

APRIL 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

APRIL PROGRESS REPORT

VLA PROGRAM

MAY 13, 1977

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

APRIL 1977

SYSTEMS INTEGRATION DIVISION

The following observing sessions were conducted this month:

- April 1-4 Program AB-2, Burke, Baan, Haschick (MIT).
 Search for radiosources for absorption
 spectra of high velocity clouds.
- Program AB-3, Balick, Heckman (University
 of Washington).
 Survey of seyfert galaxies for nuclear
 emission.
- 88 hours of observations and tests with
 6 antennas.
- April 11-13 Program AH-5, Hjellming (NRAO) and Gibson (NMIMT).
 Periodic monitoring of CYG X-1.
- 40 hours of observations and tests with 6
 antennas.
- April 14-18 Program AH-6, Hjellming, Vandenberg (NRAO).
 Follow history of Nova Vulpeculae 1976
 and Nova Cygni 1977.
- Program AB-7, Briggs (NAIC).
 Observations of Ceres and Pallas.
- Program AG-5, Graf (Stanford University).
 Search for velocity oscillations and
 stable microstructure in the sun.
- 88 hours of observations and tests with 6
 antennas.
- April 25-27 Program AH-3, Hjellming (NRAO).
 Search for emission from compact x-ray
 objects.
- Program AH-5, See April 11-13.
- 40 hours of observations and tests with 6
 antennas.

April 28-May 2 Program AG-1, Gibson (NMIMT).

Search for radioemission from single
late type subgiant stars.

Program AF-1, Bridle (Queens University),
Fomalont (NRAO).

Observe Nuclear components of radiosources
in elliptical galaxies.

88 hours of observations and tests with 6
antennas.

There were no changes in the observing antenna configuration this month. The majority of the observing sessions involved operation of 2 subarrays, one consisting of Antennas #1, #2, #4 and #6, used in observing, and a second consisting of Antennas #3 and #5, used for instrumental tests.

Antenna #1 through #6 are operational at all bands. The operational status at 21, 2 and 1.3 cm is still provisional. The antenna downtime average for the month was 12%.

ELECTRONICS DIVISION

New L-Band feeds were installed on Antennas #3 and #5 and the L-Band waveguide runs were completed on Antennas #4, #3 and #5. Antennas #2, #3, #4, #5 and #6 are now equipped with the new L-Band feeds. Preliminary tests of the two prototype L-Band circular polarizers on Antennas #4 and #6 indicate satisfactory performance although the frequency response and off-axis performance of the polarizer-feed combination still has to be evaluated.

Front end No. 7 was completed and will be installed on the antenna in early May. The excessive vibration of the Cryomech refrigerator in this front end was significantly reduced by installing a cushioning pad on the end of the refrigerator piston. However, this problem needs more investigation before we can confidently use Cryomech systems for the rest of the array.

Front ends 8 and 9 had their first cooldowns and the Cryomech systems for front ends 10 and 11 were received.

In the waveguide area new measurements of the loss on the run between CW9 and CW5 showed no increase in loss since November, 1976. Loss measurements on the run between BW6 and CW9 which was buried using the new technique showed no increase in loss since January, 1977. The section of waveguide between CN9 and CN8 was installed by encasing the waveguide in cement. The waveguide run on Antenna 8 was completed.

In the local oscillator area, work is progressing towards having all L.O. system changes specified by June 15 so that construction for systems 11-15 can proceed on schedule. Testing is continuing on the New L.O. system installed on Antennas #3 and #5.

In the monitor and control area construction was begun on a second serial line controller which will be available as a standby should the operational unit fail.

The design of the control logic for the spectral processor has started. One of the custom integrated circuits is now in fabrication for delivery in early June. The other integrated circuit is now at the mask fabrication stage with the first chips expected in early July.

COMPUTER DIVISION

During April we received a MODCOMP II/45 which will be the system controller and stand-alone test and delay system for the new delay multiplier system. An appropriate operating system has been generated, and some other system level software work done.

The on line scan averaging program is now working sufficiently to see how well the system is working.

