

ADDITIONAL BASELINE TO INTERFEROMETER

MEMO No. 127

NATIONAL RADIO ASTRONOMY OBSERVATORY  
Green Bank, W. Va. 24944

October 8, 1980

TO: Interferometer Addition Committee

FROM: R. Fisher

A number of companies have provided us with budget estimates and specifications for antennas which might be suitable for the new interferometer baseline. Buck Peery will distribute a summary of the proposed antenna specs as soon as he has compiled them. I would like to propose the relaxation of a number of our specifications and to discuss the feasibility of accepting a Cassegrain design since one or both may result in considerable savings to the project.

A meeting will be held at 1315 on Tuesday, 14 October, in the teleconference room to discuss the antenna proposals. Everyone on the distribution list is invited to attend and comment but, specifically, Jim Coe, Fred Crews, and Buck Peery should be prepared to discuss changes in antenna specifications and to say how any changes would affect integration of the antenna into the system.

xc: M. Balister  
J. Coe  
F. Crews  
R. Fleming  
D. Hovatter  
L. Howell  
H. Hvatum  
B. Meredith  
B. Moore  
B. Peery ✓  
S. Smith  
R. Weimer

Spec -

ES500

Diameter - Dish (M)	9.15 - 15.25
Dish Sur - RMS - (125)	.030"
f/D	.36 - .43
Orthogonality	18 sec
Az - Travel	± 270
Az - Drive Torque Bias	2-DC Gear
Az - Speed - Max	2.0°/min
El - Travel	-10 to +90
El - Drive Torque Bias	2-DC Gear
El - Speed - Max	2.0°/min
Min Speed	1.5 in/min
Pointing Error - Repeat	3-17 min
Pointing Error - Non Repeat	15 sec
Panel RMS - Mfg (30) (24)	.012"
Shadow	6%
Panel - Field adj -	4-pts Min
Survival Winds	110 MPH
operating Winds	15 MPH ± 3
Temp Range	-22 to +123
Brakes	Motor & Disk
Motor stop pins	No -
Ice Load	1 cm
Snow	20#/ft <sup>2</sup>
Concen Load	250 #
Feed Support -	1600 #
Pedestal Const.	Steel -
Back up structure	Steel -
Lubrication	Oil
Servo Control	No
Crack in Panels	0.60" <sup>12</sup>
Pre assemble	yes
Delivery (Months)	-
Erection time/men days/no	-
Shaped Dish	No
Power Req (KVA)	-
Drawings	yes -
Beam Width	52.4 min 17 min.

13.7 Will meet Specifications - See Letter.

Question  
20-24.

No

Question

ELECTRONIC SPACE SYSTEMS CORPORATION

OLD POWDER MILL ROAD

CONCORD, MASSACHUSETTS 01742



IN REPLY REFER TO: E5580

TELEPHONE 617-369-7200  
TELEX 92-3480

September 22, 1980

National Radio Astronomy Observatory  
Post Office Box 2  
Green Bank, West Virginia 24944

Attention: Mr. Richard L. Fleming  
Purchasing Officer

Reference: RFQ GB-176

Dear Mr. Fleming:

ESSCO is pleased to respond to the NRAO RFQ GB0176 dated August 18, 1980. Our price quotation E5580-1 is attached and this letter is made a part thereof by reference.

ESSCO proposes to supply a 13.7 meter exposed antenna essentially the same as the existing ESSCO 13.7 meter exposed antenna (supplied to NRAO in 1972), but without the transportable features. The surface panel construction will be similar but incorporating knowledge gained in subsequent antenna installations regarding bonding systems.

No specific exceptions are considered necessary as far as performance specifications are concerned. The desirability and/or necessity of certain general requirements, e.g. a) complete assembly at the plant, b) extent of documentation and c) providing proprietary drawings, are felt to be areas requiring consideration in negotiation.

We appreciate this opportunity to be of service and are looking forward to working with you on this project.

