JANUARY 1976

NATIONAL RADIO ASTRONOMY OBSERVATORY

JANUARY PROJECT REPORT

VLA PROJECT

FEBRUARY 13, 1976

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROJECT

JANUARY 1976

SITE AND WYE

Subcontract VLA-167; Site Warehouse and Maintenance Shop Buildings; Paul D. Goar Construction Company; $147,805

Subgrade preparation and installation of buried electrical conduit are complete.

This contract is estimated at 3% complete.

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

Pier drilling and belling and placement of pier reinforcing steel and concrete are complete at antenna foundations DE-1, DN-1, DW-1, 6, 7, 8, and 9 and BW-5, 6, and 7. Grade beam excavation is complete at DW-9 and CW-6, 7, and 8, while grade beam reinforcing steel is placed at CW-6 and CW-8 and grade beam forms set at CW-8. 4" PVC casement for 20 mm waveguide has been laid at DW-8 and 9 and CW-6, 7, and 8. Subgrade preparation is being performed on the north and east arms and spurs and the north-arm/east-arm connection. Sandy material is being hauled from the east arm to be mixed with clays and silt in the vicinity of the apex.

This contract is estimated at 15% complete.

Subcontract VLA-65; Control and Cafeteria Buildings; George A. Rutherford, Inc.; $2,395,400

1. The raised access flooring system of the computer, control, and digital rooms has been installed. Precast fascia end cap panels have been mounted on the exposed ends of the Control Building front fascia. Door hardware and thresholds have been installed and the wood paneling of the lobbies has been varnished. The acoustic ceiling grid is complete.

2. Chilled water and heat piping is 95% complete in the Control Building. All supply and return/relief fans are installed in the east and west mechanical equipment rooms. Approximately 85% of the diffusers and sound traps have been set in the drop-in ceiling grid, while the plenum dampers and sound attenuators and louvers of the mechanical equipment room east are installed. Insulation of ducts and chilled water and heat piping is 38% complete. The fire pump is being installed in the pump house.

3. The 15KV primary switchgear has been energized. 15KV cable terminations have been completed in the 15KV switchgear, the Control Building 750KVA transformer, the antenna assembly building 225KVA transformer, and the 75KVA transformers at CW-5, 6, 7, 8, and 9 including the CW-9 isolation switch. "High-pot" tests have been performed on 15KV cable between the SEC substation and the primary switchgear, the primary switchgear and the 750KVA switchgear pad transformer, the primary switchgear and the Cafeteria 500KVA transformer, and the southwest arm to CW-9. The 750KVA switchgear pad transformer, the Cafeteria 500KVA transformer, the antenna building 225KVA transformer, and southwest arm transformers TW-8 through TW-13 have been energized. The Cafeteria is being heated by its permanent electric heating system. Motor control centers and equipment in the mechanical equipment room east are being roughed-in. Branch circuits and feeders are complete in the Cafeteria and 90% complete in the Control Building. 98% of the lighting fixtures in the Cafeteria and 50% of the lighting fixtures in the Control Building have been installed.

This contract is estimated at 91% complete.

ANTENNA DIVISION

Antenna No. 2

Antenna No. 2 was moved from the Antenna Assembly Building to the maintenance foundation on January 6, 1976 for installation of electronic equipment. It is ready for move to Station CW-9 at the end of the month.

Antenna No. 3

E-Systems' superintendent and partial crew were at the Site January 20, 1976. First elements of reflector arrived on January 21, and E-Systems started assembly of reflector hub on January 22, 1976. Balance of E-Systems crew arrived on January 26, with a total of 9 men by the end of the month. Base pedestal frame arrived at Site on January 28, and was installed on foundation on January 29, 1976. The first shipment of surface panels arrived the week of January 19, and all panels were on hand by the end of the month. Azimuth bearing for Antennas 3 and 4 were inspected and accepted on January 13, and arrived at the Site on January 23, 1976. At the end of the month, the reflector assembly was about 50% complete with vertex room installation started.

SYSTEM INTEGRATION DIVISION

The testing schedule on Antenna No. 1 was modified this month to permit a more effective use of observing time. We now operate continuously for a period of 40 hours starting Tuesday afternoon and ending Thursday morning. Three observing runs at 6 cm that include day and nighttime operation over

a period of 3 weeks have confirmed the antenna meets the pointing specifications. Sets of pointing corrections at 6 and 2 cm and a gain curve as a function of elevation at 2 cm have been determined.

