SUBCONTRACT VLA-6

For 28 Radio Telescope Antennas

PRIME CONTRACTOR: ASSOCIATED UNIVERSITIES, INC.

SUBCONTRACTOR: E-SYSTEMS, INC.

This is an agreement made 18 October 1973, between Associated Universities, Inc. (hereinafter called "AUI"), a New York Corporation, and E-Systems, Inc., Garland Division, P. O. Box 6118, Dallas, Texas 75222, a Delaware Corporation (hereinafter called the "Subcontractor").

WHEREAS, AUI has entered into a contract (hereinafter called the "Prime Contract") with the United States of America (hereinafter called the "Government"), represented by the National Science Foundation (hereinafter called the "Foundation"), designated as Contract No. NSF-C450, for providing, maintaining and operating a Radio Astronomy Observatory (hereinafter called the "Observatory"); and

WHEREAS, the Subcontractor is willing to perform the work required by AUI, and AUI wishes the Subcontractor, in futherance of the Prime Contract, to perform that portion of the work hereinafter more fully described;

NOW, THEREFORE, in consideration of the foregoing and of the agreements hereinafter set forth, the parties hereby agree as follows:

ARTICLE I - SCOPE OF THE WORK

The Subcontractor shall furnish all material, labor, plant and equipment necessary to perform the work described in Schedule A incorporated herein and hereby made a part hereof, and in accordance with all the terms of this subcontract included in Schedules B and C and Attachments 1 through 8 made a part hereof and incorporated herein.

- Schedule A SCHEDULE AND SUPPLEMENTAL TERMS AND CONDITIONS
- Schedule B Section 04.1, SPECIAL CONDITIONS OF THE SUBCONTRACT, pages 04.4 through 04.15
- Schedule C Section 04.2, TERMS AND CONDITIONS OF THE SUBCONTRACT, pages 04.16 through 04.58.1
- Attachment 1 Section 03, SPECIFICATION AND STATEMENT OF WORK pages 03.1 through 03.28
- Attachment 2 Appendix 05.10, PROCESS SPECIFICATION, APPLICATION OF DIFFUSE REFLECTING COATING FOR SOLID FACED ANTENNA REFLECTORS, pages 05.3 through 05.8
- Attachment 3 Appendix 05.11, PROCESS SPECIFICATION, EXTERIOR PROTECTIVE COATING FOR ALL EXPOSED METALLIC SURFACES OTHER THAN REFLECTOR SURFACES, pages 05.9 through 05.11
- Attachment 4 Appendix 05.12, RELEASE OF CLAIMS FORM, pages 05.12 and 05.13

- Attachment 5 E-Systems, Inc., Technical Proposal 416-15287, Volume 1,
 Parts A and B, dated March 14, 1973; and Revision A,
 dated June 11, 1973
- Attachment 6 Documentation Requirements, dated September 28, 1973
- Attachment 7 Davis-Bacon Wage Determination, dated March 24, 1972 as amended through Modification 4.

Attachment 8 - Description - Antenna Assembly - Maintenance Building ARTICLE II - TERM OF THE WORK

Delivery of design and 28 each 25-meter radio telescope antennas shall be in accordance with the delivery schedule shown in Schedule A.

Delivery of all drawings, designs, documentation and data shall be F.O.B. the National Radio Astronomy Observatory, Charlottesville, Virginia.

Delivery of all 25-meter radio telescopes shall be F.O.B. as assembled at the VLA assembly site on the Plains of San Augustin, New Mexico.

ARTICLE III - COMPENSATION

- A. The total fixed price of this subcontract is established at \$16,893,757.00 subject to any limitations herein. Payment to the Subcontractor of this amount shall be as specified in Paragraph 1.0 of Schedule A hereto.
 - The Subcontractor shall be paid the sum or sums specified in Schedule A, as provided therein, which shall constitute full compensation for the proper performance of the Subcontractor's undertakings hereunder.
 - A.1 Notwithstanding any other provision of this subcontract, the funds available for payment to the Subcontractor are \$225,050.00 for the effort specified by items 1.1 and 1.2 of Schedule A; and AUI is hereby authorizing the Subcontractor to proceed with these items of work only. Any commitments and/or expenditures incurred by the Subcontractor for work not authorized in writing by AUI shall be at the Subcontractor's risk.

ARTICLE IV - SPECIAL CONDITIONS OF THE SUBCONTRACT

The attached Schedule B, SPECIAL CONDITIONS OF THE SUBCONTRACT, are hereby incorporated into this subcontract and made a part hereof.

ARTICLE V - GENERAL TERMS AND CONDITIONS OF THE SUBCONTRACT

The attached Schedule C, GENERAL TERMS AND CONDITIONS OF THE SUBCONTRACT, are hereby incorporated into this subcontract and made a part hereof.

ARTICLE VI - PAYMENT

Progress payments shall be provided to the Subcontractor pursuant to Special Conditions 04.1.13 Progress Payments and 04.1.12 Project Breakdown for Scheduling and Payment, as mutually agreed to between the parties hereto.

Invoices, in triplicate, shall be mailed to the Fiscal Office, Associated Universities, Inc., National Radio Astronomy Observatory, P. O. Box 2, Green Bank, West Virginia 24994.

ARTICLE VII - NOTICES

All notices or communications shall be in writing and mailed or delivered to the VLA Project Manager, National Radio Astronomy Observatory, Edgemont Road, Charlottesville, Virginia 22901, and to the Subcontractor at the address set forth above, or to such other place or places as AUI or the Subcontractor, as the case may be, shall designate in writing.

ARTICLE VIII - INSPECTION AND ACCEPTANCE

Final inspection and acceptance shall be performed in accordance with the requirements contained in the schedules and attachments hereto.

ARTICLE IX - ASSIGNMENT TO GOVERNMENT

This subcontract shall be assignable by AUI to the U. S. Government. Subject to such assignment and the acceptance thereof by the Government, this contract shall not bind or purport to bind the Government.

IN WITNESS WHEREOF, the parties hereto have executed this subcontract as of the date first above written.

Witness:	ASSOCIATED UNIVERSITIES, INC.
	Ву
(Address)	Title
Witness:	E-SYSTEMS, INC.
	Ву
(Address)	Title

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SCHEDULE AND SUPPLEMENTAL TERMS AND CONDITIONS

1.0 Quantity, Description and Price

1.1 The Subcontractor shall furnish the Design and Engineering for 25meter radio telescope antennas in accordance with Attachment 1, "Specification and Statement of Work," as revised 10 October 1973. The work shall be accomplished generally in accordance with Subcontractor's Technical Proposal 416-15287, Volume 1, Parts A and B, dated March 14, 1973, together with Revision A, dated June 11, 1973, identified as Attachment 5 hereto. The inclusion of Attachment 5 in this subcontract is only for the purpose of establishing the Subcontractor's general approach, quality, management and understanding of the specification requirements; the inclusion of Attachment 5 shall not now or in the future be interpreted as AUI approval of any design, manufacturing, engineering, testing techniques and methods, materials, vendors, or subcontractors set forth in Attachment 5; nothing in Attachment 5 shall be deemed or interpreted as authorizing, permitting or consenting to any deviation of NRAO Specification and Statement of Work as revised 10 October 1973.

\$225,050.

- 1.2 Documentation as set forth in Attachment 6 hereto shall be supplied at no additional cost during design and in manufacturing phases.
 - 1.2.1 The subcontractor shall furnish the documents and data in accordance with "Documentation Requirements" Attachment 6, dated September 28, 1973. The inclusion of Attachment 6 in this subcontract is for the purpose of generally delineating documentation and data requirements; and should not be deemed or interpreted as authorizing, permitting or consenting to any deviation of documentation and data requirements set forth elsewhere in this subcontract.
- 1.3 When authorized in writing by AUI, not later than the dates indicated, the Subcontractor shall manufacture, deliver, assemble on-site, align and test items 1.3.1 through 1.3.7 listed herebelow. Approval of design and engineering or the acceptance by AUI of one group of antennas shall not be deemed as an automatic release to proceed with the next group. Each group listed will require a specific written procurement authorization from AUI.
 - 1.3.1 Antenna Nos. 1 and 2 and 20 sets of foundation fittings AUI shall authorize go-ahead by June 18, 1974

- 1.3.2 Antenna Nos. 3, 4, 5 and 6, and 16 sets of foundation fittings - AUI shall authorize go-ahead by June 18, 1975 \$2,124,654 1.3.3 Antenna Nos. 7, 8, 9 and 10, and 16 sets of foundation fittings - AUI shall authorize go-ahead by June 18, 1976 \$2,184,607 1.3.4 Antenna Nos. 11, 12, 13, 14, and 15, and 18 sets of foundation fittings - AUI shall \$2,823,732 authorize go-ahead by June 18, 1977 1.3.5 Antenna Nos. 16, 17, 18, 19 and 20, and 18 sets of foundation fittings - AUI shall \$2,956,316 authorize go-ahead by June 18, 1978 1.3.6 Antenna Nos. 21, 22, 23, 24 and 25, and 15 sets of foundation fittings - AUI shall
- 1.3.7 Antenna Nos. 26, 27 and 28, and no sets of foundation fittings AUI shall authorize go-ahead by June 18, 1980

authorize go-ahead by June 18, 1979

\$1,992,805

\$3,094,901

2.0 Cancellation

In the event any of the items 1.3.1 through 1.3.7 are cancelled prior to receiving AUI's written authorization to proceed, there will be no cancellation cost to AUI for the item(s) cancelled. In the event that any item 1.3.1 through 1.3.7 is reduced to zero and the Subcontractor is required to remain in a standby condition, pending the start or resumption of production, the parties may negotiate an equitable adjustment in the subcontract price for the affected item. Also, in the event of either a reduction or an increase in the number of antennas procured within any of the specific groups set forth in items 1.3.1 through 1.3.7, such change will only affect the pricing of the specific groups involved and will not affect the pricing of any groups unchanged. The above stated conditions will also apply to Option Nos. 2 or 3 if exercised.

3.0 Delivery Schedule

All items listed under 1.0 above shall be delivered in accordance with the following schedule:

- 3.1 Item 1.1 above by April 18, 1974
- 3.2 Item 1.2 above as required by the dates specified in Attachment 6 of this subcontract.
- 3.3 Item 1.3.1 above by June 18, 1975
- 3.4 Item 1.3.2 above by April 18, 1976
- 3.5 Item 1.3.3 above by April 18, 1977
- 3.6 Item 1.3.4 above by April 18, 1978

- 3.7 Item 1.3.5 above by April 18, 1979
- 3.8 Item 1.3.6 above by April 18, 1980
- 3.9 Item 1.3.7 above by April 18, 1981

 Completed Vertex Rooms, which are part of the antennas listed above, shall be delivered to AUI as directed by AUI, F.O.B. Subcontractor's facility at least four (4) months prior to the time they are required by Subcontractor for installation at the VLA site; however, Vertex Rooms under 1.3.1 will be delivered no later than three months prior to the time they are required by the subcontractor for installation at 4.0 Options

4.1 Option No. 1 - Assembly Maintenance Building

AUI has the unilateral right to exercise, by 1/4/74, an option for the construction of one (1) Antenna Assembly-Maintenance Building as specified in Attachment 8 which is incorporated herein by reference, for the fixed price amount of \$308,424. Should this option be exercised in accordance with the above terms, the building shall be completed within ten and one half $(10\frac{1}{2})$ months of the date thereof, and the effort required of the Subcontractor hereunder shall not be cause for any change to the Delivery Schedule (3.0) above. In addition the subcontractor shall be reimbursed for performance and payment bonds and Builders risk insurance in the amount of \$3155.00.

Title and Control

AUI shall accept the assembly-maintenance building upon its satisfactory completion by the Subcontractor, and title to the building shall thereafter vest in the Government. The Subcontractor shall have the right to occupancy and control of the assembly-maintenance building and access thereto for the purpose of performing assembly, test, and other operations under this contract. The Subcontractor agrees that AUI may elect to erect structures attached to the assembly-maintenance building, or near the assembly-maintenance building, or may elect to use all or part of the assembly-maintenance building in a manner or at such times as such occupancy and use by AUI or its agents or subcontractors will not materially affect the use of the building by the Subcontractor or the progress of the work under this contract. As consideration for use, occupancy and control of the assembly-maintenance building, the Subcontractor agrees to maintain the building and its associated equipment in good and serviceable condition subject to normal wear and tear during the life of this contract and to return possession and control of the building to AUI upon completion of the contract in good and serviceable condition subject to normal wear and tear.

Property Insurance

In the event that AUI shall require the Subcontractor to insure the Assembly-Maintenance building against property damage, fire and other perils, AUI shall reimburse the Subcontractor for such insurance coverage at the rate of \$1066.00 per annum.

4.2 Option No. 2 - Accelerated Delivery Schedule

AUI has the unilateral right to exercise, by 4/18/74, this option for the below shown delivery schedule with the associated price changes and AUI authorization dates:

Description	Price	AUI Authorization Date	Delivery Schedule
Design and Engineering	\$ 197,612.	10/18/73	4/18/74
Documentation	No charge	10/18/73	Same as 3.2 above
Antennas 1 and 2	\$1,440,852	6/18/74	6/18/75
Antennas 3 through 8	\$3,061,293	6/18/75	6/18/76
Antennas 9 through 15	\$3,641,606	6/18/76	6/18/77
Antennas 16 through 23	\$4,304,830	6/18/77	6/18/78
Antennas 24 through 28	\$ 2, 852,511	6/18/78	4/18/79

Total value of the subcontract, if this option is exercised, is reduced by \$1,395,053, from \$16,893,757 to \$15,498,704.

4.3 Option No. 3 - Optimized Accelerated Delivery Schedule

AUI has the unilateral right to exercise, by 4/18/74 this option for the below-shown delivery schedule with the associated price changes and AUI authorization dates:

Description	Price	AUI Authorization Date	Delivery Schedule
Design and Engineering	\$ 193,245.	10/18/73	4/18/74
Documentation	No charge	10/18/73	Same as 3.2 above
Antennas 1 and 2	\$1,409,008	6/18/74	6/18/75
Antennas 3 through 8	\$5,477,817	6/18/75	6/18/76
Antennas 9 through 15	\$3,059,376	6/18/76	6/18/77
Antennas 16 through 23	\$2,703,735	6/18/77	6/1 8/78
Antennas 24 through 28	\$1,769,143	6/18/78	4/18/79

Total value of the subcontract, if this option is exercised, is reduced by \$2,281,433, from \$16,893,757 to \$14,612,324.

5.0 Taxes

- 5.1 The prices reflected in this subcontract do not include any amounts for the New Mexico Gross Receipts and Compensating Tax.
- 5.2 The Subcontractor shall comply with the requirements of Article 57 of Schedule C of this subcontract with regard to the tax cited in 5.1 above.

6.0 Bonds

Prior to commencing construction of the Assembly-Maintenance Building, the Subcontractor shall submit a performance bond to AUI covering 100% of the construction costs of this building and a payment bond to AUI covering 50% of these construction costs in accordance with the provisions of the Miller Act, as amended (40 USC 270a-270e).

7.0 Davis-Bacon

Davis-Bacon wage determination referred to in Article 18 of Schedule C is included as Attachment 7 hereto.

SECTION 04.1. SPECIAL CONDITIONS OF THE SUBCONTRACT

04.1.1 Direction of the Work

Direction of the work in accordance with the terms of this subcontract will be assigned by AUI to the VLA Project Manager, who will have authority to act on behalf of AUI in all matters relating to the work.

04.1.2. <u>Liaison During Design Program</u>

At least six technical meetings are to be held between technical personnel of the Subcontractor and AUI, during the design program. The place and time of such meetings shall be determined by the VLA Project Manager. At least two of these meetings will be formal review meetings to be held at the NRAO office in Charlottesville, Virginia.

It is expected that resident in-house technical representatives(s) of AUI will spend considerable time at the Subcontractor's home plant during design and fabrication. The Subcontractor shall provide acceptable office space for the AUI representative, with private telephone connection.

04.1.3. On-Site Work Areas

AUI will assign to the Subcontractor an adequate assembly, storage and test area for the execution of its on-site work. This area will be located on reasonably flat, cleared, level ground near the center of the VLA site. The Subcontractor's trucks will have direct access to the assembly site on temporary graveled access road to be constructed by AUI. The assembly site is a short distance from a hard surfaced road, old U.S. Route 60. The nearest railroad access is at a railhead in Socorro, New Mexico, approximately 50 miles west of the assembly site.

The Subcontractor shall confine his activities within the assigned area.

04.1.4. Assembly Foundations

Upon request of the Subcontractor, AUI will provide up to two assembly foundations, without cost to the Subcontractor, at mutually agreed upon locations in the antenna assembly area.

Each foundation will be equipped with a foundation interface to be provided by the Subcontractor and installed by AUI. Upon request the Subcontractor shall have the right to use an adjacent foundation for storage of a substantially completed radio telescope.

04.1.5. Temporary Facilities On-Site

The Subcontractor shall provide any temporary offices, tool storage, sanitary facilities, enclosed storage, open hard stand areas, storage yards, fencing, storage cribbing, tarpaulins, etc., required for field assembly.

04.1.6. Shipment, Unloading and Protection

All components shall be properly prepared, packaged and marked for shipment. Gear boxes, open gears, bearings, couplings and other mechanical components shall be given a rust preventive coating and shall be packaged such that outside storage or exposure to the elements would not damage the component. Shipment, and protection during shipment, shall be the responsibility of the antenna Subcontractor.

All unloading, receiving, storing and protecting the Subcontractor's material and equipment shall be the Subcontractor's responsibility.

04.1.7. Physical Security

The Subcontractor shall take such measures as he deems necessary to protect his material, plant and equipment and be solely liable for any loss. The Subcontractor shall comply with all physical security rules and regulations set forth by the VLA Project Manager for the VLA site.

04.1.8. Identification of Employees

The Subcontractor shall provide all of his representatives and employees with distinctive badges. These badges must be displayed in a prominent manner on the person of each man while engaged on the work.

04.1.9. Safety Equipment

The Subcontractor will provide his own fire extinguishers, first aid and safety equipment as may be required by Federal, State and Local regulations and/or the VLA Project Manager. The AUI site representative will periodically inspect these aspects of the Subcontractor's operations.

The Subcontractor shall take corrective action promptly when requested to do so.

04.1.10. <u>Utilities</u>

04.1.10.1. Electric

Electricity in quantities sufficient for the Subcontractor's normal requirements for performing the work and for warehousing and office use will be furnished free of charge at a disconnect switch adjacent to the assembly area. Service will be at 440 Volt, 3-phase 60 Hz. The Subcontractor shall install, maintain and remove, at his expense, all distribution lines required. All such installations shall be approved by the AUI Project Manager prior to installation.

04.1.10.2. Water

Reasonable quantities of potable water sufficient for the Subcontractor's requirements will be furnished free of charge on the VLA site for filling the Subcontractor's trucks or containers. Water will not be provided directly at the assembly site.

04.1.10.3. Telephone and Mail

Telephone arrangements will be handled directly between the Subcontractor and the local telephone company. The Subcontractor will handle mail and telegrams directly with the agency involved.

04.1.11. Progress Charts, Reports and Requirements for Overtime Work

04.1.11.1. <u>Schedule</u>

The Subcontractor shall, within thirty (30) days after notice of award of the subcontract, prepare and submit to the VLA Project Manager for approval three (3) copies of a practicable schedule showing the order in which the Subcontractor proposes to carry on the work, the date on which he will start each phase and subdivision thereof (including the procurement materials, plant and equipment). The work breakdown on the schedule shall include all items indicated in the paragraph of the Special Conditions entitled "Project Breakdown for Scheduling and Payment" as a minimum and shall be of adequate scale so that all

information required can be entered legibly. The Subcontractor shall enter on that chart the actual progress at the end of each month and deliver to the VLA Project Manager three (3) copies thereof by the eighth working day of the month following. The Subcontractor is encouraged to set the schedule up on a PERT or CPM basis, but this is not a requirement of the subcontract.

04.1.11.2 Manpower Schedule

The Subcontractor shall also furnish a curve or graph depicting the anticipated design, fabrication, and assembly manpower requirements of the subcontract. By the eighth working day of each month the Subcontractor shall report the average daily and the last working day manpower for the preceding month.

04.1.11.3 Updating Schedules

The Subcontractor shall keep the approved progress schedule and manpower chart in accord with the job conditions, making internal changes as necessary. The Subcontractor shall not, however, make changes of any kind that would affect the completion date of the project without the approval of the VLA Project Manager. If for any reason extensions of time are approved, the Subcontractor shall immediately revise the schedule and manpower chart accordingly and submit three (3) copies of each.

04.1.11.4 Work Progress

The Subcontractor shall furnish sufficient forces and equipment, and shall work such hours including night shifts, overtime operations, and holiday work, as may be necessary to insure the prosecution of the work in accordance with the approved progress schedule. If in the opinion of the VLA Project Manager the Subcontract falls behind the progress schedule he will notify the Subcontractor in writing, and the Subcontractor shall take such steps as may be necessary to improve his progress and regain his scheduled position. The VLA Project Manager may require him to increase his manpower, the number of shifts worked, days of work, overtime operations, and/or the amount of equipment, all without additional cost to AUI.

04.1.11.5. Other Data

In addition to the requirements set forth in this section, if the Subcontractor uses other techniques to schedule and

manage the work such as PERT or CPM, three (3) copies of all documents (including, but not limited to, network diagrams and item listings) prepared during the project, will be submitted for information to the VLA Project Manager.

04.1.11.6. Progress Payment Dependence

No monthly progress payment shall be made until the progress schedule has been updated and submitted.

04.1.11.7. Compliance with Schedule Requirements

Failure of the Subcontractor to comply with the requirements of this provision shall be grounds for determination by AUI that the Subcontractor is not prosecuting the work with such diligence as will insure completion within the specified time. Upon such determination, AUI may terminate the Subcontractor's right to proceed with the authorized and remaining work of the subcontract or any separate part thereof, in accordance with the Termination for Default article of this subcontract.

04.1.12. Project Breakdown for Scheduling and Payment

The Subcontractor shall within thirty days after award of the subcontract prepare and submit to the VLA Project Manager for approval a breakdown of the project in a manner and format described in its proposal for use in scheduling the work and for payment. This breakdown shall be comprehensive enough so that adequate control of progress payments can be exercised by AUI. Sub-items shall total to the price breakdown submitted in the proposal or as negotiated prior to the award of the subcontract.

04.1.13. Progress Payments

- 04.1.13.1. Progress payments shall be made to the Subcontractor each calendar month. Progress payments will be based on the percentage of acceptable work completed. AUI shall be the sole judge of the percentage of work completed, and the Subcontractor shall permit AUI personnel to physically identify materials delivered. The Subcontractor shall file a monthly statement (with its invoice) detailing the percentage of completion in accordance with paragraph 04.1.12 above.
- 04.1.13.2. Upon completion and acceptance of all work under each separate authorized or scheduled item or individual antenna of the subcontract, the Subcontractor will be paid the subcontract price of such item or individual antenna less the amount of prior progress payments. The price of an individual antenna shall be established as the pro-rata portion of the total line item price.

04.1.13.3. When the work of each portion is substantially completed, an antenna is accepted subject to punch list items, or full completion is delayed for reasons beyond the control of the Subcontractor, the retained percentage may be reduced or eliminated by AUI at its sole discretion.

