JULY 1976

NATIONAL RADIO ASTRONOMY OBSERVATORY

JULY PROJECT REPORT

VLA PROJECT

August 12, 1976

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROJECT

JULY 1976

SITE AND WYE

Subcontract VLA-149; Wye Construction; Burn Construction Company, Inc.; $2,913,000

1. All ballast and aggregate has been crushed and all main line ballast has been distributed.

2. Fifteen antenna foundation tie beams and pedestals remain to be poured at antenna stations DE2, 3, 4, 7, 9, CE8, BW5, 6, 7, 8, 9, AW5, 6, 7, and 8.

3. All main line trackage has been assembled except a short section near the center of the wye. The spurs scheduled for early completion are completed and most of the others have been prefabbed into panels. Raising the track to grade is 70% complete on the north and east arms and the east/north arm connection is 80% complete including switches and cross overs.

4. Electrical cabling has been installed from CN8 to CN9 and from AW6 to AW8. Grounding on all foundations has been completed as far as possible, until anchor bolts are set.

5. Primary connections to antenna station transformers are finished and secondary connections are complete to all complete foundations.

This contract is estimated at 90% complete.

Subcontract VLA-65; George A. Rutherford, Inc.; $2,395,400

All that remains for the building to be completed is the final test and balance work on the mechanical systems.

This contract is estimated at 99.6% complete.

The west arm waveguide from the Control Building to CW5, has been completed, except for 30 feet between the manhole under the Computer Trailer and CW5 manhole. Those 2 sections of waveguide will have to be removed and two 12" steel casings installed for the railroad maintenance spur. The N & E lead in has been completed from the Control Building to beyond the swale.

ANTENNA DIVISION

Antenna No. 4

Outfitting of Antenna No. 4 was completed in late July and on July 28 Antenna No. 3 was moved to permanent station CW7 and Antenna No. 4 was moved to CW6.

Antenna No. 5

Antenna servo and acceptance tests were completed on July 15, 1976. The antenna resonant frequencies were measured at 2.3 Hz rocking and 2.4 Hz torsional mode. On July 16 Antenna No. 5 was accepted from E-Systems. Antenna No. 5 was moved on July 29 to the maintenance pad to start outfitting.

Antenna No. 6

Assembly of pedestal through elevation wheel completed on July 19. Reflector completed on July 22. On July 23 the reflector and pedestal were mated and returned to the assembly building foundation for the installation of surface panels which started on July 26. By the end of the month panels were approximately 50% installed.

Antenna No. 7

On July 27 first elements of the reflector hub were assembled. Surface panels for reflector were received in mid-July. The majority of structural components were on hand with exception of yoke and yoke arms which were scheduled for shipment in early August.

Antenna No. 8

Trial assembly in progress in Hobbs.

SYSTEMS INTEGRATION DIVISION

Four observing runs were conducted this month as follows:

Run No. 1

1 h to check out system
38 h pointing A1 and A2
1 h electric level tests in A1

Run No. 2

11 h down with servo problems in A1 and A2
1 h down - L8
3 h down - F3
5 h circular beam profiles 2 and 1.3 cm
20 h dual frequency test

Run No. 3

28 h 6 and 2 cm observations of calibrators and weak sources
5 h feed tests at 6 cm
3 h down F3
3 h down - air conditioner A1
1 h check out system

Run No. 4

1.5 h system check out
38.5 h 6 cm observations of four circumpolar calibrators

Antenna No. 4 outfitting was completed except for Rack B installation and the antenna moved to station CW6 for single dish tests.

Antenna No. 3 was moved to station CW7, to free CW6.

ELECTRONICS DIVISION

On July 13 the first fringes were obtained at 1.3 cm wavelength. A request for quotations has been issued for 6 cm feed horns built to new design, and procurement of the units for antennas 1 to 10 will be pursued as rapidly as possible. Orders for 2 cm and 1.3 cm feed horns for antennas 7 to 10 have been placed. Interferometer tests of the 2 and 1.3 cm feeds on antennas 1 and 2 showed cross polarization averaged 3.5% to 4% at the -3 dB level of the beam. The prototype of the new design of 18-21 cm feed was undergoing final assembly at the close of the month and J. J. Gustincic is estimating delivery after final testing in the latter half of August. Calculations by Gustincic have shown that lateral displacement of the sub-reflector will reduce the beam offsets with circular polarization, but the magnitude of undesired effects which would also be introduced, such as loss of aperture efficiency, are not fully known as yet. Tests have been made with a lens containing spiral conducting elements in front of the 6 cm feed on Antenna No. 1, and a reduction of the beam offsets by a factor of 3 was obtained. This was accompanied by some loss in forward gain, but the result is considered promising.