We have installed the DEC RSX-11M operating system in the PDP-11 display computer, in anticipation of adding a larger disk to it (unsupported in the RT-11 operating system we have been running), and to be compatible with the array processor system. We now have a programmer (RSP) attending a school on this operating system. We have received and installed a new compiler for the SAIL language, which has several additional capabilities that the previous revision did not.

A system of polarization calibration programs is approaching readiness for its first try. The program which calculates the correction is running, but not the programs which apply to them.

We had a disk "head crash" (contact of the recording head with the disk surface; it normally "flies" a fraction of a micron above the surface on a film of air) on the MODCOMP computer system. The resulting damage put that disk drive off-line for about three weeks. Observing continued unaffected with the second disk drive, but the terminal normally supported during observing for software work or source list preparation could not be used.

ANTENNA DIVISION

Antenna No. 8

Mechanical outfitting is completed on maintenance pad and the antenna was moved to station CW6 to await electronic installation.

Antenna No. 9

Moved to the maintenance pad and mechanical outfitting started.

Antenna No. 10

Servo tests were completed with natural frequency of 2.48 Hz in elevation and 2.3 in azimuth. A new type of limit switch in the

elevation cam limit switch box was installed and proved to be unsatisfactory. To correct the switch malfunctions which have proven to be overly frequent, knocker type limit switches were installed on the elevation gear and proved satisfactory. Antenna #10 was accepted on April 26, 1977.

Antenna No. 11

Reflector assembly completed, azimuth bearing installed and pedestal aligned, yoke and alidade completed, elevation axle installed and aligned. On April 18 the reflector and pedestal were mated and panel installation started. By end of month panel installation was complete and panel alignment started.

Antenna No. 12

Trial assembly completed at fabricators, painting in progress and partially complete. Structure is ready for shipment.

The factory servo tests performed on units 11, 12 and 13. Panels are on the Site through Antenna #13. Gear reducers are at the Site through Antenna #18. Azimuth bearings are at the Site through Antenna #15. A mock-up of modified air conditioning was tested at the General Electric distributor plant in Dallas and approved. Modified access stairways were installed on Antennas #7 and #8.

SITE AND WYE DIVISION

Subcontract VLA-149; Wye Construction; Burn Construction Company, Inc.;
\$3,012,852

This contract is 100% complete.

Subcontract VLA-167; Paul D. Goar Construction; \$169,466

Poured VSQ patio and sidewalk during the month. Erected generator lean-to steel and completed 90% of roofing and siding.

Waveguide

Second test section (concrete poured around waveguide) between CN7 and CN8 is complete. The third test section (direct burial waveguide or compacted bedding) progressed during the month and is 94% complete. Layout and trenching work has commenced on the west arm in preparation of starting up the waveguide installation to AW8.

PROJECT MANAGEMENT

During the month of April, 1977, we placed 216 purchase orders and subcontracts totaling \$620,325.

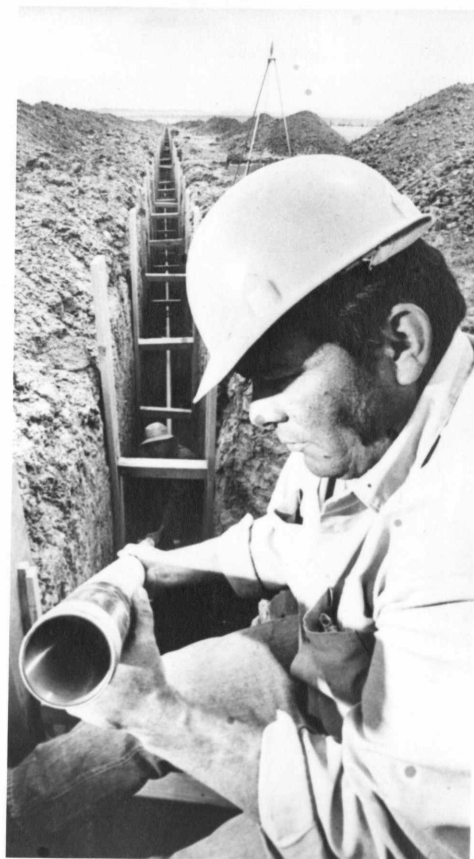
Personnel

The personnel changes as of April 30, 1977 are as follows:

