# UNITED STATES INTERNATIONAL DEVELOPMENT COOPERATION AGENCY

AGENCY FOR INTERNATIONAL DEVELOPMENT

MANAGEMENT
REPORT

# PHOTOVOLTAIC TECHNOLOGY PROJECT

JUNE 1984

LEVELS 2 & 3
FOR OFFICIAL USE ONLY

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION - LEWIS RESEARCH CENTER

# UNITED STATES
# INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
AGENCY FOR INTERNATIONAL DEVELOPMENT

MANAGEMENT
REPORT

# PHOTOVOLTAIC TECHNOLOGY PROJECT

AID/NASA
INTERAGENCY
AGREEMENT
DSB-5710-2-79

Accomplishment: William J. Bifano 7/12/84
Date

Approval: Frank J. Lutinski Jr. 7/12/84
Date

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION - LEWIS RESEARCH CENTER

CENTER LEWIS RESEARCH CTR.

RESPONSIBILITY:

APPROVAL F. J. KUTINA, JR.

ACCOMPLISHMENT W. J. BIFANO

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PROJECT: PHOTOVOLTAIC TECHNOLOGY PROJECT

2&3 LEVEL

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| RESPONSIBILITY: | | |
| APPROVAL F. J. KUTINA, JR. | PROJECT: PHOTOVOLTAIC TECHNOLOGY PROJECT (2&3 LEVEL) | STATUS AS OF July 1, 1984 (DATE) (INITIALS) |
| ACCOMPLISHMENT W. J. BIFANO | | |

## 1.0 INTRODUCTION AND BACKGROUND

The Photovoltaic Technology Project is being implemented by the NASA Lewis Research Center (LeRC) for the U.S. Agency for International Development, Bureau for Science and Technology, Office of Energy. The purpose of the project is to facilitate the use of photovoltaics for a variety of applications in support of AID's development assistance activities.

A Participating Agency Services Agreement (PASA No. NASA/DSB 5710-2-79) authorizing this project was signed by AID August 28, 1979, and approved by NASA August 30, 1979. Under this agreement, AID provided an initial funding authority of $2,000,000. This PASA was amended in August 1980 and August 1981 to provide additional funding authority of $500,000 and $921,000, respectively. An additional increment of $39,000 was provided to NASA under Reimbursable Agreement No. 1205-002-01-0 in January of 1984 and $260,449 was provided under PASA BST-5710-P-NA-4038-00 in March of 1984. Total funding authority received to date is $3,720,449.

## 2.0 OBJECTIVE

The major objective of this project is to demonstrate the suitability of photovoltaic (PV) power systems for meeting basic electrical requirements in rural areas of developing countries.

The Project Management function at the LeRC is being performed by the Solar Energy Project Office in the Energy Technology Division of the Space Technology Directorate.

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## 3.0 EXECUTIVE SUMMARY

The remaining Solar Power Corp. PV refrigerator/freezer (R/F) to be deployed in Liberia is scheduled for installation in August 1984.

A Solavolt International (SVI) R/F was installed in Jordan on June 27, 1984. The remaining SVI unit will be installed by host country personnel in late July or early August at an alternate site in the Honduras due to border conflicts near the original site.

Solarex subcontractor personnel are scheduled to visit the Waramuri, Guyana clinic in late July to inspect the PV system and complete unfinished work. No visit is scheduled for Ecuador since the facility there will soon be connected to conventional power which was recently brought to the village. Visits to Kenya and Zimbabwe are tentatively scheduled for late August or early September.

Proof-of-design testing of the earth station PV system is scheduled for early August. Shipping of both the PV system and the earth station itself will probably be accomplished in late September.

Negotiations regarding the projected $15,000 cost overrun by Hughes Aircraft relative to the PV earth station project are in process.

## 4.0 STATUS OF ACTIVITIES

### 4.1 Applications

#### 4.1.1 Medical Refrigerators

Contract NAS3-22246: Deployment of PV-Powered Refrigerators (Solar Power Corporation)

The remaining Solar Power Corp. PV refrigerator/freezer (R/F) to be deployed in Liberia is now scheduled for installation in August '84.

