DECEMBER 1978

NATIONAL RADIO ASTRONOMY OBSERVATORY

DECEMBER PROGRESS REPORT

VLA PROGRAM

JANUARY 17, 1979

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROGRAM

DECEMBER 1978

SYSTEMS INTEGRATION DIVISION

The array was scheduled for 55 percent of the time; 37 percent went to astronomical programs and the remaining 18 percent to tests. The average downtime for the month was approximately 18 percent.

First fringes were obtained with Antenna 17 on December 4. The seventeen antennas currently outfitted with electronics are located at stations W8, W32, E1, W16, E2, W24, E4, W40, W48, E3, E8, E16, E12, W56, W64, E18, and W12. These stations are positioned approximately 0.48, 5.2, 0.08, 1.6, 0.05, 3.2, 0.15, 7.7, 10.5, 0.09, 0.48, 1.6, 0.97, 13.6, 17.2, 1.95, and 0.97 km respectively from the array center. Antenna 15 was moved to W64 on December 15 making our longest astronomically usable baseline approximately 18 km. Antennas 14 and 15 were declared operational on December 19 and 29 respectively. This increases the total number of operational antennas to 15 (1 through 15). Antenna 10 was returned to operations on December 27 with the result that only Antennas 5 and 7 are presently decommissioned for electronic retrofits. Antennas 16 and 17 are in the shakedown stage. The test array consists of Antennas 3, 5 and 11.

ELECTRONICS DIVISION

The retrofit of a CTI cryogenics system into the front end for Antenna 10 was completed during the month and the front end was re-installed on the antenna. The front end for Antenna 7 was brought into the laboratory to allow installation of the CTI cryogenic system in place of an unreliable Cryomech system. When front end 7 is completed, nine antennas will remain to have their cryogenics systems replaced with CTI systems and five front ends will remain to have their paramps replaced with AIL paramps. The next front end to go into operation, the front end for Antenna 18, has had its first cool down in preparation for first fringes in January 1979. A new reliability problem concerning the 26 GHz paramp pump Gunn sources has recently become evident. Many of these sources have been found to change frequency and output power level at intervals thought to correspond with turning the paramps on and off. This problem, which necessitates the frequent returning of the Gunn sources and the paramps, is currently under investigation.

During the month, for the first time, fringes were obtained from 15 antennas simultaneously. The increasing maintenance load associated with this number of antennas has required improved maintenance techniques

in many areas of electronics. The front end group now has two Dewars dedicated to the repair and temperature cycling of cooled Comtech paramps, AIL paramps and K_u- and K-band mixers. Special bench test sets are being designed and built for the F1, F2, F3, F4, and F6 modules.

With the placement of Antenna 15 at AW8 a measurement of the loss in the transmission system out to this antenna station shows signal levels within specification and signal levels at AW9, the farthest station, can also be expected to be satisfactory. A waveguide coupler and pedestal waveguide was installed at DN8 ready for the first astronomical use of the north arm in early January 1979.

Work continues on building and testing the prototype modules for the two new module systems F4, F7, F8 (front end IF system) and T3, T4, T5, T6 (baseband system). An order was placed for 109 sets of spectral line baseband filters (for module T3), this being the total requirement for the whole project.

The final software for the new spectral processor incorporating virtually all the requirements for full spectral line operation and full self-test capability was written during the month and will be put into operation in early January 1979.

COMPUTER DIVISION

Because of the holidays, and the fact that several programmers took vacations coincident with them, very little progress was made in December.

The PDP-11/70 mapping software continues to improve, but is plagued by subtle hardware faults in the array processor. The programs have been connected in a system, so that they do not too much obtrude themselves on a user.

A character generator for the Dicomed film writer has been designed and is nearly complete.

A considerable effort has been expended in search of two bugs.

1. Low amplitude first 10 seconds of a scan when no antenna motion is involved - bug found and fixed.

2. Occasional loss of setup commands set to antenna at source change time - software not yet exonerated, but may well be hardware.