The front end rack was installed on Antenna No. 4 on July 19 in readiness for single-dish testing. The front end for Antenna No. 5 has undergone the first cool down tests.

Waveguide installation has been completed on the west arm from the Control Building to CW9, but a small section near CW5 has to have a conduit added for protection at the crossing of the maintenance railroad spur. Attenuation measurements from the Control Building to CW5 have been made and are well within specification. Preparations have been made for connection of the west arm waveguide to the signal distributor. An order has been placed with the Fujikura Company for 20 mm rotating joints for antennas through No. 15.

In other areas of the electronics work is progressing as usual on assembly of modules for antennas 7-10 and design modifications to improve performance and reliability. Modifications for the L.O. Receiver and Central L.O. Receiver modules have been finalized and will be incorporated in the building of antennas 7-10. Testing of the Monitor and Control system shows very low error rates can be achieved most of the time, and modifications to improve reliability and improve the detection of errors continue to be made. Breadboard design of the Spectral Processor is continuing. Documentation of the final design of the modem modules T1 and T2 is in progress.

As the month closed preparations were made for the movement of offices, laboratories and equipment to the Control Building. Cabling in the building for installation of the electronics was almost complete. The move was executed smoothly and on schedule during August 2-4 and will be described in more detail in next month's report.

Joe S. Ortiz joined the electronics division on July 26 as a maintenance trainee in the cryogenic group.

COMPUTER DIVISION

Asynchronous Subsystem

On July 10 the reinstallation of the DEC-10 system in the VLA computer room was completed. Some hardware problems with the card punch and tape drive are still being worked on by DEC.

During July, work on the data base continued. Progress toward solving the slowness problems and newly discovered bugs was made. The second major RUN data base design is now being implemented in a considerable faster SAIL version.

Two-way communication between the Modcomps and the DEC-10 is now possible via mag tapes written on either machine.

A CANDID program to retrieve data from the data base and return a structure to CANDID storage has been written but not tested yet. Plans for the Experimental Pre-synthesis System revolve about the use of a standard data structure which will be contained in CANDID storage. This makes portions of the visibility data readily available for rapid pre-synthesis routine development. Temporarily, until the RUN data base is available, a CANDID program which reads card images written by programs in the Modcomp can be used to put data into the standard data structure.

The procurement process for an array processor and FFT box was begun. Requests for information are being sent to various manufacturers, and an RFP will shortly be written.

The new graphics operators in CANDID have been designed and are being implemented and tested. These will have the feature of being device-independent as seen from CANDID and the various portions in the current system will be combined in one unified system.

Synchronous Subsystem

During July there were continued improvements to the monitor data check program (it is now useful but not yet complete). There were minor improvements to the off-line data processing programs. An observing list preparation program has been started. Computer operation at wavelengths of 2 and 1.3 cm was checked out by actual operation and also dichroic mode observing.

PROJECT MANAGEMENT

During July 205 purchase orders were written amounting to $108,000. Proposals were solicited for the C-Band Horns, and contracts written for a temporary draftsman and a consultant agreement with J. J. Gustincic for work on the circular polarization problem.

Amendment No. 18 to Subcontract VLA-06 was approved by the Foundation and accepted by E-Systems. This amendment provides for the early procurement of certain key items for the remaining 18 antennas.

Work on the take up of rail at Crab Orchard is about 80% complete and the take up work in California has been completed.

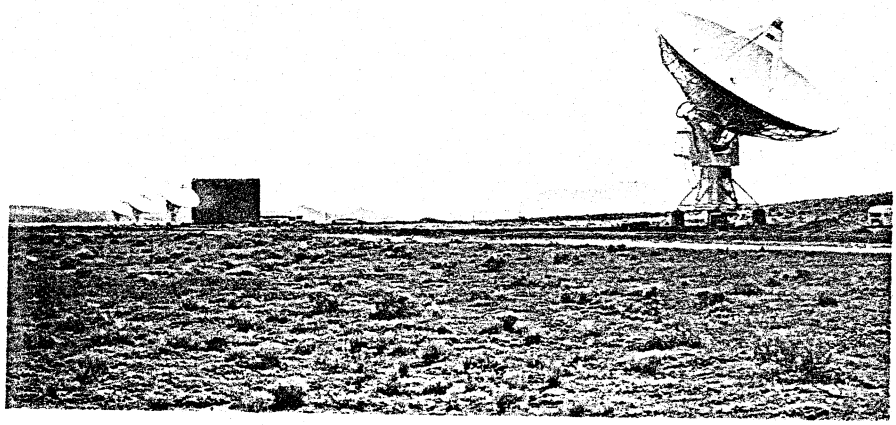
The cafeteria is now in operation at the Site serving a noon meal and also serving breakfast and sandwiches to order for the personnel spending the night at the Site.

