

Dr. Shri Alexander Praveenkumar,
NCRA-Tata Institute of Fundamental Research,

June, 29, 2002

Dr. Jaime Urrutia Fucugauchi,
Director,
Instituto de Geofísica, UNAM

Dear Dr. Urrutia Fucugauchi,

I am enclosing the report of my visit working at the Mexican IPS array in Coeneo.

Yours faithfully,

Alexander Praveen Kumar

cc. Dr. René Drucker Colín - Coordinador de la Investigación Científica, UNAM
cc. Dr. J. Américo González Esparza, Instituto de Geofísica, UNAM

REPORT ON MY VISIT TO INSTITUTO DE GEOFISICA, UNAM, MEXICO

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This report gives the details of the work that has been carried out at the Mexican IPS Array site at Coeneo, Michoacan state, Mexico and the progress that has been made in the Array during my visit to Mexico for two months in May and June 2002.

I arrived at Mexico on the 3rd May 2002 with a plan to work on the Mexican IPS Array till 29 th June 2002. I started working with the team of people consisting of

1. Dr. J. Americo Gonzalez Esparza
2. Mr. Armando Carrillo Vargas
3. Mr. Ernesto Andrade Mascote
4. Mr. Ernesto Aguilar Rodriguez
5. Mr. Julio Cesar Ramirez
6. Mr. Cesar Cortes
7. Dr. Román Pérez Enríquez
8. Dr. Stan Kurtz

When I started the work, eight rows of dipoles of the Array had been completed with good quality of workmanship. Out of the eight rows of dipoles, four rows were not meeting the allowable tolerances in length, Dipole centre. Those four rows were reinstalled such a way as to meet the allowable tolerances. Subsequently, eighteen Dipole rows were completed in a professional manner taking care of many other details like the use of environmental resistant materials to prevent environmental degradation.

After that, the design of the Balanced to Unbalanced Transformer (BALUN) was taken up. Considerable effort was put to arrive at the right enamelled copper wire, the number of twists per inch, the number of turns, the ferrite core etc. Finally we succeeded in designing the Balun with a very good and repeatable performance. For enclosing the Balun, easily available and cost effective Aluminium housing was chosen and the final design was completed. Eight completed Baluns were produced with performance testing. For waterproofing the Housing, easily available, Silicone

Gasket maker compound has been identified for use in all the units. The cable for connecting to the dipole array has been chosen. Also the RF cable assembly for connecting the Balun output to the Low Noise Amplifier (LNA) has been finalised and they are under mass production. To protect the cable joints against water entry, a proven Scotch 23 tape has been identified and is being used on all cables.

Low Noise Amplifier (LNA) packaging was taken up next. LNAs of two rows of the Array was packaged in a single Aluminium housing. This housing again was chosen from easily available low cost box. The LNAs were packaged with other associated units like Voltage Regulator, Transient Voltage Suppressor (TVS) diode, various cable assemblies etc and the design has been frozen for production. The output of 16 dipoles of a row is amplified by a single LNA. Since two LNAs are packaged in a box, four boxes are required for two rows of the Array.

The next product which was designed is the Power Combiner Unit. This unit combines the output of 16 dipoles of a row with the 16 adjacent dipoles of the same row. Two Minicircuits make combiners were packaged in a single Aluminium housing. This housing was chosen from the easily available low cost product. For package design, readily available Aluminium products were used. The required right angled connector was identified, purchased and are being used. The package will cater to combining two rows of the corresponding 32 dipole outputs.

The other product for design was the Combiner-Amplifier Unit. This unit combines the output of 32 dipoles of the eastern half of a row with the 32 dipoles of the western half of the same row. after combining, the signals are amplified for carrying on the long RF cables to the control room. This product was designed and finalised on readily available Aluminium housing and Aluminium angles. The combiners and amplifiers for two adjacent rows are packaged in a single housing with the associated cable assemblies, Voltage Regulator, TVS diode, cable support etc.

For all the above packages, a suitable Polyurethane sealing compound was identified for waterproofing which is easily available in the local market.

The lengths of all the long RF cables interconnecting the outputs of the dipole array has been finalized. Also, the type of connector to be used for the BELDEN 9913 RF Co-axial cable has been decided and will have to be ordered with relevant crimping tool.

The DC Power requirement for all the Amplifiers in the array has been estimated and the power distribution scheme for powering the Amplifiers has been decided. They will be powered using 5 numbers of 30 volt power supplies of 6 ampere rating each such a way that one power supply will cater to the power requirement of one corresponding column of 64 Amplifiers.

I provided training for all the manpower including students in theoretical and practical aspects involved in Antennas, and arrays, Radio Frequency system design and many other related subjects. I also clarified all their doubts and in my view they have a clear understanding of what they are doing. This training has given them enough motivation to carry on with the work.

In my view, the Mexican IPS array would be a trend setter for the future antenna arrays in the world and the team is capable producing a reliable and modern radio telescope. By designing state of the art digital back end to go with this array it could become a versatile instrument capable of producing high quality scientific results in many areas. I looked at the radio frequency interference (RFI) at the band at which the telescope is being designed and I was amazed to see that in the array site in Coeneo, the RFI is absent in this band and in the near by frequencies the RFI is very limited in number and their power level is very very low to affect the telescope in any way.

To conclude, I would like to say that it has been a good experience to work with the IPS array and with the team of motivated manpower. The necessary details for completing all the rows of the array has been finalised. The Beam formation and Post processing of data has to done digitally using Modern digital design techniques so that the array would be a versatile instrument for the intended applications. This project has a strong technical support from the GMRT group of NCRA, TIFR located at Pune , India. I feel that the collaboration should include design and development of a state of the art digital back end.

A. Praveen Kumar

29, June, 2002.