We have completed our analysis of our need for a second graphics terminal and have recommended purchase of a H-P 2648 and a Versatec printer to serve as a hard copy unit.

ANTENNA DIVISION

Work of the Antenna Division reached the following status at the end of December.

Antenna No. 18

Mechanical outfitting completed on December 8 and on December 19 the antenna was moved to station CW6 for electronic installation and initial operation.

Antenna No. 19

Moved on December 20 to maintenance station and mechanical outfitting started.

Antenna No. 20

Awaiting mechanical outfitting.

Antenna No. 21

Antenna moved to master pad on December 4 and final alignment completed. Servo installation completed and servo test performed on December 13 with a natural frequency of 2.3 Hz in elevation and 2.55 in azimuth exhibited. Final pointing and checkout completed and the antenna was accepted on December 19.

Antenna No. 22

Pedestal assembly completed through yoke arms and elevation axle by December 21 when E-Systems left Site for holidays. Reflector assembly approximately 65% complete.

Miscellaneous

Antenna 15 moved to station AW8 on December 15 giving a base-line length of 17,157 meters from the center of the Wye.

SITE AND WYE DIVISION

Waveguide Installation

Trenching complete to AE7. Installed approximately 3,200 feet of waveguide, 3,500 feet set to line and grade and backfilled. Completed 20 mm waveguide installation at DN8. Zinc ribbon installation is complete to AE6.

Phase IV

Pacific Railroad Constructors has completed trackage to AW8 and an antenna was moved to this station during the month. Track work on the west arm is 98% complete with small modifications required before final acceptance. Track work has started on the east arm and is partially complete to BE6. Round Place Construction has completed 88% of the earth-work between BE9 and AE8. Antenna foundation concrete tie beams have been poured to AN8.

PROJECT MANAGEMENT

General

The take up of 4500 feet of railroad trackage at Fort Huachuca, Arizona was completed.

RFP was issued for used railroad ties and a supplier was found that would be able to provide enough ties for the remainder of the project. The low bid of $7.50/tie, delivered, is some $1.50 to $2.00 below the current market price.

Personnel

The personnel changes as of December 31, 1978 are as follows:

Division	12/1978	11/30 Level	Additions	Reductions	12/31 Level
Site and Wye	9	9	0	0	9*
Antenna	15	15	0	0	15
Electronics	54	51	0	1	50**
Computer	16	15	0	0	15
Systems Integration	9	8	0	0	8***
Project Management	27	27	0	1	26****
Total	130	125	0	2	123

* Does not include one part-time employee
** Does not include one part-time employee
*** Does not include one part-time employee
**** Does not include three part-time employees