Personnel

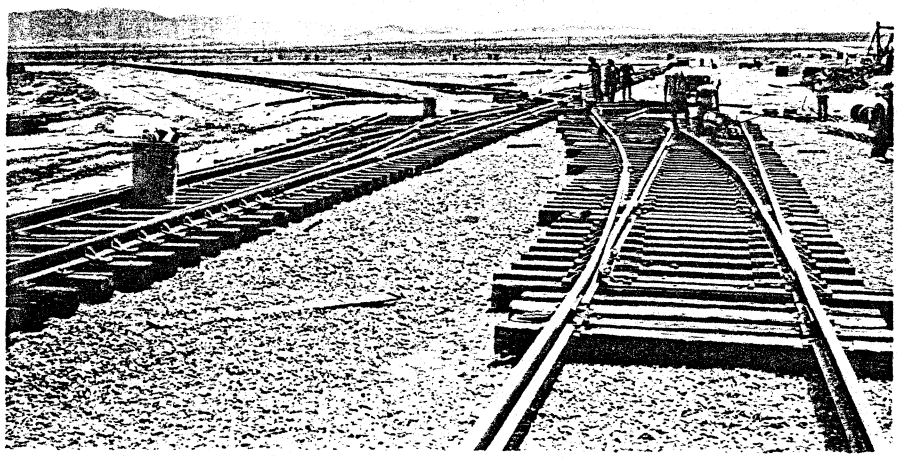
The personnel changes as of July 31, 1976 are as follows:

Division	Previous Level	Additions	Reductions	Current Level
Site and Wye	8	0	1	7
Antenna	9	0	0	9
Electronics	37	1	0	38
Computer	12	1	0	13
Systems Integration	3	0	0	3
Project Management	24	0	1	23*
Totals	93	2	2	93

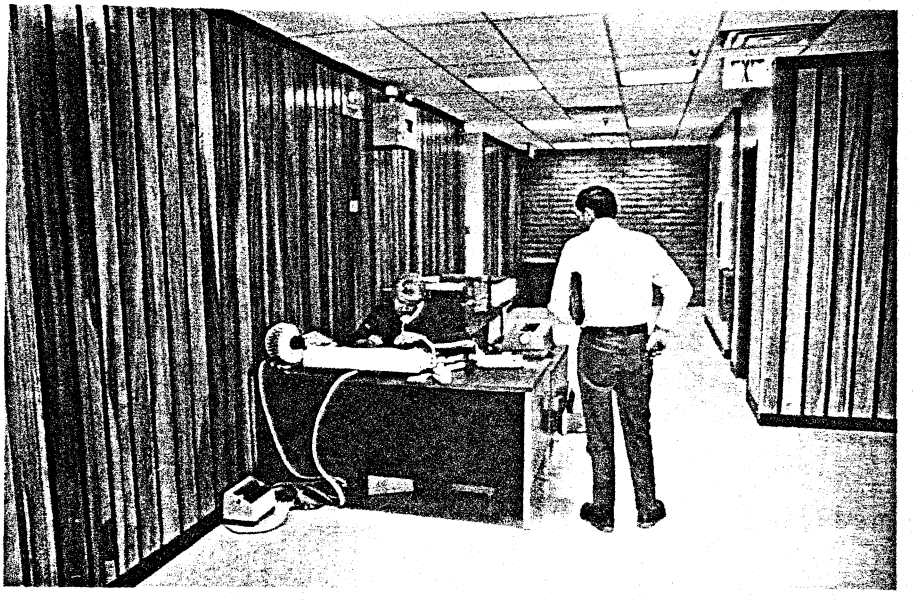
*Includes one part-time person.