There is no indication of foundation settlement at CW-5. The excessive lean of the azimuth axis has been traced to an erroneous setting of pads, which will be corrected after the transporter has undergone repairs.

Single dish testing on Antenna No. 2 was completed. The antenna efficiency is low as reported in the electronics division section. The pointing is satisfactory. The antenna is ready to be moved to station CW-9.

Linda Blankenship joined the group this month as the second VLA array operator.

ELECTRONICS DIVISION

The prototype 18-21 cm feed and the third subreflector were delivered by Structural Technology Incorporated and arrived at the Site on January 29. The feed is not expected to achieve the specified efficiency when tested on Antenna No. 1 and a study contract for a new design was let with J. J. Gustincic on January 21, 1976.

The parametric amplifiers from one channel of Antenna No. 2 were returned to Comtech for correction of the high noise temperatures mentioned in last month's report. They were to be replaced with units just received for Antennas 3 and 4, but when operation was attempted it was found that the input and output terminals of the new shipment had been reversed by Comtech. Testing of Antenna No. 2 was able to continue, however, using the one channel with the original parametric amplifier units. Front end racks for Antennas 3 to 6 arrived from Charlottesville. The cryogenics and Dewar for Antenna No. 3 were tested, and new Dewars for Antennas 4 - 6 are in construction by Noor Manufacturing of Albuquerque to replace the ones by Vactronics which were rejected.

Single-dish tests on Antenna No. 2 were performed at the maintenance foundation. The pointing was satisfactory but the aperture efficiency measured at 1.3 cm wavelength has a maximum value of 33% instead of the expected 43%. The discrepancy is tentatively attributed to the subreflector which was slightly damaged in shipment to the Site. It is planned to replace it with the No. 3 subreflector to check this hypothesis.

New specifications have been written for procurement of 20 mm waveguide components for Antennas 4 to 10 and bids have been received on various units from five companies. The Furukawa Company, our main supplier of 20 mm components in the past, is no longer bidding on flexible waveguide, rotating joints or circular to rectangular transitions. The two last items are the most serious problems and we are considering constructing the joints ourselves

and may have to face increased cost for the transitions. Measurements on the attenuation of the waveguide on Antenna No. 2 from the base to the vertex room show about 2 dB more loss than on Antenna No. 1 except at frequencies below 33 GHz where No. 1 has an attenuation peak. The difference is attributable to the flexible waveguide used which was manufactured by Furukawa on No. 1 and Sumitomo on No. 2. Couplers at CW-9 and CW-5 have been installed in the 60 mm waveguide run in preparation for interferometer testing. The coupler at CW-5, for Channel 5, was one which was detuned about 1 GHz low in frequency in the dip brazing process. It was successfully returned by deforming the cover plate of the rectangular waveguide slot to reduce the slot width by 3 to 5 thousandths of an inch.

In the local oscillator, modems and IF areas progress continues in construction of new units and maintenance of those on Antennas 1 and 2. In the delay and multiplier system one rack has been completed and is ready for testing, and two prototype cards have been designed for the new spectral line system. Construction in Charlottesville continues to make good progress with 92 out of a total of 108 modules for Antennas 3 to 6 complete and ready for testing.

The monitor and control system continues to be a prolific source of minor problems which are being steadily tracked down and corrected. The parity errors mentioned in last month's report resulted from at least three causes, two of which have now been found. Testing of rack B for the vertex room of Antenna No. 2 has continued and is almost complete. On Antenna No. 1 tests of the local oscillator stability indicate a variation of about 2^{o} in the 600 MHz round-trip phase with the elevation of the antenna.

New personnel in the electronics division are Dr. D. S. Bagri of the Ootacamund Radio Astronomy Center who joined the staff on January 14, and senior technicians B. L. Cohee and F. C. Dunn who joined on January 5, 1976. Dr. Bagri and Mr. Cohee are working on the local oscillator system, and Mr. Cohee replaces J. F. Cope who resigned on December 31, 1975.

COMPUTER DIVISION

Asynchronous Subsystem

During January the Comtal raster display device arrived (b/w monitor, color monitor, picture processor) and is now working. The Versatec electrostatic printer was activated this month and is also working. With the addition of these pieces, all parts of the mini-based graphics system are now usable, and are being programmed.

Systems work on the DEC-10 included installation of a new release of the virtual memory operating system. A new page fault handler was also installed and has greatly improved system performance. The working set of CANDID was reduced by roughly a factor of two, thus relieving some of the congestion and improving overall system performance when several people are running CANDID simultaneously. The three high-speed tape drives have been integrated into the system and are finally operational.