12/31/78

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-5 Amend. #12	BWH/CVA Joint Venture	E/A Title I and II	6/11/73	$ 1,090,684		Title I -Completed Title II -Completed Title III -Completed Title IV -VLA-325 Supervision
VLA-6 Amend. #21	E-Systems, Inc.	28 Radio telescopes	10/18/73	$ 18,156,054		Delivery in Progress.
VLA-29 Amend. #5	Sterling-Detroit	Focusing Feed Mounts thru Antenna 28 plus spares	6/17/74	$ 1,002,380		Delivery in Progress. (Mounts for Antennas 23-28 complete by 7/13/79. Amend. #5 issued 11/9/78.
VLA-70 P.O. 52322 C.O. #6 C.O. #7	Sumitomo Electric USA, Inc.	1060 pieces of waveguide 3000 pieces of waveguide and 3900 pieces of coupling sleeves	9/27/78 11/03/78	$ 3,215,847	4/30/79; 7/31/79; 10/31/79; and 1/31/80	Next 1060 pieces to arrive Oakland port by 4/30/79.
VLA-233 P.O. S-02611	Silicon Systems, Inc.	Custom Integrated Circuits	12/12/76	$ 206,375	9/15/78	Complete except for 468 each of Item 4.
VLA-256	New Mexico State University	Archaeological Excavation	9/20/77	$ 107,000	2/20/79 Completion	$80,633 invoiced thru 12/31/78 Final reports due 2/20/79.
P.O. S-04886	AIL Division Cutler-Hammer	Parametric Upconverters	9/23/77	$ 79,702		Four units still due. Promise of 4 each - 1/19/79.
P.O. S-07990	AIL Division Cutler-Hammer	Parametric Amplifiers	9/21/78	$ 197,600	Complete by 1/21/80	
P.O. S-08085	AIL Division Cutler-Hammer	Parametric Upconverters	10/23/78	$ 102,525	4/13/79 thru 8/13/79	
P.O. S-08510	MLC Electronics, Inc.	Switch filter assemblies and filters	12/12/78	$ 193,943	Start 4/3/79	
P.O. S-08535	RF Systems, Inc.	Ku and K Band Feed Horns	12/14/78	$ 71,554	4/15/79	
P.O. S-08557	Federated Metals Corp.	Diamond Line Zinc Ribbon	12/8/78	$ 59,412	2/02/79	
P.O. S-08558	Allen Avionics	L.C. Filters	1/08/79	$ 67,040	Complete by 6/30/79	

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-277 P.O. S-05376 Amend. #4	Wheeler Construction Co.	Crushed Stone		$ 659,328	Complete by 2/01/79	
P.O. S-08645	DEC	Computer Maintenance	1/08/79	$ 90,063	CY'79	Monthly expenditure rate estimated at $7,500.
VLA-316 Amend. #1	Midstate Cartage	Labor-Hour	3/28/78 12/28/78	$ 175,000	Complete by 3/27/79	Total expenditure thru 12/31/78 is $143,050.
P.O. S-06827 Amend. #2	C.T.I. Cryogenics	Cryocooler	5/23/78	$ 239,760	2/15/80	
VLA-325	Pacific Railroad Constructors, Inc.	Phase IV Construction	6/23/78	$2,916,080	9/16/79	Work progressing satisfactorily.
VLA-326 P.O. S-08191 C.O. #1	California Computer Products, Inc.	Data Storage Subsystem	11/12/78 12/18/78	$ 221,190	2/01/79	
VLA-340 P.O. S-08227 C.O. #1	Digital Equipment Corp.	Computer System	11/06/78 12/08/78	$ 102,977	2/09/79	
VLA-344 P.O. S-08595	Wheeler Construction Co.	Crushed Stone	1/08/79	$ 668,660	Complete by 4/01/80	
P.O. S-06084 C.O. #1	Structures, Inc.	Walkways & Platforms	9/27/78	$ 33,740	Complete by 3/15/79	
P.O. S-08222	Structures, Inc.	Transition & Towers for K, Ku and C-Band Horns, L-Band Towers	10/19/78	$ 23,955	Complete by 6/01/79	
P.O. S-08230	Structures, Inc.	Feed Support Structures	10/23/78	$ 26,855	Complete by 6/01/79	
P.O. S-08269	Superior Electric Co.	Motors & Translators	10/26/78	$ 30,643	1/29/79	

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
P.O. S-08329	Contact Systems, Inc.	Various Wiring Modules	10/31/78	$ 19,709	Complete by 7/19/79	
P.O. S-06387 Amend. #2	Milliflect	Subreflectors	10/23/78	$ 61,200	Complete by 8/01/79	
P.O. S-08422	Rimo Manufacturing, Inc.	L Band Horns	12/7/78	$ 71,190	Complete by 9/1/79	
P.O. S-08423	Rimo Manufacturing, Inc.	C Band Horns	11/17/78	$ 36,600	Complete by 10/01/79	
P.O. S-08443	Avantek, Inc.	Transistor Amplifiers	11/17/78	$ 23,636	Complete by 4/15/79	

