VLB ARRAY MEMO No. 249

Memorandum

20July,1983.

To: Bill Horne
From: Peter Napier
Subject:Comments on VLBA Memo No.241.

Here are my comments on your draft of the antenna chapter for Vol 3 of the VLBA Proposal.Overall I think your draft looks very good. It is thorough and includes the lessons that we have learnt from the VLA antennas.

(1)Page 1,section 1.2. I agree that we should try and include the construction and testing in with the design for this first contract. This will give us the best competition and provide the lowest cost antennas. It is not clear to me, however,that NSF will let us take this approach because of the requirement that we do only design during 1984. We will have to get NSF to bless section 1.2.

(2)Page 2. I suggest we replace the last sentence of the second paragraph of section 02 with the following:"The Cassegrain observing system shall be considered the normal mode of operation.The feed for prime-focus operation will be permanently mounted in the center of the subreflector and will be used by moving the subreflector away from the main reflector to position the prime-focus feed close to the prime-focus. A clear opening of approximately 4 feet in diameter will be required at the apex of the feed legs symmetrical about the reflector axis."

(3)Page 3,Reflector surface. Current calculations indicate that the shaped main reflector will not deviate from the best fit parabola by more than 2.2cm, the peak occurring approximately 80% of the way out to the edge of the reflector. We should leave 30mm as the number in the specifications though in case it changes in future calculations. Should we mention that a circular area of diameter 11ft in the middle of the reflector will not be paneled?

(4)Page 3,Azimuth Axis Runout. I am concerned that this spec may not be tight enough considering that we are aiming for rms pointing of 10arc.sec. due to all sources. The problem is that, although the runout may be repeatable and therefore in principle correctable, in practice a simple pointing correction model will not correct it if it is not smoothly varying. The "glitches" that occur in the azimuth bearings of a few VLA antennas are examples of this. Can we tighten the spec without impacting cost?

(5)Page 4,Elevation Drive. We need to check with the scientists to see if they are happy with the 20 degrees per minute.

(6)Page 4,Operating height. The 8000ft may not be enough for Hawaii.

(7)Page 5,Telescope differential temperatures. We have, on occasions, seen more than 3.5 degrees C differential temperatures on VLA antennas. In VLA Test Memo 129 (Pg 6) Sebastian recommends

using 5 degrees C differential between sunshine and shadow for white-painted members.

(8)Page 6, 5th line from bottom. Replace "parabola" with "surface of revolution".

(9)Page 7,Rotation of the best fit axis. We cannot allow the best fit axis of the surface to rotate in the elevation direction so much that the center of the subreflector is significantly displaced from it. Although we can correct for the resulting pointing error, there will also be an irretrievable loss of gain at the highest frequency. To prevent this we require that the center of the subreflector always be within .15in of the best fit axis. This implies needing either a means of translating the subreflector or a maximum allowable rotation of the axis of 1.5arc.min.

(10)Page 7, Repeatable pointing errors.As I have pointed out in (9) above, some repeatable pointing errors such as those caused by gravitational deformation of the reflector or subreflector support structure,have accompanying losses of gain.These types of repeatable pointing errors have to be kept to less than 1arc.min. for negligible gain loss at 44GHz. Repeatable pointing errors that do not cause gain loss,such as encoder or bearing alignment can reach 3arc.min. The VLA antennas are acceptable in this respect.

(11)Page 8. Thermal pointing errors. Your discussion covers pointing errors due to temperature differentials. Pointing errors can also be caused by changes in the absolute temperature of the structure if "bimetallic" effects are present. Do we need to remind the manufacturer about this?

(12)Page 8,line 15. Replace "antenna point systems" with "antenna paint systems".

(13)Page 8,Slewing motion. Check 20 degrees/min elevation slew rate.

(14)Page9,line 10. Replace "this" with "the".

(15)Page9,Feed legs and apex. We will not have a separate prime focus receiver package. The total combined weight of subreflector,prime-focus feeds and receiver should be no more than 700lbs. I don't have final dimensions for the subreflector yet but current calculations give the dimensions shown in the attached sketch. The feed legs must provide sufficient clearance to support the subreflector in its normal operating position and also allow it to be retracted to the prime-focus operating position. I suggest we include a sketch of this type in the specs. We should call the subreflector "an asymmetric subreflector with maximum radius 1.8m".