Sincerely,

ELECTRONIC SPACE SYSTEMS CORPORATION

Samuel L. Hensel, Jr., Sc.D.  
Sales Manager - Antenna Systems

SLH/dab

Encl: Quotation

CO

**ELECTRONIC SPACE SYSTEMS CORPORATION**  
 OLD POWDER MILL ROAD CONCORD, MASSACHUSETTS 01742

TEL. - CONCORD-(617) 369-7200  
 BOSTON -(617) 643-8500

TWX-710-347-1054  
 TELEX NO. 92-3480

QUOTATION NO. E5580-1

(PLEASE REFER TO THIS NUMBER IN PLACING  
 ORDERS OR IN CORRESPONDENCE.)

TO: National Radio Astronomy Observatory  
 Post Office Box 2  
 Green Bank, West Virginia 24944

DATE: September 22, 1980

TERMS: NET 30 DAYS, subject to the terms and  
 conditions printed herein and on the reverse  
 side hereof.

ATT: Mr. Richard L. Fleming  
 Purchasing Officer

~~XXXXXX~~ Installed on site.

YOUR REFERENCE: RFQ GB-176

Please include DMS Ratings, Contract Numbers,  
 and Tax Exemption Certificate Number on the  
 face of any resulting order. These prices apply to  
 specified quantities only. This quotation expires  
 30 days from date hereof unless otherwise indi-  
 cated.

We are pleased to submit our quotation as follows:

ITEM	QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
		<p><u>Notes:</u></p> <ol style="list-style-type: none"> <li>1. ESSCO's terms and conditions are provided on the reverse side of page 1 of this quotation.</li> <li>2. Prices are valid for 60 days from the date hereon and are to be considered budgetary.</li> <li>3. The availability of NRAO site personnel and erection equipment would result in a lowered price, as would the reduction in the documentation requirements.</li> <li>4. The design is proprietary to ESSCO as are all design and manufacturing drawings, which have not heretofore been released outside ESSCO. This requirement of subject RFQ is a subject to be considered in negotiation.</li> </ol>		

DELIVERY:

ELECTRONIC SPACE SYSTEMS CORPORATION

BY Samuel L. Hensel  
 Sales Manager - Antenna Systems  
 TITLE \_\_\_\_\_

ORIGINAL

Spec -

Scientific Atlanta

Diameter - Dish (M)	9.15 - 15.25	10		2-7
Dish Sur - RMS - f/D	.030"	.030"	(Paint ok - 2-5)	2-1
Orthogonality	.36 - .43	.39		2-1
AZ - Travel	18 sec	36 sec		5-3
AZ - Drive Torque Bias	± 270	± 390		5-7
AZ - Speed - Max	2-DC Gear	2 DC		5-3
El - Travel	20°/min	3°/sec		5 - Catalogue
El - Drive Torque Bias	-10 → +90	-5 → +185		5-8
El - Speed - Max	2-DC Gear	2 DC		5-3
Min Speed	20°/min	3°/sec		5 - Catalogue
Pointing Error - Repeat	15 min/min	.003°/sec (10.8 min/min 1000:1)		5-6
Pointing Error - Non Repeat	3-17 min	.269 min		B-7
Panel RMS - Mfg.	15 sec	1.33 min (79.7 sec)		B-7
Shadow	.012"	?		2-1 →
Panel - Field adj - Survival Winds	6 %	15 %		2-9
operating Winds	4 - fts min	None		2-5
Temp Range	110 MPH	120 MPH		C-1
Brakes	15 mph ± 3	30 MPH + 1/4" Ice		C-1
Motor slow pins	-22 - +123	-40° -		C-1
Ice Load	Motor & Disk	Motor		5-5
Snow	No -	Yes		5-5
Concen Load	1 cm	1"		C-1
Feed Support - Pedestal Const.	20 #/ft <sup>2</sup>	57 #/ft <sup>2</sup>		C-1
Back up structure	250 #	Yes - soft shoes		Verbal
Lubrication	1600 #	Will advise		
servo Control	Steel -	steel Tube		5-8
Crack in Panels	Steel -	Al		2-1
Pre assemble	Oil	Grease		Verbal & 5-4
Delivery (Months)	No	Yes -		4-1 -
Erection Time/men	.060"	Very small ?		Verbal
Shaped Dish	Yes	Yes -		Verbal & 2-1 2-2
Power Req (KVA)	-	10		verbal
Drawings	-	20/4		1-1
Beam Width	No	NO		2-1
	-	30.6 KVA	Peaking 53.7 KVA	D-1
	Yes -	No - Proprietary		Letter
	17 min	15 min		2-3