12/31/78

VLA PROGRAM

PROCUREMENT ACTIVITIES INITIATED

RFP NUMBER	ITEM DESCRIPTION	ESTIMATED COST	ISSUE DATE	PROPOSAL/BID DUE DATE	SUBMISSION TO NSF DATE	AWARD DATE	CURRENT STATUS
VLA-323	Transporter	$788,758	08/09/78	10/31/78	12/29/78	01/19/79	Two quotations received. Negotiations with both companies completed 12/08/78.
P.O. S-08684	A & K Railroad	$375,000			1/03/79	Estimate 1/12/79	
VLA-345	G. C. Dean (Labor Hour)	$170,000			1/10/79	Estimate 2/2/79	

NATIONAL RADIO ASTRONOMY OBSERVATORY
VERY LARGE ARRAY
STATUS AS OF DECEMBER 31, 1978
CY - 1978

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	5,279,348	956,870	3,225,891	18,706	3,207,185	2,055,559	5,281,450	(2,102)
12000	ANTENNA	3,762,000	511,994	1,953,938	56,762	1,897,176	1,770,774	3,724,712	37,288
13000	ELECTRONICS	3,897,000	380,987	2,947,963	76,332	2,871,631	895,783	3,843,746	53,254
14000	COMPUTER	740,000	9,811	236,643	50	236,593	325,291	561,934	178,066
16000	SYSTEMS INTEGRATION	23,000	8,543	31,982	1,133	30,849	20	32,002	(9,002)
17000	PROGRAM MANAGEMENT	111,625	11,282	110,018	4,926	105,092	1,438	111,456	169
18000	COMMON COSTS	605,527	79,847	591,654	---	591,654	7,752	599,406	6,121
19000	CONTINGENCY	330,792	---	---	---	---	---	---	330,792
	TOTAL PROGRAM	14,749,292	1,959,334	9,098,089	157,909	8,940,180	5,056,617	14,154,706	594,586

Note: Project allocation consists of $12,873,000 in CY-78 funding plus $1,876,292 in prior year funds re-allocated in CY-1978. The Total Expended for Construction at December 31, 1978, includes $28,154 chargeable to Operations. Since this oversight was noted after the 1978 closing, the necessary corrections will be made in January, 1979.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VERY LARGE ARRAY
STATUS AS OF DECEMBER 31, 1978
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	19,218,911	961,171	17,138,814	7,213,076	9,925,738	2,082,198	19,221,012	(2,101)
12000	ANTENNA	21,089,337	512,303	19,281,111	11,769,102	7,512,009	1,770,938	21,052,049	37,288
13000	ELECTRONICS	14,261,591	383,003	13,310,219	6,847,714	6,462,505	897,994	14,208,213	53,378
14000	COMPUTER	3,912,578	9,811	3,408,416	2,503,608	904,808	326,096	3,734,512	178,066
16000	SYSTEMS INTEGRATION	201,294	8,586	210,276	179,370	30,906	20	210,296	(9,002)
17000	PROGRAM MANAGEMENT	1,785,465	11,282	1,783,857	1,676,263	107,594	1,438	1,785,295	170
18000	COMMON COST	1,249,221	79,847	1,235,348	643,693	591,655	7,752	1,243,100	6,121
19000	CONTINGENCY/RESERVE	330,792	---	---	---	---	---	---	330,792
20000	CY-79 FUNDING	3,700,000	79,060	83,500	3,695	79,805	1,776,308	1,859,808	1,840,192
	SUB TOTAL	65,749,189	2,045,063	56,451,541	30,836,521	25,615,020	6,862,744	63,314,285	2,434,904
30000	RETIREMENTS	(5,045)	---	(5,045)	(5,045)	---	---	(5,045)	---
	TOTAL PROGRAM	65,744,144	2,045,063	56,446,496	30,831,476	25,615,020	6,862,744	63,309,240	2,434,904

Notes: 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) $17,111 for the NSF Hoc Advisory Panel.

