

OCTOBER 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

OCTOBER PROJECT REPORT

VLA PROGRAM

November 15, 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

OCTOBER 1977

SYSTEMS INTEGRATION DIVISION

The following observing sessions were scheduled this month:

October 3-7

Program AH3, Hjellming (NRAO)  
Search for emission from compact x-ray objects.

Program AV1, Vandenberg, Hunt (NRAO)  
Exploratory measurements of pulsar high  
frequency spectra.

Program AG1, Gibson (NMIMT)  
Search for radio emission from single  
late-type subgiants.

Program AH5, Hjellming (NRAO), Gibson (NMIMT)  
Periodic monitor of Cyg X-1.

Program A04, Owen (NRAO), Gibson (NMIMT)  
Observation of late-type binary stars.

October 10-16

Programs A04 and AH5, see above.

Program AZ1, Zirin, Marsh (Cal Tech)  
Observations of phenomena associated with the  
partial eclipse of the sun on October 12.

Program AS5, Sramek (Arecibo), Weedman (Vanderbilt)  
Attempts to detect high Z radio quiet quasars.

Program AH6, Hjellming, Vandenberg (NRAO)  
Study of nova shells to follow radio spectrum  
evolution.

October 27-31

Program AB4, Balick, Heckman, Sullivan (Washington)  
Search of normal galaxies for nuclear components.

Program AH5, See October 3-7.

A total of 7 antennas were scheduled for 311 hours of tests and observations  
(42% of the time).

By the end of the month Antennas Nos. 1 through 9 were located at stations DW8, BW8, DW3, CW8, DW2, BW6, DW7, AW5, and CW5. The maximum baseline was 7.7 km. Antennas Nos. 7 and 9 are not considered operational yet, pending completion of performance tests. The antenna downtime average for the month was 8%.

#### ELECTRONICS DIVISION

In the feed area, more detailed investigations of the instrumental polarization at C-Band shows that it varies significantly on a fine frequency scale. Several antennas show variations of several percent with periods as short as 15 MHz. The most likely cause of this is a combination of a poorly matched front end and reflections off the subreflector. Preliminary measurements on Antennas Nos. 1 and 4 indicate that this is the case. Further measurements will be made to determine what, if any, hardware changes are needed to make the effect tolerable.

No. 10 front end was installed on October 23 and is being prepared for a single dish efficiency measurement early in November. AIL parametric amplifiers have now been received for front end 11. AIL is continuing to produce paramps by selecting diodes and mounts while continuing their studies to determine the cause of spurious mode propagation in some paramps.

The prototype of the new front end control module (F5) has been received from Charlottesville. This module incorporates digital readback of all commands.

Investigation of the phase stability of the electronics has continued, activity being concentrated on Antennas No. 3 and 5 which have been fitted with the improved local oscillator modules. A small number of items requiring maintenance have been found and corrected, and as a result more recent measurements have shown a good deal less phase variation although some unexplained jumps remain. It has also not yet been satisfactorily demonstrated that the round trip phase correction works as desired.

In the waveguide area the frequency response of the transmission path to Antennas Nos. 3 and 5 has been examined as a possible cause of phase instability. After repair of a broken flange in the 20 mm run from one of the manholes, no problems have been found in the 20 mm or 60 mm runs. There is however an amplitude ripple in the transmission system resulting from TE<sub>02</sub> mode conversion in the signal distributor and the couplers. The best way to filter out the unwanted mode is under investigation. A sample quantity of 20 mm flexible waveguide from the Fujikura Company has been tested and proves to be the best that has been obtained so far. The loss is lower than the earlier Fujikura waveguide but without the troublesome loss peak near 30 GHz.

The performance of the 17-20 GHz local oscillator modules has been improved to the point where several usable units are now installed in the array. These all have an improved version of the phase lock circuit board, and will have the improved harmonic mixer installed as a second stage of modification. Design is proceeding on the units of the master local oscillator required for incorporation of the standby system. Tests of the shielding of the first new design L2 and L3 local oscillator modules assembled in Charlottesville are in progress as the month ends.

The VLA-1 correlator integrated circuits for the spectral processor are now in production and shipment is expected early next month. Assembly of all parts of the spectral processor is in progress in Socorro, and it is expected that it will be ready for testing no later than mid-1978.

Racks and modules for system No. 11 are awaiting shipment from Charlottesville as the month ends, and on their arrival system 10, which is currently used for laboratory testing, will go into operation on the tenth antenna. Plans for the 1978 build are in progress, and orders are being placed for long-lead items such as metal parts for modules and bins.

