NATIONAL RADIO ASTRONOMY OBSERVATORY
Green Bank, West Virginia

MEMO NO. 40

TO: 25m - millimeter antenna file

FROM: Buck Peery

SUBJECT: Visit to Haystack & Essco - Re Radome Research

The writer and L. King visited Haystack Observatory and Electronic Space Systems Corporation to obtain information on existing and new radome installations, designs, materials and operations.

January 13, 1976, visited Haystack and talked to Paul Sebring and "Lit" Meeks: thought radome a major advantage for their telescope and any precision high frequency system. Other thoughts and comments they had:

a. Gives protection from wind - better pointing.

b. Can operate during day as dome blocks out solar heat from sun.

c. Helps to stretch out thermal changes - painting of surface not required.

d. Heat inside of very little value - they keeps theirs 40°F because they have a distilled water system as part of their telescope.

e. Heat might be a problem as it causes snow to melt forming ice on outside of dome - snow would probably blow off without heat.

f. Had some trouble with condensation on inside dome. Determined it was coming from humidified control room. Installed double doors (a type of air lock) between control room and inside of dome; also installed blowers to blow outside air in to develope slight positive pressure. This made dome quieter (cut down on "oil canning" effect).

g. Had number of heater-blowers, some discharging up, some down. They are not used very much - a few of them are used to maintain the 40° temperature.

h. Painting their dome a big problem; the material is painted - fiber glass sheets. Some of the panels have deteriorated and need replacing. Painting is required every four or five years.

i. A program for replacing panels with Esscolam 6 has been started. Five panels were replaced this summer; this will be a continuing program. It was determined that a large amount of labor is involved in installing new material in existing panels.

j. It has been found that recovery after a rain has been a problem - not sure whether this is caused by absorption in panel material, surface attraction to water or humidity in atmosphere. Thought new materials would help this problem.

k. Dome structure members too large which causes more blockage than a newer model would. The original design was for 5/8 of a sphere and 200 knots wind (artic).

l. Temperature change, floor to top of dome 1 to 2°C. They have experienced hot air bubbles in top of dome,considering an automatic adjustable louver damper in top of dome to let this out. Keeping air mixed up in dome is a problem - no solution - have considered cloth tubes up inside to carry air up. No action taken.

m. Circulating fans mounted on side of antenna pedestal were not used. They had not proven very satisfactory.

n. Moving antenna from one position to another does an excellent job of mixing up air.

o. Radio Frequency - Electro magnetic problems are reflections from radome structure and material, blockage of radome and frame and resonance in materials. Reflections increase interference. Loss through radome 1 to 2 db.

p. Thought new materials with lower loss being developed - no information on any. Mentioned a material "Shell dahl"? might be a big improvement.

q. Had not experienced any Green House effect inside dome.

r. They are experiencing thermal lag problems in their telescope structure and are studying ways to improve that.

January 14, 1976, visited ESSCO and talked with Jack Bilodeau and Al Cohen. Their comments in general were:

a. Radome would be a must for the 25m antenna.

b. They saw no problem in making a radome with less than 1 db loss for a 300 GH radio telescope.

c. Saw little chance of much green house effect as the radome would reflect at least 90 percent of the solar heat.

d. Estimated life of material - 15 years.

e. Dielectric constant of Esscolam X-106-3 is 2.8. The best material for high frequencies they have to offer at this time.

f. They will send us mechanical and electrical specifications and test data that they have.

g. They are interested in any test we make and would be interested in making mechanical tests on our samples after exposure. They will let us know what test they can make.

h. They have done some testing and will give us copies of the results that are available.

i. Recommended a radome be made up of random panels with membrane material epoxied and crimped onto an extruded aluminum frame.

j. Thought heating and cooling should be kept to a minimum.

k. A radome should be pressurized to .02 - .04 psi with outside air to reduce oil canning of panels (up to 20 mph wind) and reduce moisture inside the dome.

l. Thought a radome would give much better results than astrodome even at very high frequencies.

m. Research and development is underway with materials to be used for frequencies as high as 1000 GH - no data available at this time.

n. A temperature approximately 2°C above outside air temperature inside dome does reduce condensation on inside.

o. Snow does not ordinarily stick on dome. Heat is not required to melt it.

p. They will send us a sample of Esscolam 6 for our information.

They spent considerable more time on antenna structures and their theory of the performance of these structures and radome combinations; showed slides on the erection of the one they built in Sweden, took us to see the University of Massachusetts antenna under construction and showed us around the plant. They thought they could meet or exceed operation specifications of our 25m antenna with their type construction. Thought they could make panels, their way, to .025 mm rms. They had several comments relative to our 25m proposal which we avoided discussing. Said they would be interested in sending us one of their panels and let us measure it for manufacturing accuracies. They will let us know about this.

Comments and notes of L. King are attached as part of this memo.

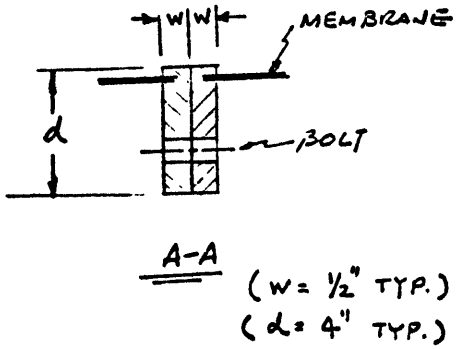
Jan. 13-14, 1976 trip to Haystack & ESSCO L J King

Haystack Radome

This first large MSF radome structure looked tremendously strong from inside. Its 3"x5" beam seemed much larger due to the short beam span of the panel. The 13% optical blockage of the frame structure is obvious too large for any present considerations. However, their experiences on operating the system (pressurized the radome, preventing condensation, forces air circulation, etc) are of interests to us.

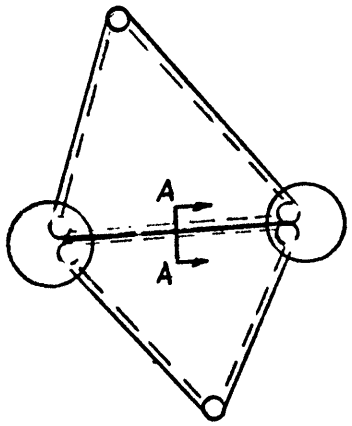
ESSCO Radomes

Basic radome geometry, wind data, and analytical methods have not been changed much since the time of Haystack radome. Manufacturing and assembling methods are however improved significantly in the same period. ESSCO radomes are of especially interested in these areas. Its 5% space frame blockage and membrane attachment method are attractive. The basic triangular panels assembled and sealed at election are quite simple.



A-A

(w = ½" TYP.)
(d = 4" TYP.)



ESSCO RADOME PANELS

A section of the typical ESSCO radome may be adapted for the astrodome sliding door, except the material must be steel for strength and minimun blockage. Similar way of bonding membrane, though not recommended by ESSCO for steel beam, may still work which we should look into in the future.

U. Mass. Telescope

45' U. Mass. system is being built by ESSCO. The reflector backup structure is made of huge 12"x36"x1/4" aluminum box beams. ESSCO claims that its dead load deformations are very small. No numerical values are available at this time, they may provide us surface measurements of two elevation positions after survey in late February. The surface panels have .0024"/.060mm rms error by their METRON. The best of 7 panels measured is .00189"/.047mm. Average size of panels is 2'x10' weights about 40#. It takes 3x8 man-hour for manufacturing one panel. They said, by grinding the panel mold, they can meet the spec. of .04mm rms error.