In CANDID, several problems were solved. The slow compilation of OPSAIL routines which build structures has been eliminated by moving most of the work to run time and increasing the run time by about 10% in those routines. A set of operators to simulate observing with the VLA has been completed, allowing the user to set up any feasible observing program and have the resulting visibility data stored in a data base available for mapping. Presently, only a point source in the center of the field is used, but eventually observations of any set of point sources and gaussians will be implemented. A package of I/O service routines has been completed, and will be incorporated into CANDID. These routines will automatically handle much of the error checking and bookkeeping involved with I/O in SAIL.

A tentative plan for data processing which will produce "standard VLA maps" has been formulated based on exactly two points per synthesized beam width. The reasoning behind this definition of the standard and its proposed implementation is being documented. In conjunction with this definition, a map data base has been designed and adopted. Its organization allows for compact data storage and minimal further processing for the FFT (in the case of visibility maps) or for display on the graphics devices (in the case of intensity maps).

The first reading and partial translation of a simulated data tape from the synchronous subsystem was accomplished.

Our night computer operator, Greg Shoemaker, is now working full time as a programmer. He will be mainly doing DEC-10 systems work, starting with the implementation of a standard tape labeling system.

Synchronous Subsystem

The main effort of the synchronous computer group during January has been the support of the single dish observations with Antenna No. 1. This includes operator training, minor error correction, writing additional data reduction programs, and making ad hoc changes to follow temporary idiosys, isaias of the hardware. Approximately 120 hours of telescope time was allocated to single dish testing, which resulted in about 80 hours of usable pointing data. The pointing of the antenna is good and well understood to the level of about 15 1b. seconds of arc. Investigation of effects below this level is proceeding. A 2 cm gain curve has been run, and the focus change from zenith to horizon (about 5 mm) has been determined.

PROJECT MANAGEMENT

Work on the rail take up at Redstone Arsenal continues with the contractor concentrating on the completion of road crossings. Also, rail take up commenced at Eglin AFB Florida and should be completed by mid-February. The GSA notified the Project that the 23 miles of rail at Crab Orchard National Wildlife Refuge had been transferred to the VLA.

During the month of January, 1976, the purchasing group placed Purchase Orders and Subcontracts totaling to approximately $541,000. This consisted of approximately 130 Purchase Orders for $160,000 and Subcontracts totaling $381,000. Some of the items procured under these were power supplies, prefab metal warehouse and maintenance shop buildings, subreflectors, parametric upconverters, polorizers, OMJ's, K and Ku band feed horns, prefabricated metal parts, and miscellaneous electronics components. A labor-hour subcontract to be used for installation of waveguide was also let.

In addition, RFP's were sent out for parametric amplifiers.

Four responses were received to RFP VLA-175 for the Computer Power Motor Generator Set. It was necessary to request additional information from all bidders. These responses are currently being evaluated with a target for completion and placement of Purchase Order by late February.

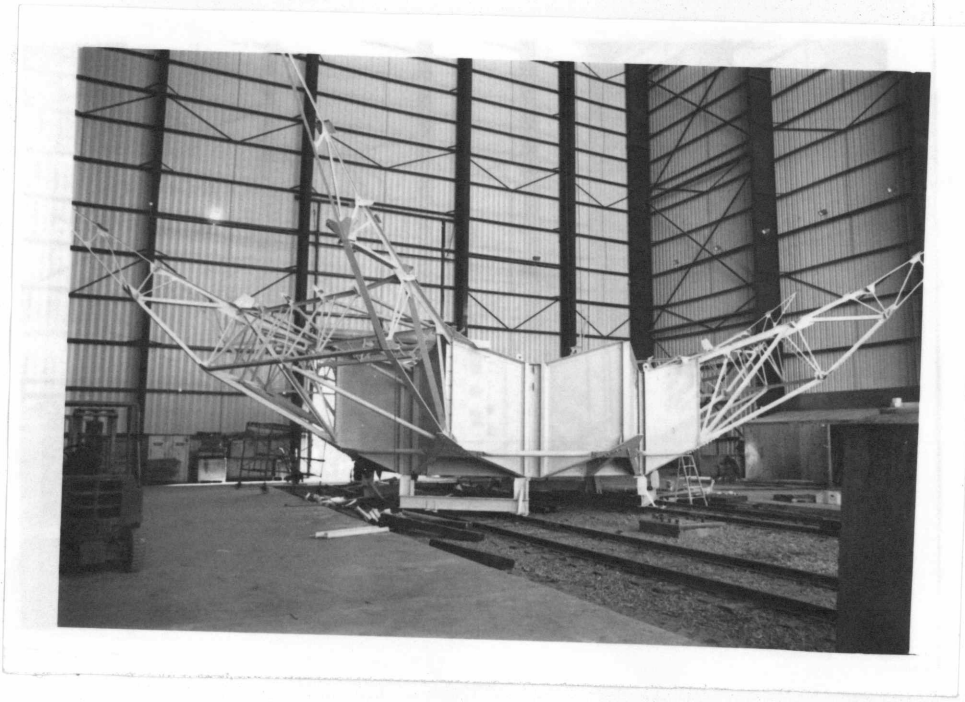
On January 19, 1976, Mr. R. M. Mitchell joined the Project Management staff as Assistant to the Project Manager.