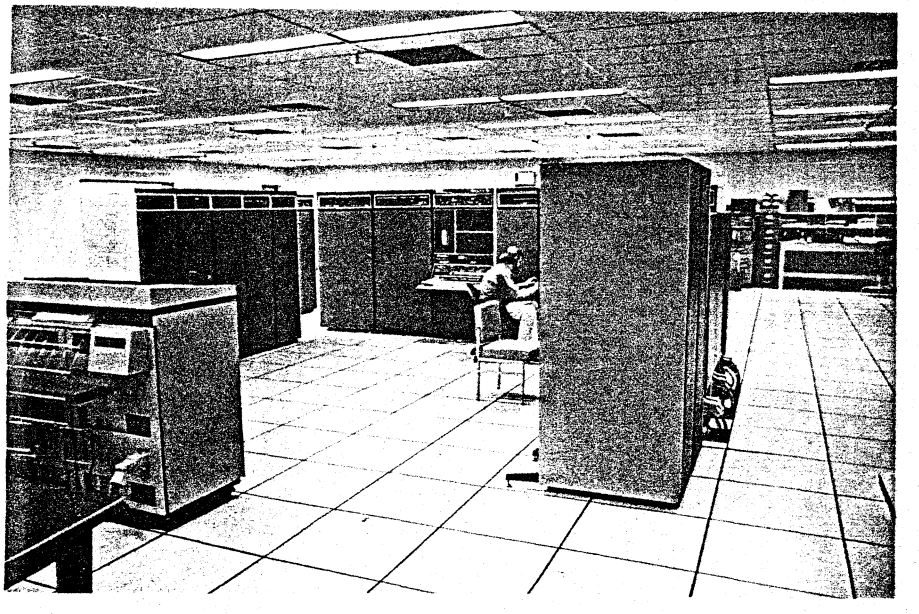
p7-76-1 Antenna on SW Arm



p7-76-2 Rail Construction at Center of Wye

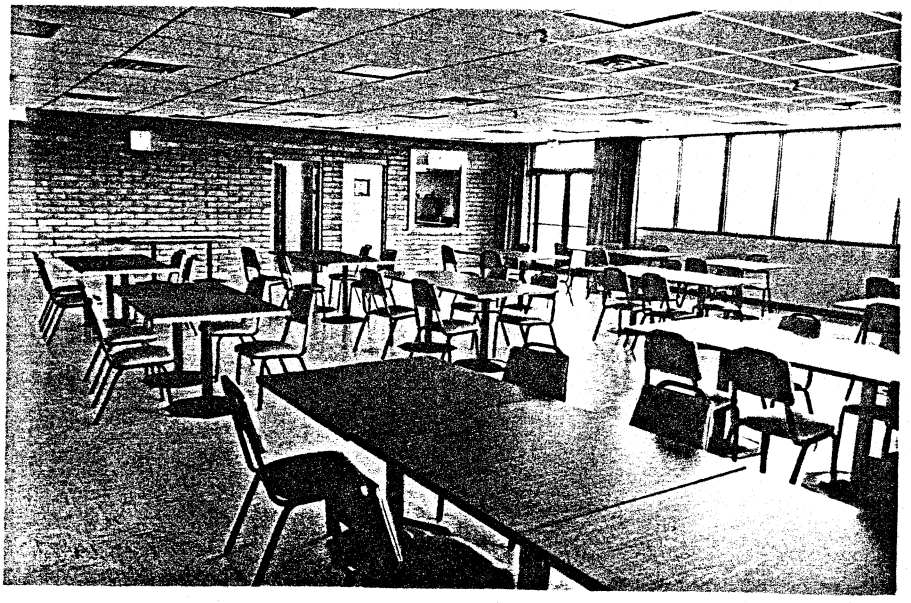


p7-76-3 Control Building, Second Floor Lobby

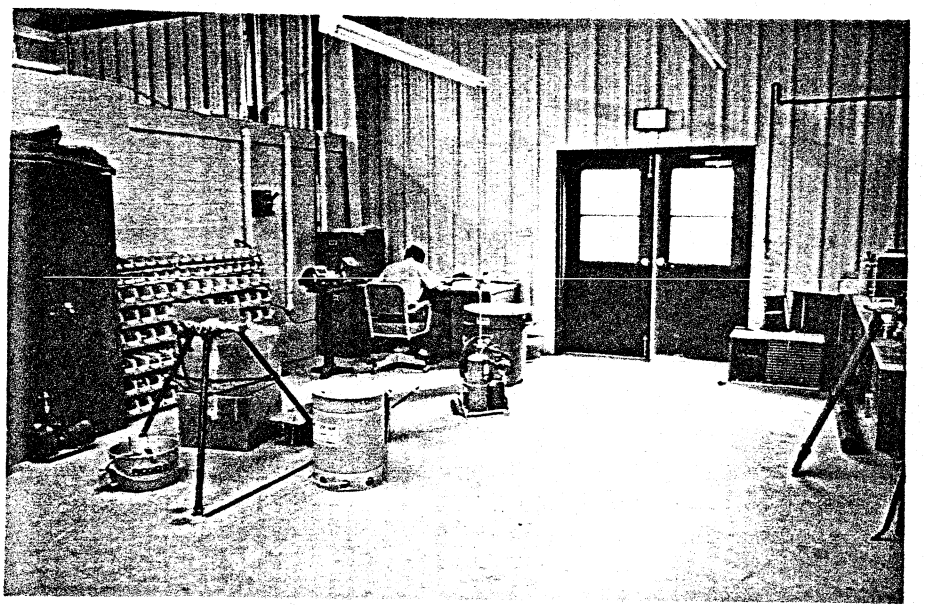


p7-76-4 Control Building, Computer Room

p7-76-5 Cafeteria, Serving Line



p7-76-6 Cafeteria, Dining Area



p7-76-7 Maintenance Building, Air Conditioning and Welding Shop

p7-76-8 Warehouse Interior

VLA PROJECT
MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

NUMBER P.O. SUBCONTRACT	VENDOR	ITEM DESCRIPITON	DATE PLACED	DOLLAR AMOUNT	DELIVERY DATE	CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED
VLA-5	BWH/CVR Joint Venture	E/A Title I and II	6/11/73	$ 1,028,269		Title I - Completed Title II - Completed Title III - Work in progress in conjunction with VLA-149. Fixed price plus cost reimbursables.
VLA-6	E-Systems, Inc.	28 Radio Telescopes	10/18/73	$17,549,422	3/1/77	NRAO has taken possession of Antenna Nos. 1, 2, 3, 4, and 5. Antenna 6 is on schedule.
VLA-14	Comtech Lab., Inc.	Parametric Amplifiers	3/13/74	$ 221,000	7/15/75	10 each additional parametric amplifiers purchased on Amendment No. 1 have been received.
VLA-53	R. F. System	K and Ku Band Feed Horns	1/26/76	$ 73,776	6/7/76 7/19/76	K Band Feeds for Antennas 3 through 6 have been received. Ku Band Feeds for Antennas 3 through 5 have been received. Final Ku Band Feed due for shipment 8/9/76.
VLA-70 P.O. 52322	Sumitomo Electric USA, Inc.	4373 pieces of waveguide 4480 each coupling sleeves	1/27/75	$ 1,446,634	1/15/77	2313 pieces of waveguide and 2350 coupling sleeves have been received. 1000 pieces of waveguide and 1030 each coupling sleeves have been received and are ready for coating.
VLA-134 P.O. 53578	Air Products and Chemicals, Inc.	Helium Compressors and Cryogenic Refrigerators	8/15/75	$ 139,545	11/1/76	Delivery of units for Antennas 7 through 10 will be completed by 10/30/76.
VLA-146 P.O. 053619	Spacekom, Inc.	Mixers for IF/LO Modems	2/20/76	$ 74,600	5/31/76	Order was completed in July, 1976.