04.1.13.4. Percentage and Conditions Applicable to Progress Payments

(a) Computation of Amounts

- (1) Each progress payment shall be 80 percent of the amount which represents the Subcontractor's percentage of completion of agreed elements of work as approved by the VLA Project Manager.
- (2) The Subcontractor's invoices shall not include (i) any costs incurred by its Subcontractors or suppliers, or (ii) any payments or amounts payable to its Subcontractors or suppliers, except for completed work (including partial deliveries) to which the Subcontractor has acquired title. The aggregate amount of progress payments made shall not exceed 80 percent of the total subcontract price.
- (3) If at any time a progress payment or the unliquidated progress payments exceed the amount permitted by this paragraph (a), the Subcontractor shall pay the amount of such excess to AUI upon demand.

(b) Liquidation

Repayment to AUI required by a retroactive price reduction will be made after recalculating liquidations and payments on past invoices at the reduced prices and adjusting the unliquidated progress payments accordingly.

(c) Reduction or Suspension

AUI may reduce or suspend progress payments, or liquidate them at a rate higher than the percentage stated in (a) above, whenever it finds upon substantial evidence that the Subcontractor (i) has failed to comply with any material requirements of this subcontract, (ii) has so failed to make progress, or is in such unsatisfactory financial condition, as to endanger performance of this subcontract, (iii) has allocated inventory to this subcontract substantially exceeding reasonable requirement, (iv) is delinquent in payment of the costs of performance of this subcontract in the ordinary course of business, (v) has so failed to make progress that the unliquidated progress payments exceed the fair value of the work accomplished on the undelivered portion of this contract, or (vi) is realizing less profit than the estimated profit used for establishing a liquidation percentage in paragraph (b), if that liquidation percentage is less than the percentage stated in paragraph (a) (1).

(d) Title

Immediately, upon the date of this subcontract, title to all parts, materials, inventories, work in progress, special tooling, special test equipment and other special tooling to which the Government is to acquire title pursuant to any other provision of this subcontract; nondurable (i.e., noncapital) tools, jigs, dies, fixtures, molds, patterns, taps, gauges, test equipment, and other similar manufacturing aids title to which is not obtained as special tooling pursuant to this paragraph; and drawings and technical data (to extent delivery thereof to AUI is required by other provisions of this subcontract); theretofore acquired or produced by the Subcontractor and allocated or properly chargeable to this subcontract under sound and generally accepted accounting principles and practices shall forthwith vest in the Government; and title to all like property thereafter acquired or produced by the Subcontractor and allocated or properly chargeable to this subcontract as aforesaid shall forthwith vest in the Government upon said acquisition, production or allocation. Notwithstanding that title to property is in the Government through the operation of this clause, the handling and disposition of such property shall be determined by the applicable provisions of this subcontract such as: The Termination for Default article and paragraph (h) of this clause; Termination article; and the Government Property article. Current production scrap may be sold by the Subcontractor without approval of AUI, and the proceeds shall be credited against the costs of material overhead. With the consent of AUI and on terms approved by it, the Subcontractor may acquire or dispose of property to which title is vested in the Government pursuant to this clause, and in that event, the costs allocable to the property so transferred from this subcontract shall be eliminated from the costs of subcontract performance and

the subcontractor shall repay to AUI (by cash or credit memorandum) an amount equal to the unliquidated progress payments allocable to the property as transferred. Upon completion or performance of all the obligations of the Subcontractor under this subcontract, including liquidation of all progress payments hereunder, title to all property (or the proceeds thereof) which had not been delivered to, and accepted by AUI under this subcontract or which had not been incorporated in supplies delivered to and accepted by AUI under this subcontract and to which title has vested in the Government under this clause shall vest in the Subcontractor.

(e) Risk of Loss

Except to the extent that AUI shall have otherwise expressly assumed the risk of loss of property title to which vests in the Government pursuant to this clause, in the event of loss, theft or destruction of or damage to any such property before its delivery to and acceptancy by AUI, the Subcontractor shall bear the risk of loss and shall repay AUI an amount equal to the unliquidated progress payments based on costs allocable to such lost, stolen, destroyed or damaged property.

(f) Control of Costs and Property

The Subcontractor shall maintain an accounting system and controls adequate for the proper administration of this clause.

(g) Reports - Access to Records

Insofar as pertinent to the administration of this clause, the Subcontractor will (i) furnish promptly such relevant reports, certificates, financial statements, and other information as may be reasonably requested by AUI, and (ii) give AUI or the Government reasonable opportunity to examine and verify his books, records and accounts.

(h) Special Provisions Regarding Default

If this subcontract is terminated pursuant to the article entitled "Termination for Default", (i) the Subcontractor shall, upon demand, pay to AUI the amount of unliquidated

progress payments and (ii) with respect to all property as to which AUI elects not to require delivery under the article entitled "Termination for Default", title shall vest in the Subcontractor upon full liquidation of progress payments, and AUI shall be liable for no payment except as provided by the "Termination for Default" article.

(i) Reservations of Rights

The rights and remedies of AUI provided in this clause shall not be exclusive, and are in addition to any other rights and remedies provided by law or under this subcontract. No payment, or vesting of title pursuant to this clause, shall excuse the Subcontractor from performance of his obligations under this subcontract, nor constitute a waiver of any of the rights and remedies of the parties under this subcontract. No delay or failure of AUI in exercising any right, power or privilege under this clause shall affect any such right, power or privilege, nor shall any single or partial exercise thereof preclude or impair any further exercise thereof or the exercise of any other right, power or privilege of AUI.

Note: The phrase "this clause" refers to paragraph 04.1.13 hereof.

04.1.14. Monthly Progress Report

During the progress of the work the Subcontractor shall submit a monthly written report narrating the status of the work under the subcontract. The report shall contain but not be limited to the following:

Work completed during the month.

Actual progress to date.

Problems encountered and solutions.

Explanation and details for any delays.

Planned activity for ensuing month.

Number of assigned men by classification, and man-hours spent, during the previous month.

Planned man and man-hour loading for ensuing month.

Reports will be signed by the Subcontractor's authorized representative and transmitted to the VLA Project Manager by the eighth day of the following month.

04.1.15. Special Tooling and Special Test Equipment

Any special tooling or special test equipment which has been fabricated, purchased, or otherwise procured, such as assembly fixtures, measuring devices, jigs, etc., which are used to fabricate or assemble any components, to locate, measure or adjust any components or assemblies, or to perform any special operation during the scope of the work shall become the property of the Government. All special tooling and special test equipment shall be delivered to AUI or disposed of at AUI's direction. Optical tools, clinometers, levels, theodolites and similar tooling which are not purchased specifically for this job and whose purchase price is not included in the cost of the work herein are excepted from this requirement.

04.1.16. Control of the Assembly Site

The AUI VLA Project Manager, or his designee, shall have complete control over the assembly site. His authority shall include but not be limited to the following:

Coordination of all subcontractors.
Assignment of work areas.
Assignment of storage space.
Access and other roads.
Utilities.
Vehicle traffic and parking.
Conduct of personnel.
Safety and fire protection.

Any lower tier subcontractors of the Subcontractor must be approved by AUI prior to entry onto the VLA site. All conditions of work applicable to the Subcontractor apply to his subcontractors and the Subcontractor shall include applicable provisions of the subcontract as well as specific reference to this section in any of its subcontracts.

04.1.17. Severability of Supply and Construction Work

Manufacture and assembly work related to the antennas is severable from the construction portions of this subcontract. Labor and services relating to site preparation, other construction and the construction of the Assembly-Maintenance Building are deemed covered by the provisions of the Davis-Bacon Act.

04.1.18. Covernment Property

No materials, property or facilities will be furnished by AUI or the Government unless otherwise provided herein.

04.1.19. Information Concerning Walsh-Healey Public Contracts Act

General information regarding the requirements of the Walsh-Healey Public Contracts Act (41 USC 35-45), the Davis-Bacon Act (40 USC 276a) and other applicable labor acts may be obtained from the Department of Labor, Washington, D. C. 20210.

04.1.20. Order of Precedence

In the event of inconsistency between the provisions of this Subcontract, the inconsistency shall be resolved by giving precedence in the following order: (a) Schedule A; (b) Special Conditions; (c) General Terms and Conditions; (d) Other provisions of the subcontract whether incorporated by reference or otherwise; (e) Specifications; (f) Drawings; and (g) Attachment 5.

04.1.21. Possession Prior to Completion

AUI shall have the right to take possession of or use any completed or partially completed antenna. Such possession or use shall not be deemed an acceptance of work not completed in accordance with the subcontract. If such prior possession or use by AUI delays the progress of the work or causes additional expenses to the Subcontractor, an equitable adjustment in the subcontract price and/or the time of completion will be made and the subcontract shall be modified accordingly.

04.1.22. Release of Claims

The Subcontractor shall submit to AUI a Release of Claims in the form set forth in Appendix 5.12 hereof, as a condition precedent to final payment by AUI for any group or groups of antennas. Any balance due to the Subcontractor under the progress payments provisions of this subcontract as a result of final acceptance of any group or groups of antennas will be held by AUI until a Release of Claims in the form set forth in Appendix 5.12 hereof has been received by AUI.

04.1.23. Change Order Authority

No change in contract performance, specifications, terms and conditions or other matters affecting the work or subcontract

price shall be authorized unless in writing signed by the VLA Project Manager, or his authorized representative, designated in writing and acting within the scope of his authority. Any changes made or work performed outside of the scope of the subcontract prior to the receipt of a written Change Order shall be solely at the Subcontractor's risk and expense.

04.1.24 Accelerated Authorization

AUI may accelerate the authorization to proceed for any line item in advance of June 18, in such case the subcontractor shall reduce its line item price by 0.4 percent for each full 30-day period up to a maximum of 120 days. Nothing herein shall preclude AUI from issuing authorization to proceed earlier than 120 days prior to the applicable June 18 date on any line item.

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SECTION 04.2. GENERAL TERMS AND CONDITIONS OF THE SUBCONTRACT

ARTICLE 1 - DRAWINGS AND SPECIFICATIONS

The Subcontractor shall keep at the site of the work a copy of the drawings and specifications and shall at all times give AUI and the Foundation access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In any case of discrepancy in the figures, drawings, or specifications, the matter shall be immediately submitted to AUI, which shall promptly make a determination in writing. Said discrepancy shall not be adjusted by the Subcontractor without AUI approval, save only at its own risk and expense. AUI shall furnish from time to time such detailed drawings and other information as it may consider necessary, unless otherwise provided.

All drawings, sketches, designs, design data, specifications, notebooks, technical and scientific information, and all photographs, negatives, reports, findings, recommendations and memoranda of every description, as well as all copies of the foregoing, relating to the work or any part thereof, shall be subject to inspection by AUI and the Foundation at all reasonable times, and, further, all such material (whether or not specifically identified above) originated in the course of the work shall be the property of the Government and may be used by the Government for any purpose whatsoever including making it available for public use without any claim on the part of the Subcontractor for additional compensation. Such material shall be delivered to AUI, or otherwise disposed of by the Subcontractor as either AUI or the Foundation may from time to time direct during the progress of the work, or in any event as AUI or the Foundation shall direct upon completion or termination of this subcontract. The Subcontractor and its subcontractors shall afford AUI and the Foundation proper facilities for any inspection pursuant to this article.

ARTICLE 2 - INDEPENDENT SUBCONTRACTORS

- (a) In the conduct of the work hereunder the Subcontractor is acting in the capacity of an independent Subcontractor and is not an agent or employee of AUI in the performance of the work. AUI, however, shall have general direction of the work and the right to control its final result obtained, within the general scope of the specifications.
- (b) The Subcontractor will defend, hold harmless and indemnify the Government of the United States, the Foundation and AUI and their respective officers, agents and employees from and against any and all liability, including all losses and damages and any expense connected therewith, resulting from the

fault or negligence of the Subcontractor and arising out of or connected with the work.

ARTICLE 3 - CHANGES

- (a) AUI may, at any time, without notice to the sureties, by written order designated or indicated to be a change order, make any change in the work within the ganeral scope of the subcontract, including but not limited to changes: (i) in the specifications (including drawings and designs); (ii) in the method or manner of performance of the work, or place of delivery; (iii) in the AUI- or Government-furnished facilities, equipment, materials, services, or site; or (iv) directing acceleration in the performance of the work.
- (b) Any other written order (which term as used in this paragraph (b) shall include direction, instruction, interpretation, or determination) from AUI, which causes any such change, shall be treated as a change order under this clause, provided that the Subcontractor gives AUI written notice stating the date, circumstances, and source of the order and that the Subcontractor regards the order as a change order.
- (c) Except as herein provided, no order, statement, or conduct of AUI shall be treated as a change under this clause or entitle the Subcontractor to an equitable adjustment hereunder.
- (d) If any change under this clause causes an increase or decrease in the Subcontractor's cost of, or the time required for, the performance of any part of the work under this subcontract, whether or not changed by any order, an equitable adjustment shall be made and the subcontract modified in writing accordingly: Provided, however That except for claims based on defective specifications, no claim for any change under (b) above shall be allowed for any costs incurred more than 20 days before the Subcontractor gives written notice as therein required: And provided further, That in the case of defective specifications for which AUI is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Subcontractor in attempting to comply with such defective specifications.
- (e) If the Subcontractor intends to assert a claim for an equitable adjustment under this clause, he must, within 30 days after receipt of a written change order under (a) above, submit to AUI a written statement setting forth the general nature and monetary extent of such claim, unless this period is extended by AUI. The statement of claim hereunder may be included in the notice under (b) above. However, nothing in this article shall excuse the Subcontractor from proceeding with the Subcontract as changed.
- (f) No claim by the Subcontractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this subcontract.

ARTICLE 4 - DIFFERING SITE CONDITIONS

(a) The Subcontractor shall promptly, and before such conditions are disturbed, notify AUI in writing of: (1) Sub-surface or latent physical conditions at the site differing materially from those indicated in this subcontract, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the

character provided for in this subcontract, AUI shall promptly investigate the conditions, and if they find that such conditions do materially so differ and cause an increase or decrease in the Subcontractor's cost of, or the time required for, performance of any part of the work under this subcontract, whether or not changed as a result of such conditions, an equitable adjustment shall be made and the subcontract modified in writing accordingly.

- (b) No claim of the Subcontractor under this clause shall be allowed unless the Subcontractor has given the notice required in (a) above within ten days, provided, however, the time prescribed therefor may be extended by AUI.
- (c) No claim by the Subcontractor for an equitable adjustment hereunder shall be allowed if asserted after final payment under this subcontract.

ARTICLE 5 - SUSPENSION OF WORK

- (a) AUI may order the Subcontractor in writing to suspend, delay, or interrupt all or any part of the work for such period of time as he may determine to be appropriate for the convenience of AUI.
- (b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted by an act of AUI in the administration of this subcontract, or by its failure to act within the time specified in this subcontract (or if no time is specified, with a reasonable time), an adjustment shall be made for any increase in the cost of performance of this subcontract (excluding profit) necessarily caused by such unreasonable suspension, delay or interruption and the subcontract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay or interruption to the extent (1) that performance would have been so suspended, delayed, or interrupted by any other cause including the fault or negligence of the Subcontractor or (2) for which an equitable adjustment is provided for or excluded under any other provision of this subcontract.
- (c) No claim under this clause shall be allowed (1) for any costs incurred more than twenty days before the Subcontractor shall have notified AUI in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of such suspension, delay, or interruption, but not later than the date of final payment under the subcontract.

ARTICLE 6 - INSPECTION

(a) All material and workmanship (except as otherwise provided in this subcontract) shall be subject to inspection, examination and test by AUI at any and all times during the manufacture and/or construction and at any and all places where such manufacture and/or construction are carried on. AUI shall have the right to reject defective material and workmanship or require their correction. Rejected workmanship shall be satisfactorily corrected, and rejected material shall be replaced with proper material without charge

therefor and the Subcontractor shall promptly segregate and remove the rejected material from the premises. If the Subcontractor fails to proceed at once with the replacement of the rejected material and/or the correction of defective workmanship, AUI may by contract, or otherwise, replace such material and/or correct such workmanship and charge the cost thereof to the Subcontractor, or may terminate the right of the Subcontractor to proceed as provided in Article 9, the Subcontractor being liable for any damage to the same extent as provided in said Article 9.

- (b) The Subcontractor shall furnish promptly, without additional charge, all reasonable facilities, labor, and materials necessary for the safe and convenient inspection and tests that may be required by the inspectors. All inspection and tests by AUI shall be performed in such manner as not unnecessarily to delay the work. Special full size and performance test shall be as described in the specifications. The Subcontractor shall be charged with any additional cost of inspection when material and workmanship are not ready at the time inspection is requested by Subcontractor.
- (c) Should it be considered necessary or advisable by AUI at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out same, the Subcontractor, on request, shall promptly furnish all necessary facilities, labor and materials. If such work is found to be defective or nonconforming in any material respect, due to fault of the Subcontractor or its subcontractors, it shall defray all the expenses of such examination and of satisfactory reconstruction. If, however, such work is found to meet the requirements of this subcontract, an equitable adjustment shall be made in the amount due under this subcontract to compensate the Subcontractor for the additional services rendered in such examination and reconstruction, and if completion of the work has been delayed thereby, it shall be granted a suitable extension of time on account of the additional work involved.
- (d) Inspection of material and finished articles to be incorporated in the work at the site shall be made at the place of production, manufacture or shipment, whenever AUI deems it necessary, unless otherwise stated in the Specifications; and, such inspection and acceptance, unless otherwise stated in the Specifications, shall be final except as to latent defects, departures from specific requirements of this subcontract and the Specifications and drawings made a part hereof, damage or loss in transit, fraud, or such gross mistakes as amount to fraud. Subject to the requirements contained in the preceding sentence, the inspection of material and workmanship for final acceptance as a whole or in part shall be made at the site. Nothing contained in this paragraph (d) shall in any way restrict AUI's right under any warranty or guarantee.
- (e) All supplies (which term throughout this clause includes without limitation raw materials, components, intermediate assemblies, and end products) shall be subject to inspection and test by AUI, to the extent practicable at all times and places, including the period of manufacture, and in any event prior to acceptance.

- (f) The Subcontractor shall provide and maintain an inspection system acceptable to AUI covering the supplies hereunder. Records of all inspection work by the Subcontractor shall be kept complete and available to AUI during the performance of this subcontract and for such longer period as may be specified elsewhere in this subcontract.
- (g) The work will be conducted under the general direction of AUI and is subject to inspection by its appointed inspectors to insure strict compliance with the terms of the subcontract. No inspector is authorized to change any provision of the specifications without written authorization of AUI, nor shall the presence or absence of an inspector relieve the Subcontractor from any requirements of the subcontract.

ARTICLE 7 - MATERIALS AND WORKMANSHIP: WARRANTY

Unless otherwise specifically provided for in this subcontract, all workmanship, equipment, materials and articles incorporated in the work covered by this subcontract are to be new and of the most suitable grade of their respective kinds for the purpose intended. Where equipment, materials or articles are referred to in the Specifications as "equal to" any particular standard, AUI shall decide the question of equality. The Subcontractor shall furnish to AUI for its approval the name of the manufacturer of machinery, mechanical and other equipment which they contemplate incorporating in the work, together with their performance capacities and other pertinent information. When required by the Specifications or when called for by AUI, the Subcontractor shall furnish AUI full information concerning the materials or articles which it contemplates incorporating in the work. Samples of materials shall be submitted for approval when so directed. Machinery, equipment, materials and articles installed or used without such approval shall be at the risk of subsequent rejection.

The Subcontractor warrants that all material and workmanship shall be free from defects and shall be in accordance with the Specifications. The Subcontractor shall repair or replace, at its own expense, any part of the equipment, materials, or workmanship proving defective within one year after the date of acceptance by AUI, or within such longer period as may be required by the Specifications. Warranties in excess of the above warranty period granted to the subcontractor by its vendors shall be passed on to AUI.

ARTICLE 8 - SUPERINTENDENCE BY SUBCONTRACTOR

The Subcontractor shall establish an office at the assembly site during the progress of the work and shall have a competent superintendent, satisfactory to AUI, on the site at all times, with authority to act for it.

AUI may require the Subcontractor to remove from the work any employee whom AUI deems incompetent, careless, insubordinate or otherwise objectionable or whose continued employment on the work is deemed by AUI to be contrary to the public interest.

ARTICLE 9 - TERMINATION FOR DEFAULT

- (a) AUI may, subject to the provisions of paragraph (c) below, by written notice of default to the Subcontractor terminate the whole or any part of this subcontract in any one of the following circumstances:
- (1) If the Subcontractor fails to make delivery of the supplies or perform the services within the time specified herein or any extension hereof; or
- (2) If the Subcontractor refuses or fails to prosecute the work, or any separable part thereof, with such diligence as will assure its completion within the time specified in the subcontract, or any extension thereof, or fails to complete said work within such time; or
- (3) If the Subcontractor fails to perform any other provision of this subcontract or so fails to make progress as to endanger performance of this subcontract in accordance with its terms and in any of these three (3) circumstances does not cure such failure within 10 days (or such longer period as AUI may authorize in writing) after receipt of notice from AUI specifying such failure.
- (b) In the event AUI terminates this subcontract in whole or in part, as provided in paragraph (a) of this Article, AUI may,
- (1) Procure upon such terms and in such manner as AUI may deem appropriate supplies or services similar to those terminated; and the Subcontractor shall be liable to AUI for any excess costs for similar supplies or services, and whether or not the Subcontractor's right to proceed with the work terminated, it and its sureties shall be liable for any damages to AUI resulting from refusal or failure to complete the work within the specified time: Provided, that the contractor shall continue the performance of this subcontract to the extent not terminated under the provisions of this Article.
- (c) Except with respect to defaults of lower tier subcontractors, the Subcontractor shall not be liable for excess costs if the failure to perform the subcontract arises out of causes beyond the control and without the fault or negligence of the Subcontractor. Such causes may include, but are not restricted to acts of God, acts of the public enemy, acts of AUI in its contractual capacity, acts of another subcontractor in the performance of a subcontract with AUI, fires, floods, epidemics, quarantine restrictions, strikes, freight embargoes, unusually severe weather, or delays of subcontractors or suppliers arising from unforseeable causes beyond the control and without the fault or negligence of both the Subcontractor and such lower tier subcontractors or suppliers; and the Subcontractor, within ten days from the beginning of any such delay (unless AUI grants a further period of time before the date of final payment under the subcontract), notifies AUI in writing of the causes of delay.

If failure to perform is caused by the default of a lower tier subcontractor, and if such default arises out of causes beyond the control of both the Subcontractor

and the lower tier subcontractor, and without the fault or negligence of either of them, the Subcontractor shall not be liable for any excess costs for failure to perform, unless the supplies or services were obtainable from other sources in sufficient time for the Subcontractor to meet the required delivery schedule.

- (d) If this subcontract is terminated as provided in paragraph (c) of this Article, AUI may in addition to any other rights provided in the Article, require the Subcontractor to transfer title and deliver to AUI, in the manner and to the extent directed by AUI (1) any completed supplies or work; and (2) such partially completed supplies and materials, parts, tools, dies, jigs, fixtures, plans, drawings, information and contracting rights (hereinafter called manufacturing materials), as the Subcontractor has specifically produced or specifically acquired for performance of such part of the subcontract as has been terminated; and (3) AUI may take over the work and prosecute the same to completion by subcontract or otherwise, and may take possession of and utilize in completing the work such materials, appliances, and plant as may be on the site of the work and necessary therefor: and the Subcontractor shall, upon direction of AUI, protect and preserve property in possession of the Subcontractor in which AUI or the Government has an interest. Payment for completed supplies shall be at the subcontract price. Payment for manufacturing materials delivered to and accepted by AUI shall be an amount agreed upon by the Subcontractor and AUI; failure to agree shall be a dispute concerning a question of fact within the meaning of the "Disputes" article of this subcontract.
- (e) If, after notice of termination of the Subcontractor's right to proceed under the provisions of this Article, it is determined for any reason that the Subcontractor was not in default under the provisions of this Article, or that the delay was excusable under the provisions of this Article, the rights and obligations of the parties shall, if the subcontract contains an article providing for termination for convenience, be the same as if the notice of termination has been issued pursuant to such article. If, in the foregoing circumstances, this subcontract does not contain an article providing for termination for convenience, the subcontract shall be equitably adjusted to compensate for such termination and the subcontract modified accordingly; failure to agree to any such adjustment shall be a dispute concerning a question of fact within the meaning of the Article of this subcontract entitled "Disputes".
- (f) The rights and remedies of AUI provided in this Article are in addition to any other rights and remedies provided by law or under this subcontract.
- (g) As used in paragraph (d) (1) of this Article, the term "Subcontractors or suppliers" means Subcontractors or suppliers at any tier.

