Interoffice

NATIONAL RADIO ASTRONOMY OBSERVATORY

TUCSON, ARIZONA

August 11, 1976

25 Meter - Millimeter Wave Telescope
Memo #50

To: M. A. Gordon

From: B. L. Ulich

Subject: Comments on 25-M Telescope Operations

First I want to bring you up to date on my activities regarding the 25-m telescope.

I. Radome Material Environmental Tests

I have erected test stands on Kitt Peak and Mount Lemmon. Three types of panels are currently installed.

II. Radome Material Transmissivity Tests

I have measured the transmissivities of 9 different fabrics between 1 cm and 1.3 mm wavelength. John Findlay has my samples now and plans to make some 2 mm measurements this month in Green Bank. When he finishes I will report all the results.

III. Antenna Surface Measuring Instrument

So far John Payne has produced three different maps of the 36-foot surface errors. We have placed foil on the dish each time but in each case the gain of the antenna decreased. However, by averaging radial cuts (and assuming the errors are a function of radius only) we have managed to foil the mean radial surface and improve the gain by about 10% at 3 mm wavelength. My conclusions are that (1) the radial cut data are probably good but (2) the two-dimensional surface maps are not. This could be due to programming errors or (more likely, in my opinion) to the fact that the end point locations for each radial cut are not well known. John Findlay is already working to solve this part of the problem with his laser radar.

IV. Electrical Design and Geometry

I am looking into the f/D question and others now. I plan to discuss things with Findlay, von Hoerner, Napier, Freund, and Payne. I will resolve things (to my satisfaction, at least) before you return in September.

V. Interference Survey

I have completed the EMI tests on Mt. Lemmon, Tucson, and Kitt Peak. On August 16 I will go to Cerro Gordo (with Cam Wade's approval) to complete the tests. I will ship the spectrum analyzer to the VLA site before September 1. I will write a summary of the survey results before September 15. Should I send a copy directly to Cam

Wade or wait until you return?

Next here are some of my thoughts concerning 25-m operations. These are drawn mainly from my experience with problems at the 36-foot telescope.

I. <u>Dome</u>

I favor an astrodome rather than a radome because of the poor transmissivities of the sample fabrics I have tested so far. The dome should rotate independently of the telescope so we can avoid sunlight on the dish when changing sources. The door should be made as transparent as possible in the RF region but opaque at IR wavelengths. The door should be physically and electrically symmetrical with respect to the telescope axis to avoid introducing astigmatism and boresite shift. This means that the center of the spherical door must lie on the electrical axis of the primary reflector.

In the future we will have much lower noise receivers than now exist, and we should therefore look carefully at ways to reduce the noise temperature of the antenna. Some radiation from the walls and floor of the dome is scattered by the secondary support legs and mirror into the feed.

If the dome surfaces are lossy at millimeter wavelengths their contribution to the antenna temperature can be many tens of degrees (about 50K for the 36-foot cassegrain system). We can substantially reduce this unwanted noise by making the inner walls and floor of the dome out of reflecting (metal) material. Now the scattered rays from the telescope will eventually be reflected up into the cold sky (whose brightness temperature varies typically from 6K to 85K). The result will be a noise contribution of only about 10K (or less), which is a substantial reduction. The aluminum sandwich panels covering the inside of the KPNO 4-meter dome would provide such a low-cost maintenance-free reflecting surface. In effect, I am suggesting that we build the telescope inside a large reflecting bowl. Another advantage of such a design is the inherent shielding of the telescope from unwanted RF interference. The reflecting bowl would act like a partial Faraday cage and block interference.

The most convenient location for a hydraulic crane would be on one inside wall of the rotating dome. The crane should conveniently reach the floor and all parts of the telescope. The same crane could be used for installing and servicing equipment both at the vertex and at the apex. One convenient service position would be with the telescope pointed at the zenith. The crane could reach down and pick up a receiver from the dome floor, extend horizontally over the edge of the reflector between the secondary spars, and lower the receiver vertically into position at the vertex. Similarly, equipment could be installed at the apex by lifting it up into position. A hatch cut into a blocked portion of the surface should also be provided for a man to climb to the vertex. Will the proposed panels support a man without permanent deformation?

The crane could also be made to reach out through the open dome door for unloading heavy equipment from trucks. I feel that two dome entrances are necessary, one primarily for people and the other for large equipment. We need a loading dock with independent access to the dome interior. We shouldn't have to stop observing (as we must do now at the 36-foot) in order to move large containers in and out of the dome.

II. Telescope

I have previously pointed out the advantages of lowering the elevation limit of the telescope to -5^{o} so that pattern measurements can be made. I think this feature should be incorporated even if it increases the cost somewhat. The limited coverage of the 36-foot telescope was, in my opinion, an expensive mistake.

The switch-over point in the cable-wrap of the 36-foot is now set at 90^{o} azimuth. This should be changed to about 70^{o} to reduce lost time waiting for rising positive-declination sources to cross the limit. If we have multiple receiver pods at the vertex we should provide enough cables on the telescope to operate them simultaneously and independently.

III. Facilities

There is sufficient room to build all the operating rooms and labs inside the dome beneath the telescope. This is an established practice for optical observatories and one which we should consider. We need a control room ($\sim$ 1000 ft^2 preferably with a view of the telescope), an electronics room ($\sim$ 1000 ft^2), an electronics lab, an observer's lounge and office, a workshop with provisions for welding, etc. ($\sim$ 1000 ft^2), several offices for on-site personnel, rest rooms, sleeping quarters, and storage space. The problem of storage will be more acute than at the 36-foot. First, we can no longer depend on KPNO for common supplies, and we will have to stock more spares on the mountain. Second, many large items are now being stored in the 36-foot dome, and essentially no storage space will be available on the floor of the 25-m dome because of the telescope design. We could possibly utilize some of the space inside the dome side walls for storage.

One big problem at the 36-foot is noise in the control room. I recommend the following solution for the 25-m. Build the electronics room adjacent to the control room but separated by a double glass wall and access door. Computers, tape decks, and receiver electronics could be located behind this glass wall which would provide thermal and audible shielding but yet would allow visual observations of the equipment to check for proper operation. These rooms should be electromagnetically shielded with wire mesh. It might also be necessary to shield the computer from the receiver and digital hardware. The control room and electronics room should have raised flooring with cabling underneath. Air conditioning could be ducted into each rack from underneath, thus eliminating the need for noisy fans in each rack.