VLA-149	Burn Construction Co., Inc.	Site Construction Phase III	9/25/76	$ 2,979,600	10/25/76	Work is Approx. 90% complete.
P.O. 53880	N. M. Tech.	Labor Hour Contract	9/1/75	$ 15,000	8/31/76	Approx. $7,564 spent effective 7/3/76.
VLA-160 P.O. S-00120	Wutzke RR Tie Co.	20,000 Used Cross Ties	10/17/75	$ 109,000	12/31/75	18,435 ties have been delivered for stockpiling.

VLA PROJECT

MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

NUMBER P.O. SUBCONTRACT	VENDOR	ITEM DESCRIPITON	DATE PLACED	DOLLAR AMOUNT	DELIVERY DATE	CURRENT STATUS - ALL FIRM FIXED PRICE CONTRACTS EXCEPT WHERE NOTED
VLA-174	Lawrence Hefner	Provide Labor and Equipment	1/26/76	$ 62,400	2/28/77	Approx. $20,012 spent effective 7/31/76.
P.O. S-00815	Deluna Bluebird Bus Sales of N.M.	Coach	3/25/76	$ 53,626	8/1/76	Delivery of coach will be approx. 8/10/76.
VLA-177 P.O. S-00985	Fujikura Cable Works Ltd.	Waveguide Coupling Components	3/5/76	$ 134,985	6/11/76 10/1/76	Partial shipments have been received and are on schedule.
P.O. S-00986	Hitachi Shibaden Corp. of America	Waveguide Adaptors	3/25/76	$ 47,800	10/1/76	Four have been received. Balance of 36 due for shipment from Japan week of 8/12/76.
P.O. S-01147	Fujikura Cable Works Ltd.	Rotary Joints	3/30/76	$ 696	6/30/76	Two received July 12, 1976. Request NSF approval to purchase 8 additional units under option on July 15, 1976
VLA-179 P.O. S-01046	AIL Div. of Cutler Hammer	Parametric Amplifiers	4/29/76	$ 62,320	10/12/76	Two due 9/2/76 and 6 due 10/12/76
S-01134	Digital Equip. Corp.	Eight Line Comm. Group	4/5/76	$ 5,060	8/30/76	Delivery is on schedule.
VLA-191 P.O. S-01162	Longwill-Scott Inc.	Rail Take Up Crab Orchard, Ill.	4/7/76	$ 118,385	7/31/76	Work is 80% Complete.
P.O. S-01749	Computer Products Unlimited Inc.	CRT Terminal	6/25/76	$ 2,965	7/30/76	Terminal will be shipped 8/5/76.
P.O. S-01752	Applied Digital Data Systems, Inc.	CRT Terminal	6/25/76	$ 2,688	7/30/76	Received and accepted July, 1976.
P.O. S-01753	Modular Computer Systems, Inc.	CRT Terminals and Interface	6/25/76	$ 4,000	7/30/76	Terminals and interface will be shipped 8/9/76.