ARTICLE 10 - TERMINATION FOR CONVENIENCE

(a) The performance of work under this subcontract may be terminated by AUI in accordance with this Article in whole, or from time to time in part, whenever

AUI or the Government shall determine that such termination is in the best interest of AUI or the Foundation. Any such termination shall be effected by delivery to the Subcontractor of a Notice of Termination specifying the extent to which performance of work under the subcontract is terminated, and the date upon which such termination becomes effective.

- (b) After receipt of a Notice of Termination, and except as otherwise directed by AUI, the Subcontractor shall:
- (1) Stop work under the subcontract on the date and to the extent specified in the Notice of Termination;
- (2) Place no further orders or subcontracts for materials, services, or facilities except as may be necessary for completion of such portion of the work under contract as is not terminated;
- (3) Terminate all orders and subcontracts to the extent that they relate to the performance of work terminated by the Notice of Termination;
- (4) Assign to AUI, in the manner, at the times, and to the extent directed by AUI, all of the right, title, and interest of the Subcontractor under the orders and subcontracts so terminated, in which case AUI shall have the right, in its discretion, to settle or pay any or all claims arising out of the termination of such orders and subcontracts;
- (5) Settle all outstanding liabilities and all claims arising out of such termination of orders and subcontracts, with the approval or ratification of AUI to the extent it may require, which approval or ratification shall be final for all the purposes of this clause;
- (6) Transfer title to the Government and deliver in the manner, at the times, and to the extent, if any, directed by AUI;
 - (i) The fabricated or unfabricated parts, work in progress, completed work, supplies, and other material produced as part of, or acquired in connection with the performance of, the work terminated by the Notice of Termination, and
 - (ii) The completed or partially completed plans, drawings, information, and other property which, if the contract has been completed, would have been required to be furnished to AUI.
- (7) Use its best efforts to sell, in the manner, at the times, to the extent, and at the price or prices directed or authorized by AUI, any property of the types referred to in (6) above: Provided, however, that the Subcontractor may acquire any such property under the conditions prescribed and at a price or prices approved by AUI: And provided further, that the proceeds of any such transfer or disposition shall be credited to the price or cost of the work covered by this subcontract or paid as AUI may direct;

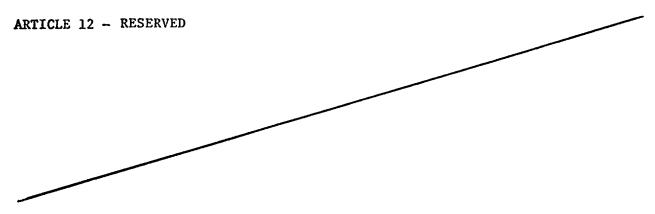
- (8) Complete performance of such part of the work as shall not have been terminated by the Notice of Termination; and
- (9) Take such action as may be necessary, or as AUI may direct, for the protection and preservation of the property related to this subcontract.
- (c) After receipt of a Notice of Termination, the Subcontractor shall submit to AUI its termination claim, in the form and with the certification prescribed b. AUI. Such claim shall be submitted promptly but in no event later than six months from the effective date of termination, unless one or more extensions in writing are granted by AUI upon request of the Subcontractor made in writing within such six month period or authorized extension thereof.
- (d) Subject to the provisions of paragraph (c), the Subcontractor and AUI may agree upon the whole or any part of the amount or amounts to be paid to the Subcontractor by reason of the total or partial termination of work pursuant to this clause, which amount or amounts may include a reasonable allowance for profit on work done: Provided, that such agreed amount or amounts, exclusive of settlement costs, shall not exceed the total contract price as reduced by the amount of payments otherwise made and as further reduced by the contract price of work not terminated. The contract shall be amended accordingly, and the Contractor shall be paid the agreed amount.
- (e) In arriving at the amount due the Subcontractor under this clause, there shall be deducted:
- (1) All unliquidated advance or other payments on account theretofore made to the Subcontractor, applicable to the terminated portion of this subcontract;
- (2) Any claim which AUI may have against the Subcontractor in connection with this subcontract; and
- (3) The agreed price for, or the proceeds of sale of, any materials, supplies, or other things kept by the Subcontractor or sold, pursuant to the provisions of this claim, and not otherwise recovered by or credited to AUI.
- (f) If the termination hereunder be partial, prior to the settlement of the terminated portion of this subcontract, the Subcontractor may file with AUI a request in writing for an equitable adjustment of the price or prices specified in the subcontract relating to the continued portion of the subcontract (the portion not terminated by the Notice of Termination), and such equitable adjustment as may be agreed upon shall be made in such price or prices.

ARTICLE 11 - OTHER SUBCONTRACTS

(a) The Subcontractor shall fully cooperate with other subcontractors engaged on work for AUI at the locality covered by this subcontract and shall not

interfere with the performance of their work. In case of a conflict, the necessary coordination shall be as directed by AUI.

(b) The Subcontractor shall not enter into any contractual commitment to a third party which involves the performance in whole or in part of a specific part of the work under this subcontract without the written approval of AUI. However, this article is not applicable to a contract of employment.



ARTICLE 13 - BUY AMERICAN ACT (SUPPLY)

- (a) In acquiring end products, the Buy American Act (41 U.S. Code 10a-d) provides that the Government give preference to domestic source end products. For the purpose of this clause:
- (i) "Components" means those articles, materials, and supplies which are directly incorporated in the end products;
- (ii) "End products" means those articles, materials, and supplies which are to be acquired under this contract for public use; and
- (iii) A "domestic source end product" means (A) an unmanufactured end product which has been mined or produced in the United States and (B) an end product manufactured in the United States if the cost of the components thereof which are mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. For the purposes of this (a) (iii) (B), components of foreign origin of the same type or kind as the products referred to in (b)(ii) or (iii) of this clause shall be treated as components mined, produced, or manufactured in the United States.
- (b) The Contractor agrees that there will be delivered under this contract only domestic source end products, except end products:
 - (i) Which are for use outside the United States:
- (ii) Which the Government determines are not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality;

- (iii) As to which the Director of the Foundation determines the domestic preference to be inconsistent with the public interest; or
- (iv) As to which the Director of the Foundation determines the cost to the Government to be unreasonable.

The foregoing requirements are administered in accordance with Executive Order No. 10582, dated December 17, 1954.

ARTICLE 14 - BUY AMERICAN ACT (CONSTRUCTION)

- (a) Agreement. In accordance with the Buy American Act (41 U.S.C. 10a-10d) and Executive Order 10582, December 17, 1954 (3 CRF Supp.), the Subcontractor agrees that only domestic construction material will be used (by the Subcontractor or its subcontractors, materialmen, and suppliers) in the performance of this contract, except for nondomestic material listed in the contract.
- (b) Domestic construction material. "Construction material" means any article, material, or supply brought to the construction site for incorporation in the building or work. An unmanufactured construction material is a "domestic construction material" if it has been mined or produced in the United States. A manufactured construction material is a "domestic construction material" if it has been manufactured in the United States and if the cost of its components which have been mined, produced, or manufactured in the United States exceeds 50 percent of the cost of allits components. "Component" means any article, material, or supply directly incorporated in a construction material.
- (c) Domestic component. A component shall be considered to have been "mined, produced, or manufactured in the United States" (regardless of its source in fact) if the article, material, or supply in which it is incorporated was manufactured in the United States and the component is of a class or kind determined by the Government to be not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities and of a satisfactory quality.

ARTICLE 15 - PERMITS AND RESPONSIBILITY FOR WORK

The Subcontractor shall, without additional expense to AUI, obtain all licenses and permits, and comply with all applicable Federal, State and Local laws, codes, and regulations in connection with the prosecution of the work. He shall be responsible for all damages to persons or property that occur as a result of his fault or negligence in connection with the prosecution of the work. He shall also be responsible for all materials delivered and work performed until completion and final acceptance, except for any completed unit thereof which theretofore may have been finally accepted. The Subcontractor shall take proper safety and health precautions to protect the work, the worker, the public and the property of others.

ARTICLE 16 - SAFETY, HEALTH, AND FIRE PROTECTION

The Subcontractor shall take all reasonable precautions in the performance of the work under this subcontract to protect the health and safety of employees and of members of the public and to minimize danger from all hazards to life and property and shall comply with all health, safety and fire protection regulations and requirements (including reporting requirements) required by Federal, State or Local authorities, including the Occupational Safety and Health Act. He shall also comply with any similar requirements established by AUI for operations on the site. In the event that the Subcontractor fails to comply with any such safety regulations or requirements, AUI ray without prejudice to any other legal or contractual rights of it or of the Foundation, issue an order stopping all or any part of the work. a start order for resumption of the work may be issued at the discretion of AUI. The Subcontractor shall make no claim for an extension of time or for compensation or damages by reason of or in connection with any such work stoppage.

ARTICLE 17 - NOTICE OF LABOR DISPUTES

- (a) Whenever an actual or potential labor dispute is delaying or threatens to delay the timely performance of this subcontract, the Subcontractor shall immediately give notice thereof in writing to AUI. Such notice shall include all relevant information with respect to such dispute.
- (b) The Subcontractor agrees to insert the substance of this clause, including this paragraph (b), into any subcontract hereunder, except that each subcontract shall provide that the Subcontractor shall provide to its next higher tier subcontractor all the information required by paragraph (a).

ARTICLE 18 - DAVIS-BACON ACT (40 USC 276a-276a-7)

(a) All mechanics and laborers, including apprentices and trainees, employed or working directly upon the site of the work shall be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by the Copeland Regulations (29 CFR Part 3), the full amounts due at time of payment computed at wage rates not less than the aggregate of the basic hourly rates and the rates of payments, contributions, or costs for any fringe benefits contained in the wage determination decision of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Subcontractor or its subcontractors and such laborers and mechanics. A copy of such wage determination decision shall be kept posted by the Subcontractor at the site of the work in a prominent place where it can be easily seen by the workers.

- (b) The Subcontractor may discharge his obligation under this clause to workers in any classification for which the wage determination decision contains:
- (1) Only a basic hourly rate of pay, by making payment at not less than such basic hourly rate, except as otherwise provided in the Copeland Regulations (29 CFR Part 3); or
- (2) Both a basic hourly rate of pay and fringe benefits payments, by making payment in cash, by irrevocably making contributions pursuant to a fund, plan, or program for, and/or by assuming an enforceable commitment to bear the cost of, bona fide fringe benefits contemplated by the Davis Bacon Act, or by any combination thereof. Contributions made, or costs assumed, on other than a weekly basis shall be considered as having been constructively made or assumed during a weekly period to the extent that they apply to such period. Where a fringe benefit is expressed in a wage determination in any manner other than as an hourly rate and the Subcontractor pays a cash equivalent or provides an alternative fringe benefit, he shall furnish information with his payrolls showing how he determined that the cost incurred to make the cash payment or to provide the alternative fringe benefit is equal to the cost of the wage determination fringe benefit. In any case where the Subcontractor provides a fringe benefit different from any contained in the wage determination, he shall similarly show how he arrived at the hourly rate shown therefor. In the event of disagreement between or among the interested parties as to an equivalent of any fringe benefit, AUI shall submit the question, together with its recommendation, to the Secretary of Labor for final determination.
- (c) The assumption of an enforceable commitment to bear the cost of fringe benefits, or the provision of any fringe benefits not expressly listed in Section 1 (b)(2) of the Davis-Bacon Act or in the wage determination decision forming a part of the subcontract, may be considered as payment of wages only with the approval of the Secretary of Labor pursuant to a written request by the Subcontractor. The Secretary of Labor may require the Subcontractor to set aside assets, in a separate account, to meet his obligations under any unfunded plan or program.
- (d) AUI shall require that any class of laborers or mechanics, including apprentices and trainees, which under the contract shall be classified or reclassified conformably to the wage determination decision, and shall report the action taken to the Secretary of Labor. If the interested parties cannot agree on the proper classification or reclassification of a particular class of laborers or mechanics to be used, AUI shall submit the question, together with its recommendation, to the Secretary of Labor for final determination. Apprentices and trainees may be added under this clause where they are employed pursuant to an apprenticeship or trainee program meeting the requirements of the apprentices and trainees clause below.

- (e) In the event it is found by AUI that any laborer or mechanic, including apprentices and trainees, employed by the Subcontractor or any of its subcontractors directly on the site of the work covered by this subcontract has been or is being paid at a rate of wages less than the rate of wages required by paragraph (a) of this clause, AUI may (1) by written notice to the Subcontractor terminate his right to proceed with the work, or such part of the work as to which there has been a failure to pay said required wages, and (2) prosecute the work to completion by contract or otherwise, thereupon such Subcontractor and his sureties shall be liable to the Government for any excess costs occasioned the Government thereby.
- (f) Paragraphs (a) through (e) of the clause shall apply to this contract to the extent that it is a subcontract subject to the Davis Bacon Act under a prime contract with the Government.
- ARTICLE 19 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT OVERTIME COMPENSATION (40 U.S.C. 327-333)
- (a) The Subcontractor shall not require or permit any laborer or mechanic, including apprentices, trainees, watchmen, and guards, in any workweek in which he is employed on any work under this Subcontract to work in excess of 8 hours in any calendar day or in excess of 40 hours in such workweek on work subject to the provisions of the Contract Work Hours and Safety Standards Act unless such laborer or mechanic, including apprentices, trainees, watchmen, and guards, receives compensation at a rate not less than 1½ times his basic rate of pay for all such hours worked in excess of 8 hours in any calendar day or in excess of 40 hours in such workweek, whichever is the greater number of overtime hours. The "basic rate of pay," as used in this clause, shall be the amount paid per hour, exclusive of the Subcontractor's contribution or cost for fringe benefits, and any cash payment made in lieu of providing fringe benefits, or the basic hourly rate contained in the wage determination, whichever is greater.
- (b) In the event of any violation of the provisions of paragraph (a), the Subcontractor shall be liable to any affected employee for any amounts due, and to the United States for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including an apprentice, trainee, watchman, or guard, employed in violation of the provisions of paragraph (a) in the sum of \$10 for each calendar day on which such employee was required or permitted to be employed on such work in excess of 8 hours or in excess of the standard workweek of 40 hours without payment of the overtime wages required by paragraph (a).

Apprentices and Trainees

(a) Apprentices shall be permitted to work as such only when they are registered, individually, under a bona fide apprenticeship program registered with a State

apprenticeship program which is recognized by the Bureau of Apprenticeship and Training, U. S. Department of Labor; or if no such recognized agency exists in a State, under a program registered with the aforesaid Bureau of Apprenticeship and Training. The allowable ratio of apprentices to journeymen in any craft classification shall not be greater than the ratio permitted to the Subcontractor as to his entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate who is not a trainee is defined in paragraph (b) of this clause, and who is not registered as above, shall be paid the wage rate determined by the Secretary of Labor for the classification or work he actually performed. The Subcontractor shall furnish to AUI written evidence of the registration of his program and apprentices, as well as of the appropriate ratios allowed and the wage rates required to be paid thereunder for the area of construction, prior to using any apprentices in the subcontract work. The term "apprentice: means (1) a person employed and individually registered in a bona fide apprenticeship program registered with the U. S. Department of Labor, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or (2) a person in his first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training, or a State Apprenticeship Council (where appropriate) to be eligible for probationary employment as an apprentice.

- (b) Trainees shall be permitted to work as such when they are bona fide trainees employed pursuant to a program approved by the U. S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training. The term "trainee" means a person receiving on-the-job training in a construction occupation under a program which is approved (but not necessarily sponsored) by the U. S. Department of Labor, Manpower Administration, Bureau of Apprenticeship and Training, and which is reviewed from time to time by the Manpower Administration to insure that the training meets adequate standards.
- (c) In connection with contracts in excess of \$10,000, the Subcontractor agrees as follows:
- (1) The Subcontractor shall make a diligent effort to hire for performance of work under this subcontract a number of apprentices or trainees, or both, in each occupation, which bears to the average number of the journeymen in that occupation to be employed in the performance of the contract the applicable ratio as set forth in paragraph (d) of this article.
- (2) The Subcontractor shall insure that 25 percent of such apprentices or trainees in each occupation are in their first year of training, where feasible. Feasibility here involves a consideration of (i) the availability of training opportunities for first year apprentices, (ii) the hazardous nature of the work for beginning workers, and (iii) excessive unemployment of apprentices in their second and subsequent years of training.

- (3) The Subcontractor shall, during the performance of the subcontract, to the greatest extent possible, employ the number of apprentices or trainees necessary to meet currently the requirements of paragraph (c) (1) and (c) (2) of this clause.
- (4) The Subcontractor shall maintain records of employment on this subcontract by trade of the number of apprentices and trainees, apprentices and trainees in first year of training, and of journeymen, and the wages paid and hours of work of such apprentices, trainees, and journeymen. In addition, the Subcontractor who claims compliance based on the criterion set forth in paragraph (c)(6)(ii) of this clause shall maintain such records of employment on all his construction work in the same labor market area, both public and private, during the performance of this subcontract. In each of the above cases the Subcontractor shall make such records available for inspection upon request of the Department of Labor or AUI.
- (5) The Subcontractor shall supply one copy of each of the written notices required in accordance with paragraph (c)(6)(iii) of this article at the request of AUI. The Subcontractor also agrees to supply at 3-month intervals during the performance of the subcontract and after completion of subcontract performance a statement describing steps taken toward making a diligent effort and containing a breakdown by craft, of hours worked and wages paid for first year apprentices and trainees, other apprentices and trainees, and journeymen. One copy of the statement will be sent to AUI and one copy to the Secretary of Labor.
- (6) The Subcontractor will be deemed to have made a "diligent effort" as required by paragraph (c)(1) if during the performance of this subcontract, he accomplishes at least one of the following three objectives: (i) The Subcontractor employs under this contract a number of apprentices and trainees by craft, at least equal to the ratios established in accordance with paragraph (d) of this clause, or (ii) the Subcontractor employs, on all his construction work, both public and private, in the same labor market area, an average number of apprentices and trainees by craft at least equal to the ratios established in accordance with paragraph (d) of this article, or (iii) the Subcontractor (A) if covered by a collective bargaining agreement, before commencement of any work on the project, has given written notice to all joint apprenticeship committees, the local U. S. Employment Security Office, local chapter of the Urban League, Workers Defense League, or other local organizations concerned with minority employment, and the Bureau of Apprenticeship and Training Representive, U. S. Department of Labor, for the locality of the work; (B) if not covered by a collective bargaining agreement, has given written notice to all of the groups stated above, except joint apprenticeship committees, and will in addition notify all nonjoint apprenticeship sponsors in the labor market area; (C) has employed all qualified applicants referred to him through normal channels (such as the Employment Service, the Joint Apprenticeship Committees, and where applicable, minority organizations and

apprentice outreach programs who have been delegated this function) at least up to the number of such apprentices and trainees required by paragraph (d) of this clause; (D) notice, as referred to herein, will include at least the Subcontractor's name and address, the agency designation, the subcontract number, jobsite address, value of the subcontract expected starting and completion dates, the estimated average number of employees in each occupation to be employed over the duration of the subcontract work, and a statement of his willingness to employ a number of apprentices and trainees at least equal to the ratios established in accordance with paragraph (d) of this article.

(d) The Secretary of Labor has determined that the applicable ratios of apprentices and trainees to journeymen in any occupation for the purpose of this article shall be as follows: (1) In any occupation the applicable ratio of apprentices and trainees to journeymen shall be equal to the predominant ratio for the occupation in the area where the construction is being undertaken, set forth in collective bargaining agreements, or other employment agreements, and available through the Bureau of Apprenticeship and Training Representative, U. S. Department of Labor, for the applicable area; (2) for any occupation for which no ratio is found, the ratio of apprentices and trainees to journeymen shall be determined by the Subcontractor in accordance with the recommendations set forth in the Standards of the National Joint Apprentice Committee for the occupation, which are on file at offices of the U. S. Department of Labor's Bureau of Apprenticeship and Training; and (3) for any occupation for which no such recommendations are found, the ratio of apprentices and trainees to journeymen shall be at least one apprentice or trainee for every five journeymen.

ARTICLE 20 - PAYROLL RECORDS AND PAYROLLS

- (a) The Subcontractor shall maintain payrolls and basic records relating thereto during the course of the work and shall preserve them for a period of three years thereafter for all laborers and mechanics, including apprentices, trainees, watchmen, and guards, working at the site of the work. Such records shall contain the name and address of each such employee, his correct classification, rate of pay (including rates of contributions for, or costs assumed to provide, fringe benefits), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Subcontractor has obtained approval from the Secretary of Labor as provided in paragraph (c) of the article entitled "Davis-Bacon Act", he shall maintain records which show the commitment, its approval, written communication of the plan or program of the laborers or mechanics affected, and the costs anticipated or incurred under the plan or program.
- (b) The Subcontractor shall submit weekly a copy of all payrolls to AUI. AUI shall be responsible for the submission of copies of payrolls of all Subcontractors to the Foundation. The copies shall be accompanied by a statement signed by the Subcontractor indicating that the payrolls are correct and complete, that the wage rates contained therein are not less than those determined

by the Secretary of Labor, and that the classifications set forth for each laborer or mechanic, including apprentices and trainees, conforms with the work he performed. Submission of the "Weekly Statement of Compliance" required under this subcontract and the Copeland Regulations of the Secretary of Labor (29 CFR, Part 3) shall satisfy the requirement for submission of the above statement. The Subcontractor shall submit also a copy of any approval by the Secretary of Labor with respect to fringe benefits which is required by paragraph (c) of the article entitled "Davis-Bacon Act."

(c) The Subcontractor shall make the records required under this clause available for inspection by authorized representatives of AUI and the Department of Labor, and shall permit such representatives to interview employees during working hours on the job.

ARTICLE 21 - COPELAND (ANTI-KICKBACK ACT) - NONREBATE OF WAGES

The Subcontractor shall comply with the Copeland Regulations of the Secretary of Labor (29 CFR Part 3) which are incorporated herein by reference.

ARTICLE 22 - WITHHOLDING OF FUNDS

- (a) AUI may withhold or cause to be withheld from the Subcontractor so much of the accrued payments or advances as may be considered necessary (1) to pay laborers and mechanics, including apprentices, trainees, watchmen, and guards, employed by the Subcontractor or any lower tier subcontractor on the work the full amount of wages required by the subcontract, and (2) to satisfy any liability of any Subcontractor for liquidated damages under paragraph (b) of Article 19 entitled "Contract Work Hours and Safety Standards Act Overtime Compensation."
- (b) If any Subcontractor fails to pay any laborer, mechanic, apprentice, trainees, watchmen, or guard, employed or working on the site of the work, all or part of the wages required by the contract, AUI may, after written notice to the Subcontractor, take such action as may be necessary to cause suspension of any further payments or advances until such violations have ceased.

