.45 Hz in torsional mode. Correction of minor structural and mechanical discrepancies remained at end of month. Acceptance to be September 2, 1977.

Antenna No. 14

Started pedestal assembly on August 12, 1977. Continued reflector assembly. At end of month reflector assembly approximately 85% complete. Pedestal assembled through yoke arms, shaft and elevation wheel. Counterweight installation in progress.

Antenna No. 15

Trail assembly in progress in fabricators plant, with delivery to Site expected by September 29, 1977.

Miscellaneous

Moved Antenna #12 to CW7. Moved Antenna #8 to AW5 on August 23 which gave a baseline length of 7.66 kilometers from center of wye. The modified air conditioning system was retrofitted in Antenna #9 in this period.

SITE AND WYE DIVISION

Waveguide Installation

Waveguide installation was completed between AW5 and AW6. Three hundred feet of waveguide has been bedded, compacted and shaded on the east arm lead-in section. Four manhole base sections were installed on the east arm (E-0, E-1, E-2, E-3).

PROJECT MANAGEMENT DIVISION

During the month of August, 1977 the VLA Program placed 287 procurements totaling \$147,253.

# Personnel

The personnel changes as of August 31, 1977 are as follows:

<u>Division</u>	<u>Previous Level</u>	<u>Additions</u>	<u>Reduction</u>	<u>Current Level</u>
Site and Wye	8	0	0	8
Antenna	13	1	1	13
Electronics	44	1	1	44*
Computer	14	1	0	15
Systems Integration	5	2	0	7
Project Management	<u>28</u>	<u>0</u>	<u>1</u>	<u>27**</u>
Total	112	5	3	114

\* Includes one part-time person

\*\* Includes two part-time people

VLA PROGRAM  
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

8/77

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	\$ 18,131,767		NRAO has taken Possession of Antenna Nos. 1 through 13. Antenna No. 14 is due for accept- ance Oct. 12, 1977.
VLA-53	R. F. Systems	K and Ku Band Feed Horns	1/26/76	\$ 154,388	9/30/77	Partial shipment by 9/20/77 and complete order by 9/30/77.
VLA-70 P.O. 52322	Sumitomo Electric USA, Inc.	5,373 pieces of wave- guide - 5,185 each coupling sleeves	1/27/75	\$ 1,801,827		Order is complete through C.O. No. 4. Negotiations will be completed in Sept. 1977 for next purchase of waveguide.
VLA-167	Paul D. Goar Construction Co.	Prefab Metal Maintenance & Warehouse Buildings	1/06/76	\$ 169,466	3/30/77	Amendment No. 1 issued for construction of lean-to type addition to Maintenance Building. Work was completed 8/8/77.
VLA-177	Fujikura Cable Works, Ltd.	Waveguide coupling components	3/21/77	\$ 217,879	7/15/77	Order was completed 8/11/77.
VLA-179 P.O. S-01046	AIL Division of Cutler-Hammer	Parametric Amplifiers	4/29/76	\$ 134,920	10/12/76	Paramps for A7-A10 have been received. Problems meeting performance specs. Two sets due for shipment in Sept. 1977.
P.O. S-01984	J. J. Gustincic Consulting Engr.	Consultant Agreement	8/02/76	\$ 4,000	12/31/76	Consultant of K, Ku, and C Band Horn. \$600 spent as of 8/31/77.



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-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 164,000	9/15/77	Delivery will be complete on 10/30/77.
P.O. S-02998	AIL Division of Cutler-Hammer	Upconverters	12/15/76	\$ 62,623	6/15/77 to 8/15/77	Five pieces have been received; six are on each order. Due for completion by 10/15/77. Vendor received defected diodes.
P.O. S-01742	Digital Equipment Corporation	Maintenance on DEC-10 System	1/07/77	\$ 101,448	12/31/77	Maintenance is performed daily at VLA Site.
VLA-240 P.O. S- 03093	Eagle-Picher Industries, Inc.	Fabricated Metal Parts	1/07/77	\$ 67,092	4/17/77	Order completed 8/29/77.
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-245 P.O. S-03633	Sandia Detroit Diesel, Inc.	Install Emergency Standby Power Generators	3/31/77	\$ 50,563.36	5/15/77	Unit was accepted 8/8/77.
VLA-254 P.O. S-03651	J. J. Gustincic Consulting Engr.	L-Band Feed Horns for A7-A14	3/31/77	\$ 81,000	6/30/77	One unit received 8/11/77. Two units scheduled for delivery 9/8/77. Balance for delivery 9/12/77.
VLA-255 P.O. S-03591	Digital Equipment Corporation	Host Computer for High- speed Array Processor	4/12/77	\$ 126,000	8/30/77	Delivered 8/30/77. Undergoing accept- ance tests.
VLA-258	Midstate Cartage Co.	Labor-Hour Subcontract	3/28/77	\$ 100,000	3/27/78	Approximately \$69,422 was spent effective 8/31/77.
P.O. S-04046	Modular Computer Systems, Inc.	Update and expand Synchronous Computer	5/12/77	\$ 54,900	9/15/77	Delivery will be 10.15/77.