VLA PROJECT
PROCUREMENT ACTIVITIES INITIATED

RFP NUMBER	ITEM DESCRIPTION	ESTIMATED COST	ISSUE DATE	BID DUE DATE	SUBMISSION TO NSF DATE	AWARD DATE	CURRENT STATUS
VLA-211	VLA Wye Communication System	$260,000	5/6/76	6/22/76	8/30/76	9/1/76	Specifications are being revised to reduce system cost.
P.O. S-01946	Labor Hour for Temporary Draftsman	$ 9,100	-----	------	7/15/76	7/21/76	Temporary draftsman until 1/26/77 by Electronics Section in Charlottesville, Va.
VLA-220	C Band Feed Horn for Antennas 2 through 10	$ 54,000	7/20/76	8/11/76	8/16/76	8/30/76	Proposals solicited from eight companies.
P.O. S-01984	Consulting Agreement	$ 4,000	8/2/76	------	7/20/76	8/2/76	Consultant is working on circular polarization on K, Ku, C, and L Band Horns.

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA--FINANCIAL STATUS REPORT
(in thousands)

As of: July 31, 1976

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Allocation to Date				Outlook			
Item	Project Ceiling	Allocated	Expended and Committed	Allocated Balance	Unallocated Balance	Est. to Complete	Est. Total	(Over) Under Ceiling	Notes
Site and Wye	27,860	11,572	11,241	331	16,288	16,482	27,723	137	
Antennas	20,400	13,303	13,096	207	7,097	8,118	21,214	(814)	
Electronics	17,000	7,465	6,239	1,226	9,535	10,919	17,158	(158)	
Computer	4,850	2,529	2,258	271	2,321	3,087	5,345	(495)	
Systems Integration	400	158	95	63	242	189	284	116	
Project Management	2,650	1,569	1,273	296	1,081	1,604	2,877	(227)	
Subtotal	73,160	36,596	34,202	2,394	36,564	40,399	74,601	(1,441)	
Contingency	2,840	105	---	105	2,735	3,522	3,522	(682)	
Total	76,000	36,701	34,202	2,499	39,299	43,921	78,123	(2,123)	

Notes: (1) Basic estimate is that of August, 1975.

(2) Escalation included for future years at 6% for site and wye work; National Radio Astronomy Observatory labor, and minor antenna equipment items. Antenna estimate is based on the existing contract costs for fabrication of the antennas. No future escalation has been included for electronics or computer purchased equipment.

(3) Estimate excludes the following deferred items: Transporters #2 and #3, $615 K; Air Strip, $268 K.

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.

CY - 1976

VERY LARGE ARRAY

Status as of July 31, 1976

Project Number	Description	Allocation	Monthly	Expended	Committed	Total	Balance	Outstanding Obligations Pending	Net Balance
11000	Site and Wye	4,807,000	48,271	3,130,436	1,342,219	4,472,655	334,345	88,105	246,240
12000	Antenna System	7,794,000	45,970	1,869,505	5,717,941	7,587,446	206,554	81,982	124,572
13000	Electronic System	2,876,000	120,399	1,202,156	468,842	1,670,998	1,205,002	306,604	898,398
14000	Computer System	720,000	27,360	332,840	169,740	502,580	217,420	114,375	103,045
16000	Systems Integration	112,000	4,640	35,483	12,808	48,291	63,709	22,465	41,244
17000	Project Management	672,000	40,252	302,261	77,110	379,371	292,629	134,766	157,863
	Contingency	105,000	---	---	---	---	105,000	---	105,000
	Total VLA	17,086,000	286,892	6,872,681	7,788,660	14,661,341	2,424,659	748,297	1,676,362