ARTICLE 23 - SUBCONTRACTS - TERMINATION - DEBARMENT

The Subcontractor agrees to insert Articles 17 through 22 hereof in all subcontracts and further agrees that a breach of any of the requirements of these articles may be grounds for termination of this subcontract and for debarment as provided in 29 CFR 5.6.

ARTICLE 24 - EQUAL OPPORTUNITY IN EMPLOYMENT

During the performance of this subcontract, the Subcontractor agrees as follows:

- (a) The Subcontractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The Subcontractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Subcontractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided by AUI setting forth the provisions of this Equal Opportunity article.
- (b) The Subcontractor will, in all solicitations or advertisements for employees placed by or on behalf of the Subcontractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
- (c) The Subcontractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice, to be provided by AUI, advising the labor union or workers' representative of the Subcontractor's commitments under this Equal Opportunity article, and shall post copies of the notice in conspicuous places available to the employees and applicants for employment.
- (d) The Subcontractor will comply with all provisions of Executive Order No. 11246 of September 24, 1965, and of rules, regulations and relevant orders of the Secretary of Labor.
- (e) The Subcontractor will furnish all information and reports required by Executive Order No. 11246 of September 24, 1965, and by the rules, regulations and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records and accounts by AUI and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations and orders.
- (f) In the event of the Subcontractor's noncompliance with the Equal Opportunity article of this contract or with any of the said rules, regulations, or orders, this subcontract may be cancelled, terminated, or suspended in whole or in part and the Subcontractor may be delcared ineligible for further Government contracts in accordance with procedures authorized in Executive Order No. 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order No. 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
- (g) The Subcontractor will include the provisions of paragraphs (a) through (g) in every subcontract or purchase order unless exempted by rules, regulations or orders of the Secretary of Labor issued pursuant to Section 204 of

Executive Order No. 11246 of September 24, 1965, so that such provisions will be binding upon each Subcontractor or vendor. The Subcontractor will take such action with respect to any subcontract or purchase order as AUI may direct as a means of enforcing such provisions including sanctions for noncompliance; provided, however, that in the event the Subcontractor becomes involved in or is threatened with litigation with a Subcontractor or vendor as a result of such direction by AUI the Subcontractor may request the United States to enter into such litigation to protect the interest of the United States.

AR' ICLE 25 - CONVICT LABOR

In connection with the performance of work under this subcontract the Subcontractor shall not employ any person undergoing sentence of imprisonment at hard labor.

ARTICLE 26 - INSURANCE

Where the Subcontractor is required to work on a site or sites owned or operated by AUI or the Government,

- (a) The Subcontractor will maintain policies providing the following insurance protection for the Subcontractor, which insurance shall apply to all perations of the Subcontractor under this subcontract and employees of the Subcontractor engaged therein. The Subcontractor shall also provide an endorsement to its liability policies naming AUI and the U. S. Government as additional insured.
- (i) WORKMEN'S COMPENSATION Coverage, as provided in the Workmen's Compensation Law of the various States wherein the work will be performed, including occupational disease coverage. Workmen's Compensation coverage in any other State, where all or any portion of this contract is performed, shall not be less than limits provided by Workmen's Compensation Laws of West Virginia unless specifically provided elsewhere in this subcontract.
- (ii) GENERAL LIABILITY Insurance with limits of \$500,000/\$1,000,000 for bodily injury liability and \$100,000 property damage in the comprehensive policy form.
- (iii) VEHICLE PUBLIC LIABILITY AND PROPERTY DAMAGE Insurance with limits of \$500,000/\$1,000,000 for bodily injury liability and \$100,000 for property damage liability on the comprehensive policy form covering all owned, non-owned and hired vehicles which will be used in connection with the work to be done under this subcontract.
- (b) The Subcontractor may purchase at its own expense such additional or other insurance protection as it may deem necessary. AUI may restrict access to the site of the work to such personnel of any insurance carrier providing additional or other insurance coverage to that referred to in the foregoing paragraph (a) as AUI may deem necessary for the proper servicing of such insurance.

- (c) The Subcontractor shall furnish a certificate of insurance with one extra copy to show compliance with subparagraph (a) above.
- (d) Subcontractor shall require that its subcontractors, any tier, working on the site shall maintain as a minimum the insurance coverage set out in paragraph (a) above, and shall provide that such subcontractors provide AUI with certificates of insurance as provided in paragraph (c) above.

ARTICLE 27 - CONTINGENT FEES

The Subcontractor warrants that no person or selling agency has been employed or retained to solicit or secure this subcontract upon an agreement or understanding for a commission, percentage, brokerage, or contingent fee, excepting bona fide employees or bona fide established commercial or selling agencies maintained by the Subcontractor for the purpose of securing business. For breach or violation of this warranty AUI shall have the right to annul this subcontract without liability or in its discretion to deduct from the subcontract price or consideration, or otherwise recover, the full amount of such commission, percentage, brokerage, or contingent fee.

ARTICLE 28- - OFFICIALS NOT TO BENEFIT

No member of or delegate to Congress or resident commissioner shall be admitted to any share or part of this subcontract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this subcontract if made with a corporation for its general benefit.

ARTICLE 29 - ASSIGNMENT

Neither this subcontract nor any interest therein, or claim thereunder, shall be assigned or transferred by the Subcontractor except with the prior written approval of AUI. AUI may assign this subcontract in whole or in part to the Government and in the event of such assignment this subcontract may continue in full force and effect, notwithstanding the termination of the Prime Contract between the Government and AUI. The Subcontractor agrees to look solely to the Government for payment of the part so assigned.

ARTICLE 30 - EXAMINATION OF RECORDS

This clause is applicable if the amount of this subcontract exceeds \$2,500 and was entered into by means of negotiation, including small business restricted advertising, but is not applicable if this subcontract was entered into by means of formal advertising.

(b) The Subcontractor agrees that the Comptroller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment under this subcontract or such lesser time specified in the Federal Procurement Regulations Part 1-20, as appropriate,

have access to and the right to examine any directly pertinent books, documents, papers, and records of the Subcontractor involving transactions related to this subcontract.

- (c) The Subcontractor further agrees to include in all his subcontracts hereunder a provision to the effect that the Subcontractor agrees that the Comptoller General of the United States or any of his duly authorized representatives shall, until the expiration of three years after final payment under the subcontract or such lesser time specified in the Federal Procurement Regulations Part 1-20, as appropriate, have access to and the right to examine any directly pertinent books, documents, papers, and records of such subcontractor, involving transactions related to the subcontract. The term "subcontract" as used in this clause excludes (1) purchase orders not exceeding \$2,500 and (2) subcontracts or purchase orders for public utility services at rates established for uniform applicability to the general public.
- (d) The periods of access and examination described in (b) and (c), above, for records which relate to (l) appeals under the "Disputes" clause of this subcontract, (2) litigation or the settlement of claims arising out of the performance of this subcontract, or (3) costs and expenses of this subcontract as to which exception has been taken by the Comptroller General or any of his duly authorized representatives, shall continue until such appeals, litigations, claims, or exceptions have been disposed of.

ARTICLE 31 - FEDERAL, STATE AND LOCAL TAXES

- (a) As used throughout this clause, the term "subcontract date" means the date of this subcontract. As to additional supplies or services procured by modification of this subcontract, the term "subcontract date" means the date of such modification.
- (b) Except as may be otherwise provided in this subcontract, the subcontract price includes, to the extent allocable to this subcontract, all Federal, State and local taxes which, on the subcontract date:
- (1) By Constitution, statute, or ordinance, are applicable to this subcontract, or to the transactions covered by this subcontract, or to property or interests in property; or
- (2) Pursuant to written ruling or regulation, the authority charged with administering any such tax is assessing or applying to, and is not granting or honoring an exemption for, a Subcontractor under this kind of subcontract, or property or interests in property.
- (c) Except as may be otherwise provided in this subcontract, duties in effect on the subcontract date are included in the subcontract price, to the extent allocable to this subcontract.

- (d) (1) If the Subcontractor is required to pay or bear the burden
- (i) Of any tax or duty which either was not to be included in the sub-contract price pursuant to the requirements of paragraphs (b) and (c), or of a tax or duty specifically excluded from the subcontract price by a provision of this subcontract; or
- (ii) Of an increase in rate of any tax or duty, whether or not such tax or duty was excluded from the subcontract price; or
- (iii) Of any interest or penalty on any tax or duty referred to in (i) of (ii) above; the subcontract price shall be increased by the amount of such tax, duty, interest, or penalty allocable to this subcontract: Provided, that the Subcontractor, if requested by AUI, warrants in writing that no amount of such tax, duty, or rate increase was included in the subcontract price as a contingency reserve or otherwise; and Provided further, that liability for such tax, duty, rate increase, interest, or penalty was not incurred through the fault or negligence of the Subcontractor or his failure to follow instructions of AUI.
- (2) If the Subcontractor is not required to pay or bear the burden, or obtains a refund or drawback, in whole or in part, of any tax, duty, interest, or penalty which:
- (i) Was to be included in the subcontract price pursuant to the requirements of paragraphs (b) and (c);
 - (ii) Was included in the subcontract price; or
- (iii) Was the basis of an increase in the subcontract price; the subcontract price shall be decreased by the amount of such relief, refund, or drawback allocable to this subcontract, or the allocable amount of such relief, refund, or drawback shall be paid to AUI as directed by AUI. The subcontract price also shall be similarly decreased if the Subcontractor, through his fault or negligence or his failure to follow instructions of AUI, is required to pay or bear the burden, or does not obtain a refund or drawback of any such tax, duty, interest, or penalty. Interest paid or credited to the Subcontractor incident to a refund of taxes shall insure to the benefit of AUI to the extent that such interest was earned after the Subcontractor was paid or reimbursed by AUI for such taxes.
- (3) Invoices or vouchers covering any adjustment of the subcontract price pursuant to this paragraph (d) shall set forth the amount thereof as a separate item and shall identify the particular tax or duty involved.
- (4) The paragraph (d) shall not be applicable to social security taxes; income and franchise taxes, other than those levied on or measured by (i) sales or receipts from sales, or (ii) the Subcontractor's possession of, interest

in or use of property, title to which is in AUI; excess profits, taxes; capital stock taxes; unemployment compensation taxes; or property taxes other than such property taxes, allocable to this subcontract, as are assessed either on completed supplies covered by this subcontract, or on the Subcontractor's possession of, interest in, or use of property, title to which is in AUI.

- (5) No adjustment pursuant to this paragraph (d) will be made under this subcontract unless the aggregate amount thereof is or may reasonably be expected to be over \$100.
- (e) Unless there does not exist any reasonable basis to sustain an exemption, AUI upon request of the Subcontractor, without further liability agrees, except as otherwise provided in this subcontract, to furnish evidence appropriate to establish exemption from any tax which the Subcontractor warrants in writing was excluded from the subcontract price. In addition, AUI may furnish evidence appropriate to establish exemption from any tax that may, pursuant to this clause, give rise to either an increase or decrease in the subcontract price. Except as otherwise provided in this subcontract, evidence appropriate to establish exemption from duties will be furnished only at the discretion of AUI.
- (f) (1) The Subcontractor shall promptly notify AUI of all matters pertaining to Federal, State, and local taxes, and duties, that reasonably may be expected to result in either an increase or decrease in the subcontract price.
- (2) Whenever an increase or decrease in the subcontract price may be required under this clause, the Subcontractor shall take action as directed by AUI, and the subcontract price shall be equitably adjusted to cover the costs of such action, including any interest, penalty, and reasonable attorneys' fees.

- (a) Except as otherwise provided in this contract, any dispute concerning a question of fact arising under this subcontract which is not disposed of by mutual agreement of the parties shall be decided by the Director (NRAO) or his designee, who shall reduce his decision to writing and mail or otherwise furnish a copy thereof to the Subcontractor. The decision of the Director (NRAO) shall be final and conclusive unless, within 30 days from the date of receipt of such copy, the Subcontractor mails or otherwise furnishes to the National Science Foundation a written appeal addressed to the Contracting Officer (N.F). Following the receipt of such appeal the Contracting Officer shall immediately transmit the appeal to the Director, NSF for decision. The decision of the Director or his duly authorized representative for the determination of such appeals shall be final and conclusive. This provision shall not be pleaded in any suit involving a question of fact arising under this contract as limiting judicial review of any such decision to cases where fraud by such official or his representative or board is alleged: Provided, however, That any such decision shall be final and conclusive unless the same is fraudulent or capricious or arbitrary or so grossly erroneous as necessarily to imply bad faith or is not supported by substantial evidence. In connection with any appeal proceeding under this clause, the parties shall be afforded an opportunity to be heard and to offer evidence. Pending final decision of a dispute hereunder, the Contractor shall proceed diligently with the performance of the contract and in accordance with the Director's (NRAO) decision.
- (b) This Disputes clause does not preclude consideration of questions of law in connection with decisions provided for in paragraph (a) above. Nothing in this contract, however, shall be construed as making final the decision of any administrative official, representative, or board on a question of law.

ARTICLE 33 - USE OF CONCERNS IN LABOR SURPLUS AREAS

The following clauses are incorporated by reference and shall be regarded as if fully set forth herein:

Utilization of Concerns in Labor Surplus Areas, Federal Procurement Regulations Section 1-1.805-3(a), and if this subcontract exceeds \$500,000, 1-1.805-3(b).

ARTICLE 34 - UTILIZATION OF SMALL BUSINESS CONCERNS

The following clauses are incorporated by reference and shall be regarded as if fully set forth herein.

Utilization of Small Business Concerns, Federal Procurement Regulations Section 1-1.710-3(a), and if this subcontract exceeds \$500,000, 1-1.710-3(b).

ARTICLE 35 - GOVERNMENT PROPERTY

The Subcontractor assumes the risk of and shall be responsible for any loss of or damage to Government property in its possession or custody, regardless of cuase, except for reasonable wear and tear and except to the extent that such property is consumed in the performance of this subcontract, or until such time as the property is finally accepted by or otherwise surrendered to AUI. The Subcontractor shall utilize Government property only for purposes authorized by this subcontract. Upon completion of this subcontract all Government property in the possession or custody of the Subcontractor shall be delivered to AUI or disposed of as AUI may direct in writing.

ARTICLE 36 - MATERIALS AND PROPERTY FURNISHED

- (a) When AUI furnishes materials, parts, tooling, equipment or other property title to which is in the Government, Subcontractor's packing sheet and final invoice must contain this statement: "All materials, parts, tooling or other property furnished or acquired for this subcontract (except that which became normal industrial waste or was replaced at Subcontractor's expense) have been returned in the form of parts, unused material, equipment and tooling." Title to all such materials, equipment, and tooling furnished by AUI shall remain with AUI or the Government, and AUI shall at all times have the right to immediate repossession thereof.
- (b) If AUI furnishes any material for fabrication hereunder, Subcontractor agrees not to use any other material in such fabrication without AUI's written consent. AUI reserves the right to retain 10 percent of the total amount of the Subcontractor's invoice until all requirements of this clause have been fulfilled.
- (c) Except as otherwise provided in this subcontract, Subcontractor shall return any AUI or Government property furnished or acquired under this subcontract in as good condition as when received except for reasonable wear and tear or for utilization of the property in accordance with the requirements of this subcontract.

ARTICLE 37 - SITE INVESTIGATION

The Subcontractor acknowledges that he has investigated and satisfied himself as to conditions affecting the work, including but not restricted to those bearing upon transportation, disposal, handling and storage of materials, availability of labor, water, electric power, road, and uncertainties of weather, river stages, tides or similar physical conditions at the site, the conformation and conditions of the grounds, the character of equipment and facilities needed preliminary to and during prosecution of the work. Subcontractor further acknowledges that he has satisfied himself as to the character, quality and quantity of surface and subsurface materials or obstacles to be encountered insofar as this information is reasonably ascertainable from an inspection of the site, including all exploratory work done by AUI, as well as from information presented by the drawings and specifications made a part of this contract. Any failure by the Subcontractor to acquaint himself with the available information will not relieve him from responsibility for estimating properly the difficulty or cost of successfully performing the work. AUI assumes no responsibility for any conclusions or interpretations made by the Subcontractor on the basis of the information made available by AUI.

ARTICLE 38 - PROTECTION OF EXISTING VEGETATION, STRUCTURES, UTILITIES, AND IMPROVEMENTS

- (a) The Subcontractor will preserve and protect all existing vegetation such as trees, shrubs, and grass on or adjacent to the site of work which is not to be removed and which does not unreasonably interfere with the construction work.
- (b) The Subcontractor will protect from damage all existing improvements or utilities at or near the site of the work, the location of which is made known to him, and will repair or restore any damage to such facilities resulting from failure to comply with the requirements of this subcontract or the failure to exercise reasonable care in the performance of the work. If the Subcontractor fails or refuses to repair any such damage promptly, AUI may have the necessary work performed and charge the cost thereof to the Subcontractor.

ARTICLE 39 - OPERATIONS AND STORAGE AREAS

- (a) All operations of the Subcontractor (including storage of materials) upon Government premises shall be confined to areas authorized or approved by AUI The Subcontractor shall hold and save AUI, its officers and agents free and harmless from liability of any nature occasioned by his operations.
- (b) Temporary buildings (storage sheds, shops, offices, etc.) may be erected by the Subcontractor only with the approval of AUI, and shall be built with labor and materials furnished by the Subcontractor without expense to AUI.

Such temporary buildings and utilities shall remain the property of the Sub-contractor and shall be removed by him at his expense upon the completion of the work. With the written consent of AUI, such buildings and utilities may be abandoned and need not be removed.

ARTICLE 40 - SUBCONTRACTORS

Within seven days after the award of any lower tier construction subcontract by the Subcontractor, he shall deliver to AUI a statement setting forth the name and address of the lower tier subcontractor(s) and a summary description of the work to be subcontracted. The Subcontractor shall at the same time furnish a statement signed by its lower tier subcontractor(s) acknowledging the inclusion in its subcontract of the clauses of this contract entitled "Equal Opportunity in Employment", "Davis-Bacon Act", "Contract Work Hours Standards Act - Overtime Compensation", "Apprentices", "Payrolls and Basic Payroll Records", "Compliance with Copeland Regulations", "Withholding of Funds", "Subcontracts", and "Contract Termination - Debarment". Nothing contained in this subcontract shall create any contractual relation between any such lower tier subcontractor and AUI.

ARTICLE 41 - CLEANING UP

The Subcontractor shall at all times keep the construction area, including storage areas used by him, free from accumulations of waste material or rubbish and prior to completion of the work remove any rubbish from the premises and all tools, scaffolding, equipment, and materials not the property of the Government or AUI. Upon completion of the construction the Subcontractor shall leave the work and premises in a clean, neat and workmanlike condition satisfactory to AUI.

ARTICLE 42 - GUARANTEE

The Subcontractor shall warrant his design, the fabrication and assembly based thereon as meeting the design requirements set forth in Section 03 of the Request for Proposals, including material and workmanship for a period of one year from final acceptance. The Subcontractor shall not be required to readjust the surface of the telescope reflectors after the final acceptance required in Section 03 unless the need for readjustment is based upon failure of the design and installation to meet all other requirements of Section 03, including material and workmanship.

ARTICLE 43 - SHOP DRAWINGS

(a) The Subcontractor shall submit to AUI for approval the requested number of copies of all shop drawings as called for under the terms, conditions and specifications of this subcontract. These drawings shall be complete and detailed. If approved by AUI, each copy of the drawings will be identified as having received such approval by being so stamped and dated. The Subcontractor shall make any corrections required by AUI. If the Subcontractor considers any corrections indicated on the drawings to constitute a change to the subcontract

drawings or specifications, notice as required under the clause entitled "Changes" will be given to AUI. One set will be returned to the Subcontractor. The approval of the drawings by AUI shall not be construed as a complete check, but will indicate only that the general method of assembly and detailing is satisfactory. Approval of such drawings will not relieve the Subcontractor of the responsibility of any error which may exist as the Subcontractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory assembly of all work.

(b) "As built" shop drawings are required for the permanent record of AUI.

Upon completion of the work under this subcontract, the Subcontractor shall furnish a complete set of reporducibles of all shop drawings as finally approved. These drawings shall show all changes and revisions made up to the time the equipment is completed and accepted.

- (c) Shop drawings for construction means drawings submitted to AUI by the construction Subcontractor or any lower tier Subcontractor pursuant to a construction contract, or the construction portion of a contract combining supply and construction work, showing in detail:
 - (1) The proposed fabrication and assembly of structural elements and.
- (2) The installation (i.e., form, fit and attachment details) of materials or equipment. AUI may duplicate, use and disclose in any manner and for any purpose shop drawings delivered under this subcontract.

ARTICLE 44 - PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA

- (a) If AUI or the Government determines that any price, including profit or fee, negotiated in connection with this subcontract or any cost reimbursable under this contract was increased by any significant sums because the Subcontractor, or any of its subcontractors pursuant to the clause of this subcontract entitled "Subcontractor Cost or Pricing Data" or "Subcontractor Cost or Pricing Data Price Adjustments," or any subcontract clause therein required, furnished incomplete or inaccurate cost or pricing data or data not current as certified in his Certificate of Current Cost or Pricing Data, then such price or cost shall be reduced accordingly and the contract shall be modified in writing to reflect such reduction.
- (b) Failure to agree on a reduction shall be a dispute concerning a question of fact within the meaning of the "Disputes" clause of this subcontract.

ARTICLE 45 - SUBCONTRACTOR COST AND PRICING DATA

(a) The Subcontractor shall require subcontractors hereunder to submit in writing cost or pricing data under the following circumstances:

- (1) Prior to award of any cost-reimbursement type, time-and-material, labor-hour, incentive, or price redeterminable subcontract, the price of which is expected to exceed \$100,000; and
- (2) Prior to the award of any other subcontract, the price of which is expected to exceed \$100,000 or to the pricing of any subcontract change or other modification for which the price adjustment is expected to exceed \$100,000, where the price or price adjustment is not based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.
- (b) The Subcontractor shall require subcontractors to certify in a form that is acceptable to AUI that, to the best of their knowledge and belief, the cost and pricing data submitted under paragraph (a) above are accurate, complete, and current as of the date of the execution, which date shall be as close as possible to the date of agreement on the negotiated price of the subcontract or subcontract change or modification.
- (c) The Subcontractor shall insert the substance of this article, including this paragraph (c), in each of his cost-reimbursement type, time-and-material, labor-hour, price redeterminable, or incentive subcontracts hereunder, and in any other subcontract hereunder which exceeds \$100,000 unless the price thereof is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation. In each such excepted subcontract hereunder which exceeds \$100,000, the Subcontractor shall insert the substance of the following article:

SUBCONTRACTOR COST AND PRICING DATA - PRICE ADJUSTMENTS

- 1. Paragraphs (b) and (c) of this article shall become operative only with respect to any change or other modification made pursuant to one or more provisions of this subcontract which involves a price adjustment in excess of \$100,000. The requirements of this article shall be limited to such price adjustments.
- 2. The Subcontractor shall require subcontractors hereunder to submit cost or pricing data under the following circumstances:
- (a) Prior to award of any cost-reimbursement type, time-and-material, labor-hour, incentive, or price redeterminable subcontract, the price of which is expected to exceed \$100,000; and
- (b) Prior to award of any other subcontract, the price of which is expected to exceed \$100,000, or the pricing of any subcontract change or other modification for which the price

adjustment is expected to exceed \$100,000, where the price adjustment is not based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.