Personnel

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

Division	Previous Level	Additions	Reduction	Current Level
Project Management	20	1	0	21*
Site and Wye	6	0	0	6
Antenna	8	0	0	8
Electronics	31	4	0	35*
Computer	14	0	0	14
Systems Integration	2	1	0	3
TOTALS	81	6	0	87

*Includes one part-time person.



p1-76-1 Antenna Support Structure for Antenna No. 3

p1-76-2 View of Computer Room with Floor Installed

VLA PROJECT

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	BWH/CVR Joint Venture	E/A Title I and II	6/17/73	$ 1,028,269	3/15/74 4/30/75 12/21/76	Title I - Completed Title II - Completed Title III - Work in progress in conjunction with VLA-65 and VLA 149. Fixed price plus cost reimbursables.
VLA-6	E-Systems, Inc.	28 Radio Telescopes	10/18/73	$17,591,262	8/9/75	NRAO has taken posssession of Antenna Nos. 1 and 2. Components and subassemblies for Antenna 3 is arriving at VLA Site.
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. Subcontractor has had trouble with shorting problems and out of band gain spike. 3 each were delivered in Dec. 1975, 4 each were delivered Jan. 1976, and 3 each are scheduled for delivery in Feb. 1976.
VLA-29	Sterling-Detroit	Focusing Feed Mounts	6/17/74	$ 328,582	3/1/75	Amendment No. 2 has been accepted by Subcontractor and work is on schedule for units 3 through 10.
VLA-44	Digital-Equip. Corporation	Asynchronous Computer	6/17/74	$ 990,869	2/15/75	Major part of system delivered 12/16/74. Balance of system was delivered 10/15/75. FFT has not passed acceptance tests yet.
VLA- 53	R. F. System	K and Ku Band Feed Horns	1/26/76	$ 73,776	4/15/76 5/24/76	Amendment No. 1 for K & Ku Band Feed Horns was mailed for acceptance on 1/26/76.
VLA-65	Geo. A. Rutherford Inc.	Site Construction Phase II	12/16/74	$ 2,395,400	6/1/76	Work is about 91% complete.

VLA PROJECT

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-70 P.O. 52322	Sumitomo Electric USA, Inc.	3313 pieces of waveguide 3410 each coupling sleeves	1/27/75	$ 1,085,129	3/30/76	1313 pieces of Item 1 and 1350 pieces of Item 2 have been received. Options for 2000 additional pieces of Item 1 and 2060 pieces of Item 2 have been exercised and delivery is on schedule.
VLA-72 P.O. 52432	Hitachi Shabeden Corp. of America	3 ea. Waveguide Signal Distributors	2/7/75	$ 230,000	12/15/75	Shipment is ready awaiting final instructions from VLA technical staff. Shipment should be made by 2/16/76.
VLA-102 P.O. 52727	Lawrence Hefner	Labor Hour Contract and Equipment Rental	3/26/75	$ 37,480	3/30/76	Blanket Purchase Order to cover the period beginning 4/1/75, and ending 3/30/76. Total expenditure increased to $37,480 by Change Order No. 1 Approx. $32,609 spent effective 1/31/76.
VLA-106 P.O. 52725	Avantek, Inc.	301 ea. 1-2GH$_z$ Amplifiers	10/17/75	$ 63,192	12/31/75	Vendor has acknowledged delivery to be completed by 2-29-76. Order is approx. 85% complete.
P.O. 53637	Faron Gutierrez	Labor Hour for Carpenter Work	6/16/75	$ 5,000	6/5/76	Approx. $3,387 spent effective 1/31/76.
VLA-134 P.O. 53578	Air Products and Chemicals, Inc.	Helium Compressors and Cryogenic Refrigerators	8/15/75	$ 77,085	10/17/75	First two units have been received. Vendor will ship balance of order by 2/29/76.
VLA-137 P.O. 53821	Comtal Corp.	Rasterscan Subsystem	8/29/75	$ 24,950	11/30/75	System was accepted 1/13/76.
VLA-149	Burn Construction Co., Inc.	Site Construction Phase III	9/25/75	$ 2,913,000	10/25/76	Work is approx. 15% complete.
P.O. 53880	N. M. Tech.	Labor Hour Contract	9/1/75	$ 15,000	8/31/75	Approx. $4,259 spent effective 1/31/76.
VLA-160 P.O. S-00120	Wutzke RR Tie Co.	20,000 Used Cross Ties	10/17/75	$ 109,000	12/31/75	Approx. 5200 ties have been delivered.