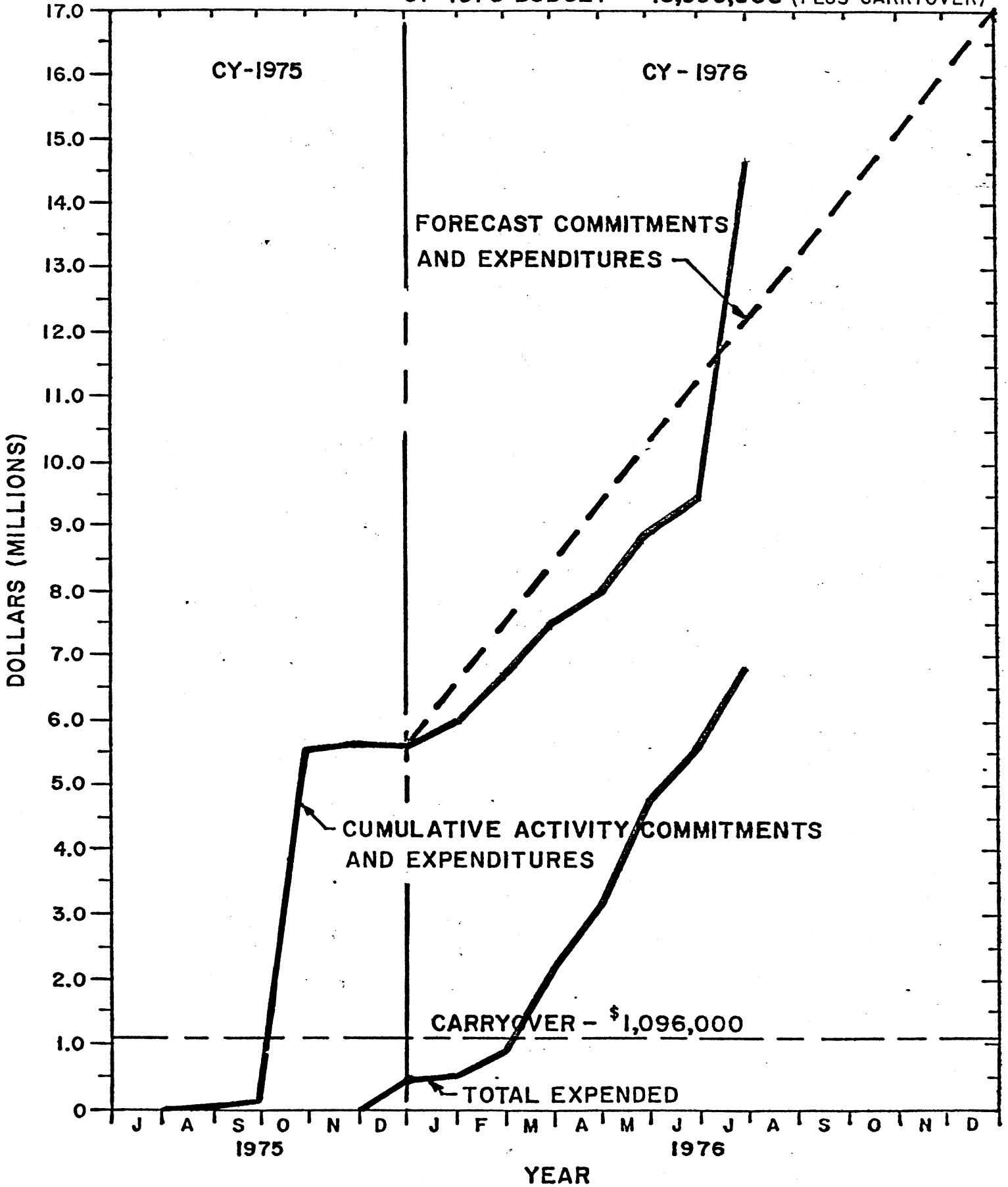
TOTAL PROJECT

VERY LARGE ARRAY

Status as of July 31, 1976

Project Number	Description	Allocation	Monthly	Expended	Committed	Total	Balance	Outstanding Obligations Pending	Net Balance
11000	Site and Wye	11,572,406	42,405	9,472,379	1,769,071	11,241,450	330,956	88,105	242,851
12000	Antenna System	13,303,344	45,752	7,377,126	5,718,578	13,095,704	207,640	81,982	125,658
13000	Electronic System	7,464,934	134,099	5,769,223	470,277	6,239,500	1,225,434	306,604	918,830
14000	Computer System	2,528,589	27,360	2,062,898	195,134	2,258,032	270,557	114,375	156,182
16000	Systems Integration	158,000	4,639	82,034	12,817	94,851	63,149	22,465	40,684
17000	Project Management	1,568,961	40,261	1,195,293	77,610	1,272,903	296,058	134,766	161,292
	Contingency	105,066	---	---	---	---	105,066	---	105,066
	Total VLA	36,701,300(1)	294,516	25,958,953	8,243,487	34,202,440	2,498,860	748,297	1,750,563