- 3. The Subcontractor shall require subcontractors hereunder to certify, in substantially the same form as that used in the Certificate by the Subcontractor to AUI that, to the best of their knowledge and belief, the cost and pricing data submitted under paragraph 2 above are accurate, complete, and current as of the date of the execution, which date shall be as close as possible to the date of agreement on the negotiated price of the contract modification.
- 4. The Subcontractor shall insert the substance of this article, including this paragraph 4, in each subcontract hereunder which exceeds \$100,000.

ARTICLE 46 - SUBCONTRACT PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA

(a) The Subcontractor shall insert the substance of the following article in each of its cost-reimbursement type, time-and-material, labor-hour, price redeterminable or incentive subcontracts hereunder in excess of \$100,000, and in any other subcontract hereunder in excess of \$100,000 unless the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.

PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA

- 1. If AUI or the Government determines that any price, including profit or fee, negotiated in connection with this subcontract was increased by any significant sums because the Subcontractor, or any of his subcontractors in connection with the subcontract covered by paragraph 2 below, furnished incomplete or inaccurate cost or pricing data not current as certified in his Subcontractor's Certificate of Current Cost or Pricing Data, then such price shall be reduced accordingly and the subcontract shall be modified in writing to reflect such adjustment.
- 2. The Subcontractor agrees to insert the substance of this article in each of his cost-reimbursement type, time-and-material, labor-hour, price redeterminable, or incentive subcontracts hereunder in excess of \$100,000 unless the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public,

or prices set by law or regulation. In each such excepted subcontract hereunder which exceeds \$100,000, the Subcontractor shall insert the substance of the following article:

PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA - PRICE ADJUSTMENTS

- 1. This article shall be come operative only with respect to any change or other modification made pursuant to one or more provisions of this subcontract which involves a price adjustment in excess of \$100,000 that is not based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation. The right to price reduction under this article shall be limited to such price adjustments.
- 2. If AUI or the Government determines that any price, including profit or fee, negotiated in connection with any price adjustment within the purview of paragraph 1 above was increased by any significant sums because the Subcontractor or any of his subcontractors in connection with a subcontract covered by paragraph 3 below, furnished incomplete or inaccurate cost or pricing data or data not current as of the date of execution of the Subcontractor's Certificate of Current Cost or Pricing Data, then such price shall be reduced accordingly and the subcontract shall be modified in writing to reflect such adjustment.
- 3. The Subcontractor agrees to insert the substance of this article in each subcontract hereunder which exceeds \$100,000.
- (b) In subcontracts hereunder in excess of \$100,000 where the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation, the Subcontractor shall insert the substance of the above article entitled "Price Reduction for Defective Cost or Pricing Price Adjustments".

ARTICLE 47 - AUDIT AND RECORDS

(a) The Subcontractor shall maintain books, records, documents, and other evidence and accounting procedures and practices, sufficient to reflect properly all costs of whatever nature claimed to have been incurred and anticipated to be incurred for the performance of this subcontract. The foregoing constitute "records" for the purpose of this article.

- (b) The Subcontractor's facilities, or such part thereof as may be engaged in the performance of this subcontract, and its records shall be subject at all reasonable times to inspection and audit by the Contracting Officer or his authorized representative.
- (c) The Subcontractor shall preserve and make available its records:
- (1) Until the expiration of three years from the date of final payment under this subcontract, and
- (2) For such longer period, if any, as is required by applicable statute, or by other provisions of this subcontract, or by the two following paragraphs.

If this subcontract is completely or partially terminated, the records relating to the work terminated shall be preserved and made available for a period of three years from the date of any resulting final settlement.

Records which relate to (i) appeals under the "Disputes" article of this subcontract or (ii) litigation or the settlement of claims arising out of the performance of this subcontract, shall be retained until such appeals, litigation, or claims have been disposed of.

(d) (1) The Subcontractor shall insert the substance of the following article in each firm fixed price subcontract hereunder in excess of \$100,000 except those subcontracts covered by subparagraph (d)(3) below:

AUDIT

- 1. For purposes of verifying that cost or pricing data submitted in conjunction with the negotiation of this subcontract or any subcontract change or other modification involving an amount in excess of \$100,000 are accurate, complete and current, AUI, or the Government, shall, until the expiration of three years from the date of final payment under this subcontract, have the right to examine those books, records, documents, and other supporting data which will permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used therein, which were available to the Subcontractor as of the date of execution of the Subcontractor's Certificate of Current Cost or Pricing Data.
- 2. The Subcontractor agrees to insert the substance of this article, including this paragraph 2, in all subcontracts hereunder in excess of \$100,000 unless the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.

(3) The Subcontractor shall insert the substance of the following article in each firm fixed-price subcontract hereunder in excess of \$100,000 where the price is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.

AUDIT - PRICE ADJUSTMENTS

- 1. This article shall become operative only with respect to any change or other modification made pursuant to one or more provisions of this subcontract which involves a price adjustment in excess of \$100,000 unless theprice adjustment is based on adequate price competition, established catalog or market prices of commercial items sold in substantial quantities to the general public, or prices set by law or regulation.
- 2. For purposes of verifying that any cost or pricing data submitted in conjunction with a subcontract change or other modification involving an amount in excess of \$100,000 are accurate, complete, and current, AUI or the Government shall, untilthe expiration of three years from the date of final payment under this contract, have the right to examine those books, records, documents, and other supporting data which will permit adequate evaluation of the cost or pricing data submitted, along with the computations and projections used therein, which were available to the Subcontractor as of the date of execution of the Subcontractor's Certificate of Current Cost or Pricing Data.
- 3. The Subcontractor agrees to insert the substance of this article, including this paragraph 3, in all subcontracts hereunder in excess of \$100,000, so as to apply until three years after final payment of the subcontract.

ARTICLE 48 - REQUIRED SOURCE FOR ALUMINUM INGOT

(a) As used in this article (i) the term "aluminum products" means aluminum or aluminum alloy in its last commercial form delivered by the producer, mill, or foundry as an end item under this contract, or used to produce an end item under this contract, such as by way of example (but not limited to) wrought aluminum products; forgings and castings; rolled bar, rod, structural shapes, and bare wire; aluminum conductor, steel reinforced and bare aluminum cable; insulated or covered wire or cable; extruded bar, rod, shapes and tube (extruded, drawn and welded tube); sheet, strip, and plate; pig or ingot; granular or shot; slab; foil; and powder, flake or paste; and (ii) the term "supplier" includes vendors, materialmen, warehousemen, distributors or manufacturers of aluminum products or other items containing aluminum in any form.

(b) Except as provided in paragraph (c) below, the Subcontractor (or subcontractor and supplier, where applicable) shall purchase from the General Services Administration (GSA) a quantity of aluminum pig or ingot equal in weight to the gross weight of aluminum products constituting, or used in the production of, the items to be delivered under this subcontract. Such purchase shall be in accordance with the terms and conditions of sale prescribed therefor by GSA. Each order placed with GSA pursuant to this article shall state that it is placed in accordance therewith and shall be sent to:

Director, Industry Materials Division Defense Materials Service General Services Administration Washington, D. C. 20405

Aluminum purchased pursuant to this article may be used in any manner the Subcontractor desires and need not be earmarked in any way after delivery to the Subcontractor, nor physically incorporated in the items to be delivered hereunder.

- (c) To the extent the Subcontractor or subcontractor or supplier, where applicable, places subcontracts or purchase orders for aluminum products, or for items other than aluminum products and containing aluminum in any form, or for construction where the Subcontractor is to furnish materials containing aluminum in any form, he is not required with respect to such subcontracts or purchase orders to purchase aluminum from the GSA. However, he agrees to incorporate this article:
- (1) In any such subcontract or purchase order for aluminum products in the total amount of \$500 or more; or
- (2) In any such subcontract or purchase order in the total amount of \$25,000 or more for any items containing aluminum in any form where the quantity of aluminum products used in the production of such items is estimated to be 10,000 pounds or more; or
- (3) Construction, where the materials are to be supplied by the Subcontractor and the total value of such materials containing aluminum (in any form) is estimated to be \$25,000 or more, and where the quantity of aluminum products used in the production of such items is estimated to be 10,000 pounds or more.
- (d) The Contractor shall furnish to the GSA calendar quarterly summaries (within 30 days following the close of the applicable quarter) of all subcontracts and purchase orders placed by him pursuant to paragraph (c)(1) above that will identify (i) each aluminum product supplier involved, (ii) the quantity (by weight) of aluminum products, and (iii) the contract number applicable to specific quantities. The requirements of this paragraph (d) are applicable only to the prime Contractor and not to any Subcontractor or other supplier hereunder. This reporting requirement has been approved by the Bureau of the Budget in accordance with the Federal Reports Act of 1942.

- (e) The requirements of this article are not intended to preclude basic agreements or other arrangements between the parties to any Subcontracts (subcontracts or purchase orders) subject to this article that will permit reference in such contracts to the applicability of the requirements of this article, without the need for physically incorporating this article in its entirety in each affected subcontract or purchase order.
- (f) In placing subcontracts and purchase orders subject to the article, the Subcontractor and all subcontractors and suppliers are authorized and encouraged to consolidate aluminum product purchases hereunder with other defense rated order purchases (ACM, DO, or DX) and other identifiable Government orders so as to apply the requirements of this article to the total purchase. Otherwise, it is required either that aluminum produce purchases subject to this article be separately made, or if consolidated with other aluminum product purchases, that the quantities (by weights) of aluminum products subject to this article be separately set forth in thepurchase document and identified as subject to this article.
- (g) Required purchases of aluminum from GSA by Subcontractor, its subcontractors, or suppliers shall be made within 90 days from the date (i) of final delivery pursuant to a subcontract or purchase order containing the requirements of this article, or (ii) when the Subcontractor, or its subcontractor or supplier, has completed deliveries of aluminum products aggregating 100,000 pounds, whichever is earlier: Provided, however, that any Subcontractor, or its subcontractor or supplier may defer required purchases of aluminum for the purpose of consolidating purchases to meet the requirement of two or more subcontracts or purchase orders containing this article until 90 days after the aggregate purchase requirements of such subcontracts or purchase orders equal the minimum order quantities established by GSA (approximately 10,000 pounds or more). Successive consolidated purchases thereafter may be made at any time within 90-day intervals. The 90-day limitations may be extended upon approval in writing by the GSA.
- (h) Certain producers of aluminum have entered into contracts with GSA effective as of November 1, 1965, under which they have made long-term commitments to purchase certain minimum and maximum quantities of aluminum from that Agency. The obligations of such producers under this article shall be governed by the provisions of those contracts to the extent of any inconsistency.
- (i) All purchases made purusant to this article, other than from GSA, which are rated (ACN, DO, or DX) in accordance with DMS Regulation 1, NPA Order M-5A and GDSA Regulation 2, are subject to the provisions of those regulations governing the maintenance of records, rights and inspection and audit, and the penalty provisions contained therein for willful noncompliance.

ARTICLE 49 - COMPLIANCE WITH LAWS AND REGULATIONS

The Subcontractor agrees to comply with all applicable Federal, State and local laws and regulations, including those applicable by reason of the fact that this subcontract is issued under a prime contract with the United States Government.

ARTICLE 50 - DISCLOSURE OF INVENTIONS

- (a) Whenever, in the course of the work hereunder, any discovery of invention related to said work is made by the Subcontractor or any of his employees, or by any person directly associated with the Subcontractor in technical or professional work hereunder, the Subcontractor shall furnish the Foundation with complete information thereon. After appropriate consideration of the public interest and the equities of the parties, in accordance with Section 12a of the National Science Foundation Act of 1950, the Foundation shall determine the disposition of the invention and right thereto, including title to and rights under any patent application or patent that may issue thereon. The Subcontractor agrees to execute all documents necessary for the Foundation to make proper disposition.
- (b) No claim against the Government shall be asserted by the Subcontractor or its employees with respect to any invention conceived in performance under this subcontract.
- (c) If the Subcontractor shall secure execution of agreements in approved form to effectuate the purposes of the foregoing paragraph (a) from each person covered by paragraph (a) other than clerical and manual labor personnel who do not have access to technical information in the regular course of their employment, the Subcontractor shall not be responsible to the Government for any default under this Article on his part which is caused by the non-performance of such agreement by such individual; the Subcontractor, however, agrees that in the event any such individual shall fail to perform his agreement with the Subcontractor to such extent that he is unable to perform his obligations to the Government under this Article, the Subcontractor will assign to the Government so far as is legally possible, all rights of the Subcontractor therein.

ARTICLE 51 - LISTING OF EMPLOYMENT OPENINGS

(This clause is applicable pursuant to 41 CFR 50-250 if this contract is for \$2,500 or more.)

(a) The Subcontractor agrees, in order to provide special emphasis to the employment of qualified disabled veterans and veterans of the Vietnam era, that all suitable employment openings of the Subcontractor which exist at the time of execution of this subcontract and those which occur during the performance of this subcontract, including those not generated by this subcontract and including those occurring at an establishment other than the one wherein the subcontract is being performed but excluding those of independently operated corporate affiliates, shall be offered for listing at an appropriate local office of the State employment service system wherein the opening occurs and to provide such reports to such local office regarding employment openings and hires as may be required: Provided, That if this contract is for less than \$10,000 or if it is with a State or local government, the reports set forth in paragraphs (c) and (d) are not required.

- (b) Listing of employment openings with the employment service system pursuant to this article shall be made at least concurrently with the use of any other recruitment service or effort and shall involve the normal obligations which attach to the placing of a bona fide job order, including the acceptance of referrals of veterans and non-veterans. This listing of employment openings does not require the hiring of any particular job applicant or from any particular group of job applicants, and nothing herein is intended to relieve the Subcontractor from any requirements in any statutes, Executive orders, or regulations regarding non-discrimination in employment.
- (c) The reports required by paragraph (a) of this clause shall include, but not be limited to, periodic reports which shall be filed at least quarterly with the appropriate local office or, where the Subcontractor has more than one establishment in a state, with the central office of the state employment service. Such reports shall indicate for each establishment (i) the number of individuals who were hired during the reporting period, (ii) the number of those hired who were disabled veterans, and (iii) the number of those hired who were nondisabled veterans of the Vietnam era. The Subcontractor shall submit a report within 30 days after the end of each reporting period wherein any performance is made under this subcontract. The Subcontractor shall maintain copies of the reports submitted until the expiration of 1 year after final payment under the subcontract, during which time they shall be made available, upon request, for examination by any authorized representatives of AUI, the Foundation or of the Secretary of Labor.
- (d) Whenever the Subcontractor becomes contractually bound by the listing provisions of this clause, he shall advise the employment service system in each state wherein he has establishments of the name and location of each such establishment in the state. As long as the Subcontractor is contractually bound to these provisions and has so advised the state employment system, there is no need to advise the state system of subsequent subcontracts. The Subcontractor may advise the state system when it is no longer bound by this subcontract article.
- (e) This article does not apply to the listing of employment openings which occur and are filed outside of the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands.
- (f) This article does not apply to openings which the Subcontractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement. This exclusion does not apply to a particular opening once an employer decides to consider applicants outside his own organization or employer-union arrangement for that opening.

(g) As used in this article:

(1) "All suitable employment openings" includes, but is not limited to, openings which occur in the following job categories: Production and non-production; plant and office; laborers and mechanics; supervisory and non-supervisory; technical; and executive, administrative, and professional openings which are compensated on a salary basis of less than \$18,000 per year. The term includes full-time employment, temporary employment of more than 3 days' duration, and part-time employment. It does not include openings which the Subcontractor proposes to fill from within his own organization or to fill pursuant to a customary and traditional employer-union hiring arrangement.

- (2) "Appropriate office of the state employment service system" means the local office of the Federal-State national system of public employment offices with assigned responsibility for serving the area of the establishment where the employment opening is to be filled, including the District of Columbia, the Commonwealth of Puerto Rico, Guam, and the Virgin Islands.
- (3) "Openings which the Subcontractor proposes to fill from within his own organization" means employment openings for which no consideration will be given to persons outside the Subcontractor's own organization (including any affiliates, subsidiaries, and parent companies), and includes any openings which the Subcontractor proposes to fill from regularly established "recall" or "rehire" lists.
- (4) "Openings which the Subcontractor proposes to fill pursuant to a customary and traditional employer-union hiring arrangement" means employment openings for which no consideration will be given to persons outside a special hiring arrangement, including openings which the Subcontractor proposes to fill from union halls, which is part of the customary and traditional hiring relationship which exists between the Subcontractor and representatives of his employees.
- (5) "Disabled veteran" means a person entitled to disability compensation under laws administered by the Veterans Administration for a disability rated at 30 percentum or more, or a person whose discharge or release from active duty was for a disability incurred or aggravated in line of duty.
- (6) "Veteran of the Vietnam era" means a person (A) who (i) served on active duty with the Armed Forces for a period of more than 180 days, any part of which occurred after August 5, 1964, and was discharged or released therefrom with other than a dishonorable discharge, or (ii) was discharged or released from active duty for service-connected disability if any part of such duty was performed after August 5, 1964, and (B) who was so discharged or released within 48 months preceding his application for employment covered by this clause.
- (h) If any disabled veteran of the Vietnam era believes that the Subcontract tractor has failed or refuses to comply with the provisions of this subcontract clause relating to giving special emphasis in employment to veterans, such veteran may file a complaint with the veterans' employment representative at a local state employment service office who will attempt to informally resolve the complaint and then refer the complaint with a report on the attempt to resolve the matter to the state office of the Veterans' Employment Service of the Department of Labor who shall investigate such complaint and shall take such action thereon as the facts and circumstances warrant consistent with the terms of this subcontract and the laws and regulations applicable thereto.

ARTICLE 52 - PRICING OF ADJUSTMENTS

When costs are a factor in any determination of a contract price adjustment pursuant to the "Changes" clause or any other provision of this contract, such costs shall be in accordance with the contract cost principles and procedures in Part'1-15 of the Federal Procurement Regulations (41 CFR 1-15) in effect on the date of this subcontract.

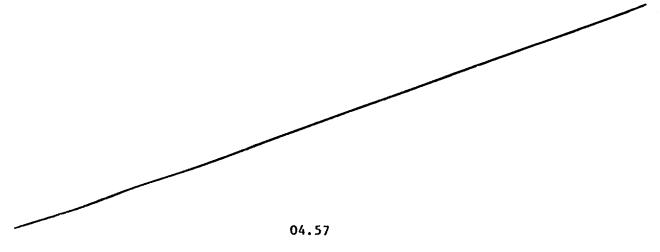
ARTICLE 53 - WALSH-HEALEY PUBLIC CONTRACTS ACT

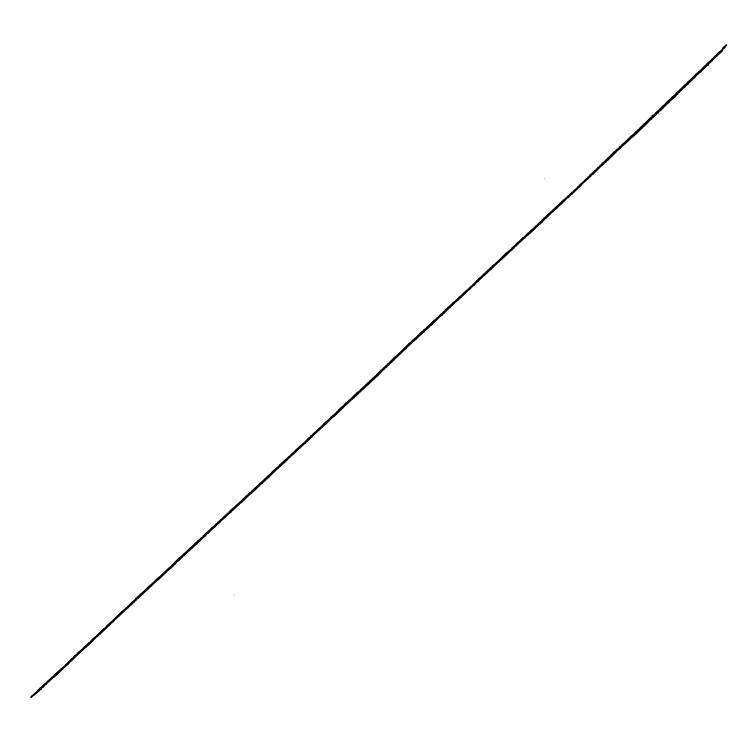
If this Subcontract is for the manufacture or furnishings of materials, supplies, articles, or equipment in an amount which exceeds or may exceed \$10,000 and is otherwise subject to the Walsh-Healey Public Contracts Act, as amended (41 U.S. Code 35-45), there are hereby incorporated by reference all representations and stipulations required by said Act and regulations issued thereunder by the Secretary of Labor, such representations and stipulations being subject to all applicable rulings and interpretations of the Secretary of Labor which are now or may hereafter be in effect.

ARTICLE 54 - LIMITATION OF PRICE AND SUBCONTRACTOR OBLIGATIONS

- (a) Funds are available for performance of this subcontract in the amount specifically described in the Schedule, as available for subcontract performance. The amount of funds so described at the time of award is not considered sufficient for the subcontract performance required by and described in the Schedule for any quantity other than that specifically authorized at the start of this subcontract. Upon availability to AUI of additional funds sufficient for performance of the full requirements or the next quantity, AUI shall, not later than the date specified in the Schedule, unless a later date is agreed to by the parties, so notify the Subcontractor in writing and the amount of funds described in the Schedule as available for subcontract performance and the quantity authorized shall be modified accordingly. This procedure shall apply for each quantity.
- (b) AUI is not obligated to the Subcontractor for subcontract performance in any monetary amount in excess of that described in the Schedule or modifications thereto, as available for subcontract performance.
- (c) The Subcontractor is not obligated to incur costs for the performance required for any quantity after the first authorized quantity until he has been notified in writing by AUI of an increase in availability of funds in accordance with paragraph (a) of this article. If so notified, the Subcontractor's obligation shall be increased only to the extent subcontract performance is required for the additional quantity for which funds have been made available.
- (d) In the event of termination pursuant to the "Termination for Convenience" article of this subcontract, the term "total subcontract price" as used in that clause refers to the amount available for performance of this subcontract, as provided for in this clause, plus administrative settlement costs, and a reasonable profit. In the event of termination for default AUI's rights under this subcontract shall apply to the entire quantity.
- (e) Notification to the Subcontractor of an increase or decrease in the funds available for performance of this subcontract as a result of a clause other than this clause (e.g. the "Changes" clause) shall not constitute the notification contemplated by paragraph (a) of this clause.

ARTICLE 55 - RESERVED





ARTICLE 56 - AUTHORIZATION AND CONSENT

In accordance with the terms of its contract with the Foundation, AUI hereby gives its authorization and consent (without prejudice to any rights of indemnification) for all use and manufacture, in the performance of this subcontract or any part hereof or any amendment hereto or (including any lower-tier subcontract), of any invention described in and covered by a patent of the United States (i) embodied in the structure or composition of any article the delivery of which is accepted by AUI under this contract, or (ii) utilized in the machinery, tools, or methods

the use of which necessarily results from compliance by the subcontractor or the using lower-tier subcontractor with (a) specifications or written provisions now or hereafter forming a part of this contract, or (b) specific written instructions given by AUI directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clauses, if any, included in this subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.