	Spec -
Diameter - Dish (M)	9.15 - 15.25
Dish Sur - RMS - (.125)	.030"
f/D	.36 - .43
Orthogonality	18 sec
AZ - Travel	± 270
AZ - Drive Torque Bias	2-DC Gear
AZ - Speed - Max	20°/min
EI - Travel	-10 ± 190
EI - Drive Torque Bias	2-DC Gear
EI - Speed - Max	20°/min
Min Speed	15 min/min
Pointing Error - Repeat	3-1 min
Pointing Error - Non Repeat	15 sec
Panel RMS - Mfg. (30) (24)	.012"
Shadow	6 %
Panel - Field adj.	4 - fts Min
Survival Winds	110 MPH
operating Winds	15 mph ± 3
Temp Range	-22 - +123
Brakes	Motor & Disk
Motor Stow Pins	No -
Ice Load	1 cm
Snow	20 #/ft <sup>2</sup>
Concen Load	250 #
Feed Support -	1600 #
Pedestal Const.	Steel -
Back up structure	Steel -
Lubrication	Oil
Servo Control	No
Crack in Panels	.060"
Pre assemble	Yes
Delivery (Months)	-
Erection Time/men	days/no
Shape Dish	No
Power Req - (KVA)	-
Drawings	Yes -

### Other Points To Consider.

- Limit Switches
- Mechanical Stops
- Lightning Protection
- Type Pedestal Brg.
- Hand Crank
- Weather proof
- Torque Tube (6") Cable Wrap
- Transport Ability
- Acceptance Test
- Special Equipment to Erect -
- Weights Total 40,000\* (28,000 Elev)
- Elevation over Azimuth
- Paint

Section 5  
 ↓  
 Section 11  
 Section 12  
 12-2  
 Catalogue # 5  
 1-2  
 2-5

	Spec -	Ford Aerospace	
Diameter - Dish (M)	9.15 - 15.25	10.7	1-1
Dish Sur - RMS - (.125)	.030"	.047"	2-1
f/D	.36 - .43	.39	2-1
Orthogonality	18 sec	10 sec	2-1
AZ - Travel	± 270	± 365°	2-1
AZ - Drive Torque Bias	2-DC Gear	2-DC Gear	3-4
AZ - Speed - Max	20°/min	10°/sec @ 600°/min	2-1
EI - Travel	-10 → +90	-5 → 92	2-1
EI - Drive Torque Bias	2-DC Gear	2-DC Gear	3-4
EI - Speed - Max	20°/min	10°/sec @ 600°/min	2-1
Min Speed	15 min/min	? (Assuming local speed reduction = .6°/min = 36 min/min)	
Pointing Error - Repeat	3-min	? (6 min) (360 sec)	2-1
Pointing Error - Non Repeat	15 sec		
Panel RMS - Mfg <sup>(20)</sup> (24)	.012"	.011	3-5
Shadow	6 %		
Panel - Field adj -	4 - fts Min	4	3-7, 3-6
Survival Winds	110 MPH	120 mph	2-1
operating winds	15 mph ± 3	50 mph	2-2
Temp Range	-22 → +123	0 → 125 °F	2-2
Brakes	Motor & Disk	Motor	3-12, 3-10, 3-4
Motor stow pins	No -	No - Manual stow pins -	3-13
Ice Load	1 cm	None	2-2
Snow	20 #/ft <sup>2</sup>	None	2-2
Concn Load	250 #	?	
Feed Support -	1600 #	?	
Pedestal const.	Steel -	Steel & Concrete	3-8
Back up structure	Steel -	Aluminum - Steel Hub -	3-10, 3-5
Lubrication	Oil	Oil	3-12
servo Control	No	No (could supply)	Sales Brochure
Crack in Panels	.060"	?	
Pre assemble	Yes	?	1-1
Delivery (Months)	-	?	
Erection Time/men days/NO	-	?	
Shaped Dish	No	No?	
Power Req (KVA)	-	?	
Drawings	Yes -	No (Erection Only)	Verbal
Beam Width 52.4 min 17 min.			