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>
P.O. S-04382	Industrial Design Engr. Assoc.	Temporary Draftsman		\$ 8,000	12/31/77	Approximately \$1,415 spent effective 8/31/77.
P.O. S-04400	New Mexico Institute of Mining and Technology	Labor-Hour Contract		\$ 10,000	8/31/77	Approximately \$412 spent effective 8/31/77.

## 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-277	Crushed Stone	\$664,000	-----	-----	8/5/77	-----	Proposed RFP submitted to NSF 8/5/77 requesting permission for solicitation from bidders.
P.O. S-04886	Parametric Upconverters	\$ 79,702	-----	-----	8/29/77	9/30/77	Awaiting NSF approval.

CY - 1977

## VERY LARGE ARRAY

STATUS AS OF AUG 31

TOTAL 1977

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	282288300	9069471	80506934	4383530	76123404	20786918	101893852	180994448
12000	ANTENNA	413450000	131213688	194790271	447792	194342479	206527219	401317490	12132510
13000	ELECTRONICS	383550000	24065203	197528636	2749100	195079536	75034939	272863575	110686425
14000	COMPUTER	105300000	2470781	34873818	76236	34797582	18342695	53216513	52083487
15000	SYSTEMS INTEGRATION	67000000	611934	2813138	21560	2791578	46242	2859380	3840620
17000	PROJECT MANAGEMENT	10000000	760560	6439251	.00	6439251	.00	6439251	3560749
18000	COMMON COST	69100000	5265600	41830800	.00	41830800	1507300	42738100	26361900
19000	CONTINGENCY/RESERVE	39500000	.00	.00	.00	.00	.00	.00	39500000
TOTAL PROGRAM		1309888300	173457237	558482848	7678218	550804630	382245313	580728161	429160139

VERY LARGE ARRAY

STATUS AS OF AUG 31

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	1449088200	9301285	1242308685	332214500	910094185	23707649	1236016334	183071866
12000	ANTENNA	1736150800	131213688	1517285488	306540400	1210745088	206579557	1723265045	12285755
13000	ELECTRONICS	1091972400	24080403	905788203	195653600	710134603	76778396	982566599	109405801
14000	COMPUTER	344987100	2495981	273705681	92729600	180976081	18930876	892636557	52350543
16000	SYSTEMS INTEGRATION	19303100	611934	15410934	5905500	9505434	50395	15461319	3841781
17000	PROGRAM MANAGEMENT	170028400	858412	163540612	96046400	67494212	629142	164169754	5858646
18000	COMMON COST	69100000	5260700	41230800	00	41230800	1507300	42738100	26361900
19000	CONTINGENCY/RESERVE	39500000	00	00	00	00	00	00	39500000
TOTAL PROGRAM		4920130000	173822603	4159270403	1029090000	3130180403	328183305	4487453708	432676292

NATIONAL RADIO ASTRONOMY OBSERVATORY  
VLA PROGRAM

FINANCIAL STATUS REPORT  
(in thousands)

As of: August 31, 1977

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Item	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	14,491	12,660	1,831	13,369	14,090	26,750	1,110	(6)
Antennas	20,400	17,361	17,239	122	3,039	4,910	22,149	(1,749)	
Electronics	17,000	10,920	9,826	1,094	6,080	7,478	17,304	(304)	
Computer	4,850	3,450	2,926	524	1,400	2,478	5,404	(554)	
Systems Integration	400	193	155	38	207	78	233	167	
Program Management	2,650	1,700	1,642	58	950	326	1,968	682	
Common Cost	-	691	427	264	(691)	1,644	2,071	(2,071)	
Subtotal	73,160	48,806	44,875	3,931	24,354	31,004	75,879	(2,719)	
Contingency	2,840	395	---	395	2,445	2,273	2,273	567	
TOTAL	76,000 <sup>(1)</sup>	49,201 <sup>(2)</sup>	44,875	4,326	26,799	33,277	78,152	(2,152)	

Notes: (1) Includes estimate of \$283K for site acquisition and \$15.7K for ECAC Study withheld by NSF.

(2) Total allocation includes \$50K withheld by NSF on Amendment 24 to Contract C-780.

(3) Basic Estimate is that of August 1976.