VLA-NRAO
PROJECT REPORT
EXPENDITURES AND COMMITMENTS
CY-1976 CUMULATIVE ACTIVITY

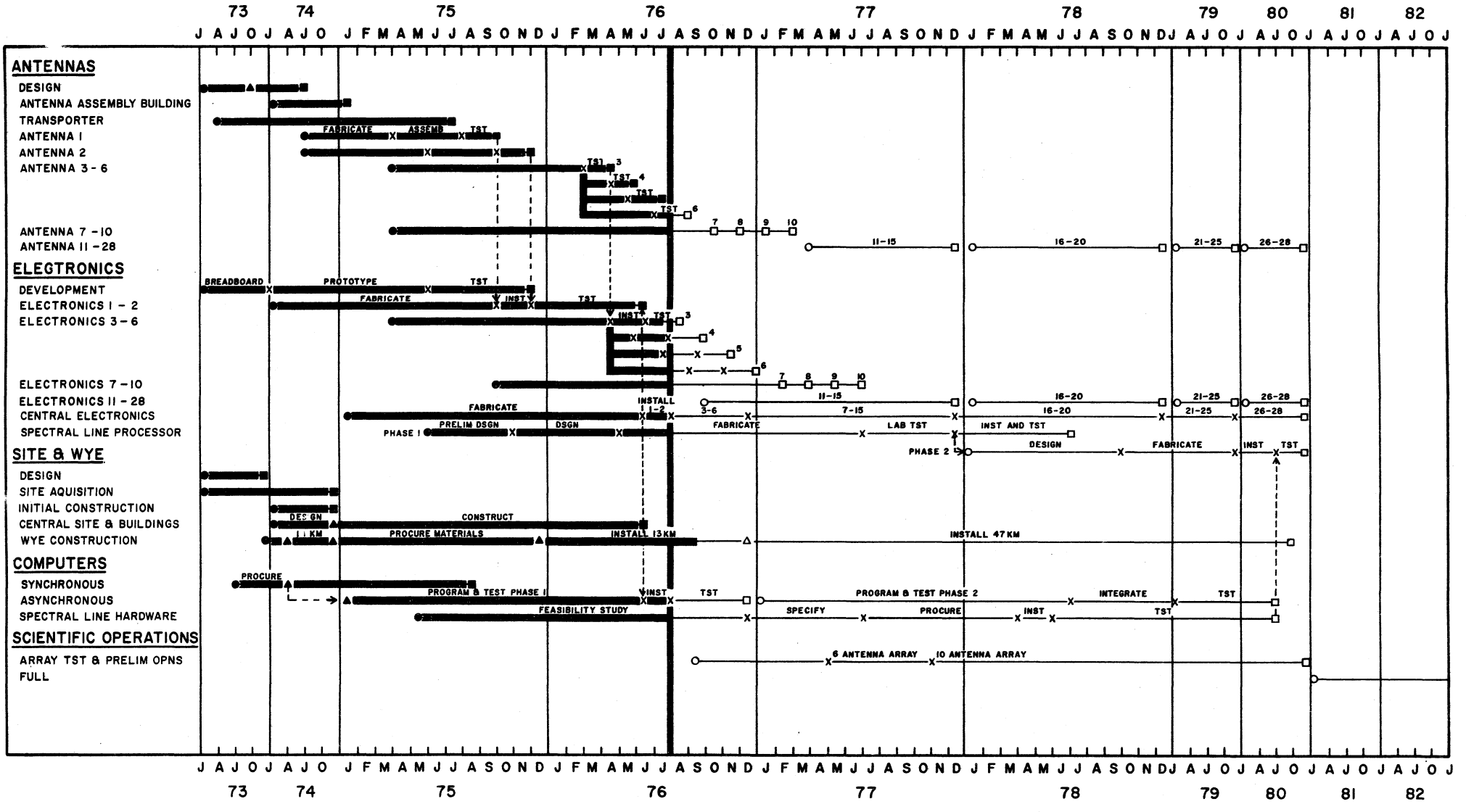


NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA ACTIVITY SCHEDULE

11/15/75

UPDATE DATE: 8/1/76



ABBREVIATIONS

ASSEMBLE - ASSEMB	CH-VILLE - CV	INSTALL - INST		PRELIMINARY - PRELIM	
COMPLETE - CMPL	DESIGN - DSGN	INTEGRATE - INTG		SELECT - SLCT	
CONTRACT - CNTR	DETAIL - DTL	OPERATIONS - OPNS		TEST - TST	

SYMBOLS

O START OF A PHASE — △ CONTRACT AWARD

X END OF AN ACTIVITY — □ END OF A PHASE

REV. NO.	REV. DATE	REVISION
1	12/4/75	WYE CMPL 10/80