AID/W personnel recently informed LeRC that an informant working in Liberia reported that it rains 70% of the time in that country. If the insolation conditions, in fact, are very poor, the usefulness of the R/F unit will be severely limited.

Contract NAS3-23713: Deployment of PV-Powered Refrigerators (Solavolt International)

A Solavolt International PV R/F was installed in Jordan on June 27, 1984. One channel on the thermograph recorder was found to be inoperative due to a damaged sensor. The damage occurred during shipping. Because of cost and complexity, there are no plans to repair the sensor. A locally supplied thermometer is being used to measure refrigerator temperature.

A cable was received from AID/Honduras dated June 19 indicating that the Ministry of Health (MOH) has still not installed the PV R/F because of border conflicts. The MOH has requested and AID/H has approved transfer of the field-test site to Marale in the northern region of the country. Installation is expected in early July.

The user manuals for the Polar Products and Marvel refrigerators were submitted to LeRC for review. Solavolt personnel were informed of the revisions/corrects needed. Final copies will be printed and sent to all users by the end of July.

In-House Testing and Evaluation of PV-Powered Refrigerators

Endurance testing of the three prototype PV refrigerators (from Adler-Barbour, Polar Products and Marvel) continued in June. Accrued test time, under simulated environmental conditions, is now in excess of 9700 hours.

A letter was sent to Mr. Kenneth D. Baer, Director of Save the Children Federation on the Republic of Kiribati, in response to his letter of May 4 requesting a PV vaccine refrigerator. He was informed that, although all field-test units have been assigned, LeRC would contact him in the future regarding the availability of one of the endurance test units (after collaboration with AID, CDC and DOE).

The overall status of the AID PV medical refrigerator test activities are summarized in Tables 1 and 2.

4.1.2 Medical Applications

Contract NAS3-22240: Photovoltaic Development and Support Program for Medical Systems in Developing Countries

Personnel from Development Sciences Inc. (DSI), the Solarex subcontractor, are tentatively scheduled to visit the Waramuri, Guyana clinic in mid to late July. The annual visit to the clinics in Zimbabwe and Kenya is expected to be conducted as soon as possible after the DSI personnel return from Guyana (probably in late August or early September). AID/Ecuador has agreed with NASA that a Solarex/DSI visit this summer would

not be needed due to the fact that Pedro Vicente Maldonado will soon be receiving AC utility power and the clinic will be connected to the utility.

A letter from U.S. AID/Ecuador was received on July 2, 1984 indicating that AC utility power has not yet been connected to the clinic. The report also states that there have been several problems with the PV system in the last six months. The problems reported were: battery fuses malfunctioned, refrigerator motor failed, short circuit and a faulty breaker switch. These problems had not been previously reported to LeRC and are currently being investigated.

No results have been received from the World Health Organization laboratory in London, England concerning their testing of the sterilizer.

No new technical problems have been reported from the four other field test sites. It is assumed that these systems are still operating satisfactorily.

The overall status of the PV medical system field test activity is given in Table 3.

4.1.3 Remote Earth Station

Contract NAS3-23862: Design, Development and Deployment of Photovoltaic Power Systems for Satellite Earth Stations in Remote Areas

Hughes is preparing the Final Design Package and tentative completion is scheduled for mid July.

Proof-of-Design testing is tentatively scheduled for early August. The system should be ready for shipment in late August. AED (AID contrac-

tor) reported that the earth station shipping date will be late September. The PV power system will be stored in Long Beach until the earth station is ready for shipment. The two systems will then be combined into one shipment to Indonesia to facilitate clearance through customs.

Technical discussions are planned for early July with AED and Teleconsult regarding the final interface between the PV power system and the earth station and classroom. Discussions will be held in late July with AED concerning the common shipment of the PV power system and the earth station.

Negotiations concerning the projected $15,000 cost overrun by Hughes (see last month's report) are in process.

4.2 Training and Information

No activity scheduled during this reporting period.