(4) Estimate excludes the Airstrip: \$268K.

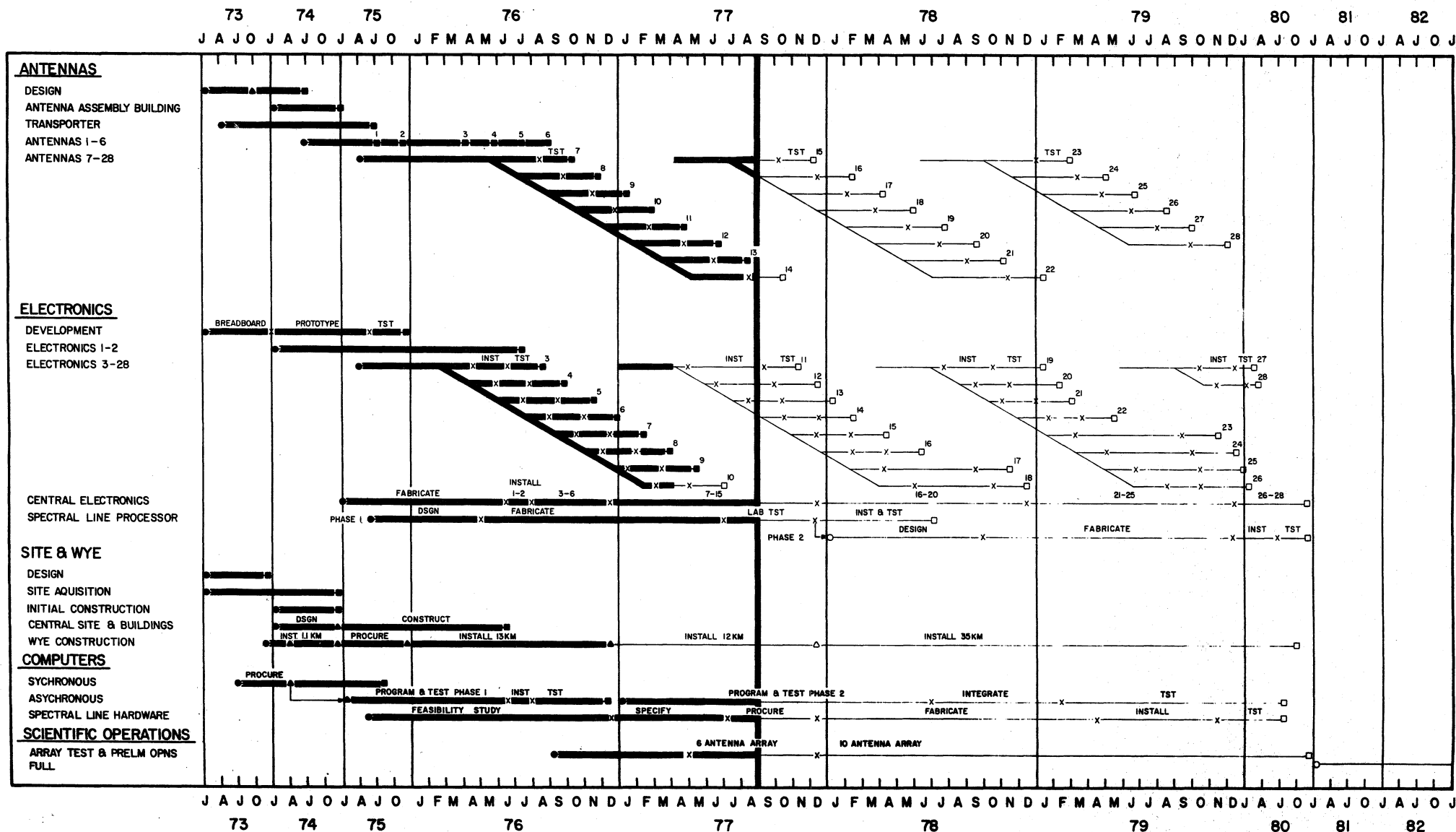
(5) Escalation included for future years at 6% for Site/Wye work, National Radio Astronomy Observatory labor, minor antenna equipment items and certain electronic equipment. No future escalation has been included for computer purchased equipment.

(6) Includes \$525,000 for Transporter #2.

# NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

11/15/76

UPDATE DATE: 9/1/77



## SYMBOLS

○ START OF A PHASE      △ CONTRACT AWARD  
X END OF AN ACTIVITY      □ END OF A PHASE

## ABBREVIATIONS

DSGN - DESIGN      TST - TEST  
LAB - LABORATORY      PREL - PRELIMINARY  
INST - INSTALL      OPNS - OPERATIONS

REV NO.	REV DATE	REVISION