<u>Division</u>	<u>Previous Level</u>	<u>Additions</u>	<u>Reductions</u>	<u>Current Level</u>
Site and Wye	7	1	0	0
Antenna	13	1	0	14
Electronics	42	2	1	43*
Computer	15	0	0	15
System Integration	5	0	0	5
Project Management	<u>28</u>	<u>2</u>	<u>2</u>	<u>28**</u>
Total	110	6	3	113

* Includes one temporary person

** Includes three part-time people



p4-77-1

Installation of Waveguide Between CN7 and CN8
(second test section which will use poured concrete)



p4-77-2

Control Room



p4-77-3

DEC-10 Computer



p4-77-4

Electronics Room, "D" Racks

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/CVR Joint Venture	E/A Title I and II	6/11/73	\$ 1,039,064		Title I - Completed Title II - Completed Title III - Work in progress in conjunction with VLA-149 and preparation of bid documents for Phase IV construction. Fixed price plus reimbursables
VLA-6	E-Systems, Inc.	28 Radio Telescopes	10/18/73	\$ 18,131,767	3/01/77	NRAO has taken possession of Antennas Nos. 1 through 10. Antenna 11 should be completed by 5/31/77.
VLA-29	Sterling-Detroit Co.	Focusing Feed Mounts	11/03/76	\$ 524,032	8/01/77	Three units were accepted the week of April 1, 1977. All units are complete.
VLA-53	R. F. System	K and Ku Band Feed Horns	1/26/76	\$ 154,388	9/30/77	All K and Ku Band Horns for Antennas 7-10 have been received. Work has begun on horns for A11 - A15.
VLA-70 P.O. 52322	Sumitomo Electric USA, Inc.	5373 pieces of waveguide 5185 each coupling sleeves	1/27/75	\$ 1,801,827	1/15/77	4313 pieces of waveguide and 4380 coupling sleeves have been received. First shipment under C.O. No. 4 was shipped April 20, 1977.
P.O. 53880	N. M. Tech.	Labor Hour Contract	9/01/75	\$ 15,000	8/31/76	Approx. \$13,901 spent effective 4/30/77
VLA-167	Paul D. Goar Construction Co.	Prefab Metal Maintenance and Warehouse Bldgs.	1/06/76	\$ 169,466	3/30/77	Amendment No. 1 issued for construction of Lean-to-type addition to maintenance building. Work on addition about 95% complete.
VLA-177	Fujikura Cable Works, LTD.	Waveguide coupling Components	3/21/77	\$ 217,879	7/15/77	Amendment No. 1 has been accepted by vendor. Delivery is on schedule.

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-179 P.O. S-01046	AIL Div. of Cutler Hammer	Parametric Amplifiers	4/29/76	\$ 134,920	10/12/76	Paramps for A7 - A11 have been received. Vendor has begun work on paramps for A11 - A15.
P.O. S-01946	Industrial Design Engineering Assoc.	Labor Hour Contract for Temporary Draftsman	7/21/76	\$ 19,000	1/26/77	Draftsman is working in drafting section at 2015 Ivy Rd., Charlottesville, Va. \$13,547 spent effective 4/30/77.
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 effective 4/30/77.
VLA-211 P.O. S-02412 P.O. S-02524	Executone Systems of New Mexico Inc.	VLA Wye Comm. System	10/05/76	\$ 72,980.83	3/30/77	Installation was completed December 1976 on all antennas that have been delivered and all cable has been installed.
VLA-220 P.O. S-02245	J. J. Gustincic	C-Band Horns for A11 - A15	2/08/77	\$ 74,550	4/30/77	Delivery will be completed 5/30/77.
VLA-229 P.O. S-02717	Digital Equipment Corp.	128K words of Main Memory and two Data Channels	11/30/76	\$ 83,760	1/30/77 3/31/77	128K words of memory received 4/04/77. Delivery of data channels will be 6/30/77.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	\$ 164,000	9/15/77	Delivery is on schedule.
P.O. S-02998	AIL Div. Cutler Hammer	Upconverters	12/15/76	\$ 62,623	6/15/77 to 8/15/77	Delivery is on schedule.
P.O. S-01742	Digital Equipment Corp.	Maintenance on DEC-10 System	1/07/77	\$ 67,560	6/30/77	Maintenance is performed daily at VLA Site.
VLA-240 P.O. S-03093	Eagle Picher In- dustries, Inc.	Fabricated Metal Parts	1/07/77	\$ 67,092	4/17/77	Scheduled for completion May 15, 1977.