5.0 PROJECT MANAGEMENT

In response to a telephone request, a number of reports related to the economics of PV systems were sent to Mr. Robert Spongberg of Louis Berger International, Inc. for use in support of the AID/Egypt renewable energy program.

Richard DeLombard will meet with Shirley Toth on July 6 to discuss the Indonesian remote earth station project and the planned TDY in support of the PV medical system project.

TABLE 1.

NASA/SOLAR POWER CORPORATION
REFRIGERATOR/FREEZER SYSTEMS
OPERATIONAL STATUS AS OF 1 JULY 1984

| SITE LOCATION | DATE INSTALLED | DATA RECEIVED THROUGH | R/F OPERATIONAL | PROBLEM/FAILURE SUMMARY |
|---|---|---|---|---|
| INDONESIA | | | | |
| Cibungbulang | 5/15/82 | 8/5/83 | NO | 7/83 - Stopped taking data. Refrigerator and instruments not working. |
| Batujaja | 5/16/82 | 8/1/83 | NO | 7/83 - Stopped taking data. Refrigerator and instruments not working. |
| DOMINICAN REP. | | | | |
| Las Tablas | 8/28/82 | 5/17/84 | YES | 1/5/84 - System shutdown due to overuse by new, untrained operator.<br>2/2/84 - Returned to operation. |
| HAITI | | | | |
| Anse-A-Veau | 9/2/82 | 3/14/83 | YES | 5/24/84 - Letter from USAID/HAITI notes that refrigerator is working well although data recording has been stopped for unknown reasons. |
| ECUADOR | | | | |
| Comuna Cobos | 9/16/82 | 4/13/84 | YES | 10/82 - Reported damage to cables by mules. Did not affect operation.<br>9/83 - Minor repairs performed by LeRC engineer during visit. |
| GUYANA | | | | |
| Schepmoed | 9/30/82 | 4/26/84 | YES | 3/83 - Battery regulator replaced.<br>3/84 - Poor electrical connections from array to battery caused numerous outages between March, 83 and March, 84 when repairs were made. |
| GUATEMALA | | | | |
| Tierra Blanca | 10/7/82 | 5/31/84 | YES | 12/30/82 - Thermographs not working. |
| ZAIRE | | | | |
| Kionzo | 2/11/83 | 3/22/84 | YES | 2/84 - Stopped taking data.<br>4/84 - Some measuring instruments are not working. |
| ZIMBABWE | | | | |
| Chiota | 2/14/83 | 4/1/84 | YES | 5/1/83 - Thermographs not working. |
| UNITED STATES | | | | |
| LeRC | 2/22/83 | 6/1/84 | YES | 12/20/83 - System shutdown. Batteries discharged due to low insolation.<br>2/10/84 - System restarted. Operating at room temperature.<br>6/11/84 - Setting up test to evaluate system operation at elevated temperatures. |
| MOROCCO | | | | |
| Bouaboute | 10/28/83 | 4/30/84 | YES | |
| LIBERIA | | | | |
| Suehn | Not installed | | | Installation scheduled for August, 1984. |

*Assumed on the basis of no information to the contrary.

TABLE 2.