VLA PROJECT

MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

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VLA-160 P.O. S-00271	Timber Mtn. Forest Products	20,000 Used Cross Ties	10/17/75	$ 115,000	12/31/75	1900 ties have been delivered.
VLA-167	Paul Goar Construction Co.	Prefabricated Metal Warehouse and Maintenance Buildings	1/6/76	$ 147,805	4/30/76	Subcontract has been accepted and work began the week of 2/2/76.
VLA-174	Lawrence Hefner	Provide Labor and Equipment	1/26/76	$ 62,400	2/28/77	Subcontract was mailed to subcontractor for acceptance on 1/26/76.

VLA PROJECT

MAJOR SUBCONTRACTS AND PURCHASE ORDERS PLACED

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NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA--FINANCIAL STATUS REPORT
(in thousands)

As of: January, 1976

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		Allocation to Date				Outlook			
Item	Project Ceiling	Allocated	Expended and Committed	Allocated Balance	Unallo-cated Balance	Est. to Complete	Est. Total	(Over) Under Ceiling	Notes
Site and Wye	27,860	11,924	10,029	1,895	15,936	17,625	27,654	206	
Antennas	20,400	8,590	7,875	715	11,810	13,521	21,396	(996)	
Electronics	17,000	7,465	4,881	2,584	9,535	12,345	17,226	(226)	
Computer	4,850	2,429	1,964	465	2,421	3,281	5,245	(395)	
Systems Integration	400	194	50	144	206	318	368	32	
Project Management	2,650	1,569	930	639	1,081	1,947	2,877	(227)	
Subtotal	73,160	32,171	25,729	6,442	40,989	49,037	74,766	(1606)	
Contingency	2,840	1,048	--	1,048	1,792	3,200	3,200	(360)	
Total	76,000	33,219	25,729	7,490	42,781	52,237	77,966	(1966)	

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 January 31, 1976

Project Number	Description	Allocation	Monthly	Expended	Committed	Total	Balance	Outstanding Obligations Pending	Net Balance
11000	Site and Wye	5,129,000	244,766	244,766	2,999,442	3,244,208	1,884,792	107,753	1,777,039
12000	Antenna System	3,081,000	11,494	12,242	2,352,967	2,365,209	715,791	181,023	534,768
13000	Electronic System	2,876,000	64,171	79,618	206,549	286,167	2,589,833	693,198	1,896,635
14000	Computer System	620,000	27,287	111,665	46,135	157,800	462,200	250,092	212,108
16000	Systems Integration	148,000	3,730	3,730	128	3,858	144,142	48,658	95,484
17000	Project Management	662,000	30,583	31,223	4,956	36,179	625,821	273,923	351,898
	Contingency	1,048,000	---	---	---	---	1,048,000	---	1,048,000
	Total VLA	13,564,000	382,031	483,244	5,610,177	6,093,421	7,470,579	1,554,647	5,915,932