The Total Expended for Construction at December 31, 1978, includes $28,154 chargeable to Operations. Since this oversight was noted after the 1978 closing, the necessary corrections will be made in January, 1979.

NATIONAL RADIO ASTRONOMY OBSERVATORY
VLA PROGRAM
FINANCIAL STATUS REPORT
(in thousands)

As of December 31, 1978

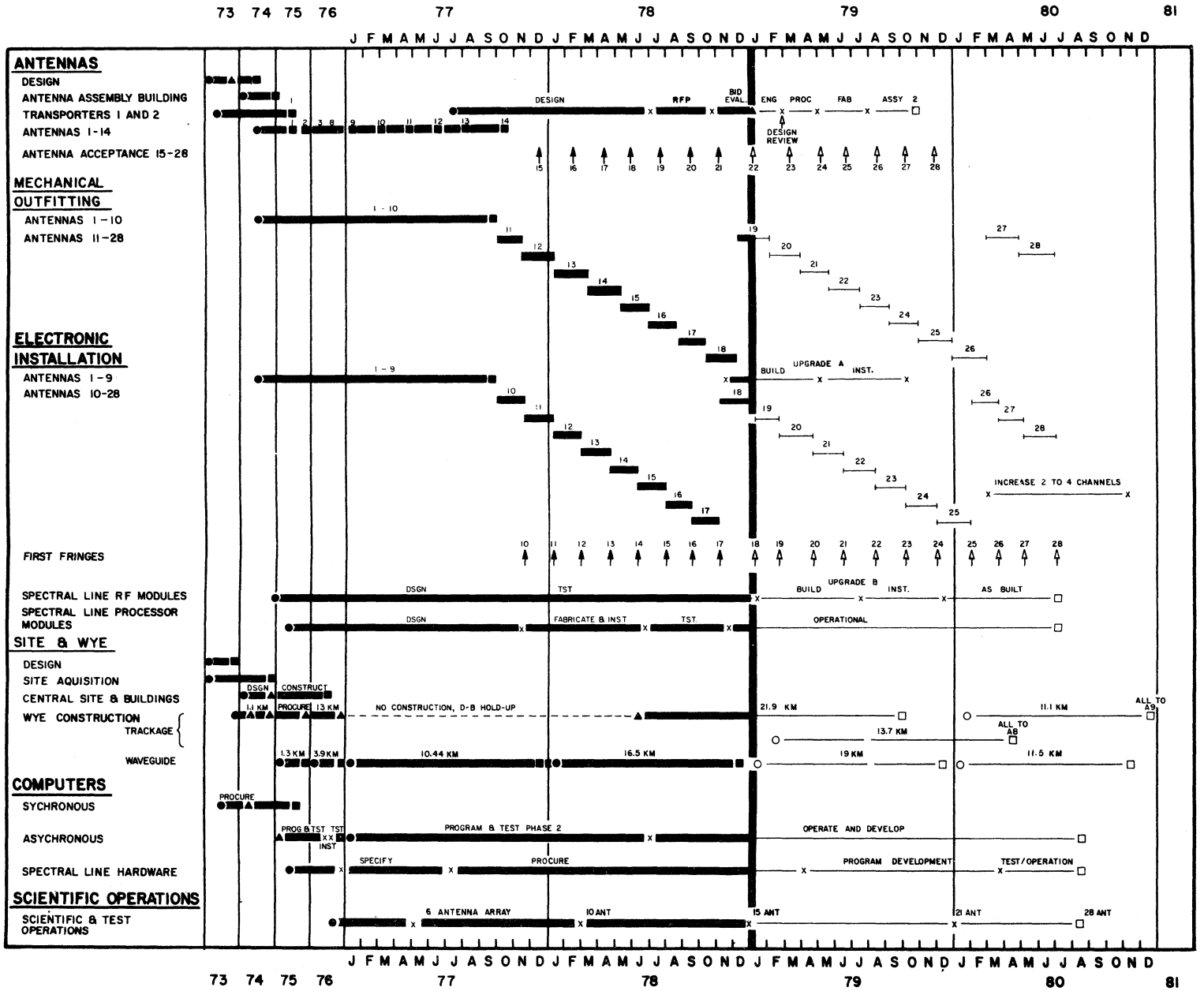
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Item	(A) Original Program Ceiling	Allocation to Date			Un-allocated Balance	Outlook		
		Allocated	Expended and Committed	Allocated Balance		Estimate to Complete	Estimate Total	(Over) Under Ceiling
Site and Wye	27,860	19,219	19,221	(2)	8,641	7,846	27,067	793
Antennas	20,400	21,089	21,052	37	(689)	1,672	22,724	(2,324)
Electronics	17,000	14,262	14,208	54	2,738	3,432	17,640	(640)
Computer	4,850	3,913	3,734	179	937	2,448	6,182	(1,332)
Systems Integration	400	201	210	(9)	199	(9)	201	199
Program Management	2,650	1,785	1,785	-	865	317	2,102	548
Common Cost	-	1,249	1,243	6	(1,249)	871	2,114	(2,114)
Subtotal	73,160	61,718	61,453	265	11,442	16,577	78,030	(4,870)
Contingency	2,840	331	-	331	2,509	1,000	1,000	1,840
TOTAL	76,000 (A)	62,049	61,453	596	13,951	17,577	79,030	(3,030)

