Memo # 7

A Proposal for the 25-meter Millimeter Telescope

J.W. Findlay, 27th July 1974

1. Outline

I propose that we start work fairly soon on the design, fabrication and test of the reflector support structure for the telescope. I hope the reasons for this suggestion will become clear if I set out the various things which should be done and the ways in which the whole project would be helped by this approach.

2. Design and build the reflector support structure

(a) The Design The design, which has already been started, should be based on the 65-meter structure. It should be homologous, capable of withstanding the same survival wind loads as were used for the 65-m. The design should be complete for all the structure that rests on the elevation bearings, that is, it will include the feed support and the elevation wheel. It should be planned to carry surface plates as heavy (in weight per square foot) as the Philco-Ford plates. It will also be planned to carry an intermediate panel structure, to connect the support structure to the surface plates. However, it is not my intent (as will become clear later) to fabricate either the intermediate panel structure or surface plates until much later in time. It is, however, my intent to design and fabricate the reflector support structure which eventually will become part of the completed telescope.

The design phase will include a rigorous deflection analysis, since later the structure will be tested with methods which will be accurate enough to uncover any divergences between predicted and actual performance of the telescope.

I believe that this total design effort is within the capabilities of our engineering group. In fact, to be more blunt, I would prefer this design to be the task of our own group rather than any other that I know in the world.

(b) Fabrication and Erection I propose that we have our design fabricated. This should be planned in such a way that the reflector support structure can later be unbolted into smaller pieces (which I picture as still quite large fully welded structures) for shipment to the final telescope site. Since I wish to be able to rely on the tests of the structure with some bolted connections in it, I assume these will have to be made as good as welds (which I believe to be possible) At this distance I have not got enough data to forecast the fabrication cost, but it will be steel in the dollar per pound category.

I would plan to erect the structure on its two elevation bearings at Green Bank, on towers high enough to allow the structure to be tilted through 60 to 80 degrees from the zenith. No elevation drive is needed at this stage, but it may be desirable to simulate the weight of the elevation gear

and perhaps the forces imposed by the drive on the elevation wheel. The structure will, of course be carrying its correct counterweight. The preparation of tower foundations, and the erection of the structure on the towers are both simple tasks.

3. A structural test program

(a) Deflection tests with varying loads I would plan an extended series of tests on how the structure deflects under loads. The X-band Antenna Measuring Instrument (see E.D Internal Report No.136) would be used. For most of the tests it would be mounted firmly near the prime focus, and a number (up to 21) of transponders would be located at points on the structure whose deflection patterns had been predicted in the design phase. A series of tests in the zenith would be made by applying vertical dead loads to various parts of the structure. These would be followed by measurements of the deflections as the telescope is tilted. I believe the measurement accuracy could be .001" (.025 mm). There should be agreement between calculations and measurements to that sort of accuracy. If there is, we are all happy and can proceed. If there is not, then thank me and others for finding it out in time!

(b) Effects of wind and temperature I am not too concerned as to the effects of wind, but with the structure well-instrumentsd we probably would look at feed support motions in wind. We would, however, study the effect of temperature differences. Here I would prefer to use the modulated laser beam distance measurer, which we believe can also have the required accuracy. This choice is made because it is much less dependant on atmospheric conditions that the X-band radar. We would probably want to put a crude surface on the structure in these tests. The results of these tests would be vital to the radome/no radome problem.

4. The choice and setting of a surface I still say that this is one of the most difficult tasks in the whole telescope. So, after having completed the above tests (which would I hope also have proved we are on safe ground so far) I would continue into the surface problem. By this time we will probably have a preferred way of fabricating panels. We should fabricate a number of panels, devise the best support and mounting methods, and go ahead and mount the plates on the structure. My present choice would be to mount 4 lines of plates frmm center to edge to make a 90^{o} reflecting cross. We should then set these plates using our best-liked setting procedure. This would prove to us that the setting can be done. It might even be possible to observe with the reflecting cross at 1 mm to check performance.

4. Conclusion I won't give anymore reasons why I think we should follow this plan, except to say that it is, to me, far preferable to spending money on paper design studies. If it were to be adopted, I should be happy to work on it.