TOTAL PROJECT

VERY LARGE ARRAY

Status as of January 31, 1976

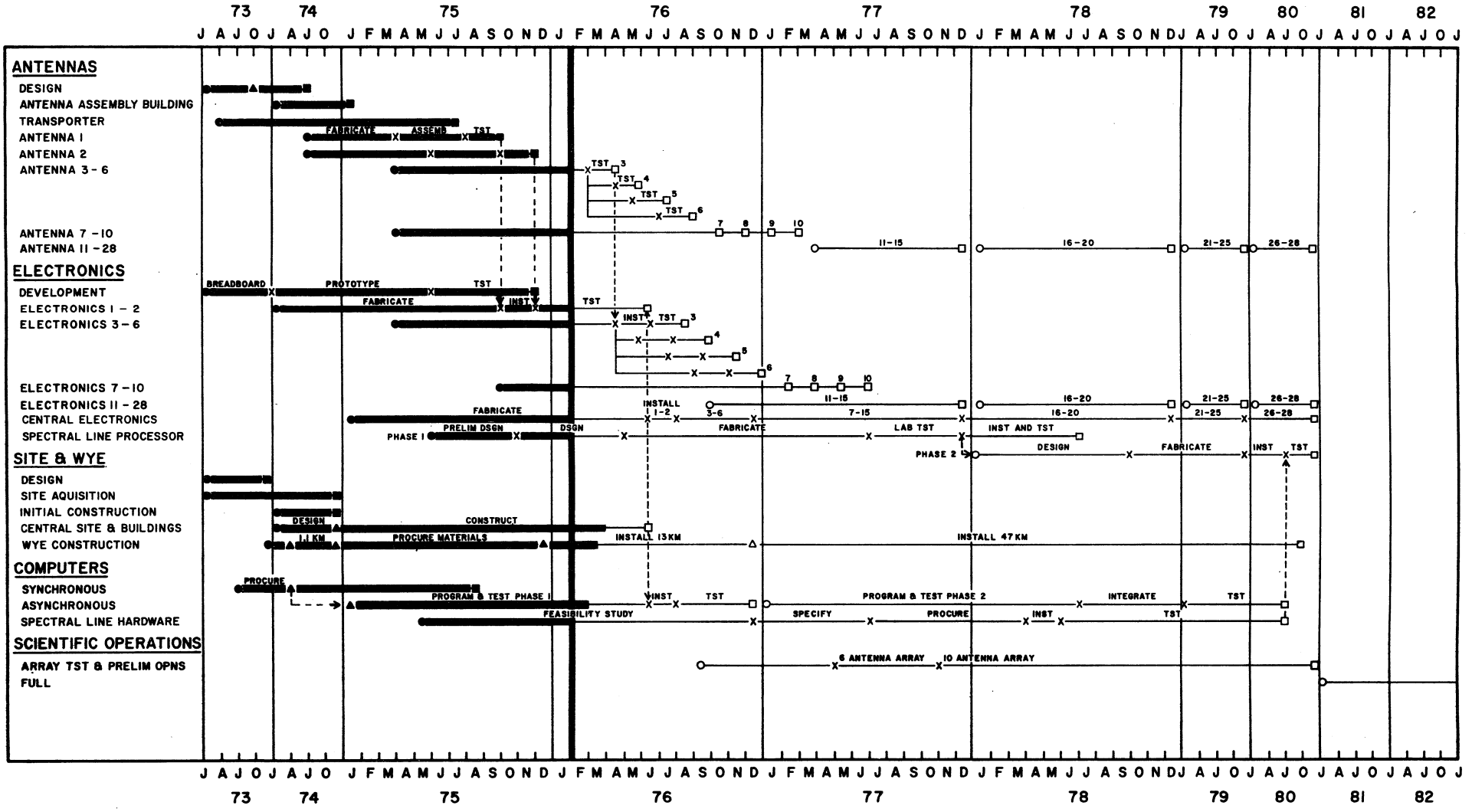
Project Number	Description	Allocation	Monthly	Expended	Committed	Total	Balance	Outstanding Obligations Pending	Net Balance
11000	Site and Wye	11,924,406	213,062	5,823,515	4,205,518	10,029,033	1,895,373	107,753	1,787,620
12000	Antenna System	8,590,344	60,911	4,785,443	3,089,221	7,874,664	715,680	181,023	534,657
13000	Electronic System	7,464,934	113,138	4,162,051	719,201	4,881,252	2,583,682	693,198	1,890,484
14000	Computer System	2,428,589	111,717	1,678,361	285,698	1,964,059	464,530	250,092	214,438
16000	Systems Integration	194,000	3,861	49,129	1,289	50,418	143,582	48,658	94,924
17000	Project Management	1,568,961	32,512	923,704	6,029	929,733	639,228	273,923	365,305
	Contingency	1,048,066	---	---	---	---	1,048,066	---	1,048,066
		33,219,300	535,201	17,422,203	8,306,956	25,729,159	7,490,141	1,554,647	5,935,494

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA ACTIVITY SCHEDULE

11/15/75

UPDATE DATE: 2/1/76



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