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-03306	Modular Computer Systems, Inc.	Host Computer for Array Processor	1/28/77	\$ 62,075	4/30/77	Computer was received 4/30/77.
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.
VLA-244 P.O. S-03351	Floating Point Systems	Two High Speed Array Processors	2/08/77	\$ 160,582.40	5/15/77	One Array Processor was shipped 4/30/77.
VLA-245 P.O. S-03633	Sandia Detroit Diesel, Inc.	Install Emergency Standby Power Generators	3/31/77	\$ 50,563.36	5/15/77	Work is in progress.
VLA-254 P.O. S-03651	J. J. Gustincic	L-Band Feed Horns for A7-A14	3/31/77	\$ 81,000	6/30/77	Delivery will be completed approx. July 31, 1977.
VLA-255 P.O. S-03591	Digital Equipment Corp.	Host Computer for High Speed Array Processor	4/12/77	\$ 126,000	8/30/77	Acknowledgement of Purchase Order has not been returned yet.
VLA-258	Midstate Cartage	Labor Hour Subcontract	3/28/77	\$ 100,000	3/27/78	Approx. \$5,813 was spent effective 4/30/77.

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-265	Integrated Circuits	\$ 90,000	3/10/77	3/25/77	4/11/77	4/26/77	Orders placed with 6 different vendors on bases of low bid within NRAO contract authorization.
P.O. S-04046	Update and Expand Synchronous Computer	\$ 51,200	-----	-----	4/29/77	5/15/77	Awaiting NSF approval.

CY - 1977

VERY LARGE ARRAY

STATUS AS OF APRIL 30, 1977

	<u>ALLOCATION</u>	<u>EXPENDED MONTHLY</u>	<u>TOTAL EXPENDED</u>	<u>TRANSFER TO FIXED ASSETS</u>	<u>BALANCE CONSTRUCTION IN PROGRESS</u>	<u>TOTAL COMMITTED</u>	<u>TOTAL EXPENDED & COMMITTED</u>	<u>BALANCE</u>	<u>OUTSTANDING OBLIGATIONS PENDING</u>	<u>NET BALANCE</u>
SITE AND WYE	2,822,883	44,096	104,022	18,056	85,966	647,262	751,284	2,071,599	181,831	1,889,768
ANTENNA	4,006,500	43,109	296,291	1,968	294,323	3,447,671	3,743,962	262,538	161,038	101,500
ELECTRONICS	3,835,500	263,701	838,067	11,644	826,423	1,221,508	2,059,575	1,775,925	493,910	1,282,015
COMPUTER	1,053,000	31,146	96,564	---	96,564	299,567	396,131	656,869	148,658	508,211
SYSTEMS INTEGRATION	67,000	2,564	10,366	188	10,178	554	10,920	56,080	20,755	35,325
PROJECT MANAGEMENT	100,000	7,865	33,222	---	33,222	---	33,222	66,778	54,203	12,575
COMMON COST	691,000	49,001	196,992	---	196,992	16,553	213,545	477,455	477,455	---
CONTINGENCY/RESERVE	523,000	---	---	---	---	---	---	523,000	---	523,000
TOTAL	13,098,883	441,482	1,575,524	31,856	1,543,668	5,633,115	7,208,639	5,890,244	1,537,850	4,352,394