Spec -

E - Systems

Diameter - Dish (M)	9.15 - 15.25	15.5 m -	(They Have 10 Meter also - Don't have specs.) Some what similar -	1-1
Dish Sur - RMS - f/D	.030"	.043"		2-10
Orthogonality	.36 - .43	.31		2-10
Az - Travel	18 sec	11 sec ?		2-10
Az - Drive Torque Bias	± 270	± 270		1-2
Az - Speed - Max	2-DC Gear	2-DC Gear SHP		2-11
EI - Travel	20°/min	1°/sec		2-14
EI - Drive Torque Bias	-10 → 90	0 - 90		1-2
EI - Speed - Max	2-DC Gear	DC - Gear SHP		2-11
Min Speed	20°/min	1°/sec		2-14
Pointing Error - Repeat	15 min/min	.002°/sec (12°/min) (7.2 min/min)	Appendix 2-6	
Pointing Error - Non Repeat	3-min	1.8 min (108 sec) (36 sec)		2-14 1-2
Panel RMS - Mfg.	15 sec.			2-10
Shadow	.02"	.025"		8-15
Panel - Field adj.	6 %	4 % (Cassegrain)		3-5
Survival Winds	4-fts Min	8 pts		1-2
Operating Winds	110 MPH	120 mph		2-14
Temp Range	15 mph ± 3	30 mph		2-15
Brakes	-25 - +123	-30 - +120		3-15, 2-15
Motor stow pins	Motor & Disk	Motor		3-22, 2-8, 2-15
Ice Load	No -	No		2-7
snow	1 cm	1"		2-15
Concen Load	20#/ft <sup>2</sup>	1 ft snow		2-15
Feed Support - Pedestal Const.	2.50 #	?		
Back up structure	1600 #	?		
Lubrication	Steel -	Steel -		2-10
Servo Control	Steel -	Steel		2-10
Crack in Panels	oil			
Pre assemble	No	No (Can be supplied)		2-6
Delivery (Months)	.060"	.125"		2-10
Erection Time/men	Yes	?	(Sub assemblies Only)	
shaped Dish	—	6 Mo		Verbal
Power Req (KVA)	—	42/6		Verbal
Drawings	No	No		
	—	25KW		2-12
	Yes -	Yes		2-17



Total Weight - 156,000 #<sup>E</sup> Systems - (107,000 # Elev.)

Spec -

RSI & UAW

Diameter - Dish (M)	9.15 - 15.25	13			1-1
Dish Sur - RMS - (.125)	.030"	.040"			2-9
f/D	.36 - .43	.375			2-9
Orthogonality	18 sec	?	Axis Displaced 2'-10"	Letter	Dwg. LA 10116
AZ - Travel	± 270	± 270°			2-6
AZ - Drive Torque Bias	2-DC Gear	2 Gear Drives - Cyclical	2-3hp -	Table 2	1-1
AZ - Speed - Max	20°/min	1°/sec. (60°/min)			2-6
EI - Travel	-10 → +90	0 - 90°			2-6
EI - Drive Torque Bias	2-DC Gear	Dr and Jack screw	1.10hp. (7 1/2 hp?)		1-1
EI - Speed - Max	20°/min	9°/min			Letter
Min Speed	15 min/min	.002°/sec - (.12°/min) (7.2 min/min)	(servo spec.)		
Pointing Error - Repeat	3 min	?			
Pointing Error - Non Repeat	15 sec.	.04° (2.4 min) (144 sec.)	(servo 10° (16 min) 36 sec.)		2-6
Panel RMS - Mfg (30) (24)	.012"	.015"			Letter
Shadow	6%	2.5% (Casse grain)			2-7
Panel - Field adj.	4 - fts Min	?	4		Letter
Survival Winds	110 MPH	12.5 mph No ice	(62 mph + 1" ice)		2-6
operating Winds	15 mph ± 3	30 mph			2-6
Temp Range	-22 → +123	-40 → +123 F			2-6
Brakes	Motor & Dish	Motor (M3)	Screw (E1)	Table 1, Letter, Servo Spec,	
Motor Stow Pins	No -	No			
Ice Load	1 cm	1"			2-6
Snow	20#/ft <sup>2</sup>	?			
Concen Load	250 #	?			
Feed Support	1600 #	?			
Pedestal Const.	Steel -	steel + concrete room -		2-2 & Dwg - LA 10116	
Back up structure	Steel -	Steel			2-1
Lubrication	Oil	Grease			2-9 & Letter
Servo Control	No	No (can be furnished)			2-9
Crack in Panels	.060"	.125"			2-9 Letter
Pre assemble	Yes	Semi only (some components)			Letter
Delivery (Months)	-	?			
Erection Time/men	days/no	?			
Shaped Dish	No	No			
Power Req (KVA)	-	-			
Drawings	Yes -	No -			
Beam Width	52.4 min 17 min				

