Interoffice

MILLIMETER ARRAY
MEMO NO. 5

National Radio Astronomy Observatory

Socorro, New Mexico

December , 1982

To: Frazer Owen

From: W. Horne

Subject: Estimate Antenna Costs - Millimeter Array

At your request I have prepared the following rough estimate of the structural, mechanical and construction costs for providing the antenna elements of the proposed millimeter array. The following qualifications should be remembered in the utilization of this estimate:

(1) No actual antenna design has been performed; based on past experience only an estimate of configuration and weight has been made with allowances for reasonable cost increases due to increased accuracy requirements.

(2) Estimate is based on a VLA site location with use of the VLA Assembly building for the antenna assembly operation. A change of the site location would affect shipping costs and assembly costs as well a site, foundation and mobility system costs.

(3) As assumed production schedule of 5 of the 10 meter antennas per year is used. A lesser number would probably increase costs. Production rate of the 3 meter antennas would have a lesser influence on costs within a restriction that we not produce enough of them in any one year to restrict 10 meter production and not produce so few per year that 3 meter production would be too intermittent.

(4) All estimates are based on use of contractors to provide detailed design, procurement, fabrication, shipping and assembly. Any part of the above performed by NRAO forces would reduce costs but the limited number of NRAO personnel limits the capacity of NRAO to perform such work.

The estimate is based on the following parameters

(1) There will be 15 antennas of 10 meter reflector diameter and 15 antennas of 3 meter diameter.

(2) Prime operating frequency will be 100 GHz with the desired goal of operating of 230 GHz under favorable conditions (perhaps 35 to 40% of the time). It is understood that observing at 230 GHz could be restricted to certain favorable periods of the 24 hour period.

(A) 10 M. Antennas Summary

Recurring Costs	Single Ant
Antenna Structure	$221.7^k
Antenna Mech	140^k
Field Assbly	58^k
G & A @ 15%	68.2^k
Profit @ 10%	62.8^k
Panels	193.8^k
TOTAL	744.5^k

If 15 antennas are bought price per antenna would be 15% less
TOTAL = 744.5 x 15 x .85 = 9492^k

Non-Recurring Costs	
Engineering	400^k
Panel Engr & Tooling	80^k
Servo Design	35^k
TOTAL	515^k

(B) 3 M. Antennas Summary

Recurring Costs	Single Ant
Antenna Structure	27.5^k
Ant. Mech.	55.2^k
Field Assbly	14.5^k
GTA 15%	14.6^k
Profit 12%	13.4^k
TOTAL	125.2^k

If 15 antennas are bought price per antenna would reduce 15%
125.2 x 15 x .85 = 1,596^k

Non Recurring Costs	
Engineering	65^k
Panel Engr. & Tooling	16^k
Servo Design	8^k
	89^k

In reviewing the above estimate I am sure you will note the apparent discrepancy is which the structure for the 10 meter antenna is approximately twice the cost of the mechanical costs while the reverse is true for the 3 meter antenna. Note however that the servo controls and the position measuring system will have practically the same requirements for either antenna some servo components will be smaller due to the reduced power required but the function will be the same.

I am attaching copies of my estimate work sheets for your information.

