SOLAR ARRAY WORKSHOP

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The solar array workshop, which was attended by 20 people, began with a review of the needs and objectives in this area as presented by the various government representatives during the preceding sessions. The major problem noted with respect to needs was the potentially conflicting requirements of low cost and low weight. Since the importance of weight and cost and relationship between them are strongly mission dependent, the workshop concluded that the requirements of military missions in synchronous orbit could be quite different from the requirements of NASA low-orbit missions and that an assignment of specific technology deficiencies could only be related to specific mission classes.

TECHNOLOGY DEFICIENCIES

The major overall problem areas identified during the workshop were as follows:

(1) Lack of an overall program technology plan for specific mission classes

(2) Funding not compatible with technology requirements

(3) Dependency on results from DOE terrestrial programs, which may not produce usable results

The specific technology deficiencies identified were as follows:

(1) The overall problems of using solar arrays at voltages of hundreds of volts and higher are not understood and have not been amply demonstrated. Problems include not only a definitive understanding of plasma effects versus voltage, but also system level problems with higher voltage, including load switching and voltage regulation.

(2) The space application of concentrators is not well understood. Problems include

(a) Design optimization for cost or weight reductions

(b) Applicability of high concentration ratios

(c) Lifetime characteristics

(d) Packaging and deployment characteristics

(e) Heat rejection techniques

(f) Orientation and spacecraft interaction characteristics

(g) Applicability to different mission classes

(3) The relationship between solar cell stack parameters and mission weight and cost is not well understood and is mission dependent. The following approaches all have weight and cost implications whose benefits vary greatly between low-orbit and synchronous-orbit missions as well as between conventional and shuttle launches:

(a) Increase cell stack efficiency

(b) Reduce cell stack costs at the expense of efficiency

(c) Reduce cell stack weight at the expense of efficiency and cost

(4) The potential role and benefits of gallium arsenide cell technology integrated into space arrays are not clear. Problem areas include:

(a) What efficiency and cost goals are required to permit the economical use of GaAs in planar as well as concentrator arrays?

(b) Does the space utilization of GaAs arrays depend upon a terrestrial market?

ADEQUACY OF CURRENT AND PROPOSED PROGRAMS

The workshop's comments on current and proposed programs were directly related to and integrated into our discussion of problems and deficiencies as follows:

(1) Military synchronous-orbit missions are presently very close to being weight constrained because of the IUS weight restrictions. It is not clear that certain missions well above 2 kW can be launched without significant weight reductions, especially in the power subsystem area. The need for improved performance, higher efficiency cell technology, higher voltage, hardness, and higher energy density batteries was identified, but a quantitative assessment of specific needs and performance improvements was not made. It was recommended that this be done in each of the power system technology areas so that specific goals could be established for driving the technology.

(2) The needs for NASA higher power, low-orbit missions such as the power module were discussed and, except for the comments made in the deficiency section of this report, the workshop agreed with the NASA plans for proposed programs. These were understood to have included

(a) Concentrator versus planar studies

(b) Concepts for on-orbit maintainability

(c) Heat rejection techniques

(d) Techniques for solar array stationkeeping and pointing

The group concluded that in addition to these programs, systematic studies should include the importance of weight and volume in these missions, and the interrelationship between cost, weight, and volume parameters.

ADDITIONAL TASKS

Implicit in the discussion were recommendations of additional tasks which should be undertaken. In addition to these, the working group provided the following ideas and comments:

(1) Inflatable arrays

(2) Spectrum selection to increase efficiency

(3) Solar cell annealing techniques

(4) Reduce cell operating temperature

(5) Interconnect designs for long-life operation

(6) Rollup array backup for PEP and/or power module usage

(7) Accelerate work in polymer coatings for cells

(8) On-array power conditioning

(9) Techniques for converting array power to ac

(10) Accelerate development of low-weight and low-cost arrays by evaluating alternative solar array module approaches which could lead to significant improvements both in manufacturability and in weight reduction

SOLAR ARRAYS

NEEDS - LOW COST AND LOW WEIGHT

- o PROBLEMS OF PRIORITY
- o MISSION DEPENDENCY

GENERAL DEFICIENCIES

- o LACK OF OVERALL PROGRAM TECHNOLOGY PLAN
- o DEPENDENCY ON OTHER AGENCIES
- o FUNDING NOT COMPATIBLE WITH PROGRAM R&D'S

SPECIFICS

- o NEED FOR EARLY GaAs SYSTEM VERIFICATION
- o MAJOR WORK IN HIGH VOLTAGE TECHNOLOGY REQUIRED
- o NEED TO INTEGRATE CONTROLS, STRUCTURES AND POWER
- o DID NOT SEE ADVANCED TECHNOLOGY IN LIGHTWEIGHT STRUCTURES, ANNEALING CONCEPTS, RADIATION HARDENING, SPECTRUM SHIFTING, ETC.
- o "CLEAN SHEET" APPROACH IN MODULE DESIGN
- o DID NOT SEE AGGRESSIVE APPROACHES TO COVER PROBLEM
- o ROLE OF CONCENTRATORS NOT CLEAR

NEEDS - COST/WGT

DEFICIENCIES

- o HIGH VOLTAGE
- o CELL STACK OPTIMIZ
- o APPLICABILITY OF CONC.
- o CONTROLS/STRUCTURES
- o GaAs VERIFICATION

IDEAS

- o "CLEAN SHEET" APPROACH
- o ANNEALING
- o CELL OPERATING TEMP.
- o INTERCONNECT LIFE
- o INFLATABLE CONCEPTS