	Spec -
Diameter - Dish (M)	9.15 - 15.25
Dish Sur - RMS - (.125)	.030"
f/D	.36 - .43
Orthogonality	18 sec
AZ - Travel	± 270
AZ - Drive Torque Bias	2-DC Gear
AZ - Speed - Max	20°/min
EI - Travel	-10 to +90
EI - Drive Torque Bias	2-DC Gear
EI - Speed - Max	20°/min
Min Speed	15 min/min
Pointing Error - Repeat	3 min
Pointing Error - Non Repeat	15 sec
Panel RMS - Mfg (30) (24)	.012"
Shadow	6%
Panel - Field adj	4 - fts Min
Survival Winds	110 MPH
operating Winds	15 MPH ± 3
Temp Range	-22 - +123
Brakes	Motor & Disk
Motor Stow Pins	No -
Ice load	1 cm
Snow	20#/ft <sup>2</sup>
Concen load	250 #
Feed Support	1600 #
Pedestal Const.	Steel -
Back up structure	Steel -
Lubrication	Oil
Servo Control	No
Crack in Panels	.060"
Pre assemble	Yes
Delivery (Months)	-
Erection Time/men days/no	-
Shaped Dish	No
Power Req - (KVA)	-
Drawings	Yes -
Beam Width	52.4 min 17 min

Other Points To Consider:

- Detecting system (60 watts/ft<sup>2</sup>) 2-10
- 3300 foot Elevation - Why - Servo system
- 62° - 82° F Servo Electronics? Servo system
- Total weight 34,000# 2-9
- Weight on Elev. Bearings 16,000# 2-9
- Paint used on reflective surface - 2-7
- No Counter Weights Letter.

Universal Antennas



*Thought our you would like to see  
good looking antennas look like. You  
can have your choice*  
incorporated  
410 Kirby St./Garland, Texas 75042/(214) 494-1491/TLX 791564

September 30, 1980

National Radio Astronomy Observatory  
Post Office Box 2  
Green Bank, West Virginia 24944

Attention: Mr. Richard L. Fleming

Subject: Radio Telescope Antenna, RFQ GB-176

References: A. NRAO Letter RFQ GB-176, dated  
August 18, 1980  
B. NRAO Specification, dated August 18, 1980

Enclosures: 1. Picture of the UAi 13-Meter Antenna  
2. Proposal Drawing LA 10116

Dear Mr. Fleming:

Universal Antennas, Inc. (UAi), in conjunction with its parent company, Radiation Systems, Inc. (RSi) is pleased to submit this proposal in response to your RFQ GB-176 for a radio telescope antenna (Reference A). Our review of your specification results in the determination that our standard 13-meter antenna subsystem will, with only minor modifications, provide almost compliant performance for your application. UAi feels that the use of a previous design offers NRAO an economical, proven design with the several specification exceptions which are discussed in the following paragraphs.

UAi proposes to supply the antenna system shown in the attached drawing LA 10116 (Enclosure 1). This system is a modification of the 13-meter system shown on the attached photograph (Enclosure 2). The reflecting surface has an F/D of .37 and is made up of 60 all-aluminum panels. These panels are of 3 separate sizes and are formed of .062" aluminum doubly-curved sheets resting on stretch-formed Z-sections. The panels are supported at each corner on threaded rods which are used to field align the reflector. The panels rest upon 24 steel trusses which emanate from a large diameter hub and are supported by intercostal and diagonal members as required. The reflector hub pivots in elevation on a yoke structure and is adjusted in that axis by means of a jackscrew assembly. The yoke structure is coupled to a steel pedestal by means of a large turntable bearing with external gearing. Two counter-rotating azimuth gearboxes drive