NASA/SOLAVOLT INTERNATIONAL
VACCINE REFRIGERATOR/FREEZER SYSTEMS
OPERATIONAL STATUS AS OF JULY 1, 1984

| SITE LOCATION | DATE INSTALLED | TYPE | DATA RECEIVED THROUGH | R/F OPERATIONAL | PROBLEM/FAILURE SUMMARY |
|---|---|---|---|---|---|
| UNITED STATES | | | | | |
| LeRC | 2/23/83 | PP | 6/1/84 | Yes | 11/17/83 - System shutdown. Batteries discharged due to low insolation.<br>2/10/84 - System restarted. Operating at room temperature.<br>6/11/84 - Setting up test to evaluate system operation at elevated temperatures. |
| LeRC | 2/23/83 | MV | 6/1/84 | Yes | 12/20/83 - System shutdown. Batteries discharged due to low insolation.<br>2/10/84 - System restarted. Operating at room temperature.<br>6/11/84 - Setting up test to evaluate system operation at elevated temperatures. |
| THAILAND | | | | | |
| Tambon Tha Thong | 11/3/83 | MV | 3/15/84<br>4/26/84<br>6/14/84 | Yes | 12/20/83 - Two PV modules replaced.<br>2/17/84 - Replacement air door shipped.<br>3/28/84 - Apparent problem with refrigerator use. Telexed instructions to check.<br>4/13/84 - Replacement instrument assembly shipped.<br>4/16/84 - Telex query on status of module return shipment.<br>5/11/84 - Telex query on receipt of air door and instrument assembly. Data through Apr. 12 still shows refrigerator problems.<br>6/27/84 - Air door and replacement instrument received and passed to CDC. According to CDC, they have been installed. |
| HONDURAS | | | | | |
| Aldea Las Selvas | 1/12/84 | MV | NONE | No | 1/12/84 - Refrigerator not yet installed at Las Selvas due to border conflicts. Refrigerator set up at hospital at Tegucigalpa.<br>2/17/84 - Replacement electronic control module, electronic control card, wiring harness, and fan shipped.<br>3/20/84 - Telex query on receipt of replacement parts and status of system.<br>6/19/84 - Refrigerator still not installed at Las Selvas due to border conflicts. MOH is moving site to Marale in the north of the department of Francisco Marazan with installation estimated for early July. |
| ST. VINCENT AND THE GRENADINES | | | | | |
| New Sandy Bay | 1/18/84 | MV | NONE | Yes | No communication since installation. |
| Canouan | 1/15/84 | PP | NONE | Yes | No communication since installation. |

TABLE 2. (Cont.)

| | | | | | |
|---|---|---|---|---|---|
| **TUNISIA** | | | | | |
| Es Smirat | 2/3/84 | PP | NONE | Yes‡ | No communication since installation. |
| Bir Amama | 2/6/84 | MV | NONE | Yes‡ | 3/22/84 - Replacement instrument package shipped to replace failed array A-H meter.<br>3/28/84 - Replacement parts delayed in customs. Additional information for customs clearance sent 4/3/84.<br>4/27/84 - Cleared customs. |
| **MALI** | | | | | |
| Ouelessebougou | 2/14/84 | PP | 2/28/84<br>4/26/84<br>5/28/84 | Yes | 4/12/84 - Fan jammed - apparently gummed up. Cleaned and repaired by local technicians. Array A-H meter wire broken. Repaired by local technicians. Shut off due to low voltage several times. Sent telex requesting more data (telex sent by contractor Richard Flood). Data indicates extensive freezing taking place each night.<br>4/26/84 - Telex from Terry Hart, AID/MALI. Study of system made. Believes array too small.<br>5/9/84 - Phone from Richard Flood. Observed system. Operational about one-half time. Day temps. about 100 - 110 deg F.<br>5/15/84 - Phone from Flood. System still not operational much of the time. Told him to turn R/F compressors off until batteries recharged. Reportedly had turned freezer compressor off approximately 5/11/84.<br>5/16/84 - Phone from SVI. Mali system was originally sized for Yemen and was not resized when redirected to Mali. Additional modules possibly needed. SVI will check sizing and determine need.<br>6/5/84 - Discussions with Solavolt show that Mali system is sized the same as the Upper Volta System and should be satisfactory if it is not used too much. |
| **UPPER VOLTA** | | | | | |
| Orodara | 2/21/84 | PP | NONE | Yes‡ | 5/3/84 - LeRC telex to AID/UV to determine system status for comparison with observed problems noted with Mali system.<br>6/8/84 - AID/UV personnel not yet able to visit the site; however they understand that the refrigerator is being used and has stopped only once. They do not know the nature of the problem; however the local technicians were able to repair the system. |
| **IVORY COAST** | | | | | |
| Menee | 2/25/84 | PP | NONE | Yes‡ | No communication since installation. |
| **JORDAN** | | | | | |
| Mowagar | 6/27/84 | M | NONE | Yes | |

‡Assumed on the basis of no information to the contrary.