#### COMPUTER DIVISION

A primitive software interface has been constructed for the PDP 11/70 array processing system that uses the parallel link with the DEC-10 computer. This link provides system support features (magnetic tape backup, line printer) but does not yet provide the usage of the system in its eventual role.

A memory expansion and upgrade (directed to eventually sharing a portion of the memory) has taken place on the MODCOMP computers. We are now in the process of software changes to make use of the additional memory (the most elementary expansions - control blocks for Antenna No. 10 and a third sub-array - have already been installed).

An error in the planetary motion ephemerides was found and corrected. We now have good support software for solar and planetary observations.

The new DEC-10 command decoder has been installed in several programs.

Minor changes in the new DEC-10 map-making package are underway to bring its map storage format into closer correspondence with the Leiden system, to facilitate eventual exchanges of data.

#### ANTENNA DIVISION

##### Antenna No. 11

Mechanical outfitting on maintenance pad started October 5, 1977, and modified access walkway installed.

##### Antennas No. 12, 13, and 14

Previously accepted by AUI, and awaiting mechanical and electronic outfitting.

##### Antenna No. 14

Moved to Master pad on October 4. Servo testing completed on October 17, 1977 with a resonant frequency of 2.4 Hz in rocking mode and 2.6 Hz in torsional mode. Antenna was accepted on October 21, 1977.

### Antenna No. 15

Started pedestal assembly on October 4, 1977, and reflector and pedestal structure mated on October 25, 1977.

### Antenna No. 16

Trial assembly complete at fabricator's plant and all material expected at Site by November 18, 1977.

### Miscellaneous

Moved Antenna No. 10 to CW6 on October 3. Moved Antenna No. 11 to maintenance pad on October 5. Moved Antenna No. 9 to AW6 on October 31, giving us a baseline of 10.5 km from center of wye. Modified air conditioners were accepted on Antennas No. 4, 10, and 13 during this period.

## SITE AND WYE DIVISION

### Waveguide Installation

Waveguide installation was completed up to CE9. Trenching progressed to CE9 and four manholes were installed on the east arm (E10, E11, E12, E13).

## PROJECT MANAGEMENT

### Personnel

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

<u>Division</u>	<u>Previous Level</u>	<u>Additions</u>	<u>Reductions</u>	<u>Current Level</u>
Site and Wye	8	0	0	8
Antenna	13	1	1	13
Electronics	47	1	0	48*
Computer	15	0	1	14
Systems Integration	7	0	0	7
Project Management	<u>27</u>	<u>1</u>	<u>2</u>	<u>26**</u>
Total	117	3	4	116