*an RSi company*

this bearing about its (azimuth) axis. The pedestal rests on top of a foundation which incorporates a cylindrical enclosure which serves to raise the antenna centerline and house transducers, cable wraps, switches, etc. Access ladders and platforms are provided to permit periodic maintenance and access to the feed. The feed is attached to the front of the reflector hub with an enclosed area of 4' - 6" diameter x 4' deep available for the LNA assemblies. The sub-reflector/prime focus feed is held at the focal point by means of a quadrupod support structure similar to that shown in the attached photograph.

While UAI feels that the proposed design will provide the operational performance required, there are certain areas which are not in accordance with your specification. The implications of these exceptions were discussed with Mr. G. M. ("Buck") Peery of your office on September 17, 1980. The major areas of specification exceptions are as follows:

o Elevation Jack

An elevation jack is proposed in lieu of your specified elevation gear drive. The jack will be equipped with an anti-backlash feature so that load reversals are limited to a maximum of .002" at the output screw. This coupled with dead weight bias virtually eliminates deadband in the elevation axis. UAI feels that this design approach offers the following advantages over a gear-driven elevation drive system:

- oo a simplified servo control system which does not require the bias electronic complexity that is mandatory with a gear driven system.
- oo increased environmental protection with a bellows boot covering the extended jackscrew output shaft and a pipe cover shielding the retracted portion. This type of environmental protection cannot easily be designed into gear driven systems.
- oo counterweights are not required. Since the proposed elevation jack drive assembly is nonoverhauling, it cannot be driven from the output screw. Theoretically, no drive system can be back driven if its efficiency is less than 50% while the proposed system is approximately 15% efficient providing an ample margin of safety. This feature eliminates the need for elevation counterweights and their associated pointing error deflection contributors. Over the last 8-10 years since we have employed jacks to drive

parabolic antennas, computer deflection analyses have consistently demonstrated the superiority of this jack design approach. Since the jackscrew cannot be back driven a brake, as such, is not required, but one of small capacity can be provided as a tracking aid.

- oo access to the elevation drive mechanism is enhanced due to the centralized location of the jackscrew. The access provisions incorporated with this design are straight forward and are not penalized with undue complexities associated with elevation gear driven antennas. Enclosures (1) and (2) can be studied to verify this position.
- oo the antenna does not require a zenith stow provision. Since the jackscrew and elevation bearing can accommodate the survival loads and the jackscrew is self-locking, no elevation stow is required. However, if it is so desired, simple stow provisions can be provided.

7. The use of a jackscrew means that the elevation and azimuth axes are offset. This 2'10" offset minimizes the redesign effort and aids in access provisions.

#### o Elevation Travel

In order to accommodate design simplification, an elevation range of  $0^{\circ}$  to  $90^{\circ}$  is proposed instead of the specified  $-10^{\circ}$  to  $90^{\circ}$ . Since a shallow reflector is proposed (.37 F/D), the edge slope at a  $0^{\circ}$  elevation angle is approximately  $60^{\circ}$  thereby not presenting a problem in dumping snow.

#### o Elevation Velocity

9. The elevation velocity is proposed as an average velocity of  $.15^{\circ}/\text{sec}$  ( $9^{\circ}/\text{min}$ ) in lieu of your specified  $.33^{\circ}/\text{sec}$  ( $20^{\circ}/\text{min}$ ). This change is requested to keep the elevation motor size below  $7\frac{1}{2}$  HP and within the capacity of off-the-shelf antenna digital drive servo electronics. It is also felt that this velocity reduction does not degradate tracking performance since the elevation operating range is one quarter of the nominal azimuth range ( $90^{\circ}$  EL;  $360^{\circ}$  AZ), thereby permitting azimuth and elevation slews to be accomplished in approximately the same time.

o Reflector Panel Gap

UAI proposes a nominal panel gap of 0.125" (with no gaps exceeding 0.188" or less than .050") as opposed to the 0.060" specified. This smaller gap is easily achieved, but does not allow the use of existing panel tooling which is seen as a considerable cost savings to NRAO. The larger panel gaps if present will be located, to the maximum extent possible, in the RF shadow of the apex support structure.