TABLE 3. - PV MEDICAL SYSTEM APPLICATIONS: STATUS

| Country: | |
|---|---|
| Guyana: | System assumed to be operating satisfactorily. Corrosion problem reported in vaccine refrigerator battery compartment. |
| Ecuador: | System problems reported by AID/E. Further information needed to determine system operational status. |
| Kenya: | Both systems assumed to be operating. |
| Zimbabwe: | System assumed to be operating satisfactorily. |

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# 6.0 MILESTONE SCHEDULE

PROJECT PHOTOVOLTAIC TECHNOLOGY PROJECT

2&3 LEVEL

STATUS AS OF July 1, 1984

| MILESTONES | FY 1983 | | | | | | | | | | | | FY 1984 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP |
| 4.1 APPLICATIONS | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1.1 MEDICAL REFRIGERATORS | | | | | | | | | | | | | | | | | | | | | | | | |
| o Contract for Fabrication, Deployment and Service | | | | | | | | | | | | | | | | | | | | | | | | |
| 1st Buy (11 Units) | | | | | | | | | | | | | | | | | | K2 | | | | C | | |
| 2nd Buy (9 Units + 1 Spare) | | | | | A | | | | | | | | | | | | | | | | | K2 | | K |
| 4.1.2 MEDICAL SYSTEMS | | | | | | | | | | | | | | | | | | | | | | | | |
| o Contract for Design, Development, Deployment and Monitoring | | | | Sc | | Se | Sz | Sk | | | | | | | | | | | | | | | | |
| 4.1.3 REMOTE EARTH STATIONS | | | | | | R | | | | | | | A1 | | | | | | | | | | | |
| o Contract for Design, Development and Deployment | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1.4 UPPER VOLTA PV PROJECT | | | | | | | | | | | | | C2 | | | | | | | | | | | |
| 4.2 TRAINING AND INFORMATION | | | | i | | g | e | z | k | | | | | | | | | | | | | | | |
| 5.0 PROJECT MANAGEMENT | | | | a | | b | | | | | | | | | | | | | T | | | | | |

NOTES:

1... N = RESCHEDULED MILESTONE
A AWARD CONTRACT OR GRANT
B BEGIN
C ACTIVITY COMPLETE
K CONTRACT COMPLETE
R RELEASE RFP OR IFB
V SITE VISIT
S SYSTEM OPERATIONAL
a ANNUAL REVIEW
b ANNUAL OPERATING PLAN COMPLETE

PV SEMINARS
i INSTRUCTIONAL MATERIAL
e ECUADOR
g GUYANA
k KENYA
z ZIMBABWE

NASA-C-190a (4-82)



