SOLAR CELL WORKSHOP

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The workshop addressed three issues in respect to the NASA solar cell technology requirements for future orbital missions. First, we identified technology areas that were considered most significant and indicated what deficiencies and concerns we had with each area. Second, we made recommendations of what tasks should be undertaken to reduce the costs and risks of future orbital power systems. Third, we made an attempt to identify the lowest priority items in the present program in terms of content and timing.

TECHNOLOGY DEFICIENCIES AND CONCERNS

Three technology areas were identified as being most significant, and the concerns for each are listed along with some conclusions. The three most significant areas were radiation resistance, manufacturing capability, and cost reduction. The comments made for each area are listed here:

(1) Radiation resistance: This area was considered more important than efficiency. Of particular concern was end-of-mission-life efficiency. It was noted that military requirements are often quite different than NASA's. The conclusions were that we still have many approaches available to improve end-of-life output, that good radiation resistance and high efficiency are compatible objectives, that both material properties and impurity control are major factors to be better understood, and that other materials such as gallium arsenide and amorphous silicon provide new opportunities for progress.

(2) Manufacturing capability: The concern here was the capability and availability of new improved solar cells such as thin 2-mil cells and wraparound cells. The comment was made that users must provide the incentive for this area by deciding to use new technology. There is a need for tooling buildup and pilot production of the new technology, and this takes a lot of time and money. It was felt there was not sufficient backing of the manufacturing programs to meet the time scales projected. Also there was a feeling that the qualification and integration steps for achieving technology readiness were uncertain. The conclusions were that more stimulation of thin-2-mil-cell and wraparound-cell manufacturing capability is needed, that sustained comitments are needed, that there is no assurance these new technologies will be available when needed, that long-range plans and expected commitments are not sufficient assurance to manufacturers, and that large surprise program requirements (such as comet ion drive) could disrupt industry and cause problems.

(3) Cost reduction: This was stated to be "a can of worms." High-volume production does not seem to be justified by near-term program plans. The ter-

restrial cost-reduction program will have a very limited impact over the next 5 years. Terrestrial and space technology may even be incompatible. But, over the long run, they will probably be compatible and may merge together. The conclusions were that the approach should be to reduce the cost of high-quality cells rather than to increase the performance and reliability of a low-cost cell, that near-term cost reductions are a problem because of low-volume production, that the long-term cost-reduction goals can probably be met if the volume projections are correct and terrestrial technology merges with space technology, and that GaAs cell cost reduction is a major problem.

(4) Other concerns: Efficiency is a major cost driver on the complete system. Silicon cells are well developed, with open-circuit voltage the last hurdle. GaAs cells are closer to the theoretical limit. Other approaches that will lead to 25 percent or greater efficiency are a major problem. The conclusions were that 25 to 30 percent efficiency would not be needed in the next 10 years, that we must continue to build a good research base for future thrusts, that there is no need to accelerate in this area but we should continue as we are, and that lack of basic knowledge is a serious deficiency.

Process technology is primarily concerned with contacting methods although they are not now a problem. Welding technology is not well advanced and implemented, especially on very thin cells. Thin cover glasses are also not readily available. The nonglass cover technology is not a necessity but is highly desirable since glass problems are not fully known. Texturized surface technology is in pretty good shape, but absorptivity control still needs improvement.

RECOMMENDATIONS

Two recommendations made by the workshop related to activity that was needed beyond that presently being done.

(1) Pilot demonstration: It was recommended that we start demonstrating manufacturing capability of new cell technology on a large-scale pilot line basis. In particular, thin cells (2 mil), wraparound cells, and thin glass covers (2 mil) are important technologies that should be brought to manufacturing readiness as soon as possible.

(2) GaAs cell technology: It was recommended that high-efficiency, radiation-resistant GaAs cell technology be accelerated and brought to readiness. In particular, emphasis should be placed on contact metallization, manufacturability, material availability, thin cells, and the use of concentration.

LOW-PRIORITY AREAS

The workshop believes that the present program is a bare-minimum effort with no obvious areas that are unimportant, considering the very ambitious large-scale missions being projected for the future. However, if a priority rating were to be applied to the solar cell technology development program, the lowest priority areas would be the development of concentrator cells and GaAs cells. Both of these technologies are felt to be less important in the near term and primarily to provide advancements that could be used 5 to 10 years from now.