NATIONAL RADIO ASTRONOMY OBSERVATORY

Charlottesville, Virginia

August 31, 1977

25 Meter Millimeter Wave Telescope
Memo #100

MEMORANDUM

TO: B. Peery

FROM: W-Y. Wong

SUBJECT: Visits to Onsala Space Observatory's 20-m radio telescope and notes on the discussion with J. Baars of Bonn on the proposed 30-m radio telescope

The OSO's 20-m radio telescope was completed and officially in operation in May of 1976. The telescope, including the back-up structure, the subreflector, the control system and the 30-m radome, was designed and sold to OSO as a package by ESSCO at a cost of approximately $800,000. To the opinion of Dr. Ake Hjalmarson, it is a very inexpensive telescope for 3-mm wave. So far the performance of the telescope has already shown that the aperture efficiency at 23 GHz is 65%, at 110 GHz 35% when the telescope is pointing at 45° above the horizon. These are recent measurements. Early this year, observation performed at 24 GHz showed that the beamwidth is 150 arc-sec, beam efficiency is 70%, and pointing error is 12 arc-sec rms. A receiver is recently ready to operate at 115 GHz. It is due to this high frequency performance of the receiver, that improvements of the certain problematic areas become quite pressing: 1) High precision pointing program is needed to reduce the point error by a factor of approximately 5. This is still in progress. 2) Problems existed on measuring and adjusting of the telescope surface. It is difficult, due to inadequate design, to maintain the theodolite in a stable position. It is also difficult to adjust the surface plates into their proper positions. The latest data showed that the deviation from the best-fit paraboloid is 0.17 mm rms at elevation angle of 60° (ESSCO predicted 0.25 mm rms), 0.21 mm rms at Zenith (ESSCO predicted 0.35 mm rms). Hjalmarson believes that further improvements on measurements are possible by using J. W. Findlay's stepping method, for instance. 3) There were some distortions induced by the misalignments of the feed support legs to the surface, but the problems were resolved after some shimmings applied at the connections to the back-up structure.

Temperature distortion seems not to be a problem for this 20-m dish. There is an air circulation system at the base of the radome. The space between the rim of the dish and the wall of the radome is

about 5-m, the air can be more freely between the front and the back of the telescope. Measurements of temperature at various parts of the telescope is planned some time in the future. These measurements would be useful also for the NRAO's 25-m design.

In conclusion, the instrument is very impressive operating at 24 GHz. Observation results would be most interesting at their designed goal of 115 GHz.

Notes taken in discussion with J. Baars of Bonn (June 29, 1977): The current test surface plate is produced by a German firm called Dorncier. It is a honeycomb (35 mm thick) and aluminum skins sandwich construction held in place by 9 adjustment screws. The dimensions of the individual plate is 1m by 1.5 m. Four of these plates are supported by one framework, forming a module. These four surface plates are adjusted at the factory to the proper shape, and then held permanently in place. Insulation material is installed between the surface plates and the frame work. The frame work module in turn has 4 adjustable screws at the four corners connecting to the back-up structure, so that the frame work module can be adjusted to the best fit parabolid. The back-up structure is to be covered as an envelope with insulation material, hence the entire telescope is insulated except the surface plates. Forced air circulation within the backup structure is expected to reduce the thermal gradient to an acceptable level. Krupp has recently finished some thermal analysis, and these results will be available to us some time in the future. These results indicate that their proposed scheme is workable. Since 1969, Krupp had already been using this approach to build communication antennas, such as the 25-m antenna in Raisting and recently completed 32-m antenna in Persian Gulf. Despite the requirements of these antenna are far less demanding than the proposed 30-m radio telescope, they will have some hard data in temperature measurement to work with.