ARTICLE 57 - NEW MEXICO GROSS RECEIPTS AND COMPENSATING TAX

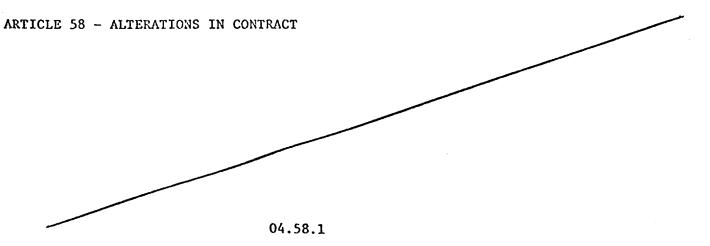
Until such time as the liability of AUI and its subcontractors for payment of the New Mexico gross receipts and compensating tax is resolved, subcontractor payment of taxes assessed by the State of New Mexico shall be made in accordance with the following:

Immediately upon receipt of their assessment against the subcontractor by the State of New Mexico, subcontractors shall request approval by AUI to pay such taxes. The request for approval shall include:

- 1. The amount of the tax
- 2. Value of the work or services against which the tax is assessed
- 3. The physical location of the work or services against which the tax is assessed
- 4. Date when tax must be paid without penalty

Upon receipt of approval from AUI, the subcontractor shall pay the approved amount of taxes under protest or in accordance with such other written instructions as are issued by AUI.

AUI shall reimburse the subcontractor for the amount of the New Mexico gross receipts or compensating taxes actually paid when paid in accordance with written approval of AUI. The amount of such payments will be added to the subcontract price by change order to the subcontract. In the event AUI or the subcontractor become entitled to a refund of the New Mexico gross receipts or compensating taxes paid to the State of New Mexico, the subcontractor shall diligently pursue the request for such refund and shall, at the option of AUI, pay back the amount of any and all refunds received plus any accrued interest or credit such amounts against the sum or sums due from AUI to the subcontractor, and the subcontract will be modified to reflect a decrease in the total price measured by the amount of the tax refund.



SECTION 03. SPECIFICATIONS AND STATEMENT OF WORK

03.1. Introduction

03.1.1. General Statement of Work

The work described herein shall consist of the furnishing of all labor, materials, services, drawings, data and other items required for the detailed design, manufacture, assembly on site, alignment and testing of antennas for the VLA antenna system.

03.1.2. Objectives of the Program

The objectives of the effort under this subcontract are the following:

The design of an antenna that meets the operating parameters and requirements set forth in this specification.

The design for an antenna that is optimized for production of a quantity of 28 antennas, taking advantage of economies that may be realized by maximum duplication of parts, use of tooling to minimize labor, and simplification of assembly effort.

A design that takes into consideration ease of maintenance and the reliability of components to minimize maintenance.

The manufacture of antennas using the techniques and tooling developed and specified in the design effort.

The assembly and alignment of the antennas according to the specifications and procedure.

The performance of tests to establish that antennas meet specified performance requirements.

03.2. Design

03.2.1. Applicable Documents

The following documents are to be used as a guide in the preparation of the design. The development of additional drawings and specifications supplementing and extending these documents are a part of the effort required in the design stage. In the event of a conflict between this specification and any of the documents listed, this specification shall govern:

SK 2390, Sheets 1, 2, 3 - 82 Diameter AZ-EL Antenna - Concept 4

Dwgs. 90D00001 and 90D00002 - Concept No. 5

Dwg. 112-D-001, Sheets 1, 3, 4 - Transport Vehicle

Electronic Industries Association RS-222 - Structural Standards for Steel Transmitting Antennas and Supporting Steel Towers

National Fire Protection Association - National Electrical Code - Latest edition

American Institute of Steel Construction - Manual of Steel Construction - Latest edition

MIL. STD. - 461A - Electromagnetic Interference

Dwgs. SK 2390, Sheets 1, 2 and 3 and Dwgs. 90D00001 and 90D00002 are for reference use to describe a concept that AUI considers as representing a desirable configuration. They are not to be considered as establishing design dimensions, component sizes or design details. It will be the responsibility of the Subcontractor to develop a design configuration and detailed design that meet the operating and performance parameters as set forth later in this document.

03.2.2. Design and Performance Parameters

The antenna system for which this antenna is designed consists of 28 antennas with 25-meter diameter reflectors. The antennas are to be transportable to various stations along a double railroad track by use of a transport vehicle as shown on Dwg. 112-D-001.

The antenna shall be an elevation over azimuth configuration with a 25-meter diameter solid surfaced paraboloid of revolution as the main reflector. The observing systems to be used shall be both Cassegrain and prime focus. Use of a Cassegrain observing system shall be considered the normal mode of operation, but provision for removal of the secondary reflector and installation of a receiver for operating as a prime

focus instrument will require a clear opening of approximately 4 feet diameter at the apex of the feed legs symmetrical about the reflector axis.

The antenna shall meet the following mechanical and operating parameters and conditions:

03.2.2.1. Mechanical Parameters

Diameter - 25 meters (82 ft) Focal Length - 9 meters (29.5 ft) f/D - 0.36

Sky Coverage - Elev. +5° to 125°; Az. + 270° Observing System - Cassegrain or prime focus (feeds and secondary reflector are not a part of this contract)

Operational Frequency - 1.35 GHz (22 cm) to 25 GHz (1.2 cm)

Surface Accuracy - Installed RMS of 0.75 mm (0.030 in.) including manufacturing, alignment, gravity operating wind and thermal errors under the specified precision operating conditions. Peak deviation from best fit design surface of revolution shall not exceed 2.2 mm (0.090 in.) under the specified precision operating conditions.

Panel Gap - 1.5 mm \pm 0.5 mm (0.060 in. \pm 0.020 in.) Axis Alignment -

Azimuth axis to plane of telescope base plates - 18 arc seconds

Orthogonality azimuth to elevation - 18 arc seconds

Orthogonality reflector axis to elevation - 18 arc seconds

Subreflector axis to reflector - alignment of the subreflector will be accomplished by an AUI furnished adjustable mounting mechanism. The structure at the apex of the feed legs must, however, locate the center of the opening coincident within 0.1 in. and the axis of the opening parallel within 30 arc seconds of the axis of the reflector.

Counterbalancing - Overbalanced to allow the antenna to return to zenith with no drive power under no wind, no ice, no snow conditions.

Tower - Internal adjustment features are to be provided at the base of the tower to permit alignment of the azimuth axis to gravity in order to match all antennas on a master foundation.

Drive Requirements - Azimuth and elevation drives shall have a capability of driving the antenna at a velocity of 40° per minute in azimuth and 20° per minute in elevation, with the reflector in any attitude under the specified operating conditions. Azimuth and elevation drives shall drive the antenna at sidereal tracking rates with an accuracy as specified in Section 03.2.8.9.

03.2.2.2. Operating Parameters and Conditions

General

The antennas will be exposed to the elements on a site 7000 feet above sea level. The antennas are to be designed for a life expectancy of 20 years. No damage to the operating components of the antennas must occur due to airborne sand or dust or accumulation of frozen or liquid water.

Requirements to be met for precision operation

Precision operation requires that the telescopes meet the surface and pointing accuracies stated above. Precision operation must be achieved under the following conditions:

Temperature range - -15° - +80° F

Maximum temperature difference between any
parts of the antenna structure - 5° F

Relative humidity - 0 - 50%

Rain rate - Maximum rate up to 0.2 in./hour

Ice or snow load - None

Wind (measured at 40-ft elevation) - Up to
15 miles/hour with gusts of ± 3 miles per
hour superimposed. Wind from any direction,
reflector in any position.

Requirements to be met for normal operation

Normal operation means that the telescopes will continue to be fully operable, but with reduced

pointing and surface accuracies. Normal operation must be possible under the following conditions:

Temperature range - -22° F to 123° F
Relative humidity - 0 - 98%
Rain rate - Maximum rate up to 2 in./hour
Ice or snow load - None
Wind (measured at 40-ft elevation) - Up to
40 miles/hour, with gusts of ± 5 miles/hour
superimposed. Wind from any direction;
reflector in any position.

Requirements to be met in moving to stow and in the stowed position

<u>Slew to stow</u> - The antenna shall be capable of being slewed to the stow position in winds of 60 miles/hour with all exposed surfaces of the structure coated with 1-cm radial thickness of ice. The slew rate may fall to 10°/minute.

Slew to dump snow - The antenna shall be capable of dumping snow by slewing at 20°/minute to any position 5° above the horizon with a wind of 25 miles/hour blowing from any direction and with an original uniform snow load in the reflector of 4 lbs/ft². No damage or overload shall occur to either structure or drives.

<u>Survival</u> - The antenna is to be designed to survive in the zenith position in winds of 110 miles/ hour with 1 cm of radial ice on all exposed surfaces or when loaded with 20 lbs/ft² snow. When loaded under these conditions, yield stresses of materials shall not be exceeded and no permanent deformation shall occur. Stow brakes shall be provided capable of holding the antenna in the zenith position when subjected to the design survival loading.

All components of the antenna shall be properly designed for the loads and operating conditions to which they will be subjected. Design shall be based on a normal operating life of 20 years. The design shall provide adequate protection for all

parts of the antenna against rain, dust, weathering and the accumulation of frozen or liquid water. It is anticipated that antennas will receive an overhaul at approximate 3-year intervals.

03.2.3. Statement of the Design Work

The-objective of the design work shall be the production of the design of an antenna which will meet the Design and Performance Parameters as set forth above. The design shall be for a transportable antenna which may be used as either a Cassegrain or prime focus instrument. The antenna shall be designed to operate from fixed foundations and shall be movable to other locations in the array by use of a transport vehicle which lifts the antenna from its foundation and transports it on a rail system to another foundation. The antenna structure will be a fully steerable elevation over azimuth configuration supporting a 25-meter diameter primary reflector. It is anticipated that the main structure will be of steel with surface panels of aluminum.

The areas of design for which the antenna subcontractor will be responsible include the following:

Antenna Structure

Reflector assembly

Primary reflector surface
Reflector back-up structure
Feed structure and support
Vertex equipment cabin
Elevation wheel
Reflector counterweight system

Azimuth Structure

Antenna pedestal
Elevation drive system (including motors, gears,
operating and stow brakes, gear boxes and
servo system)
Elevation and azimuth data system
Azimuth drive system (including motors, gears,
operating and stow brakes, gear boxes and
servo system)

Antenna Support Tower

Tower structure (including alignment features) Equipment room at base of tower

Foundation of reinforced concrete (typical type)

Interfaces

Transporter interface
Foundation interface
Servo and control interface
Power cable interface
Secondary reflector interface

Maintenance and Repair Features

Procurement, Assembly and Alignment Plans

03.2.4. Design Analysis

A three-dimensional analysis of the reflector, back-up structure, pedestal and tower shall be conducted under varying conditions of pointing directions, wind force, and thermal gradients. A computer analysis shall be conducted using standard accepted programs to determine structural deflections, coordinates of the best fit paraboloid and the RMS deviation of the surface from this paraboloid. The computer analysis shall also determine the repeatable and non-repeatable pointing errors contributed by the various elements of the antenna for use in assuring that the error budget has been met. Results of these analyses shall be submitted to AUI along with the design drawings of the antenna structure as they are submitted for approval. Analysis of the dynamics of the antenna shall be conducted to determine the significant frequencies and the transfer functions applicable to the drive system and wind disturbance characteristics of the servo system. The total error analysis shall be made considering all factors which degrade the surface accuracy and the pointing and tracking capabilities of the antenna system. This analysis shall include: consideration of the error contributions of the antenna structure as developed in the structural analysis (under both wind and gravity loads); the pointing and tracking

error of the servo and drive system under required rates and wind conditions; antenna structural and mechanical alignment; the position indicating and data readout system errors and other system components contributing to pointing errors.

03.2.5. Design Features and Requirements

The antenna shall perform as required under any combination of operational and environmental conditions as specified herein.

03.2.5.1. Mechanical Motion

Elevation +5° to +125° Azimuth + 270°

03.2.5.2. Operational Wavelength

The antenna system shall be designed to operate at wavelengths as short as 1.2 cm. The surface requirements and the pointing errors as specified are compatible with this requirement.

03.2.5.3. Pointing Error

The pointing error is defined as the difference between the commanded position of the antenna and the position of the main beam of the reflector. The repeatable pointing error is due to gravity deformation, axis alignment error, encoder offset, bearing runout and similar errors. The non-repeatable pointing error is due to wind forces and gusts, acceleration forces, encoder resolution, servo and drive errors, and random errors.

The allowable repeatable pointing error for this antenna shall not exceed 3 minutes of arc. The allowable non-repeatable pointing error for precision operation shall not exceed 15 seconds of arc RSS under conditions specified in Section 03.2.2.2. with the antenna in any attitude and while tracking a source at the specified tracking rates. The values of individual errors which contribute to the RSS error budget should be RMS values, wherever these can be determined. It may only be possible in some cases, such as the wind-induced distortions of the reflector, yoke, alidade and tower, to identify the reflector attitude and wind direction which gives the greatest error (the "worst-case"). One half of such "worst-case" error values should be used in the RSS error budget. The non-repeatable error contribution of the servo system shall be based on wind gusting 15 ± 3 miles per hour.

03.2.5.4 Slewing Motion

Slewing motion is defined as rapid movement of the antenna about either axis simultaneously or independently. The antenna shall be capable of driving at a rate of 20°/minute of time about the elevation axis and 40°/minute about the azimuth axis in winds to 45 miles/hour with the reflector in any attitude. It shall be possible to slew each axis independently while the other axis is stationary or moving at the tracking rate or to slew both axes simultaneously. The antenna shall be capable of azimuth and elevation accelerations of 0.25°/sec².

03.2.5.5 Tracking Motion

The antenna shall be capable of tracking a stellar source at the azimuth and elevation rates which correspond to the sidereal rate for the star position. The antenna shall be capable of azimuth and elevation accelerations necessary to produce the azimuth and elevation velocities required to track stellar sources at any position up to the cone of avoidance. The acceleration required under the tracking mode shall be accomplished in less than a second of time. The cone of avoidance near the zenith when in the tracking mode shall have a half-angle less than 2.5°.

03.2.6. Structural and Mechanical Features

03.2.6.1 Reflector Assembly

Surface - The reflecting surface shall be a surface of revolution comprised of individually adjustable, doubly curved, solid surface aluminum panels with the minimum number of panels being approximately 120 and the maximum number 180. The reflecting surface of the antenna shall be a shaped surface which approximates a paraboloid, but deviates to a minor extent in order to secure a higher gain. The exact shape of this surface will be specified to the subcontractor at the start of the design phase, but it is anticipated that the peak deviation from a parabola will not exceed 0.650 inches with the RMS deviation not to exceed 0.285 inches. The spacing between panels shall be nominally 2.0 mm (0.080 in.) with a tolerance of 0.75 mm (0.030 in.). The installed RMS deviation of the surface from the best fit design surface shall not exceed 0.75 mm (0.030 in.) including manufacturing, installation

and alignment, gravity, and thermal errors with the antenna in any operating attitude and with winds not exceeding 18 miles/hour. Flush panel surfaces are of course preferred. Button head rivets, or other projecting rivets, are acceptable provided the sum of the areas of all rivet heads on each panel surface is less than one-half of one percent of the panel surface area. An error budget shall be prepared during the design stage showing distribution and projected levels of each error contribution.

Panels shall be designed to withstand either a 20 lbs/ft² uniform load or a concentrated load of 250 lbs. over a 6 in. square area located at any point without exceeding the allowable design stresses for the material.

Feed Legs and Apex - The feed leg supports shall be designed to support either a subreflector of 2.5 meter diameter weighing approximately 800 lbs. or a prime focus feed of approximately the same weight. The feed legs shall also be designed to support a cable weight of 8 lbs. per foot on each leg. The apex structure shall be so designed that a clearance of 18 to 24 in. (with 18 in. preferred) exists between the bottom of the apex structure and the focal point of the main reflector. Its configuration shall be such that an opening of approximately 48 in. diameter exists on the centerline of symmetry for the location and attachment of adjustment mechanism and support of the prime focus feed. The feed legs and apex structure, including a 2.5 meter subreflector, shall not cause RF blockage in excess of 6 percent of the total aperture area.

<u>Back-up Structure</u> - The reflector back-up structure shall provide the rigidity required to achieve the specified reflector tolerance and shall be designed so as to achieve the highest practical stiffness to weight ratio.

The reflector back-up structure shall be designed to support at the vertex of the reflector a removable feed cone assembly and a removable equipment room. The equipment room shall attach rigidly to the reflector support structure by bolting and shall support a feed cone assembly. The feed cone assembly will weigh approximately 1200 lbs. with its center of gravity lying on the axis of the reflector approximately 5 ft above the vertex. Access shall be provided from the back of the reflector to the equipment room.

Vertex Equipment Room and Feed Mounts - An approximately circular room of 78 sq. ft area, having an inside diameter of approximately 10 ft 0 in. by 7 ft 6 in. height for mounting of feeds and equipment shall be provided by the antenna manufacturer. The floor of this room shall be parallel to the ground with the antenna pointed at zenith and shall be a minimum of 8 ft 0 in. below the vertex of the antenna. This room shall be provided with the following features:

Mounting provisions for up to five 2 ft x 2 ft x 7 ft floor mounted racks with a total weight of 2000 lbs.

An access door or hatch for access by personnel and for means of installing racks by use of hoist.

Thermal insulation and air conditioning to provide 23° C \pm 1° C (74° F \pm 2° F) temperature control with an interior heat input of up to 3 kW. No special humidity conditions are required.

The top of the Vertex Equipment Room shall be designed to accept a feed mount ring of 10 foot diameter and a feed structure weighing 4500 lbs. with a center of gravity 5'0" above the vertex.

<u>Panel Supports</u> - Each surface panel shall be supported at a minimum of four points by means which allow adjustment. The panel supports shall be designed to allow one 250 pound man to walk on the panel without causing permanent deformation.

Feed Systems Design - The antenna feed system and Cassegrain reflector are not a part of this specification. The parameters and interface information for the antenna feed and Cassegrain subreflector will be specified to the successful antenna subcontractor during the design phase.

03.2.6.2. Antenna Pedestal

Structure - The pedestal structure shall be designed to provide the stiffness and strength required to meet the operating and survival requirements and to provide the range of motion as specified. Components of the pedestal structure shall be designed to facilitate field assembly to the required tolerances. Field assembly shall preferably be by use of high strength bolting. Adjustment provisions shall be provided for alignment of bearings, gear racks and supported

drives and gear boxes. The antennas shall be so designed and assembled that the azimuth and elevation axes intersect and are orthogonal within the tolerances specified in Section 3.2.2.1. The axis of symmetry of the paraboloid shall intersect the elevation and azimuth axes and shall be orthogonal to the elevation axis within the tolerance specified in Section 3.2.2.1.

<u>Drive Equipment</u> - Electrical drives using DC servo motors are the preferred drive system for each axis. The drive systems shall be supplied in pairs and torque biasing shall be provided so that paired gear trains oppose each other during operational function so as to minimize backlash. Motors selected shall have a base speed not to exceed 1750 RPM. The drive motors shall be able to withstand the following current load conditions:

100% rated continuous
150% rated 2 minutes out of every 20 minutes
200% rated instantaneous, 0.5 seconds, repeated once every minute

The reducer ratio from motor to antenna axis shall be sized to deliver the torque required and to meet the speed requirement.

Brakes - Brakes that actuate with the power off shall be provided on each axis. Brakes on each axis shall have the capacity of three times rated motor torque. Brakes must have the capacity to hold the antenna in any position in winds to 60 miles/hour and to hold the antenna in the stow position in winds to 110 miles/hour. Brakes may be provided in either of two configurations:

Operating brakes mounted on the motors and braking through the gear train plus stow brakes which act on the main section gear. This is the preferred configuration.

Brakes which serve both as operating and stow brakes which operate through the gear train.

Remotely controlled stow locking devices, such as stow pins, shall not be used as an operating feature. A manually operated stow pin shall be provided on the elevation axis for use in maintenance or in the transport mode.

Bearing and Gears - All main axis bearings and power train gearing shall be conservatively designed with a minimum 20 year expected life period. Running friction and breakaway friction for the drive system shall be held to levels which satisfy the non-repeatable pointing error budget.

Cable Wraps - Access shall be provided at the azimuth axis in the form of a cable wrap through the axis which will accommodate a minimum of 20 cables of 1.5 in. in diameter with connectors of 3 in. outside diameter. Arrangement shall be such that cables are neither stressed by twisting or damaged by pulling over edges of fixed structure. Cables may pass the elevation axis by means of a cable loop.

Lubrication - Provision shall be made in the design for proper lubrication of all components. Gear boxes, gear trains, couplings, bearings, motors and similar equipment provided by the Subcontractor shall have easily accessible lubrication fittings, drain fittings and be provided with vents where advisable. The design Subcontractor shall prepare a list of recommended lubricants and lubrication schedule. Lubricants shall be adequate to meet the performance and environmental requirements specified herein. The use of different types of lubricants and the frequency of lubrication shall be held to a minimum.

<u>Lighting and Grounding</u> - Adequate outside lighting shall be provided and installed on the structure for operation, safety and maintenance. All lighting shall be incandescent type.

The antenna requires safety and equipment grounds. A station ground will be provided by NRAO for the antenna structure. The Subcontractor shall ground the antenna structure, and its equipment, in accordance with National Electrical Code Specifications to this station ground. All elevation and azimuth bearings shall have a by-pass grounding connection.

<u>Waveguide Run</u> - A route for one 4 in. diameter rigid waveguide shall be provided from the ground to the vertex equipment room. The run shall be short and contain a minimum number of bends. Provision shall be made for rotary joints on the azimuth and elevation axes.

03.2.6.3. Antenna Tower

The tower structure shall be a space-frame with an equipment room located near the base. The tower shall be triangular in configuration and shall interface at three points on the concrete foundation. This interface shall contain the repositioning indexing system which shall mate with the foundation indexing system. The base of the tower shall be rigidly tied together to provide a stable plane necessary for re-indexing.

To facilitate the mobility requirement, the center of the tower shall incorporate a vertical triangular structure which shall terminate at the base in three rigid support or lifting points for interfacing with the transport vehicle which is used to carry the antenna from station to station. The inner tower structure shall support the antenna while being moved and will be integrated within the main tripod tower structure.

A joint use equipment room shall be located within the central tower, shall provide a minimum of 80 sq. ft of area with height of 8 ft, and shall be temperature controlled at 23° C \pm 5° C (74° F \pm 9° F) with a 5 kW interior heat input. A door and access provisions shall be included. This room in conjunction with any drive equipment enclosure at the pedestal area shall provide adequate space for drive controls, cables and electrical cabinets.

The tower structure shall be designed to allow for sufficient clearance between the top of the rails and the base of the structure to interface with the transport vehicle. Dwgs. SK 2390, sheets 1, 3 and 4 and 112-D-001, sheets 1 and 2 show a configuration to accomplish this. During the final design of the antenna, and the coordination between the antenna

subcontractor and the transporter subcontractor, the antenna subcontractor will be required to assure the accuracy of the interface. The tower shall be adjustable on its foundations to provide azimuth axis alignment on a master foundation so that each antenna may occupy any observing station and be identical in alignment with all other antennas which may occupy that station.

03.2.6.4. <u>Miscellaneous Requirements</u>

All operating components of the antennas, such as motors, bearings, drive units, brakes, gear boxes, switches, breakers, etc., shall to the extent possible be of standard design, and of proven operating life.

Access ladders, walkways and platforms for service, access and maintenance to bearings, motors and drives and all equipment shall be designed according to best antenna practice, shall meet the requirements of the Occupational Safety and Health Act and shall have sufficient strength to support at least a concentrated load of 400 lbs. at any point.

Safety devices shall be provided for protection of the antenna in the event of servo or mechanical failure. An auxiliary control shall be provided for use of maintenance personnel who may be servicing the antenna. This shall provide at least open loop driving of the antenna in both azimuth and elevation from a control such as a potentiometer located at the antenna. This auxiliary control shall also provide control of the brake mechanism.

Limit switches shall be provided for each axis of the antenna.

All machinery shall be covered or protected in such a way that working personnel are not subject to hazards.

