

COLLINS and RICE
Consulting Engineers
AREA CODE 217 • TELEPHONE 527-2501
1622 SOUTH FIFTH STREET • SPRINGFIELD, ILLINOIS

R. DEAN COLLINS
MARCUS J. RICE

March 15, 1966

Memorandum to file 430

Re: Phone call with Mr. J. Caldwell Wilson, Staff Engineer, Mountain States Telephone Co., Albuquerque, New Mexico

Subject: Limbaugh Engineers, Inc.

Mr. Wilson is the National Society of Professional Engineers Vice President Elect for the Southwestern Region. I called him concerning the capabilities of Limbaugh Engineers, Inc. Limbaugh Engineers Inc. have done various projects for the Mountain States Telephone Co. and these projects have been handled by Mr. Wilson.

I briefly outlined the type of information we were seeking and he replied that he did not know of anyone more highly qualified. The work they have done for Mountain States Telephone has been very satisfactory. He indicated that Limbaugh Engineers, Inc. have good equipment and qualified personnel. In one instance where they were not able to furnish a specialist they were able to extend their capabilities by flying in personnel from Bovay Engineers, Inc.

I also inquired about Flatow, Moore, Bryan & Fairburn and he indicated that their fields were more architectural and planning. He again reiterated that for the problem as outlined, Limbaugh Engineers, Inc. would be much better qualified than any other firm in the area.

R. D. Collins

cc: N.R.A.O., Attn: Dr. G. W. Swenson, Jr.

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R. DEAN COLLINS

MARCUS J. RICE

March 15, 1966

National Radio Astronomy Observatory
Edgemont Dairy Road
Charlottesville, Virginia 22901

Attention: Dr. George W. Swenson, Jr.

Re: Preliminary Site Facilities Design

Gentlemen:

In line with my discussion as presented in my letter of March 14, 1966, I have investigated firms in the New Mexico region and recommend the following firm for your consideration.

LIMBAUGH ENGINEERS, INC.
P. O. Box 335
3135 Carlisle Blvd., N.E.
Albuquerque, New Mexico

I would like to state that I have no relationship with any of the members of the above organization or with Bovay Engineers, Inc., nor do I have any financial interest of any type with either of these organizations.

I have known the president of Limbaugh Engineers, Inc., Mr. Frank W. Edwards, for a number of years through both engineering work and professional work. Data concerning Mr. Edwards is given in the enclosed information and actually needs no elaboration. I might add, however, that the Illinois Society of Professional Engineers conferred honorary membership on Mr. Edwards in 1965. This is only the eighth honorary membership to be awarded in the 80-year history of our Society.

Limbaugh Engineers, Inc. is affiliated with Bovay Engineers Inc. through joint ownership. Consequently Limbaugh Engineers, Inc. have the backup of an additional staff of approximately 150. (Incidentally, this is not unique in that our organization has affiliations with two other larger engineering firms. We provide them with a specialized force and they in turn provide us with necessary personnel as required on larger projects.) Limbaugh Engineers, Inc. is larger than our organization and within the time limits set forth would be able to handle the project with their own forces. However, I am quite certain that for portions of the work they would rely upon the experience of personnel of Bovay Engineers Inc.

March 15, 1966

A partial list of clients and projects performed by Limbaugh Engineers, Inc. is as follows:

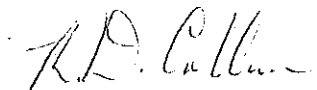
1. General storm and drainage plans and maps for the Corps of Engineers, Albuquerque, New Mexico.
2. Aerial photography and preparation of detailed site maps, White Sands Missile Range for the Corps of Engineers.
3. Various projects for the Atomic Energy Commission, Los Alamos, New Mexico.
4. Mapping of cratering experiments for the Sandia Corporation.

Perusal of the enclosed material indicates numerous other projects and clients, but the above sets forth the responsibility and types of clients for which this firm has operated. In addition, they are qualified by the State of New Mexico to furnish comprehensive planning for communities. This organization would be able to complete all phases of study and development from initial mapping, through preliminary design, planning and engineering design and specifications for your facility.

In summary, we believe Limbaugh Engineers, Inc. to be completely qualified to perform the preliminary site facilities design and recommend that they be given consideration for this project. Data concerning this organization is enclosed.

Very truly yours,

COLLINS and RICE, Inc.



R. D. Collins

RDC/bb

Encls.

March 26, 1966

Limbaugh Engineers, Inc.
3125 Carlisle Blvd., N. E.
Albuquerque, New Mexico

Gentlemen:

As you know, The National Radio Astronomy Observatory is planning the construction of a large radio telescope, to be known as the "VLA", consisting of an array of perhaps 35 to 40 steerable, paraboloidal antennas, mounted on wheels so as to be movable along tracks or roadways. It is necessary that a choice of site be made from among several possibilities, and you are invited to submit a proposal for the performance of the engineering work necessary to make such a decision. The work is to be completed by October 15, 1966, assuming the contract is issued by May 1, 1966.

