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PHOTOVOLTAIC ENGINEERING TESTBED

A facility for space calibration and measurement of solar cells on the International Space Station

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ABSTRACT

The Photovoltaic Engineering Testbed ("PET") is a facility to be flown on the International Space Station to perform calibration, measurement, and qualification of solar cells in the space environment and then returning the cells to Earth for laboratory use. PET will allow rapid-turnaround testing of new photovoltaic technology under AM0 conditions.

INTRODUCTION

The Photovoltaic Engineering Testbed ("PET") is a facility to be flown on the International Space Station to perform calibration, measurement, and qualification of solar cells in the space environment and then return the cells to Earth for laboratory use [1].

The goal of PET is to allow rapid-turnaround testing of new photovoltaic technology under actual space (true AM0 spectrum) conditions. PET is also designed to allow long-duration exposure tests of cells to the space environment, with regular measurement of changes in cell properties, and to measure the temperature coefficient of the current-voltabe (I-V) characteristic of photovoltaic cells under space conditions.

ENGINEERING

Figure 1 shows an overall layout of the PET design. Some of the engineering considerations involved in the design of PET are discussed in reference 2.

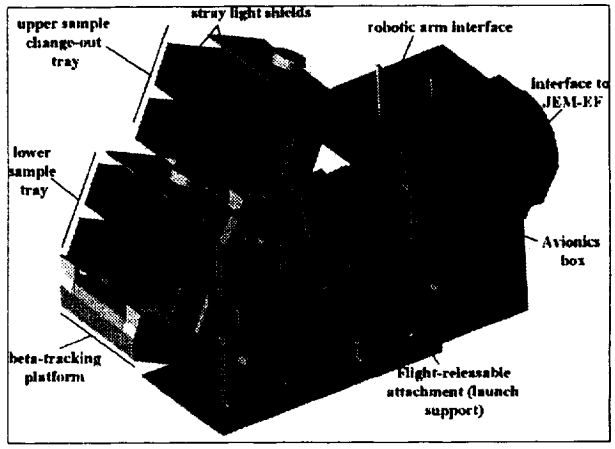

Fig. 1. Conceptual layout of Photovoltaic Engineering Testbed Facility on International Space Station

The PET assembly includes a beta-angle tracking platform. By tracking in the beta (orbital inclination) angle, measurements at normal sun incidence can be achieved once per orbit. This allows up to fifteen measurements to be taken per day.

Two sample change-out units are mounted to the beta tracking platform. Each change-out unit carries four individual sample mounting holders, each of which can carry up to sixteen 2-cm by 2-cm solar cells (or a smaller number of larger area cells). Sample holders are shielded

from stray light reflected from the station and from reflected Earth albedo by a small shield.

PET is mounted on the Japanese Experiment Module (JEM) Exposure Facility (figure 2, 3). The sample change-out unit is exchanged through the airlock with by use of the Japanese robotic arm, permitting rapid testing and return of samples.

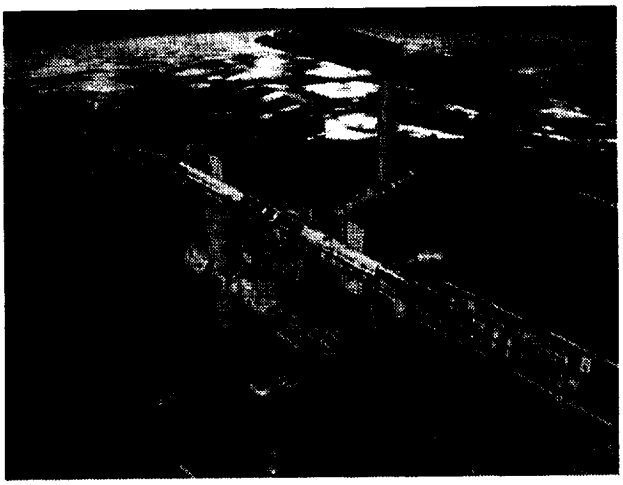

Figure 2: PET location on the International Space Station

Each of the sample holders includes separate electronics for measuring the I-V characteristics of the individual solar cells. PET will be capable of controlling each solar cell to the standard reference temperature of 25°C during the I-V measurement, or to allow heating of the cell from 20 to 80 °C for temperature coefficient measurement.

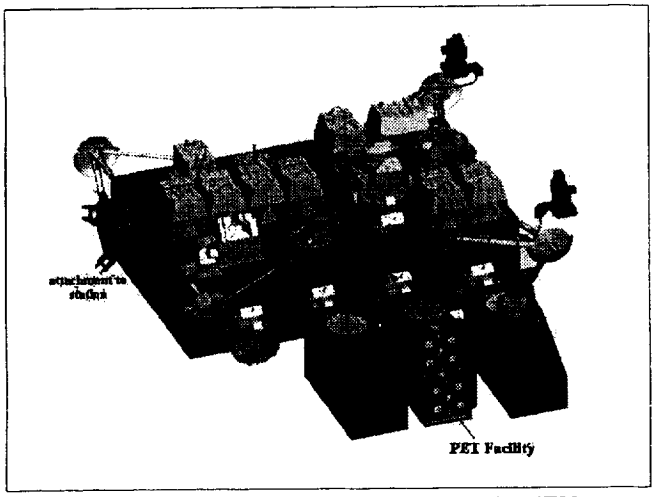

Figure 3: Mounting of PET Facility on the JEM Exposed Facility platform

TEST STATUS

The engineering unit of the 16-cell sample holder incorporating I-V measurement electronics has been manufactured and tested in the thermal-vacuum environment to verify operation.

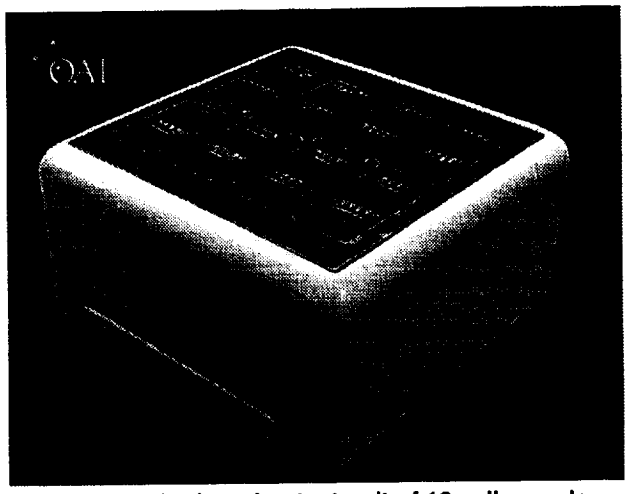

Figure 4: Engineering test unit of 16-cell sample holder and I-V curve electronics

CONCLUSIONS

The Photovoltaic Engineering Testbed is a facility designed to allow rapid testing of solar cells in the AM0 space environment. The purpose of this facility is to reduce the time required to bring new photovoltaic technologies to commercial use by simplifying the process of acquiring test data in the space environment.

REFERENCES

1. G.A. Landis and S.G. Bailey, "Photovoltaic Engineering Testbed on the International Space Station," *2nd World Conference on Photovoltaic Energy Conversion, Vol. III,* Vienna, Austria, July 1998, pp. 3564-3567.
2. G.A. Landis, J.A. Sexton, R. Abramczyk, J. Francz, D.B. Johnson, L. Yang, D. Minjares, and J. Myers, "The Photovoltaic Engineering Testbed: Design Options and Trade-offs," *AIP Conference Proceedings Volume 504,* presented at Space Technology and Applications International Forum (STAIF-2000), Jan. 30 - Feb. 3, 2000, Albuquerque NM.