Limit switches, cables, connectors used on telescope drives, brakes, motors, gear boxes, interlocks, etc., are to be weather-tight.

03.2.7. Foundations

The Subcontractor shall provide the design of a typical foundation. Final design and detailing of all foundations and construction of these foundations will not be the responsibility of the Subcontractor but the Subcontractor must assure that the design of the typical foundation provides the stiffness and the pointing accuracy required. Generally the soil on site consists of a sandy silt, silty sand within certain locations with varying amounts of small gravel. A number of soil borings and penetration tests have already been made in the area. The penetration resistance was measured using a 2-in. diameter bullnose penetrometer with standard 30-in. free fall hammer weighing 140 lbs. The blow count consistently reached 50 blows per foot at 10 feet below the surface. Full data on foundation conditions will be furnished the successful Subcontractor.

Each foundation shall be so designed that releveling of each antenna after repositioning is not required. This shall be accomplished at each location by optically aligning the foundation baseplates to offset the curvature of the earth from station to station. In addition, each foundation shall provide for a reindexing system compatible with the tower design which will re-orient and relocate the vertical axis simply and with a minimum of down time.

The Subcontractor shall include as part of the supplied equipment the furnishing of 103 sets of foundation fittings (base plates or weldments or hardware) which provide the interface between the top of the concrete foundation at each station and the base of the antenna. The anchor bolts which attach this foundation fitting to the foundation will be provided by AUI.

03.2.8. Servo and Controls

03.2.8.1. The servo system shall provide the necessary control for and monitoring indications of the antenna in both azimuth and elevation. The Subcontractor shall be responsible for the design of the system and for fabricating, furnishing, installation and test of the system from a connection

point at the base of the antenna (from which command information from a central computer is received) including all necessary components and cabling. The major sub-systems of the control system are

- (1) the drive units, (2) the control units, and
- (3) the position indicator system.
- 03.2.8.2. The control system shall have the following modes of operating: (1) Non-operating mode

in which the antenna brakes are applied and power is removed from the drive system, and (2) operating modes which shall cover all occasions in which brakes are released and power is applied to the drive and control system.

03.2.8.3. The non-operating mode shall have the following features:

Power on-off condition shall allow the antenna operator at the central control station or at the antenna local control unit to release brakes and apply power to the complete drive and control system.

Emergency off condition shall completely remove power from the antenna drive control, allow the brakes to set and be initiated by controls on the antenna structure or by command by the central control station.

A pre-standby condition shall indicate the presence of an antenna interlock condition. On completion of power start-up, this mode shall be activated if an interlock condition exists. If an interlock condition shall occur during operation, the system shall revert to a pre-standby condition. Upon clearing the interlock condition, the system shall enter standby condition automatically. Provisions shall be made to insure that the system remains in pre-standby until start-up transients have passed.

Azimuth and elevation axis interlocks shall be provided. A minimum of four interlock conditions shall be provided for in azimuth; +270° limit and override, -270° limit and override, drive interlock (overspeed, overload, etc.) and stow interlock. The limits shall be activated by multiple limit switches connected in a fail-safe arrangement. The limit override shall allow the operator to remove the antenna from the first limits but shall not permit further travel into the limit. A minimum of four interlock conditions shall be provided for in elevation; +5° limit and override, +125° limit and

override, drive interlock and stow interlock. Operation of these interlocks shall be identical in azimuth and elevation.

Standby or ready condition shall be provided to allow the antenna system to be ready for immediate operation when an interlock condition does not exist. In this condition power shall be applied to the control system but operating brakes shall not release.

03.2.8.4. The Operating Modes

Two operating modes shall be provided: Manual rate and digital position. These modes shall have the following features:

In the manual rate mode a local operator at the antenna position shall be able to command continuous velocity in either or both azimuth and elevation from a local control unit. This velocity shall be smoothly variable from 0 to 20° per minute in either direction in elevation and and 0 to 40° per minute in azimuth; and shall not depend on the control computer or position indicating system for operation. Pointing and rate accuracy requirements specified previously shall not apply in this mode.

The normal mode will be through digital azimuth and elevation commands from a central computer or a portable test and control unit, to be designed and furnished by AUI. The Subcontractor shall provide the electronics to subtract the digital commands from digital position indications, convert this error signal to an analog voltage, and provide proper compensation and drive level to drive the servo power amplifiers.

03.2.8.5. <u>Limit switches</u> shall have redundancy provided for each antenna limit and shall operate as specified.

03.2.8.6. Rate Loop

The servo system shall contain a rate loop which operates as a velocity servo in the manual mode.

The digital position mode shall be closed about the rate loops. All control loop electronics shall be solid state. Other loops which are required to meet the specified performance shall be provided.

The rate loop for each axis shall contain dual D.C. drive motors, D.C. tachometers, power amplifiers, rate loop amplifiers and a D.C. motor field power supply. Torque bias and motor current limit circuitry shall be provided. In addition, monitoring of the drive motor currents with an 8-bit modular A/D convertor shall be provided for transmission to the central control room. The power amplifiers used shall be high performance, solid state units which shall accommodate the rate loop bandwidth. The digital loop shall be closed about the rate loop.

- 03.2.8.7 The drive system prime power shall be 120/208 volts +10%, 3 phase, 4 wire 60 Hz prime power supplied from a ground mounted transformer and switchgear to be supplied by AUI. The Subcontractor shall supply a 40 kva electric entrance service inside the pedestal equipment room for connection to the outside power source. The Subcontractor shall be responsible for all his antenna electrical wiring from this point. In addition he shall furnish for the later use of AUI one 100 amp 120/208 V, 3 phase, 4 wire, fused disconnect switch or breaker.
- 03.2.8.8 The control circuits, D.C. drive motors, amplifiers, and switching devices shall be designed and constructed with emphasis on Mil-Std-461A, paragraphs 4.2.1.2, 4.2.1.4, and 4.2.1.5 concerning radiated and conducted electromagnetic energy. In particular, all motor leads, power and control should be filtered. All relay contacts and actuators should be properly bypassed. shielded and/or filtered. All amplifiers and oscillators should be mounted in shielded enclosures that will provide effective shielding of radio frequency energy. Siliconcontrolled rectifier switching devices shall not be used unless phase controlled, zero current crossing switching techniques are used. No gaseous discharge devices, except noise sources for test and neon pilot lamps, shall be employed. Means shall be employed to reduce static-electricity and the consequent R.F. noise generated in any rotating machinery. The frequency range of interest extends from 10 MHz to 40 GHz. The design goal shall be to conform to Mil-Std-461A. However, no verification measurements by the contractor will be required.
- 03.2.8.9. The total tracking error (including the effects of friction, noise, dynamic lag at peak rates, wind gusts) shall be consistent with the

following telescope performance while maintaining the stability specified above during performance in the precision operating condition:

Repeatable pointing error shall not exceed 3 minutes of arc.

Random pointing error (non-repeatable) shall not exceed 15 arc seconds RMS.

The above accuracies shall be maintained at the azimuth and elevation velocities and accelerations required by the sidereal rate of the source referred to the axes for any position of the source outside of the cone of avoidance. An acceleration rate shall be provided under this tracking mode which allows the antenna to reach the required velocity in less than one second of time. Angular errors refer to space angle errors.

- 03.2.8.10. The servo system electronics shall operate from a disconnect switch installed in the pedestal equipment room with the following nominal characteristics:
 - (a) Frequency 60 Hz \pm 1 Hz
 - (b) Voltage 120/208 volt +10%, 3 phase, 4 wire system
- o3.2.8.11. The azimuth and elevation position angles shall be measured by position indicating devices directly coupled to the axes and shall use coarse and fine resolvers converted to azimuth (including an overlap bit) and elevation binary words by appropriate electronic equipment located in the pedestal equipment room. The position encoding system shall be a system making the measurement directly in binary form. The system provided shall provide 20 bits using a 256 speed inductosyn for the fine transducer. The RMS error of the position indicating system, including douplings and electronics, shall not exceed 3 seconds of arc.

The position indicating device used on the asimuth axis shall allow for passage through, on the azimuth centerline, of the AUI 4 in. diameter waveguide.

A coarse analog dial indication of telescope position with an accuracy of 0.1° shall be provided. The digital encoder positions shall be indicated with binary light-emitting diodes for monitoring purposes.

Position indicating devices shall be accessible for servicing, shall be easily installed, shall be capable of later re-alignment, shall have provisions for mechanical indexing and shall be environmentally protected.

- 03.2.8.12. <u>Junction boxes</u> shall be provided to accommodate all electrical connections to be supplied by the Subcontractor. Separation in junction boxes shall be provided for power and signal wiring; junction boxes shall meet National Electrical Code specifications, for NEMA Type IV.
- 03.2.8.13. Control Signal Interface. All control and monitor information shall be coupled to the antenna by means of one or two serial digital control coaxial cables utilizing TTL logic levels with a 10 Hz updating rate. The exact format and electrical specifications of these control signals must be approved by AUI before manufacture. The system must include error checking circuitry to ignore erroneous commands occurring over a 10-minute interval and stow the antenna if erroneous commands are received for longer than 10 minutes. Monitor jacks and light-emitting-diode indication must be provided for all interface bits. A typical but not definitive list of control monitor bits is as follows:

To Antenna System

Azimuth Command	20 bits
Elevation Command	19 bits
Operate Azimuth Code	8 bits
Operate Elevation Code	8 bits
Spare Commands	8 bits

From Antenna System

Azimuth Position	20 bits
Elevation Position	19 bits
Limit Switches	8 bits
Error Indications	8 bits
Overload Indications	8 bits
Az. Motor Drive Current	8 bits
El. Motor Drive Current	8 bits

Equipment to be supplied as part of the control signal interface shall include the following:

a. Line drivers and receivers capable of transmission through 100 feet of coaxial cable shall be included for the antenna side of the antenna transmission system interface.

- b. A simple modem shall be proposed and included if judged necessary by the antenna manufacturer.
- c. Parallel to serial and serial to parallel converters for the antenna side of the antenna transmission system interface shall be included.
- d. Error checking and check code generation equipment shall be included.

03.3. Materials and Fabrication

03.3.1. <u>General</u>

Materials shall be in agreement with the general requirements as set down in these specifications. It shall be

the responsibility of the Subcontractor to prepare specific material specifications for the various components of the antennas. These specifications may be either on the drawings or in a separate document and shall be subject to AUI review and approval. Fabrication shall be in accordance with best shop practice and shall be fabricated to proper size and tolerance as shown on the approved drawings.

03.3.2. Materials

The tower, antenna pedestal, yoke and alidade, and reflector back-up structure is to be of steel using the most economical shapes available from both a weight and fabrication cost standpoint. The type of steel selected for the antenna structure shall be such that the low temperature embrittlement characteristics shall be acceptable to AUI. The nil-ductility transition temperature of the selected material shall not exceed -50°F. Nil-ductility transition temperature is defined as a temperature below which a specimen will exhibit cleavage fracture with very little or no evidence of notch ductility. It is the intent of these specifications to secure a metal which at the lowest operating temperature will not be brittle enough for flaws or defects in joints or welds to be subject to brittle propogation. A guide to meeting this requirement would be that the Charpy V-notch value of the metal chosen should be a minimum of 15 foot-pounds at a temperature of minus thirty-five degrees (-35°) Fahrenheit.

All components which are designed for welded connections shall be of a weldable grade material. Bull gears and pinions shall be of a material having a minimum hardness of 255 BHN and may be surface hardened.

03.3.3. Manufacture

All structural components shall be manufactured to proper size and tolerance and in the manner shown on the approved drawings. Methods of manufacture shall be of the best shop practice. Mis-manufactured members shall be discarded and not repaired unless prior approval is obtained from AUI. Shop connections may be by either welding or bolting (as stated on the design drawings), but components to be field assembled shall preferably be by high strength bolting. All holes shall be drilled or sub-punched and reamed according to good practice so that connection clearances may be held to a minimum.

Manufacture and assembly of all components will be such that uniform dimensions of the components and sub-assemblies of the antenna may be maintained and maximum commonality of both components and antennas may be obtained.

03.3.4. Protective Coatings and Finishes

The reflector surface of the antenna shall receive a protective coating which will provide diffuse reflection. of the solar rays. Material, preparation, application and quality control testing shall be as set forth in National Radio Astronomy Observatory Process Specification dated August 30, 1972, entitled "Application of Diffuse Reflecting Coating for Solid Faced Antenna Reflectors", attached hereto as Appendix 05.10.

To limit the effect of solar heating and associated differential expansion of structural members and to protect the structure against atmospheric corrosion, the antenna structure, with the exception of the reflecting surface, shall be painted with a white solar reflecting paint. Material, preparation, application and quality control testing shall be as set forth in National Radio Astronomy Observatory Process Specification dated August 30, 1972, entitled "Exterior Protective Coating for all Exposed Metalic Surfaces other than Reflector Surfaces", attached hereto as Appendix 05.11.

03.4. Field Assembly

03.4.1. General

The Subcontractor shall furnish all materials, plant and equipment, tools (except such materials, plant and equipment, and tools as may be furnished by AUI as provided elsewhere in this document) and all labor, services and supervision necessary to complete the assembly, alignment and testing of the antennas.

03.4.2. Work at the Site

Special and other conditions applying to work at the site are contained in Section 04 Form of Subcontract, Paragraph 04.1 Special Conditions of the Subcontract.

03.4.3. Optional Assembly Structure - Option No. 1

There are certain advantages in having the final stages of assembly, painting, precision alignment, and testing accomplished inside a weather enclosure, serviced by an overhead travelling crane. The existence of such an assembly structure should have a considerable cost and schedule

advantages to the Subcontractor and its continuance as a permanent addition to the VLA site will have definite advantages to AUI for antenna maintenance and servicing. It is realized that this structure will probably cost more than its value to the Subcontractor during assembly operations. Subcontractor shall set forth the type and general specifications for an assembly structure that he would find most useful, considering also its use as a permanent maintenance structure. Should this option be accepted, AUI, at its expense, will install within the structure one of the concrete assembly foundations mentioned in paragraph 04.1.4 entitled "Assembly Foundations" of the Special Conditions of the Contract. AUI will also install one set of double railway track to service this foundation. The net extra cost for this structure shall be set forth on the price data form as Option No. 1.

Should such a structure be constructed, it shall be made available for AUI use in maintaining telescopes whenever it is not in active use by the Subcontractor. No rental or other charges shall be made for its use by AUI.

03.4.4. Transport Vehicle

As soon as the transport vehicle is completed and accepted by AUI, it will be made available, without cost, to the Subcontractor for its use in transporting the antenna components. AUI will schedule its use between its own requirements and those of its subcontractors. It is anticipated that the transporter will be completed in February, 1975, but this date cannot be guaranteed.

03.4.5. Shipment of Vertex Room

The completed Vertex Equipment Rooms shall be shipped to AUI as directed by AUI, at least four months prior to the time they are needed for final installation at the site. AUI will install electronics within these rooms, test them and return them to the Subcontractor at the site for installation. Shipment to AUI will be F.O.B. Subcontractor's designated manufacturing plant.

O3.4.6. Installation of Vertex Rooms, Subreflectors and Feeds
The Subcontractor shall furnish the necessary labor,
equipment and materials to install and align
the Vertex Equipment Rooms, the subreflector and its
adjusting mechanism, and the feeds and feed structure.
AUI, during the design stage, shall provide complete
drawings and interface data for the subreflector, its
operating mechanism, the feeds and feed support structure.

AUI shall supply alignment tolerance requirements for the installation of the AUI furnished equipment prior to the start of the assembly phase of the subcontract and shall furnish the equipment to the Subcontractor at the assembly site prior to the time set forth in the Subcontractor's assembly schedule.

03.5. Drawings, Specifications and other Data

03.5.1. Design and Manufacture Drawings

Design and manufacturing drawings shall be completed to the point at which shop and supplier detailing is all that is required for a complete description of the antenna.

Drawings shall be produced on standard size drawing forms whose size and format have been approved by AUI, shall conform to good commercial practice, and shall use symbols, conventions and notations endorsed by manufacturing and standards associations. At the start of the design phase, the Subcontractor shall submit a copy of his drafting standards to AUI for its review and approval.

Two print copies of all design and manufacturing drawings shall be submitted to AUI for its review and approval at the time of completion of the drawings.

One reproducible and five print copies shall be furnished to AUI after approval of drawings.

03.5.2. Manufacturing and Procurement Specifications

Five copies of all manufacturing and procurement specifications, referenced on any drawing or prepared for procurement of purchased items, are to be submitted for AUI approval.

O3.5.3. Shop Drawings

Detail drawings of all fabricated components and assemblies and any working drawing or sketches which the Subcontractor, or its subcontractors, may require to detail or illustrate any part of the work, supplementing the information in design or manufacturing drawings and specifications shall be furnished by the Subcontractor at no additional cost to AUI.

Such detail and/or working drawings shall be consistent with the purpose and intent of the design drawings and specifications and shall be subject to the approval of AUI.

Detail drawings and sketches prepared by the Subcontractor and for all purchased manufactured components shall be submitted to AUI for approval. One reproducible and five copies of all such drawings and sketches shall be submitted to AUI not later than four weeks prior to manufacture.

03.5.4. Design Calculations and Data

Three copies of all design calculations, design data, studies or other information prepared or utilized by the Subcontractor in the performance of the work shall be delivered to AUI.

One copy of all computer programs * and calculation runs and print-outs shall be furnished AUI for review.

*(where computer program is not owned by the subcontractor input and output data will be provided along with identification of the computer program.)

One copy of all purchase orders issued for this work shall be delivered to AUI immediately upon issuance.

03.5.5. Assembly and Alignment Plans

The Subcontractor shall, at the completion of detailed design, prepare and submit to AUI for its approval

An assembly plan which shall specify each step in the assembly, equipment proposed, assembly area, and facilities to be used, and schedule for completion of the work.

An alignment plan which shall demonstrate to AUI the methods to be used to assure that the alignment tolerances specified in this document and specified in the antenna Subcontractor's design effort shall be accomplished, and that performance parameters and error budgets set forth in specifications shall be satisfied.

Estimates of manpower requirements for each phase of assembly and alignment.

03.5.6. Testing and Acceptance Plans

The Subcontractor shall prepare a test plan acceptable to AUI that will qualify the mechanical, electrical and electronic system performance in accordance with this specification after assembly and alignment are completed. Four copies of the test plan shall be submitted to AUI for its approval prior to commencement of acceptance testing of any antenna. Approval of a test plan shall not preclude AUI from requiring additional testing and shall not be deemed to be a waiver of the requirement to demonstrate the performance of the antenna in accordance with any or all performance specifications.

AUI shall provide for this testing program a digital command input to Subcontractor's equipment connection at the equipment room of the antenna.

During this testing program, the Subcontractor shall demonstrate to AUI that the performance specifications set forth in this specification have been met.

03.5.7. Quality Assurance Plan and Inspection Procedures

The Subcontractor shall prepare and submit to AUI for review and approval, prior to the start of procurement and manufacturing, four copies each of a Quality Assurance Plan and Inspection Procedures to be utilized during the course of the work.

Quality assurance tests will be performed on materials, components and assemblies as specified in the Quality Assurance Plan.

AUI will be notified of such tests and may witness such tests.

All quality assurance test results recorded by either the Subcontractor or its subcontractors shall be signed and submitted to AUI in an approved documented form.

AUI may perform such inspections or tests as it considers necessary, on any component, or assembly, during or after fabrication at the site of fabrication or assembly.

Copies of results of tests normally performed by suppliers, such as certification of steel, bearings, etc., shall be supplied to AUI, in duplicate.

03.5.8. Spare Parts

Immediately upon approval of detailed design, the Subcontractor shall prepare a recommended spare parts list to be based on the number of antennas supplied. Six copies of the list shall be furnished AUI. Each item listed shall be detailed as to identity, part number, drawing reference, manufacturer, model number, etc.

AUI shall have the right by Change Order to its subcontract to order such spare parts as it shall have selected and/or such parts, whether so selected or not, which were originally manufactured by the Subcontractor. The Subcontractor agrees to negotiate in good faith to arrive at a firm fixed price for such spare parts.

The Subcontractor shall maintain a capability to furnish to AUI the agreed spare parts for a period of ten years from the acceptance of the final antenna.

AUI may purchase such spare parts from any supplier or have such parts manufactured by others as it appears in its best interest so to do without limitation or liability to the Subcontractor and/or its lower tier subcontractor(s).

03.5.9. Operation and Maintenance Manuals

The antenna subcontractor shall deliver at start of assembly of the first antenna four (4) copies of an Operation and Maintenance Manual. This Operation and Maintenance Manual shall contain the following information:

Manufacturer's drawings, exploded view assembly drawings, parts lists and recommended lubrication procedures for all purchased mechanical components. Manufacturer's drawings, parts lists, specifications, wiring diagrams and testing procedures for all purchased electrical or electronic components. A lubrication schedule showing lubrication points, types of lubrication and recommended lubricant, frequency of lubrication.

A maintenance section which describes method of removal of mechanical components, methods and control to be used in re-assembly and re-alignment and components which might reasonably be expected to be replaced because of wear characteristics. Assembly and sub-assembly drawings which include mechanical setting dimensions such as bearing preloads, gear runouts, gear backlash settings, torque bias settings, drive train alignment requirements and weight of components.

An operations section which describes the function of the various mechanical and electrical components of the antenna. A narrative section shall be provided which describes the various controls and modes of operation which shall include illustrations of the control circuitry.

NATIONAL RADIO ASTRONOMY OBSERVATORY

PROCESS SPECIFICATION

APPLICATION OF DIFFUSE REFLECTING COATING

FOR SOLID FACED ANTENNA REFLECTORS

August 30, 1972

SCOPE

1.0. This specification establishes the procedure for material acceptance, preparation, application, and quality control testing of diffuse reflecting organic coating systems for solid face micro-wave antenna reflector surfaces.

MATERIALS

- 2.0. Solvants used as cleaners.
- 2.1. Naptha, Petroleum Aliphatic T-T-N-95.
- 2.2. Methyl Ethyl Ketons TT-M-261.
- 2.3. Toluene TT-T-548 or Jan-T-171 Grade A.

AQUEOUS CLEANERS

- 2.4. Vel Colgate-Polmolive Company.
- 2.5. Kelite L-17 Kelite Products Company.

THINNERS

- 2.6. Sol Cal No. 1 Standard Oil Company.
- 2.7. Xylol TT-X-916 Grade B.

TOP COAT

2.8. Hi-Reflectance Flat White No. 6 - Triangle Paint Co.,2222 Third Street, Berkeley 10, California.

PRIMERS

- 2.10. Mil-C-8514 Coating Compound Metal Pretreatment.
- 2.11. Mil-P-8585 Primer Coating, Low Moisture Sensitivity.

PURCHASING

- 2.12. Purchase orders shall require that materials procured to Government Specifications conform to the applicable requirements. Purchase orders for proprietary materials shall require identification per Federal Test Standard 141 Method 1031.1. A copy of the supplier's record of batch production data and test results shall be required when ordering proprietary top coating. The supplier's record of batch production data shall be retained in file for a period of three years.
- 2.13. Materials shall be procured only from suppliers listed in current Qualified Product Lists. Substitutions of proprietary or commercial products or procurement from suppliers not listed in this specification is not allowed without Engineering approval. Finish coatings shall be purchased in 5 gallon or smaller containers.