TOTAL PROJECT
VERY LARGE ARRAY
STATUS AS OF APRIL 30, 1977

	<u>ALLOCATION</u>	<u>EXPENDED MONTHLY</u>	<u>TOTAL EXPENDED</u>	<u>TRANSFER TO FIXED ASSETS</u>	<u>BALANCE CONSTRUCTION IN PROGRESS</u>	<u>TOTAL COMMITTED</u>	<u>TOTAL EXPENDED & COMMITTED</u>	<u>BALANCE</u>	<u>OUTSTANDING OBLIGATIONS PENDING</u>	<u>NET BALANCE</u>
SITE AND WYE	14,490,882	54,067	11,709,930	3,296,366	8,413,564	688,125	12,398,055	2,092,827	181,831	1,910,996
ANTENNA	17,233,508	1,377,027	13,388,019	3,062,894	10,325,125	3,581,454	16,969,473	264,035	161,038	102,997
ELECTRONICS	10,919,724	296,937	7,877,823	1,936,489	5,941,334	1,271,306	9,149,129	1,770,595	493,910	1,276,685
COMPUTER	3,449,871	34,555	2,482,908	926,533	1,556,375	307,618	2,790,526	659,345	148,658	510,687
SYSTEMS INTEGRATION	193,031	2,576	136,151	59,027	77,124	788	136,939	56,092	20,755	35,337
PROJECT MANAGEMENT	1,700,284	10,031	1,598,087	960,464	637,623	14,399	1,612,486	87,798	54,203	33,595
COMMON COST	691,000	49,001	196,992	---	196,992	16,553	213,545	477,455	477,455	---
CONTINGENCY/RESERVE	523,000	---	---	---	---	---	---	523,000	---	523,000
TOTAL	49,201,300 ⁽¹⁾	1,824,194	37,389,910	10,241,773	27,148,137	5,880,243	43,270,153	5,931,147	1,537,850	4,393,297

(1) Project Allocation does not include \$293,000 withheld by NSF for Army Corp. of Engineers or \$15,700 for ECAC Study. \$50,000 withheld by NSF on Amendment #24 is included in the total allocation.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLA PROGRAM

FINANCIAL STATUS REPORT
(in thousands)

As of: April 30, 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	12,398	2,093	13,369	14,352	26,750	1,110	(6)
Antennas	20,400	17,233	16,969	264	3,167	5,052	22,021	(1,621)	
Electronics	17,000	10,920	9,149	1,771	6,080	8,155	17,304	(304)	
Computer	4,850	3,450	2,791	659	1,400	2,613	5,404	(554)	
Systems Integration	400	193	137	56	207	96	233	167	
Program Management	2,650	1,700	1,612	88	950	356	1,968	682	
Common Cost	-	691	214	477	(691)	1,857	2,071	(2,071)	
Subtotal	73,160	48,678	43,270	5,408	24,482	32,481	75,751	(2,591)	
Contingency	2,840	523	---	523	2,317	2,401	2,401	439	
TOTAL	76,000 ⁽¹⁾	49,201 ⁽²⁾	43,270	5,931	26,799	34,882	78,152	(2,152)	

Notes: (1) Includes estimate of \$293K 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.

Explanation to Accompanying Statement

Column (2) - Project Ceiling: Original estimates

Column (3) - Allocated: Funded by NSF and included in total funds provided in Contract C-780.

Column (4) - Expended and Committed: Actual cash paid out and orders written and accepted by vendors.

Column (5) - Allocated Balance: Column 3 less Column 4. (Current funds available for expenditure and commitment.)

Column (6) - Unallocated Balance: Column 2 less Column 3. (Funds due from NSF to fund the total project as originally estimated.)

Column (7) - Estimate to Complete: Original estimate updated to take into account current or known costs.