o Azimuth Drive Gearboxes

1. UAI proposes to employ cycloidal azimuth gearboxes in lieu of the more conventional spur gear drive assemblies. Cycloidal gearboxes offer a design that uses grease lubrication in lieu of a submerged oil bath or oil pump design. The advantage over the oil bath type is that the efficiency is sufficiently superior (80% vs 40% at rated input velocity) while it is simpler than the oil pump design. These boxes are in use in many 32-meter Intelsat parabolic antennas and other similar type applications with successful results.

o Factory Assembly

A complete assembly of the antenna at the factory is not proposed, but a partial assembly will be performed to assure proper fit and function of the steel fabricated structure. The aluminum reflector panels are checked on their precision assembly tools to establish surface contour and interface. This same approach was employed successfully in the previous 13-meter design. Since this antenna will be field aligned to establish the azimuth axis, elevation axis, and reflector surface contour, UAI feels that this proven approach is an efficient solution using this design concept.

*See TWX*  
UAI can provide the proposed design, including design, fabrication, tooling and installation for a total cost of \$371,330. This is a budgetary price given in September, 1980 dollars. *sub assembly not field assembly. See TWX*

UAI feels that the past relationship between RSi and NRAO has demonstrated the ability to deliver high quality, compliant products within cost and schedule. The 300' antenna at Green Bank features panels which were fabricated, installed and aligned by RSi personnel. RSi has also designed and fabricated nearly 5,000 reflector panels for the 28 VLA antennas that are the standard of excellence throughout the world. While UAI as an entity

has existed for only two years, the many earth stations pictured in the attached annual report attest to the excellence of design and acceptance in the community. I would like to point out that each panel on the 13-meter antenna shown on page 15 of our annual report has an RMS of .015" or less. In fact, without any special tooling or manufacturing emphasis, 64% of the panels had an RMS of .012" or less. Therefore, RSi/UAi is 100% confident in meeting your RMS specification. In conclusion, UAi feels that the proposed design draws heavily upon our past experience and will result in an economical, proven system which will be fully operational. UAi welcomes the opportunity to discuss this concept more extensively with your personnel and to modify it in accordance with your current thinking.

380  $\mu$ m  
300  $\mu$ m

In the event you require additional information, please contact our President, Charles J. Beuley and/or Andrew V. Crossley, Vice President of Engineering.

Sincerely,

UNIVERSAL ANTENNAS, INC.

Richard E. Thomas  
Chairman and  
Chief Executive

RET/jc  
Attachment



Parameters Considered	Specification or Desired	Parameters of Manufacturer's Antenna Under Consideration Mfg. _____
Diameter of Dish (Meters)		
f/D		
Dish Surface rms		
Panel Mfg. rms		
Dish Shaped or Paraboloid		
Panel Adjustments (Number)		
Feed System (P.F./Cassegrain)		
Type (E1/Az)		
Feed System (Wt. supported)		
Shadow		
Panel Separation (Crack)		
Axis Orthogonally		
Repeatable Pointing Error		
Non-Repeatable Pointing Error		
Total Pointing Error		
Azimuth Travel		
Azimuth Drive (Torque Bias)		
Max. Azimuth Speed		
Min. Azimuth Speed		
Elevation Travel		
Elevation Drive (Torque Bias)		
Max. Elevation Speed		
Min. Elevation Speed		
Operating Wind Speed		
Survival Wind Speed		
Temperature Range (operate)		
Ice Load		
Snow Load		
Concentrated Load		
Pedestal Construction		
Structure Construction		
Total Weight		
Weight on Elev. Bearings		
Type Pedestal Bearing		
Mechanical Stops		
Limit Switches		
Type Brakes		
Motorized Stow Pins		
Torque Tube Size		
Weatherproof		
Lightning Protection		
Painting		
Hand Crank		
Lubrication System		
Servo System		
Preassemble before ship		
Special Equipment to Erect		
Erection Time (Days/No. Men)		
Power Requirements		
Drawings		
Acceptance Test in Field		
Maintenance Manual		
Delivery (Months)		

Revised Comparison Sheet  
 Any Comments?  
 "Bucks"