NATIONAL RADIO ASTRONOMY OBSERVATORY

SEPTEMBER PROJECT REPORT

VLA PROJECT

October 15, 1976

NATIONAL RADIO ASTRONOMY OBSERVATORY

MONTHLY PROGRESS REPORT

VLA PROJECT

September 1976

SITE AND WYE

Subcontract VLA-149; Wye Construction; Burn Construction Company, Inc.; $3,001,176

1. All antenna station spur trackage has been constructed, aligned, and raised to final grade on the west and east arms and all but four spurs on the north arm.

2. All antenna station foundations have been poured and completely backfilled.

3. All primary electrical work is complete on all arms and total electrical work is estimated at 99% complete.

This contract is estimated at 96% complete.

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

1. All that remains for completion is final test and balance work on the water systems.

This contract is estimated at 99.8% complete.

P.O. 02171; Don's Evergreens and Landscaping; $16,282.95

1. All landscaping work is complete.

Approximately 3900 feet of waveguide have been completely installed.

ANTENNA DIVISION

Antenna No. 5

Mechanical outfitting has been completed and the antenna was moved to station CW5 for completion of electronic installation and single dish tests.

Antenna No. 6

Antenna 6 was accepted from the contractor on September 3 and has been moved to the maintenance pad for mechanical outfitting.

Antenna No. 7

Panel installation has been completed for Antenna No. 7 and was measured as 0.011 inches RMS. The Antenna is now undergoing final alignment, servo installation and servo tests on the master pad.

Antenna No. 8

Antenna No. 8 is being assembled at the Site and the reflector is approximately 30% complete.

Antenna No. 9

Trial assembly has been completed on the base frame and base is being shipped to Site. Trial assembly of reflector has been completed and is now being painted.

SYSTEMS INTEGRATION DIVISION

The following observing sessions were conducted this month:

September 7-9 - 37 hours of interferometer tests at 6 cm with 2 antennas
September 13-15 - 36 hours of single dish and interferometer tests at 21 and 6 cm with 2 antennas
September 20-22 - 33 hours of interferometer tests at 6 cm with 3 antennas
September 27-29 - 35 hours of tests at 21, 18, and 6 cm with 2 or 3 antennas

The maximum baseline in these tests was 1.9 km (DW2-CW9).

Mr. Adrian Herzog joined the group this month as the third array operator.

ELECTRONICS DIVISION

In the feed area, chief interest has been with the testing at the new 18-21 cm feed installed on Antenna 2. On September 14, fringes were obtained for the first time at 18 cm and the antenna efficiencies were measured at 18 and 21 cm. Measured efficiencies were 52% and 50% for 18 and 21 cm respectively. On September 27 beam circularity, beam shape and sidelobe level, feed pointing and antenna pointing were all measured in interferometer mode at both 18 and 21 cm. No problems were found except for an unexpected difference at 2 arcmin in the pointing at 18 and 21 cm. This is the only problem remaining to be investigated before more of the new feeds are ordered.

On Antenna 4 a problem of receiver stability has slowed down measurement of the single dish antenna efficiency at 1.3 cm. The front end for Antenna 5 was ready to install on the antenna when two parametric amplifiers failed and had to be replaced. Front End No. 5 should be installed early in October.

Construction of Front End No. 6 was completed and a first cool down and test performed. Two parametric amplifiers in Front End No. 1 failed because of short circuited bias components and were replaced.

The first of the new 40 dB gain GaAs FET amplifiers was received from Avantek. The noise figure of this amplifier was 2.5 dB which was considerably better than the specified 3.0 dB value.

In the cryogenics area one compressor has now been completely fitted with stainless steel piping, vibration resistant compressor mounts and new klixon temperature control switches to provide more reliable operation. It is hoped that these modifications will cure all of the problems experienced to date in the compressor. The compressor for Antenna 7 was received from Air Products with stainless steel piping installed. There were minor problems with this compressor, resulting mainly from poor quality control at Air Products. The cryogenics engineer visited Air Products to ensure that these problems do not reoccur and that Air Products reduces vibration in the compressor.