NOTES:
(A) Includes $293K for site acquisition, $15.7K for ECAC Study, and $17.1K for NSF Ad Hoc Advisory Panel.
(B) Estimate to complete is as of November 1978 and it excludes $172K for airstrip.
(C) Escalation included for future years for Site/Wye work (8%): NRAO labor (6%); and certain electronic elements (8%). Antenna estimate is based upon the existing contract costs for fabrication of the antennas.
(D) The antenna estimate includes $800K for transporter No. 2.
(E) Allocated includes new funds received from the NSF in the amounts of $200K on Amendment No. 32 and $175K on Amendment No. 33.
(F) The above statement does not reflect the $3,700K advanced by the NSF for CY 1979 commitments and expenditures on Amendment No. 34 dated October 31, 1978.
(G) Allocated and Expended includes $5K in assets which were retired in prior years.
(H) The Total Expended for Construction at December 31, 1978, includes $28,154 chargeable to Operations. Since this oversight was noted after the 1978 closing, the necessary corrections will be made in January, 1979.

NATIONAL RADIO ASTRONOMY OBSERVATORY

VLA ACTIVITY SCHEDULE

UPDATE DATE: 1/2/79



TASKS

UPGRADE A	RECEIVER FRONT-END FILTERS, MODULES F4, F7, F8. INSTALL 5 ANT/MO. (25 MODULES)
UPGRADE B	SPECTRAL LINE IF MODULES T3, T4, T5, T6. INSTALL 4 SYSTEMS (24 MODULES) PER MONTH.
INCREASE 2 TO 4 CHANNELS	ADDITIONAL MODULES OF ABOVE TYPES. TOTAL 224. INSTALL 36 PER MONTH.

ABBREVIATIONS

DSGN — DESIGN	TST — TEST
LAB — LABORATORY	PRELM — PRELIMINARY
INST — INSTALL	OPNS — OPERATIONS
ANT — ANTENNA(S)	

SYMBOLS

O START OF A PHASE	△ CONTRACT AWARD
X END OF AN ACTIVITY	□ END OF A PHASE
⇩ SCHEDULED	⇩ COMPLETED

REV. NO.	REV DATE	DESCRIPTION
1	12/1/78	UPDATE PROGRAM PLAN