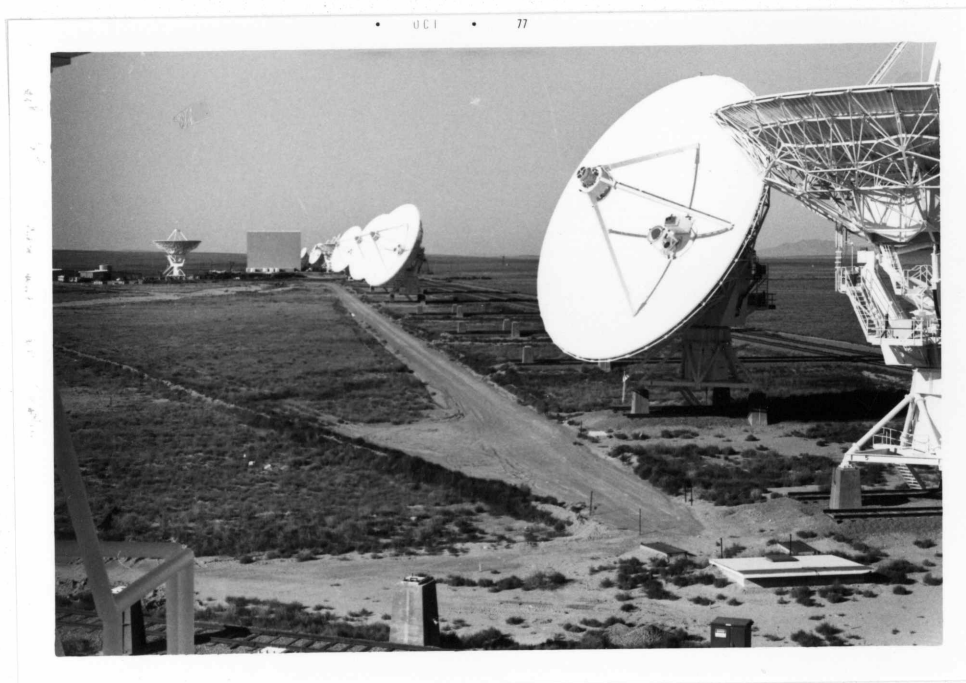
\* Includes one part-time person

\*\* Includes two part-time people



p10-77-1

Aerial View of Southwest Arm of Array



p10-77-2

Center of Wye looking to Southwest



p10-77-3

Southwest View of Array



10/77

## 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-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 14. Antenna No. 15 is due for acceptance Dec. 9, 1977.
VLA-53	R. F. Systems	K and Ku Band Feed Horns	1/26/76	\$ 154,388	9/30/77	All K and Ku Band Horns have been received through Antenna 15.
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.
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. Delivery at present is indefinite.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 206,375	9/15/77	Delivery will be completed on 1/31/78.
P.O. S-02998	AIL Division of Cutler-Hammer	Upconverters	12/15/76	\$ 62,623	6/15/77 to 8/15/77	Seven pieces have been received; six are on back order. Due for completion by 11/15/77. Vendor received defective diodes.
P.O. S-01742	Digital Equipment Corporation	Maintenance on DEC-10 System	1/07/77	\$ 102,312	12/31/77	Maintenance is performed daily at VLA Site. Approximately \$88,334 was spent effective 10/31/77.

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-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-255 P.O. S-03591	Digital Equipment Corporation	Host Computer for High- speed Array Processor	4/12/77	\$ 126,000	8/30/77	All but item 11 of Purchase Order has been received and accepted. Item 11 is undergoing acceptance tests.
VLA-256	New Mexico State University	Archaeological Excavation	9/20/77	\$ 107,000	7/01/77	Work not started yet. Owner of land will not permit entry.
VLA-258	Midstate Cartage Co.	Labor-Hour Subcontract	3/28/77	\$ 195,000	3/27/78	Approximately \$98,934 was spent effective 10/31/77.
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.
P.O. S-04382	Industrial Design Engr. Assoc.	Temporary Draftsman		\$ 8,000	12/31/77	Approximately \$4,364 spent effectively 10/31/77.
P.O. S-04400	New Mexico Institute of Mining and Technology	Labor-Hour Contract		\$ 10,000	8/31/77	Approximately \$1,257 spent effective 10/31/77.
P.O. S-04738	AIL Division Cutler-Hammer	Parametric Amplifiers	10/14/77	\$ 102,900	5/03/78	Vendor has not accepted order yet.
P.O. S-04886	AIL Division Cutler-Hammer	Parametric Upconverters	9/23/77	\$ 79,702	7/15/78	Order has been accepted by AIL and work is in progress.
P.O. S-05002	Modular Computer Systems	Back up Synchronous Computer System	10/17/77	\$ 95,383.20	1/02/78	Delivery is on schedule.
VLA-283 P.O. S-05136	Fujikura Cable Works Ltd.	20 mm Waveguide		\$ 168,756	4/30/78	Withholding placement of order until tests can be completed on 2 meter flexible waveguide.

10/77

## 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-6	Amendment No. 21 for completion of Antennas 21-28	\$3,125,083	-----	-----	9/07/77	-----	Awaiting NSF approval.
VLA-70 S-052322	C.O. No. 5 15,000 meters of TE <sub>01</sub> Mode WG	\$1,083,300	-----	-----	10/11/77	11/15/77	Awaiting NSF approval.
VLA-29	Amendment No. 4 Focusing Feed Mounts for Antennas 17 thru 22	\$ 210,728	-----	-----	9/28/77	10/15/77	Awaiting NSF approval.
VLA-277	Crushed Stone	\$ 292,600	9/20/77	10/11/77	10/17/77	10/31/77	Awaiting NSF approval.
VLA-278	Rail Take up	\$ 325,000	10/20/77	11/19/77	12/01/77	12/31/77	Proposals solicited from 12 companies.
VLA-288 P.O. S-05427	Installation of armored Cable	\$ 18,520	-----	-----	10/25/77	-----	Awaiting NSF approval.
P.O. S-05428	Equipment to Expand Graphics Display System	\$ 61,953	-----	-----	10/26/77	11/15/77	Awaiting NSF approval.
VLA-291	Fabricated Metal Parts	\$ 60,000	10/20/77	11/10/77	11/30/77	12/15/77	Proposals solicited from four companies on bid list.
VLA-293	Bins and Brackets	\$ 45,000	10/20/77	11/10/77	11/30/77	12/15/77	Proposals solicited from four companies on bid list.