In the local oscillator area redesign of modules L2 and L3, the only modules for which radical redesign is necessary, is making good progress. Prototype modules of the new designs are complete and in the case of L2 tests have been made. The temperature coefficient of phase for the new L2 is smaller than that of the original design by a factor of approximately six. In the case of L3 an alternate version of the new design which is cheaper and simpler to adjust is being tested in breadboard form. Two modified versions of the L11 module which incorporate the new round-trip phase measuring circuitry were brought out from Charlottesville for testing in the array. Modifications to improve the reliability of phase locking of the 3.2 GHz upconverter pump for 18-21 cm observations and the 17-20 GHz local oscillator for 1.3 and 2 cm observation are in progress.

Attenuation measurements of the 1.24 km section of waveguide between CW5 and CW9 were made on September 17. At 40 GHz there was no detectable change in attenuation, but at 50 GHz there was an increase of 0.07 dB/km and at 60 GHz, well above the frequency range that we use, the increase was 0.18 dB/km. This last figure could be high due to absorption by residual oxygen in the waveguide. The increases had taken place since April when the last measurements were made. The measurements required the removal of the waveguide couplers at intermediate stations that have been inserted in recent months as more antennas are being tested. A measurement on the more recently installed 185 m on the north arm showed 1.18 dB/km at 40 GHz and 1 dB/km at 50 GHz.

Documentation of the modem (T1) modules is now complete and a request for quotations on assembly has been issued. The samplers and delay and multiplier system are now complete for two channel operation with up to six antennas. No failures of integrated circuits have occurred in the delay and

multiplier system since the move to the Control Building. This increased reliability over that experienced in the trailer is attributed to the more efficient temperature control of the equipment provided by the air conditioning system in the Control Building.

In Charlottesville assembly has been completed for 19 out of 33 types of modules and other units for antennas 7-10.

On September 13 Michael E. Fusco joined the project as a digital technician in the Spectral Processor group, and on September 16 Martin G. Chavez was transferred to the position of feed technician in the Front End group.

COMPUTER DIVISION

Asynchronous Subsystem

An Experimental Data Reduction System, written and developed in CANDID, was completed during September. It has been used to examine and begin reducing data taken during several recent observing sessions. The system includes programs to plot data, make listings, fit baselines, determine clock errors, and edit or flag data. The first complete run data base has been filled by translating Modcomp observing tapes, and a preliminary bookkeeping and backup system for these data bases has been established. A program to list the contents of a run data base at various levels of detail is working. A program to retrieve selected portions of a run data base and return it to CANDID storage is also in use. Development will continue on this experimental system; as routines are frozen, they will be translated into SAIL.

An initial design was made for the format and contents of the data tape to be read by the 360/65 in Charlottesville.

A set of new device-independent graphics operators has been incorporated into CANDID. Plots can be made on either the ADDS, Tektronix, or line printer using the same operators, and considerable flexibility is allowed in scaling, labelling, and selecting data.

The monitor log tape written by the Modcomp can now be read successfully and interpreted by the DEC-10 program. Any monitor data point can be selected and the data written into a disk file. Another program reads these files and plots the data in a variety of ways. The data will be examined and its contents and quality evaluated before a monitor data base is written.

A new operating system was installed on the DEC-10 which incorporates the use of the card punch, and allows up to 16 teminal ports. A fix was made to the SAIL compiler so that segmentation of CANDID can proceed.

The RFP for an additional 128K of DEC-10 core was sent out. Evaluation procedures for the responses, which should arrive by October 1, have been established.

Synchronous Subsystem

We have verified that the software to handle the new correlator configuration works. We have implemented our arrangements for adding antennas to the array and have, in fact, observed with three. We can add, on demand, up to about ten antennas with no major reconfigurations. The 21 cm software was verified by actual operation. Improvements are continuing on the observing list preparation program and the monitor data checking. We are working toward, but have not yet reached, a sub-array capability (to observe two different objects with different sets of antennas). The dish interface to the DEC-10 computer is now wired and entering a checkout phase.

PROJECT MANAGEMENT

Purchase Orders and Subcontracts placed in September 1976 totaled $175,000. Of this total approximately 200 purchase orders amounting to $125,000 and Subcontracts amounting to $50,000 were awarded.

The take up of rail has started at Hill AFB, Utah.