The principal goals of the proposed site study are as follows:

1. Preparation of preliminary designs of the necessary engineering works, buildings, roads, water and power supply, etc., suitable for estimation of the cost of site development for each site.
2. Preparation of a map showing the property ownership of each site, and an estimate, based upon detailed investigation, of the cost of acquiring the necessary real estate by lease or purchase.
3. Detailed cost estimates for the development of each site.

4. An evaluation of each site from the standpoint of accessibility, convenience to suitable residential areas and schools; and availability of the services necessary to maintain a working force of approximately fifty persons, many of whom will be highly skilled and well educated.

Pursuant to the above goals it will be necessary to perform a certain amount of field work, possibly including some topographic mapping. It is emphasized that this work is subsidiary to the main mission and will be made of existing information, including maps, ground control, hydrological data, geological data, etc., and no unnecessary duplication will be permitted.

It is believed that the successful prosecution of this work requires that the personnel roster of the project include persons with competence in the following specialties:

1. Highway engineering, including the necessary experience in drainage design.
2. Soils and foundations.
3. Electric Power Supply.
4. Water Supply.
5. Architecture.
6. Topographic Engineering.
7. Real Estate.
8. Cost Estimation.

Linbaugh Engineers, Inc.

March 26, 1966

- (B) Your fixed price for the job, or, if your propose a "Time And Materials" contract, the rates to be charged for various categories of labor and services, and a price list of all the other expenses for which you would expect cost reimbursement. In the case of a "Time And Material" contract you must estimate the total cost, and the Observatory will specify a ceiling which must not be exceeded. A fee contract will not be considered.

It is desired that a contract be entered into by May 15, 1966 thus, your proposal must be in my hands, in quadruplicate, by April 10, 1966.

Permission by the owners or tenants for access to the site will be obtained by you, but the Observatory will extend its good offices in this regard in any situation in which this seems indicated. The Observatory desires to avoid public speculation upon the ultimate choice of site for this instrument; therefore, this work must be carried out in confidence, insofar as possible.

Sincerely yours,

W. W. Powell
Purchasing Officer

WWP/jg

APPENDIX A

TECHNICAL REQUIREMENTS OF VIA SITE DEVELOPMENT STUDY

- I. Laboratory Building - 16,000 square feet - Air conditioned
 - A. Control and Electronic Equipment - 10,000 sq. ft.
 - B. Offices - 2,000 sq. ft.
 - C. Electronics Laboratory - 3,000 sq. ft.
 - D. Storage - 1,000 sq. ft.
- II. Shops Building - 10,000 sq. ft.

(Minimal machine and carpenter shops, automotive shops, general storage)
- III. Garage-

Garage for five 2 1/2-ton trucks and roofed parking area for five additional trucks.
- IV. Dormitory - Air conditioned

Ten private rooms, appropriate bath facilities (not necessarily private), Kitchen and dining area to accommodate 25 persons at one sitting, and lounge room
- V. Railway Tracks or Roadway
 - A. Decision on choice between rails and roadways will be made during the course of the study by Observatory Personnel.
 - B. Rail - Roadway configuration is in the shape of a Wye, as shown on the maps in Appendix D. Two sizes of Wye should be studied for each site: one in which each arm is five miles long and one in which each arm is 15 miles long. In each case, there will be twelve observing stations on each arm, uniformly spaced, and one at the center (See Appendix B).

APPENDIX A

- C. Limits on gradients are those imposed by mobility of antennas. Arms of Wye need not be straight, but should conform to the general trend shown on site maps in Appendix D. Until more specific data are furnished, the antenna parameters of Appendix B should be used.

VI. AIR STRIP

An air strip will be required to serve air craft of the DC-3 class.

VII. CABLE TRENCHES

Each arm of the Wye will have a parallel cable trench. Cables for each arm will require total duct cross section of one square foot. Top of duct must be 3 1/2 feet below surface. Ducts should be designed for ease of installation costs and removal of cables. Cable and installation costs will be estimated by others. At each observing station a cable-terminal vault is required, of concrete, flush with surface, with space for fanning 16 cables in an area of 12 square feet of terminal board. Trenches will be backfilled with earth.

VIII. ACCESS ROADS

Access roads are required to service all observing stations from the central area, suitable for 45 MPH or more.

IX. UTILITIES

- A. Electric power: 1.5 MW total for technical use; 30 KW at each observing station, 100 KW for technical use in laboratory building. Distribution by overhead open-wire or cable. Other power as required.
- B. Water and Sewer: As required in central area only. No water needed for technical use.

X. TELEPHONE

Four outside lines. PAX serving all residential, shop, and office areas. Communication and data transmission from observing stations to be estimated by others.

XI. ARCHITECTURAL REQUIREMENTS

More detailed requirements concerning the function of items I through IV will be developed between the Observatory and the engineer's architect as work progresses. The following are the minimum requirements to be submitted:

- (A) Floor plans of each structure, scale 1/8" equals 1'0".
- (B) One elevation of each structure.
- (C) Site plan of building complex, scale 1" equals 20'.
- (D) Description of building materials and structural components contemplated.
- (E) Estimates of cost of each structure broken down into General, Plumbing, Electrical and Heating, Air Conditioning, and Ventilating Work.
- (F) Additional sketches for schematics, as required, to compliment the over-all architectural design.