10 Meter Antenna
Millimeter Array

Pedestal - Est. wt. 15,000 lbs x 62¢	=	$ 9300
Fabrication 15,000 lbs x 75¢	=	11,250
Base Plates Material	=	500
Fabrication	=	600
Bearing Support Housing - Est wt. 3000 lbs @ 62¢	=	1800
Fabr. 3000 x 75¢	=	2250
Machining	=	4500
Elevation Wheel Est. Wt. 12,000 lbs x 60¢	=	7200
Fabr. 12000 x 83¢	=	9950
Reflector Structure Wt. 16,000 x 92¢	=	14.700
Fabr. 16,000 x $1.27	=	20,300
Counterweight 32,000 lbs x 50¢	=	16,000
Platforms & Walkways 6000 lbs x 65¢	=	3900
Fabr. 6000 lbs x 1.15	=	6900
Material mark-up 64,500 x 13%	=	8400
Fabrication Burdon 66,600 x 110%	=	73,250
SUB-TOTAL		$ 221,700
Surface Panels 884 ft^2 x $220.00/$ft^2$	=	193,750
Engr & Tool Design	=	30,000
Non Recurring Tooling Mfr.	=	50,000
SUB-TOTAL	=	$ 273,750
Servo Design (non-recurring)		$ 35,000
Servo Controls		15,000
Drive Motor 4 x 3600.00		14,400
Az Bearing & Gear		18,000
Encoders		20,000
El. Gear Segments		7000
Elevation Bearings		2600
Speed Reducers 4 x 7600.00		30,400
Air Conditioning		10,000
Pedestal & Vertex Rooms		12,000
Insulation, heating & cooling structure		11,000
SUB-TOTAL		$ 175,000
Field Assembly Cost 6 men (4800.00 wk) x 10 wks	=	48,000
Crane & equipment rental	=	10,000
SUB-TOTAL		$ 58,000

Recurring Costs	Antenna Str.	=	221.7^{k}
	Antenna Mech.	=	140.0^{k}
	Field Assbly	=	58.0^{k}
	G & A @ 15% x 455^{k}	=	68.2^{k}
	Profit @ 12% c 523	=	62.8^{k}
	Panels	=	193.8^{k}
TOTAL			$ 744.5^{k}

Non Recurring	
Engineering Design	400^{k}
Panel Engr & Tooling	80^{k}
Servo Design	35^{k}
	515^{k}

3 Meter Antennas - Millimeter Array

Pestal Est wt @ 1700 lbs @ 62¢	=	$ 1054
Fabr. 1700 lbs @ 75¢	=	1275
Base Plates	=	200
Fabrication	=	300
Bearing Housing 700 lbs @ 62¢	=	435
Fabr. 700 @ 75¢	=	525
Machining	=	850
Yoke & Alidade 2000 lbs @ 60¢	=	1200
Fabr. 2000 lbs @ 83¢	=	1660
Machining	=	850
Elev. Wheel 1200 lbs @ 60¢	=	720
Fabr. 1200 lbs @ 83¢	=	1000
Reflector Str. 1600 lbs @ 92¢	=	1500
Fabr 1600 lbs @ 83¢	=	2100
Ctr wk 3000 lbs @ 50¢	=	1500
Platforms and Walkways 1200 lbs @ 65¢	=	800
Fabr. 1200 x $1.15	=	1400
Material mark-up $7410 x 13%	=	970
Fabrication Burden $8260 x 110%	=	9100
SUB-TOTAL	=	$ 27,450

Surface Panels 80 ft^2 x 250.00/ft^2	20,000
non recurring Engr & Tool Design	6000
non recurring Tooling Mfr.	10,000
Servo Design (non-recurring)	8000
Servo Controls	12000
Drive Motors 4 x 1200	4800
Az Bearing & Gear	5200
Encoders	14,000
El. Gear Segments	2000
Elevation Bearings	1800
Speed Reducers 4 x 1600	6400
Air Conditioning	4000
Insulation	2000
Receiver Room	3000
	55,200

Field Assembly Costs	
5 men ($4000 wk) x 3 wks	$ 12000
Equip, Crane etc	2500
	14,500

Recurring Costs	
Antenna Str	27.5^{k}
Ant. Mech	55.2^{k}
Field Assbly	14.5^{k}
G & A @ 15% x 97.2^{k}	14.6^{k}
Profit @ 12% x	13.4^{k}
	125.2^{k}
Non-Recurring Costs	
Engineering Design	65^{k}
Panel Engr. & Tooling	16^{k}
Servo Design	8^{k}
	89^{k}

WH/bmg