(16)Page10,Vertex equipment room. The VLBA vertex room will contain 7 different cryogenics packages where the VLA room contains 1. The low frequency feeds will be larger than the VLA feeds and will take up more space in the room. Also,in place of the VLA feed ring, the VLBA will use a single large feed cone (see figure IV-1, VLBA Proposal Vol 1) which will be an upper

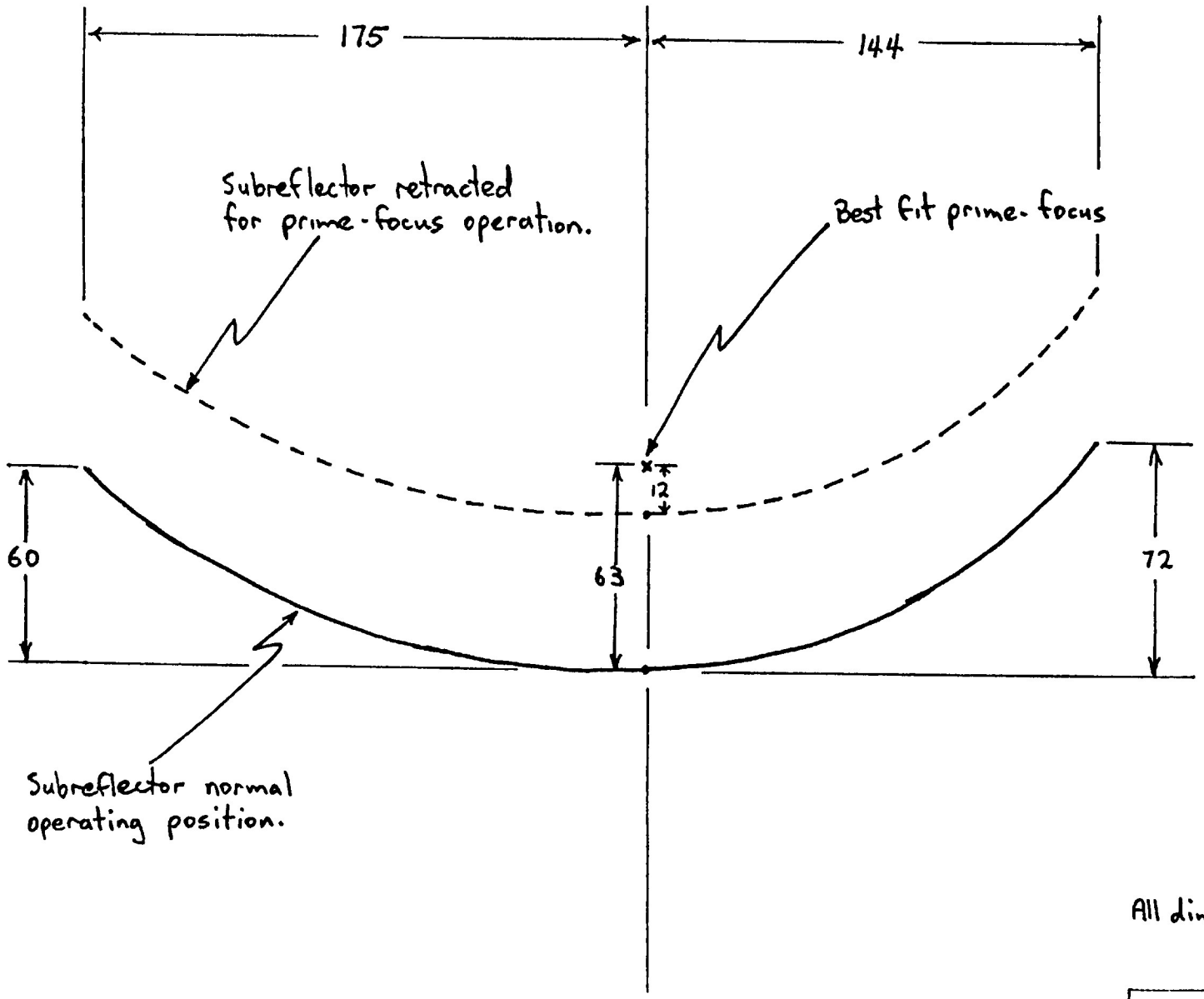
level to the Vertex room. A stairway up to this "upstairs room" will have to be provided inside the vertex room. For these reasons I think it is unwise to plan for a room much smaller than the VLA vertex room, unless it is clear that the room is too expensive or degrades performance.

Include the following sentence: "The vertex room will be electrically shielded so as to prevent the leakage of radio frequency interference out of the room. The room will be constructed so that signals in the frequency range 1MHz to 44GHz are attenuated by at least 50db when they leak from the room".

Include the following sentence:"Access to the vertex room will be suitable for a man having one hand available for support and carrying a piece of test equipment weighing 40lbs in the other hand".

The feed cone will be approx. 11ft in diameter rather than 8ft.

(17)Page 10. Pedestal Room. Won't we need a Pedestal room for the same reasons that we need one on the VLA antenna?



All dimensions in cm.

Preliminary Subreflector
Layout for VLBA Antenna

PJN 07 JULY 83