VLB ARRAY MEMO No. 490

NATIONAL RADIO ASTRONOMY OBSERVATORY
Charlottesville, Virginia

1985 September 16

To: VLBA Science Group

From: K. I. Kellermann

Subject: Notes on September 6 Science Group Meeting

These notes summarize the September 6 meeting and include additional comments and discussion from the September 10/11 Design Meeting.

Present: CV: Kellermann, Hvatum, Sebring, Brown, Thompson, Balister, Romney, D'Addario, Bridle, Seielstad, Benson, Cotton, Fomalont, Vanden Bout
GB: Peery
Tucson: Hogg, Hjellming
VLA/Soc: Napier, Walker, Crane, Ekers, Horne, Clark
Caltech: Pearson, Moffet, Cohen, Readhead
Haystack: Rogers, Salah
Others: Shaffer, Jones, Linfield, Backer, Broderick, Shapiro, Reid, Moran

Funding Status: 1986 Budget not yet out of Congress. Somewhere between $8M (House upper limit) and $11.5M (Senate lower limit) is expected. Planning is continuing on the basis of $11.5M which is the number in the President's budget.

Antennas: Pie Town antenna to be completed by late 1986. Electronics to be installed early 1987. Tests in Spring 1987 and available for VLBI with VLBN by mid-1987 (assuming operating funds are available).

Masers: Bids received from 5 manufacturers. They are being evaluated.

Correlator: Expected funding schedule will stretchout project and delay start of correlator. As a result, Caltech is not able to make a commitment at this time to design and fabricate the correlator as planned. NRAO will plan to build the correlator.

Cost-to-Complete estimate is now finished. Many of the improvements which were suggested during the design effort will lead to cost increase. Also some cost increases, particularly

the correlator, site, and building construction, are due to higher costs than originally estimated. It has been our policy to carry along all the proposed improvements in the construction plan, recognizing that it will not be possible to implement them all. While some cost estimates here stayed level others have increased. Very few here decreased, because of a tendency to make "improvements" in those areas where it looked like the costs could be less than the budget estimate. As a result the best estimate of the cost-to-complete of the VLBA as now designed is about $1.5M over our budget level. If we wish to keep a 10% contingency we need to cut an additional $6M, for a total of $7.5M. Some of the improvements (e.g. better surface panels for high frequencies, record system, fast slew rates for astrometry/geodesy) have already been committed. Work on some receivers has already started, as has work on the record system, so options for cost cutting measures are limited unless we "throw out" some already completed work.

Some specific cost increases are:

1)	Accurate antenna surface panels	$ 700k
2)	Accurate subreflector	500k
3)	Site development	800k
4)	Correlator	3000k
5)	Record/DPS (mostly due to increase in price of Honeywell recorder)	500k
6)	AOC building	500k

Our aim is to defer to the end of the project a sufficient number of options to bring the contingency up to about 10%. If further cost increases can be prevented, many or even all of these deferred items can be reinstated. Otherwise they may have to be deferred until the operating years, by which time other more important options may take their place.

VLBA Memo No. 473 (Romney) lists a number of positive (improvements) and negative (cost saving) options. To this we should add:

1) Interim Correlator
   Description: 7 stations correlator
   Effect: Provide processing capability prior to completion of VLBA correlator
   Cost: $800k
   Decision Point: Now
   There was no enthusiasm for doing this.

2) Green Bank Antenna
   Description: Move Northeast antenna to Green Bank
   Effect: Slight degradation of (u,v) coverage
   Saving: $250k - $500k

Discussion of other options centered around list proposed in VLBA Memo No. 474 (Kellermann).

No RFI Shielding: Need unclear. Biggest impact (possibly only impact) is at long wavelengths, which in effect makes these receivers the most expensive. Shield only instrument room. Do only work which needs to be done during construction. Defer filters, stripping, etc. Hope bids will be below A/E estimate since RFP will be to "build to plans" not "to specs".

Size of Site Building: Contains room for expansion. Could be reduced, but would not save proportional amount of money.

Receivers: Consensus that there are too many receivers, but no consensus on which to defer. Only a few not yet started. Biggest saving in S-band receiver (about $700k) due to large feed and dichroic. Also not clear if space is available. No S-band receiver would leave large gap between 1.5 and 5 GHz bands, and would eliminate compatibility with current receivers at other sites, particularly DSN. DSN availability not clear. Value of compatibility not clear. Dual frequency essential for astrometry/geodesy. Other pairs, e.g. 5/15 GHz may be as good or even better as ionosphere effect is less. But long wavelength needed for pulsar astrometry. Possible to do pulsars at L-band. S-band needed for spectral and polarization studies. Perhaps S-band more useful on VLA rather than VLBA. 22 and 43 GHz also need to be paired with low frequencies to extend phase coherence. Many band pairs are possible by rapidly changing frequency. Should not give up possibility of S-band in future. Maybe put on a few antennas, such as Hawaii.

Correlator: May be able to reduce labor costs substantially with no loss of performance. Further cost savings possible if fringe rotation at antenna, if number of independent channels is reduced from 16 to 8 per converter, or through technological advances. Should handle 32 Mbps per channel. Strong case made for retaining digital filter.

AOC: Combination of VLBA and VLA facilities reduces VLBA funded facility to 27,000 sq. ft. But recent cost estimate based on New Mexico Tech building would still require about $2.5M. Possibly could reduce AOC further by 1k to 2k sq. ft. but probably not more. Situation uncertain due to other NRAO plans in Socorro (i.e. supercomputer, VLA, scientific activities), and uncertainty of how to fund non-VLBA part of proposed plan.

Other Cost Savings: Eliminate amenities such as paved roads, etc. Very little cost savings here.

Reduce post-processing, e.g. from 4 to 3 Vaxes. But it was never intended to buy 4 VAX 11/780s. Rather the intent was to keep $2M in budget so growth in computer power per dollar would keep pace with our increasing desires in this area.

Consider outside funds, e.g. state of New Mexico for control building.

Reduce number of independent channels to 8. No fundamental problem for astrometric or geodetic work, but may compromise pulsar dedispersion interference suppression, and bandwidth synthesis observations. Also requires use of 16 MHz channels for full sensitivity, and this degrades slightly the closure accuracy. Further cost saving possible by reducing the number of formatters from 2 to 1. This allows 256 Mbit rate, but not 512 Mbit rate.