Personnel

The personnel changes as of September 30, 1976 are as follows:

Division	Previous Level	Additions	Reductions	Current Level
Site and Wye	7	0	0	7
Antenna	10	0	0	10
Electronics	38	4	2	40**
Computer	13	0	0	13
Systems Integration	3	1	0	4
Project Management	24	1	1	24**
Total	95	6	3	98

*Includes one part-time person
**Includes one temporary person

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	6/11/73	$ 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	$18,131,767	3/1/77	NRAO has taken possession of Antenna Nos. 1 through 6. Antenna 7 is due for acceptance 10/15/76.
VLA-53	R. F. System	K and Ku Band Feed Horns	1/26/76	$ 109,168	6/7/76 7/19/76 11/15/76	K and Ku Band Feeds for Antennas 3 through 6 have been received and accepted. K and Ku Band Horns for Antennas 7 through 10 due for delivery 11/15/76.
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 cleared customs and will be coated approx. 10/26/76.
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. Units retrofitted with ss tubing after fabrication.
VLA-149	Burn Construction Co., Inc.	Site Construction Phase III	9/25/76	$ 2,979,600	10/25/76	Work is Approx. 96% complete.
P.O. 53880	N. M. Tech.	Labor Hour Contract	9/1/75	$ 15,000	8/31/76	Approx. $9,218 spent effective 9/30/76.
VLA-160 P.O. S-00120	Wutzke RR Tie Co.	20,000 Used Cross Ties	10/17/75	$ 109,000	12/31/75	18,350 ties have been delivered for stockpiling.
P.O. S-00271	Timber Mtn. Forrest Products	20,000 Used Cross Ties	10/17/75	$ 115,000	12/31/75	16,290 ties have been delivered for stockpiling.

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-174	Lawrence Hefner	Provide Labor and Equipment	1/26/76	$ 62,400	2/28/77	Approx. 37,406 spent effective 8/31/76.
VLA-177 P.O. S-00985	Fujikura Cable Works Ltd.	Waveguide Coupling Components	3/5/76	$ 134,985	6/11/76 10/30/76	Partial shipments are on schedule.
P.O. S-00986	Hitachi Shibaden Corp. of America	Waveguide Adaptors	3/25/76	$ 47,800	6/30/76 10/30/76	Order was completed 9/16/76.
P.O. S-01147	Fujikura Cable Works Ltd.	Rotary Joints	3/30/76	$ 7,660	10/30/76	Delivery is on schedule.
VLA-179 P.O. S-01046	AIL Div. of Cutler Hammer	Parametric Amplifiers	4/29/76	$ 62,320	10/12/76	Two due 10/15/76 and 6 due 11/15/76.
P.O. S-01753	Modular Computer Systems, Inc.	CRT Terminals and Interface	6/25/76	$ 4,000	7/30/76	Terminals and interface were delivered 9/15/76.
P.O. S-01946	Industrial Design Engineering Assoc.	Labor Hour Contract for Temporary Draftsman	7/21/76	$ 9,100	1/26/77	Draftsman is working in drafting section at 2015 Ivy Rd., Charlottesville, Va. $3,303 spent effective 9/30/76.
P.O. S-01984	J. J. Gustincic Consulting Engr.	Consultant Agreement	8/2/76	$ 4,000	12/31/76	Consultant on K, Ku and C Band Horn. $600 spent effective 9/30/76.

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	$73,000	5/6/76	6/22/76	9/16/76	9/30/76	Awaiting approval from NSF.
VLA-223	Rail Take up Hill AFB Utah	$58,203	8/9/76	9/9/76	9/15/76	9/30/76	Order awarded to A and K Railroad Materials on the basis of their low bid of $49,972.
VLA-226	Prefabricated Mobil Motel Unit	$30,000	8/13/76	8/30/76	9/15/76	9/30/76	Proposals solicited from 19 companies. Four proposals received within NRAO contractual authorization.
VLA-227	Motor Vehicle for operation on RR Track and Ground	$12,000	8/25/76	9/28/76	10/15/76	10/30/76	Proposals solicited from 13 companies. Six proposals received are being evaluated.
VLA-5	Amendment No. 5 to A/E Contract	$10,795	-----	-----	9/22/76	10/15/76	Amendment No. 5 for preparation of bid documents for Site Construction Phase III.
VLA-229	128 K Words of Main Memory	$50,000	9/9/76	9/29/76	10/15/76	10/30/76	Proposals solicited from four companies.
VLA-233	Custom Integrated Circuits	$169 - $230 K	9/24/76	10/15/76	10/30/76	11/15/76	Proposals solicited from fifteen companies.