RECEIVING

- 2.14. Receiving Inspection shall examine all incoming materials to insure conformance to Purchase Orders and applicable specifications.
- 2.15. Incoming acceptance testing of materials not covered by specification shall consist of any test by the Quality Control Laboratory which will assure maintenance of quality but shall at least consist of the following.
- 2.16. Federal Test Standard 141 Method 6101; Gardener 60 degree Specular Gloss Meter, specular gloss shall be two or less, specimens shall be prepared in accordance with paragraph 3.0. Wash primer may be omitted.
- 2.17. Federal Test Standard 141 Method 4041; volatile content. Volatile content shall be 33.5 percent ± 1.0 percent.
- 2.18. Weight per gallon as received shall be $11.6 \text{ lbs.} \pm 0.2 \text{ lbs.}$

STORAGE AND CONTROL

- 2.19. Paint type materials shall be stored under shelter at temperatures between 45° F and 80° F. Short periods above or below these limits shall not be cause for rejection. Paint subjected to prolonged periods outside the above temperature limits shall be inspected by Quality Control Laboratory for deterioration.
- 2.20. Issue of paint shall be on a first-in-first-out basis. Material shall be warmed to paint room temperature before use.

EQUIPMENT

- 2.21. Equipment, application technique, handling and mixing shall conform to Mil-F-18264 and as instructed by specific details in this specification.
- 2.22. Appropriate safety precautions applicable to handling of toxic and flammable materials shall be observed during all operations.
- 2.23. Cleanliness of spray guns and equipment is necessary to produce high quality coatings. Application of finish coatings shall be conducted in clean, dust free spray booths.

PROCESS APPLICATION

3.0. The coating system shall consist of the following:

```
1 coat Mil-C-8514 Wash Primer - 0.1 - 0.3 mils thick dry
1 coat Mil-P-8585 Primer - 0.3 - 0.7 mil thick dry
2 coats Triangle No. 6 - 1.2 - 1.5 mils thick dry each
```

Total dry film thickness shall be 3.1 to 4.0 mils unless otherwise specified on Engineering Drawing.

PREPARATION OF PRIMERS AND COATINGS

- 3.1. All paint shall be well mixed prior to use. Agitation for 15 to 30 minutes on a Red Devil paint shaker is recommended. Continuous mechanical agitation during use is mandatory.
- 3.2. Primers shall be thinned to spraying consistency by addition of thinner in ratios up to one to one.
- 3.3. Coating, Triangle No. 6, shall be thinned in the ratio of two parts paint to one or less parts thinner.

3.4. So Cal No. 1, Item 2.6, thinner shall be used to reduce Triangle No. 6 when spraying indoors. Xylo1, Item 2.7, shall be used when application of coating is made in direct sunlight in the field or when ambient air temperatures are over 100° F. Xylo1 may also be used indoors.

SURFACE PREPARATION

- 3.5. All surfaces shall be clean and dry at the time of application of any organic coating.
- 3.6. After cleaning or surface treatment, parts must not be contaminated by handling or other means before painting.
- 3.7. Aluminum alloy assemblies containing faying surfaces which might retain liquids shall not be subjected to any acid or alkaline etching process.
- 3.8. Priming and painting shall be discontinued when the relative humidity of ambient air is greater than 75 percent or temperatures less than 50° F.
- 3.9. To insure that surfaces to be painted are free from dust and handling contamination they shall be tack-ragged immediately before priming or painting. Tack-rags shall be prepared by dampening a piece of clean cheese cloth with toluene.

CLEANING OF ALUMINUM SURFACES

- 3.10. Reflecting surfaces of panels which have been manufactured by structural bonding require only degreasing prior to wash primer application.
- 3.11. Wipe surfaces to be painted with clean cheese cloth dampened with toluene. Wipe dry with second clean cloth before solvent evaporates. Repeat until second cloth shows no soil.
- 3.12. Aluminum surfaces fabricated by riveting or welding shall be cleaned as follows unless parts have been cleaned in detail prior to assembly.
- 3.13. Degrease by washing with any solvent listed in Item 2 using clean cheese cloth. Remove water soluble soil by sponging with detergent Item 2.4, until clean.

- 3.14. Apply deoxidizer, Item 2.5, while surface is still wet from previous washing by sponging or mopping. Continue until surface appears clean and bright but no longer than 10 minutes. Remove deoxidizer with water wash and dry with clean rags.
- 3.15. One wet thin coat of wash primer, Item 2.10, shall be applied to all surfaces requiring paint. Dry for 30 minutes minimum before applying additional coats. When relative humidity is between 70-75 percent drying time shall be extended to 2 hours and extreme care must be exercised that primer does not blush. If blushing should occur, primer shall be removed. If primer appearance is doubtful, test for adhesion by scraping surface with the sharp edge of a piece of 1/8" thick plexiglas. If primer can be removed to bare metal, the primer shall be removed and reapplied.
- 3.16. Apply one full box coat of zinc chromate primer, Item 2.11, and allow to dry for 1.5 hours to 24 hours. Air dry 2 to 24 hours if air temperature is less than 70° F. Primer may be force dried for 45 minutes at 140° to 160° F. Apply final top coating within 72 hours. If primer is older than 72 hours, reactivate the surface by sanding lightly with 320 mesh or finer wet or dry paper lubricated with toluene. Dry with clean cloth and apply top coat within four hours.
- 3.17. The dry film thickness of entire primer system shall be 0.4 to 1.0 mils.

APPLICATION OF TOP COAT

- 3.18. Surfaces to be top coated shall be free from dust, dirt, lint or other contaminants. Primer which is rough or grainy shall be sanded smooth with 280 abrasive paper or finer. Remove sanding dust and shop soil with tack rags per Item 3.9.
- 3.19. Apply two or more cross coats of Triangle No. 6 per Item 2.8 to form a dry film thickness of 1.2 to 1.5 mils. The paint film shall be uniform in appearance and thickness.
- 3.20. Dry a minimum of 6 hours at 72° F and relative humdity 80 percent or less. When ambient temperature is between 50° F and 60° F, dry for 12 hours before recoating.
- 3.21. Apply two or more cross coats to provide a finish coat 1.2 to 1.5 mils dry film thickness. Dry for a minimum of 6 hours before handling.

TOUCH UP AND REPAIR

- 3.22. Clean the entire area around the damaged portion with solvent cleaners per Item 2, followed by a thorough wash with detergent and water. Rinse well and dry with clean cheese cloth. Do not recoat for 30 minutes or until surface is completely dry.
- 3.23. Damaged coating may be repaired by fairing the edges of damaged areas into surrounding areas with 320 mesh paper or finer.

 Reapply primer system per Item 3.15 and Item 3.16 when damage extends to the bare metal.
- 3.24. If recoating is to be accomplished in hot sunlight or ambient temperatures higher than 100° F, top coating shall be thinned with Xylol. If coating appears too dry or grainy, add up to 50 percent mineral spirits to slow the evaporation rate.

QUALITY CONTROL

4.0. The Inspection Department shall determine that cleaning and surface preparation, mixing, application of coatings and film thickness is in compliance with this specification.

In addition, they shall insure that coatings are uniform in appearance and free from runs, sags, blisters, holes, cracks, dirt, orange peal or other defects.

4.1. Adhesion shall be determined by means of a tape test as follows:

Firmly press a 6-inch piece of 1-inch paper tape per UU-T-106 to the area to be tested. After loosening one end of the tape remove it in one quick single jerk. If no paint is removed by the tape, adhesion is adequate. A slight whitening of the tape is not cause for rejection.

4.2. Total film thickness shall be measured on the concave face at each corner of the panel and over the surface, at intervals no greater than 2 feet. Film shall dry for 6 hours minimum prior to thickness measurements.

APPENDIX 05.11

NATIONAL RADIO ASTRONOMY OBSERVATORY

PROCESS SPECIFICATIONS

EXTERIOR PROTECTIVE COATING

FOR ALL EXPOSED METALIC SURFACES OTHER THAN REFLECTOR SURFACES

August 30, 1972

GENERAL CONDITIONS

- 1. All coating materials to be used, including solvents, thinners, etc., are specifically to be Sherwin-Williams products or (Wisconsin Protective Coating Corporation Products) as specified in the specifications made a part of this Scope of Work.
- 2. The work must be done in a manner and sequence that no coated parts will be damaged by subsequent coating operations, that is, all coated areas or parts must be protected from damage by rigging or other operations required for coating later parts of the unit; similarly, parts to be coated later in sequence must be properly cleaned of any materials splashed or dropped from previous operations.
- 3. No painting is to be performed when the surface to be painted is wet, nor when the air temperature is less than 50° F, nor when the relative humidity exceeds 70 percent.
- 4. Wire brushing for the removal of all mill scale, rust, etc., must be performed on all steel surfaces to be painted—simple spot brushing is not sufficient. All steel surfaces must be prime painted the same day as the wire brushing is done.

I. ALUMINUM

A. Surface Preparation

Aluminum Oxide provides an excellent substrate for painting materials. Therefore, the general requirements of cleanliness and dryness only need apply. Aluminum surfaces should be steam cleaned or detergent washed followed by thorough rinsing and drying.

B. Primer

Spray a wet coat of Sherwin-Williams Zinc Chromate Primer, B50Yl, reduced up to 12-1/2 percent with mineral spirits. This material is very similar to Government Spec. MIL-P-8585. Primer should be applied to obtain a minimum dry film thickness of 1.5 mils and should dry 18 hours before recoating.

C. Second Coat (Intermediate)

Spray Sherwin-Williams Metalistic Undercoat "B50A2" or equivalent subject to AUI approval according to manufacturers instructions, in a manner to obtain a minimum dry film thickness of 1.5 mils. This is a white rust inhibiting primer and is recommended to insure complete metal coverage. Holidays and metal peaks provide areas susceptible to early corrosion. This coat insures complete metal primer contact and provides an ideal surface for topcoating. Intermediate coat shall be tinted with lamp black or carbon black to a contrasting shade so that complete coverage by the final coat is readily determined. Minimum time before recoating is overnight.

As an alternate to Item I-C above, Subcontractor may apply an intermediate coat of "Plasite 2050 Primer" according to the manufacturers instructions (Wisconsin Protective Coating Corporation). The minimum dry film thickness of the intermediate coat shall be 1.5 mils.

D. Third Coat

Spray Sherwin-Williams G&C White Enamel, B54WC4, reduced up to 12-1/2 percent with V.M.&P. Naphtha, in as heavy a wet coat as possible without running and sagging. Minimum dry film thickness - 2 mils.

As an alternate to Item I-D, Subcontractor may apply a top coat or coats of "Plasite 2050 Top Coat" Color White, according to the manufacturers instructions. Minimum dry film thickness of top coat shall be 2 mils.

E. A minimum of 5 mils (0.005) of dry paint thickness is required for durability. The ability to achieve this thickness will vary because of many factors: Application, thinners, surface, temperature, etc. Measurements must be made to insure proper film thickness and if this is not achieved in three coats a fourth coat (second coat of G&C Enamel White, B54WC4) shall be applied.

II. STEEL

A. Surface Preparation

Surfaces should be as clean and dry as possible. Power wiring brushing is recommended to remove all loose rust and dirt. If oil and grease are present these should be removed by solvent washing. On several areas of the steel mill

scale may still be attached. Mill scale should not be left on the surface as it is not permanently adherent to the base steel. Specifications for surface preparation should include its removal. Any stratified rust or blisters shall be removed by power impact tools, rotary scalers, or by use of power grinding equipment.

B. Primer

In order to achieve intimate metal-primer contact, Sherwin-Williams E41N1 Kromik Primer should be applied full body by brush. Although spraying under normal conditions, a full wet coat of a long oil primer will usually yield satisfactory results. Actual application methods and conditions fall far short of the ideal, and intimate metal-primer contact is not attained. Where it is not attained, the electrochemical properties are mostly lost and the physical barrier remains as the only corrosion deterrent.

1. Zinc Chromate Primer, B50Y1, may be used on the steel as well as on the aluminum surfaces, but the requirement of brushing would apply for the steel surfaces.

C. Second Coat

Same as aluminum second coat. See I-C.

D. Third Coat

Same as aluminum third coat. See I-D.

E. The same comments apply as for aluminum in I-E.

NATIONAL RADIO ASTRONOMY OBSERVATORY

APPENDIX 5.12

RELEASE OF CLAIMS

Contractor	
Contract (Purchase Order No.)	
I hereby certify that the following we (hereinafter referred to as the "Cont Subcontractor and Associated Universities, as AUI) which is a subcontract under Prime AUI and the United States Government, has been subcontracted to the subcontract of the subcontrac	tract") between the above named Inc. (hereinafter referred to Contract No with
In consideration of the total payment on ac sum of \$ made by AUI, the under leases AUI, its officers, agents and employees, frunder the Contract or in connection with the quired to be performed thereunder, and here the Government of the United States against harmless from, any claims by any person are nected with the Contract or the work thereof the foregoing release and agreement:	rsigned Contractor hereby re- yees and the Government of the rom any and all claims arising ne work, described above, re- by agrees to indemnify AUI and t, and to save each of them ising out of or in any way con-
Witness:	(Contractor)
	By
(Address)	(Title)

I,	, certify that I am the
(President) (Secretary) of the Corp	poration named as Contractor herein; that
	who signed this Release on behalf of the
Contractor was then	of the said Corporation;
that said Release was duly signed	for and in behalf of the said Corporation
by authority of its governing body powers.	y, that is within the scope of its corporate
	(Signature)
	(Title)
	(Date)

DOCUMENTATION REQUIREMENTS

September 28, 1973

<u>DESIGN PHASE</u> - Assume six (6) month program. The first five months to be active calculation and drawing; the sixth month would be update due to meetings and AUI checking, etc.

1) Meetings -(Sec.04.1.2) At least six.

One per month for six months, starting one month after contract. The first and sixth at NRAO in Charlottesville, Virginia. These are formal technical meetings (design review).

Minor visits by both parties should not be limited in number - are necessary for day to day liaison.

2) To be received by AUI thirty (30) days after contract

	Section No.	Description	Number of Copies
1.	04.1.11.1	Overall Schedule - Complete Task - all phases - should be PERT or CPM	3
2.	04.1.11.2	Manpower Schedule - all phases	3
3.	04.1.12	Project Breakdown - Scheduling and Payment AUI does not specify format. Subcontracto will use PERT chart for progress and cost computer programed.	r

3) To be received by AUI monthly (prior to the 8th working day of the following month.)

	Section No.	Description	Number of Copies
1.	04.1.11.1	Overall Schedule Update	4
2.	04.1.11.2	Manpower Schedule Update	4
3.	04.1.12	Project Breakdown Update	4
4.	04.1.14	Monthly Progress Report	4

4) Technical Items to be received by AUI as noted

	Section No.	Description	Number of Copies
1.	03.5.1	Design Drawing Standards and Format	(end of first month)- 3
2.	03.5.2	Vendor to schedule design of all elements within first month period and submit all drawings in schedule sequence. The design	2 copies for R/A
		schedule covers the six month period. NOTE: Will be Vendor "in-house schedule"	5 copies and 1 Repro. after R/A
3.		Design analysis - Computer Readout or Report The following analysis will be scheduled in parallel to 03.5.2 and contain support data. Due with the drawing submission in schedule sequence over six month period.	N/M
	03.2.7	Foundation Design (Calculation)	3
	03.2.6.2	Gear Ratio "	3
	03.2.6.2	Gearing Friction "	3
	03.2.6.2	Torque and HP	3
	03.2.5.4	Accelerations and Velocity (Calculation)	3
	03.2.5.5	Tracking Motion "	3
	03.2.4	Structural Deflections (Computer Program) *	1
	03.2.4	Best Fit Surface Paraboloid " *	1
	03.2.4	Surface RMS " *	1
	03.2.4	Resonant Frequency " *	1
	03.2.4	Servo Design " *	1
	03.2.4	Position and Readout System	1
	03.2.8.13	Control Monitor Bits (Calculation)	3

^{*}refer to paragraph 03.5.4 page 03.25.

	Section No.	Description	Number of Copies
4.	03.2.4	Error Budgets - to be initiated during first month of contract and submitted to AUI	
	03.2.4	Repeatable Errors (Calculation)	3
	03.2.4	Non-repeatable errors "	3
5.	03.2.5	Purchase Orders - Monthly after issue, (Computer time, etc.)	1
6.	03.3.1	Material Specifications - Drawings and follows schedule of 03.5.2	3
7.	03.5.2	Mfg. and Procurement Specifications Submit six months after contract date	5
8.	04.1.15	Special Tooling - submit list six months after Contract date - Update on monthly basis if necessary. This is related, in part, to Assembly and Alignment 03.5.5).	3
9.	03.3.3	Mis-manufacturing procedure - Submit 6 months after contract date.	3
10.	03.5.5	Assembly and Alignment Plan - Submit five months after contract date.	4
11.	03.5.7	Quality Assurance Plan - Submit 4½ months after contract date.	4
12.	03.5.6	Test and Acceptance Plan - Submit 5½ months after contract date.	4
13.	03.5.8	Spare Parts List - Submit six months after contract date	et 6
14.	03.5.9	Preliminary Operation and Maintenance Manual - Submit six months after contract date.	4

MANUFACTURING PHASE

	Section No.	Description	Number of Copies
1.	03.2.5	Purchase Order for Materials	4
2.	03.3.3	Mis-manufacturing Reports	3
3.	03.5.7	Inspection Reports per QC Plan	4
4.	04.1.15	Special Manufacturing Tooling List	4
5.		Shipping Documents	1
6.	04.1.11.1	Overall Schedule Update (monthly)	4
7.	04.1.11.2	Manpower Schedule Update (monthly)	4
8.	04.1.12	Project Breakdown Update (monthly)	4
9.	04.1.14	Monthly Progress Report (monthly)	4
10.		Manufacturing Plan	4
<u>ASS</u>	EMBLY PHASE		
1.	04.1.11.1	Overall Schedule Update (monthly)	4
2.	04.1.12.1	Manpower Schedule Update (monthly)	4
3.	04.1.12	Project Breakdown Update (monthly)	4
4.	04.1.14	Monthly Progress Report (monthly)	4
5.	03.5.5	Assembly and Alignment Test Results	4
6.	04.1.15	Special Tools not included in Design and Manufacture	4
7.	03.5.9	Final Operation and Maintenance Manual to include Lubrication Schedule	4

	Section No.	Description	Number of Copies
8.		Specified Foundation Fittings	-
9.		Antenna Components per Contract	-
10.		All Drawings and Specifications of Complete Antenna per Contract	-
11.		All Lubricants required for one complete change	-
12.		Vertex Room Delivery at AUI time and to designated site	-
13.	03.2.5	Purchase Orders during this Phase	4
14		Payroll Records (weekly) (Construction only)	

TYPICAL DESIGN SCHEDULE

∆ - Start Task

lacktriangle - End Task - Delivery Available

		MONTHS AFTER CONTRACT				
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QC Plan) 			
Cest and Acceptance Plan						
Spare Parts List					<u></u>	
Prelim. Operation Manual			,			
Design Meetings				Liaison	dates n	ot shown
Final Design Package for Submission						
dministrative Reports and Schedules	A	A		🛦		

NATIONAL SCIENCE FOUNDATION WASHINGTON, D.C. 20550

Contract NSF-C450 Amendment No. 26

Contracting Parties: Associated Universities, Inc., and the National Science Foundation

Contract NSF-C450 is hereby amended as follows:

At the end of Appendix A, <u>DAVIS-BACON ACT WAGE RATES</u>, incorporated in the Basic Contract, add the following:

"The following rates of wages and fringe benefits shall be the minimum rates per hour to be paid in the locality indicated for work performed by the Contractor and for work under subcontracts awarded during the period "January 1, 1973 through June 30, 1973."

Decision No. AM-11,406 dated March 24, 1972 New Mexico, State Wide

State: New Mexico; statewide.

Decision No. AM-3,615, dated Aug. 25, 1971; in 36 F.R. 16763.

Description of work: Street, highway, uting, and light engineering construction.

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Contract NSF-C450

Amendment No. 26

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Decision No. AM-11,406, dated March 24, 1972

Decision No. AM-11,406, dated March 24, 1972

DECISION FIN-11,406 - Hod. #3

(37 FR 5169 - Hirch 24, 1972)

Statewide, New Hexico

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This amendment consists of three pages and a signature page attached hereto.

Contracting Parties: Associated Universities, Inc., and the National Science Foundation

Contract NSF-C450 is hereby amended as follows:

At the end of Appendix A, DAVIS-BACON ACT WACE RATES, incorporated in the Basic Contract, add the following:

"The following rates of wages and fringe benefits shall be the minimum rates per hour to be paid in the locality indicated for work performed by the Contractor and for work under subcontracts awarded during the period "July 1, 1973 through June 30, 1974."

> Decision No. AM-11,406 dated March 24, 1972 Statewide, New Mexico

Basic Hourly DECISION #AM-11,406 - Mod. #4 Vacation App. Tr. Ct. Rates H&MPensions ()/ 1k 4169 - Harch 24, 1972) Statewide, New Mexico Charger .01 Coannt Pasons .26 \$4.94 lronvotters: Structural 6.53 •35 -50 Power Equipment Operators: Kole operator 6.09 .15 .10 Truck Drivers: Distributor (aschalt) 3.78 Dumpster or dumpter 3.86 Dump or batch trucks Under 8 c.y.
8 c.y. and under 16 c.y. 3.57 3.67 16 c.y. & under 20 c.y. 3.81 20 6.7. 6 6/22 24.6 Diesel-powered transport (non self-louding) 10 yes. & over 4.09 Flathedi 13 ton or under 3.57 Over 15 ton 3.72 Lumber carrier 3.60 Lewboy, heavy tequipment 4.19 lowboy, light equipment 3.51 Off-highway hauter 3.64 Pickup truck 3/4 ton år under 3.42 Service station attendent 3.46 Spreader box 3.51 Spreader box (self-propelled) 3.75 Susuper or rider helper 3.33 Tank trucks 3,000 gal. or under 3.65 3,001 gal. to 6,000 gal. 4,001 gal. & over 3.75 3.65 Teometer, 2 or 4 or wore 3.3å Trailor or scal-trailor dump 3.94 Transic alk 3.61 Varchouseman 3.56

Description - Antenna Assembly - Maintenance Building

A large steel assembly-maintenance building having a minimum clear hook height of 87', a clear width of 90', and a clear length of 135', will be designed and constructed by the Subcontractor on a site to be determined by AUI. The structure is to be designed in accord with the provisions of the Uniform Building Code as published by the International Conference of Building Officials, the National Electric Code, and other applicable codes adopted by the state of New Mexico. The building will be covered with permanent bonderized and painted steel siding and roofing. Siding shall be carried to ground level on all walls except where large doorways are required. Large doorways shall be framed for installation of doors, but no doors included. Walls and roof shall not be insulated. A concrete floor slab and sanitary facilities shall be included as shall gravity type roof ventilators. The building shall be equipped with lighting and normal power. AUI will provide the power source and a transformer at the side of the building. The building will contain 500 square feet of lighted office space. Two 30-ton electric hoists and a five ton traveling bridge crane will be provided. Additional building details are contained in E-Systems Proposal 416-15287, dated 14 March 1973, Part B and Revision A, dated 11 June 1973, pages 15A 1/7 thru 7/7 as modified to accept the provisions of this paragraph.

CERTIFICATE OF CURRENT COST OR PRICING DATA

This is to	o certify that, t	o the best of m	y knowledge
and belief, cost of			
submitted, either	actually or by sp	ecific identifi	cation in
writing (see FPR 1			
representatives in			
GCQ 73-0001 "B" dat	ted 25 July 1973	are accurate,	complete,
and current as of		10	1973 .
_	Month	Day	Year

Firm	E-Systems Inc., Garland Division
Name	
	Howard D. Clark, Sr.
Fitle	Director of Contracts

Date of execution:

11 October 1973