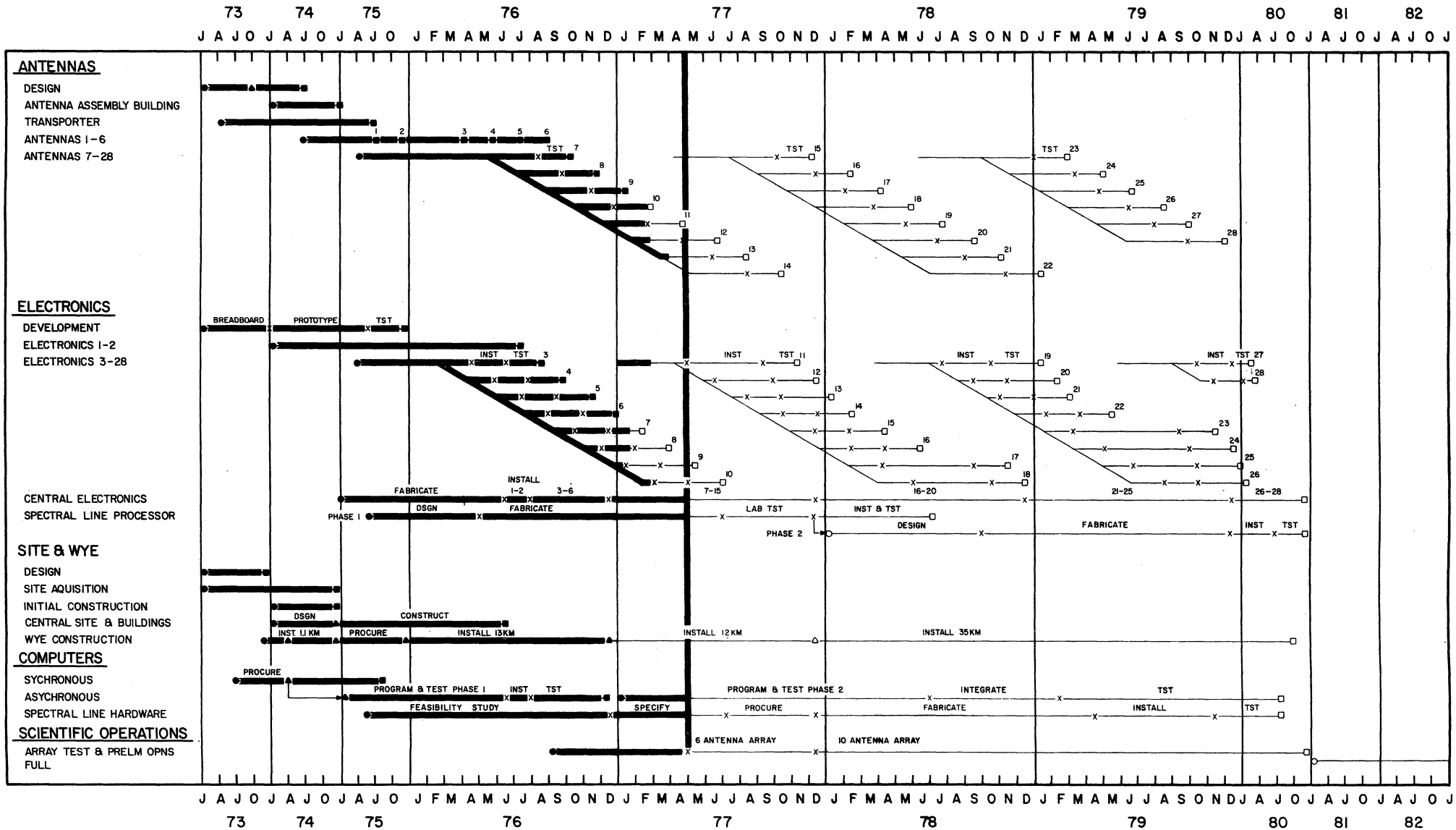
Column (8) - Estimated Total: Column 4 plus Column 7.

Column (9) - (Over) Under: Column 2 less Column 8.

NATIONAL RADIO ASTRONOMY OBSERVATORY VLA ACTIVITY SCHEDULE

UPDATE DATE: 5/1/77

11/15/76



SYMBOLS

O START OF A PHASE Δ 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