CY - 1977  
V E R Y L A R G E A R R A Y

STATUS AS OF OCT 31 77

TOTAL PROGRAM CY-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	4658077	96036446	4383530	91652916	32363710	128400156	153888144
12000	ANTENNA	413450000	7874809	207187738	447792	204739946	203845981	411053719	2394281
13000	ELECTRONICS	383350000	12618843	252379103	2749100	249630003	48225181	320404284	62943718
14000	COMPUTER	105300000	1346959	48945160	76236	48868924	22521313	71466473	33833527
16000	SYSTEMS INTEGRATION	6700000	435687	4160876	21560	4139316	1062782	5223658	1476342
17000	PROJECT MANAGEMENT	10000000	738343	8287330	.00	8287330	1620461	9907791	92209
18000	COMMON COST	69100000	3098212	51861623	.00	51861623	2524926	54386549	14713451
19000	CONTINGENCY/RESERVE	36985900	.00	.00	.00	.00	23148432	23148432	13840468
TOTAL PROGRAM		1307377200	30990930	668858276	7678218	661160058	355332786	1024171062	2893186138

Notes: (A) 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) \$15,111 for the NSF Ad Hoc Advisory Panel.

(B) The commitments against contingency represent CY-1978 procurements for which funds have not yet been received.

(C) Total commitments includes \$265,207 in estimated salaries and benefits for the remainder of the calendar year 1977.

CY - 1977

## VERY LARGE ARRAY

STATUS AS OF OCT 31 77

## 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	4458077	1257880637	332405150	925475487	35242001	1293122638	155945562
12000	ANTENNA	1736150800	7874809	1529482955	307002206	1222680749	203918319	1733601274	2549526
13000	ELECTRONICS	1091972400	12618843	940222587	195424230	764798357	70784892	1031007479	60944921
14000	COMPUTER	344987100	1566959	287778598	92729400	195048998	23107919	310886517	34100583
16000	SYSTEMS INTEGRATION	19303100	435687	16857422	5905500	10951922	1066925	17924347	1378753
17000	PROGRAM MANAGEMENT	170028400	738343	145289941	96051244	69238697	2249603	147539544	2488856
18000	COMMON COST	491000000	3098212	51841623	.00	51841623	2524926	54386549	14713451
19000	CONTINGENCY/RESERVE	36988900	.00	.00	.00	.00	23148432	23148432	13840468
TOTAL PROGRAM		4917618900	30990930	4249573763	1029517930	3240055833	362043017	4431616780	286002120

Notes: (A) 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) \$15,111 for the NSF Ad Hoc Advisory Panel.

(B) The commitments against contingency represent CY-1978 procurements for which funds have not yet been received.

(C) Total commitments includes \$265,207 in estimated salaries and benefits for the remainder of the calendar year 1977.

NATIONAL RADIO ASTRONOMY OBSERVATORY  
VLA PROGRAM

FINANCIAL STATUS REPORT  
(in thousands)

