NASA CONSORTIUM INVESTIGATING AREA ARMY PACKAGING TECHNOLOGY FOR MINIATURIZATION APPLICATIONS

by

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ABSTRACT

The Jet Propulsion Laboratory (JPL) is currently assessing the use of Area Array Packaging (AAP) for NASA spaceflight applications. This work is being funded through NASA Headquarters, Code Q. The objectives of the project are to demonstrate the robustness, quality and reliability limitations of AA}' technology, and to assist in the development of the rapidly growing industrial infrastructure for this technology. JPL has solicited industrial, academic and other related consortia to work together to leverage the related efforts into a synergistic cooperative effort. The wide industrial use of AAP technology will afford NASA inexpensive access to this technology. Moreover, AAP technology will support NASA's miniaturization thrust for its next generation spacecraft, The organizations that are involved to-date include:

- **Military sectors-** Hughes Missile Systems Company (HMSC) to design Printed Wiring Board (PWB) test vehicle and Boeing Defense and Space Group to perform environmental testing for military applications.
- **Commercial facilities-** Amkor/Anam Electronics, Inc. to provide plastic packages, Altron Inc. to fabricate PWBs, Celestica, Canada, to assemble test vehicles, Electronics Manufacturing Productivity Facility (EMPF) to perform environmental testing, and American Micro Devices (AMD) and IBM to provide resistive die and ceramic packages,
- **Infrastructure-** Interconnection Technology Research Institute (ITRI) established by the Institute for Interconnecting and Packaging Electronic Circuits (IPC) to provide a vehicle for collaboration among the various sectors of electronic interconnection industries.
- **Academia-** Rochester Institute of Technology (RIT) to assemble test vehicles. More than 20 industrial advisory including JPL redirecting the RIT metal manufacturing laboratory into Computer Integrated Electronics Manufacturing

(CIEM) to meet the current national demand for electronics manufacturing engineers.

All participants in this effort are furnishing in-kind contributions. The interest in participation by other facilities is rapidly increasing, however, we have currently focused our investigation based on our fact-finding search in this area. Cost, facility capability for board fabrication and assembly, and the availability of environmental test facilities were considered in narrowing selection of test vehicles using statistical methodology. The number of test vehicles could be increased after initial evaluation and based on availability of additional resources.

The NASA Consortium will characterize AAPs in the following areas:

- Processing/assembling PWBS using AAPs, including rework
- Inspection/QA methods for ascertaining the process controls, acceptance methodologies and final quality of AAP assemblies.
- Investigating the reliability of assemblies utilizing AAPs over several different types of environments (thermal and dynamic).

Parameters inside the design, manufacturing and test of the test vehicles are being statistically toggled using a DoE technique to determine the influence and criticality of these parameters, as tested. The output of this effort will be published in a suitable industrial guidelines document, providing a common point of reference and use between NASA/JPL and industry for this technology.

Currently, the JPL Consortium has finalized the test vehicle design and is in the process of fabricating the PWBs. All package types both plastic and ceramic BGA and fine pitch plastic gull wings have been selected and are available. The critical manufacturing parameters have been identified and Celestica and RIT are ready to perform assemblies. Boeing, EMPF and JPL have allocated electrical test equipment for real time electrical monitoring during environmental testing and power cycling (more than 2,000 channels). X-ray as well as visual inspections including SEM will be performed on assemblies prior to and periodically during environmental testing. It is anticipated that environmental testing will be started in late December of 1995 and to have some results early in the next calendar year.

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BIOGRAPHY

Mr. Phillip R. Barela

Mr. Barela is presently the Technical Group Supervisor for the Applications Engineering Group, Quality Assurance Section, where he has worked for the last four years. Over the last nine years, Mr. Barela has served in numerous positions dealing with packaging design, failure analyses and manufacturing engineering at Gould Electronics, NavCom Defense Systems, Loral Electro-Optical Systems and the Jet Propulsion Laboratory. Mr. Barela has held positions as a failure analyst, lead Microelectronics Engineer and Manufacturing Engineer working with the package design and manufacture of hybrids (thick and thin), MCMs, COB, through hole, surface mount and mixed assembly technologies. In this capacity, he has started numerous product lines for low to medium volume military and space products. Mr. Barela has extensive experience with design and producibility issues relating to new and mature product lines for low to medium volume applications. Mr. Barela is a member of the SMTA, IPC, ITRI, SOCA, SME, is a certified Manufacturing Engineer and received his BS in Manufacturing Engineering.

Dr. Reza Ghaffarian

Dr. Reza Ghaffarian has more than fifteen years of industrial and academic experience in mechanical, materials, and manufacturing processes engineering. At JPL, He supports research and development activities in SMT for infusion in NASA missions including projects in advanced electronics packaging, interconnection, and assembly. His responsibilities include technical coordination, Design of Experiment (DOE) statistical test vehicle implementation, manufacturing process, inspection methodology development, failure analysis, and environmental test data collection and anal ysis. Dr. Ghaffarian has authored or co-authored over 15 technical papers and numerous patentable innovations. He has also organized and chaired many technical sessions. He received his M.S. in 1979, Engineering Degree in 1980, and Ph.D. in 1982 all in Engineering from University of California at Los Angeles (UCLA).