XII. ENGINEERING REQUIREMENTS

The following is not intended to instruct the engineer as to procedures, or to limit the engineer's resources, but is included as a guide and sets forth minimum requirements to be submitted with the engineer's proposal. The Engineer shall submit with his proposal an outline which will set forth his general method of procedure and the method by which he expects to obtain needed information. It is suggested that this outline separate the work to be accomplished into two phases.

Phase I-This will consist of preliminary investigation of the 3 sites in Appendix E. Minimum information to be obtained would include the following:

- (A) Topographic studies to obtain an approximation of the earth moving requirements for each array and approximation of the drainage requirements.
- (B) Collection of available geographical data supplemented by soil boring and soil tests to determine the suitability of each array for support of a rail-roadway and for support of rigid observing stations. (Refer to Appendix B)
- (C) General information to determine preliminary course of site development in accordance with the enclosed specification.
- (D) The engineer's recommendation concerning suitability of the 3 proposed sites, together with recording data, submitted as a brief interim report. This phase to be completed by approximately August 1, 1966.

Phase II-This phase will consist of an economic comparison for development of the 2 sites selected at the end of phase II:

- (a) The information of paying for Phase I will be amplified as required to provide for detailed estimate of cost.
- (b) The required engineering work, architectural work and other work required in this appendix would be completed.
- (c) The outline should indicate the number and type of map that will be included, the drawing that will be included and the necessary computation that will be included. Also, of course, all of the information will be amplified by a written report stating the procedures used, the work done, and the results accomplished, along with recommendations concerning the suitability of the two sites.

Dr. Hvatum

VLA DEVELOPMENT MEETING

Albuquerque, New Mexico

October 3, 1966

In attendance:

- Dr. G. W. Swenson - NRAO
- Mr. R. F. Pavley - RCA
- Mr. Irving D. Kruger - RCA
- Mr. George C. Love - Limbaugh Engineers, Inc.
- Mr. J. L. Shields - Limbaugh Engineers, Inc.

Items discussed generally followed an outline prepared by Limbaugh which included the following salient points.

- (1) The Site Development Study is to be complete on November 11. Pertinent information will be forwarded to the NRAO at that time with multiple copies of the bound report to follow two weeks later.
- (2) The utilities -
 - (a) Cable way to be 4 - 3-1/2 " diameter ducts with no particular expensive provisions made for water proofing. It was determined later that these ducts will run between the two parallel tracks.
 - (b) Each antenna requires three kw per axis. Therefore, if the antennae are to be rotated around both axes concurrently during a high wind, each antenna would require six kw for driving and four kw for the electronics. However, during maximum load conditions only one of the pointing motors per antenna will be operated concurrently and therefore the total maximum electrical requirement is seven kw per antenna at a 90% power factor.
 - (c) In the building complex, the computer will require ten kw and other electronics will require fifty kw in addition to the normal building complex requirements.
 - (d) The emergency power -- a 500 kw emergency power generator will be included in the estimate.
 - (e) Power lines will be maintained a minimum of 50 feet from the antenna observing positions.
 - (f) Limbaugh is to consider electrical heating for the building complex.
- (3) Antenna Configuration -

RCA presented results of their preliminary studies which indicated that a 25 meter dish (the size which is the basis for the Site Development Study) should have a 25 foot spacing between supports. They also indicated that it should be possible

to move the antenna on a rail system which was narrower than the main support frame and inside of the observing station foundations.

After some discussion, it was decided that a hydraulic jacking arrangement could best be located on the "rolling stock." The jacks would simply lift the antenna off of the foundations and after the antenna was located at the next observing station, the jacks could be compressed and allow the rolling stock to be used in moving other antenna.

RCA were considering driven wheels under at least one of the three support legs which would be powered by a prime mover which would trolley along behind the antenna. Maximum speed considered as four miles per hour. It is not considered possible at this time to pass vehicles under the telescope.

- (4) The water supply was discussed and Limbaugh is considering a single 5,000 gallon per day well and 65,000 gallon elevated tank which would supply both the fire protection demands and the domestic use.
- (5) Real Estate. It is our intention to acquire a 200 yard wide strip of land for the branches and in addition, it will be necessary to acquire land for the building complex, access road, air strip, and other facilities. RCA brought up the need for a staging and assembly area for the antenna. Clarification will be obtained from them later on the size required.
- (6) Estimates. We are to base our estimate on a five mile long branch complete facility and a 15 mile long branch complete facility, either of which will be constructed completely. In other words, our estimate will not be based on a five mile long branch initial construction and incremental construction at a later time for the ten additional miles.
- (7) Buildings. These were discussed later in the day at the architect's office with Messrs. Swenson, Love, Stevens and Pearl in attendance. A review of the second schematic presentations by the architects indicated that they were essentially satisfactory. The architect is to complete schematics at this time and include them in the final report.

The only unusual heat source is in the 10,000 square foot electronics area where the air conditioner must dissipate 20 kw.


G. C. Love