As of: October 31, 1977

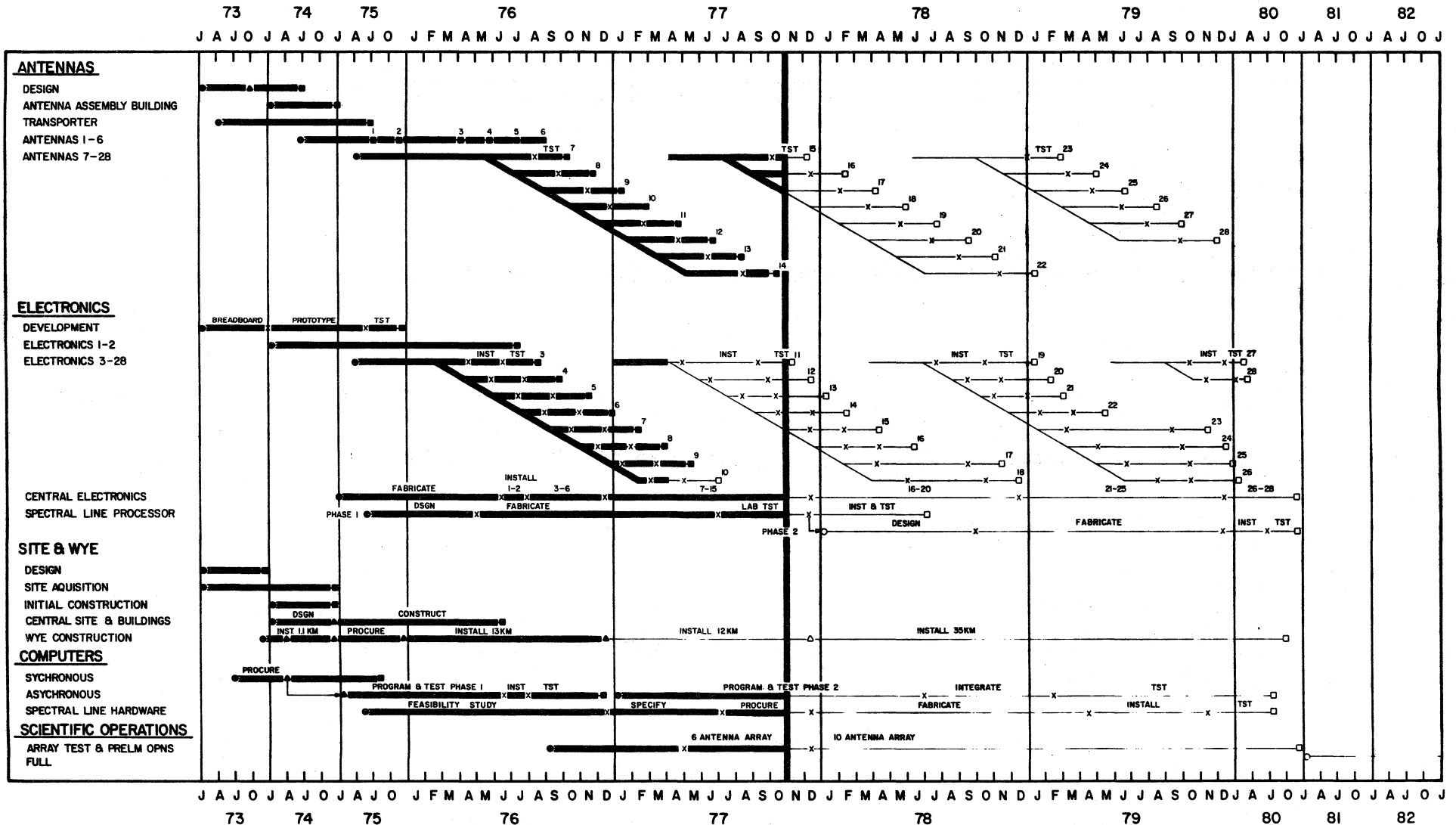
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Item	Program Ceiling	Allocation to Date			Un-allocated Balance	Outlook			Notes
		Allocated	Expended and Committed	Allocated Balance		Estimate to Complete	Estimate Total	(Over) Under Ceiling	
Site and Wye	27,860	14,491	12,931	1,560	13,369	13,819	26,750	1,110	
Antennas	20,400	17,361	17,336	25	3,039	4,813	22,149	(1,749)	
Electronics	17,000	10,920	10,310	610	6,080	6,994	17,304	(304)	
Computer	4,850	3,450	3,109	341	1,400	2,295	5,404	(554)	
Systems Integration	400	193	179	14	207	54	233	167	
Program Management	2,650	1,700	1,675	25	950	293	1,968	682	
Common Cost	-	691	544	147	(691)	1,527	2,071	(2,071)	
Subtotal	73,160	48,806	46,084	2,722	24,354	29,795	75,879	(2,719)	
Contingency	2,840	370	231	139	2,470	2,042	2,273	567	
TOTAL	76,000	49,176	46,315	2,861	26,824	31,837	78,152	(2,152)	

- Notes: (A) Allocated excludes \$293K for site acquisition, \$15.7K for ECAC study, and \$15.1K for NSF Ad Hoc Advisory Panel.  
 (B) Estimate to complete is as of August, 1976, and it excludes \$268K for airstrip.  
 (C) Estimate to complete includes escalation factor of 6% for Site/Wye work, NRAO labor, minor antenna equipment items and certain electronic equipment. No future escalation has been included for computer purchased equipment.  
 (D) Antennas estimate includes \$525K for transporter #2.

# NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

UPDATE DATE: 11/1/77

11/15/76



## SYMBOLS

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

## ABBREVIATIONS

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

REV. NO.	REV. DATE	REVISION