NASA-Lewis

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ACCOMPLISHMENT RESPONSIBILITY W. J. BIFANO

# 7.0 FINANCIAL STATUS

PHOTOVOLTAIC TECHNOLOGY PROJECT

776-54-01

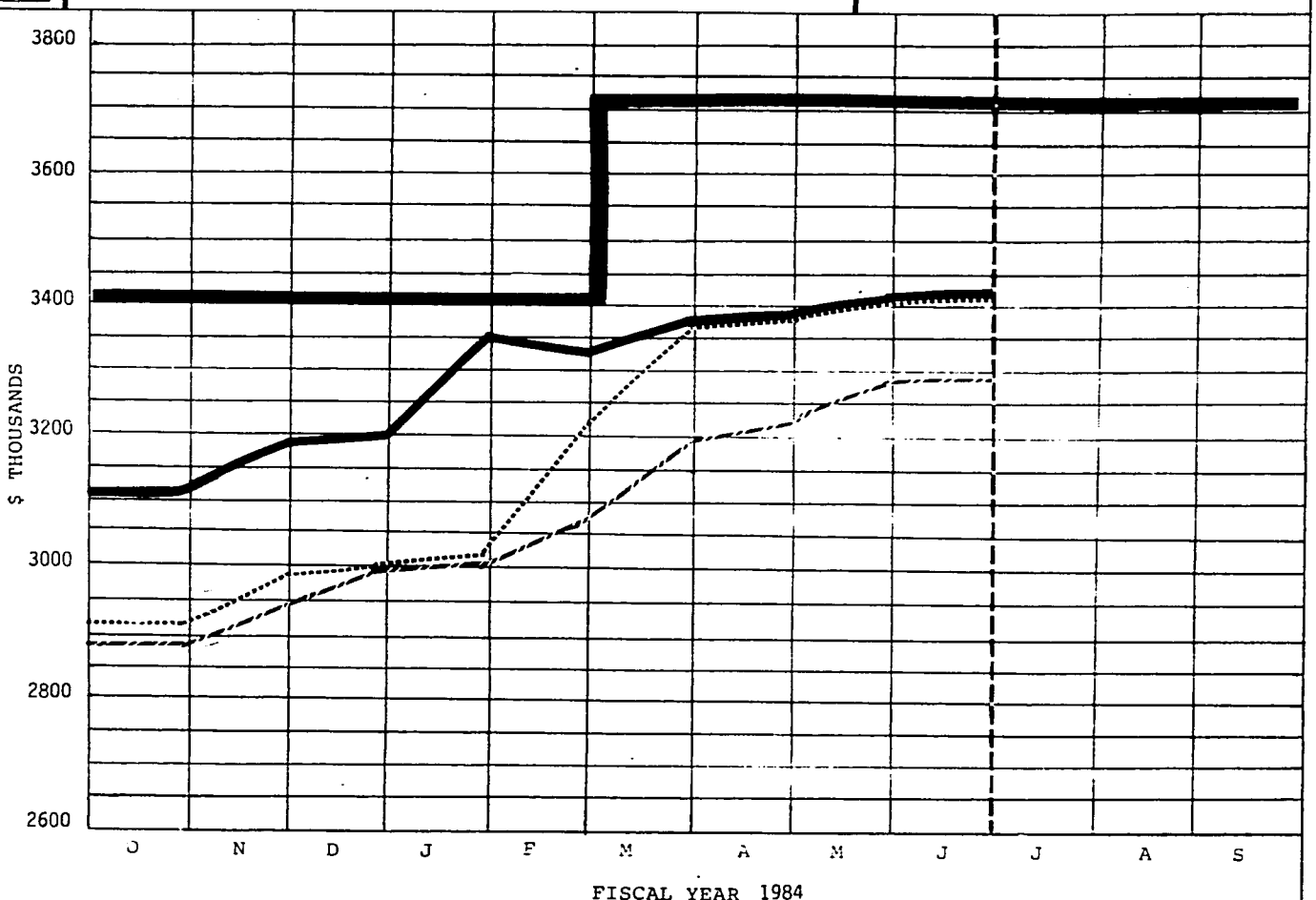
STATUS AS OF July 1, 1984

CUMULATIVES TO START OF FY 84:

| | |
|---|---|
| AUTHORITY | $3,405K |
| OBLIGATIONS | $ 2,956K |
| UNOBLIG. PRIOR YEAR AUTHORITY | 449K |
| FY 84 NEW AUTH. RECEIVED | 0 |

INCLUDES R&D, TRAVEL AND INSTITUTIONAL SUPPORT (MANPOWER BASED)

DOES NOT INCLUDE FUNDS RETAINED BY NASA HQ FOR DCAS CHARGES




| CUMULATIVE | 9/83 | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AUTHORITY | 3405 | 3405 | 3405 | 3405 | 3405 | 3405 | 3720 | 3720 | 3720 | 3720 | 3720 | 3720 | 3720 |
| COMMITMENTS (ACTUAL) | 3156 | 3120 | 3189 | 3200 | 3352 | 3344 | 3370 | 3385 | 3402 | 3418 | | | |
| OBLIGATIONS (ACTUAL) | 2956 | 2920 | 2989 | 3000 | 3016 | 3201 | 3370 | 3385 | 3402 | 3418 | | | |
| COSTS (ACTUAL) | 2898 | 2890 | 2959 | 2996 | 3012 | 3064 | 3194 | 3228 | 3258 | 3287 | | | |

NASA-C-382 (9-82)

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# 8.0 PROJECT MANPOWER

PROJECT MANPOWER
U.S. AID PHOTOVOLTAIC
TECHNOLOGY PROJECT

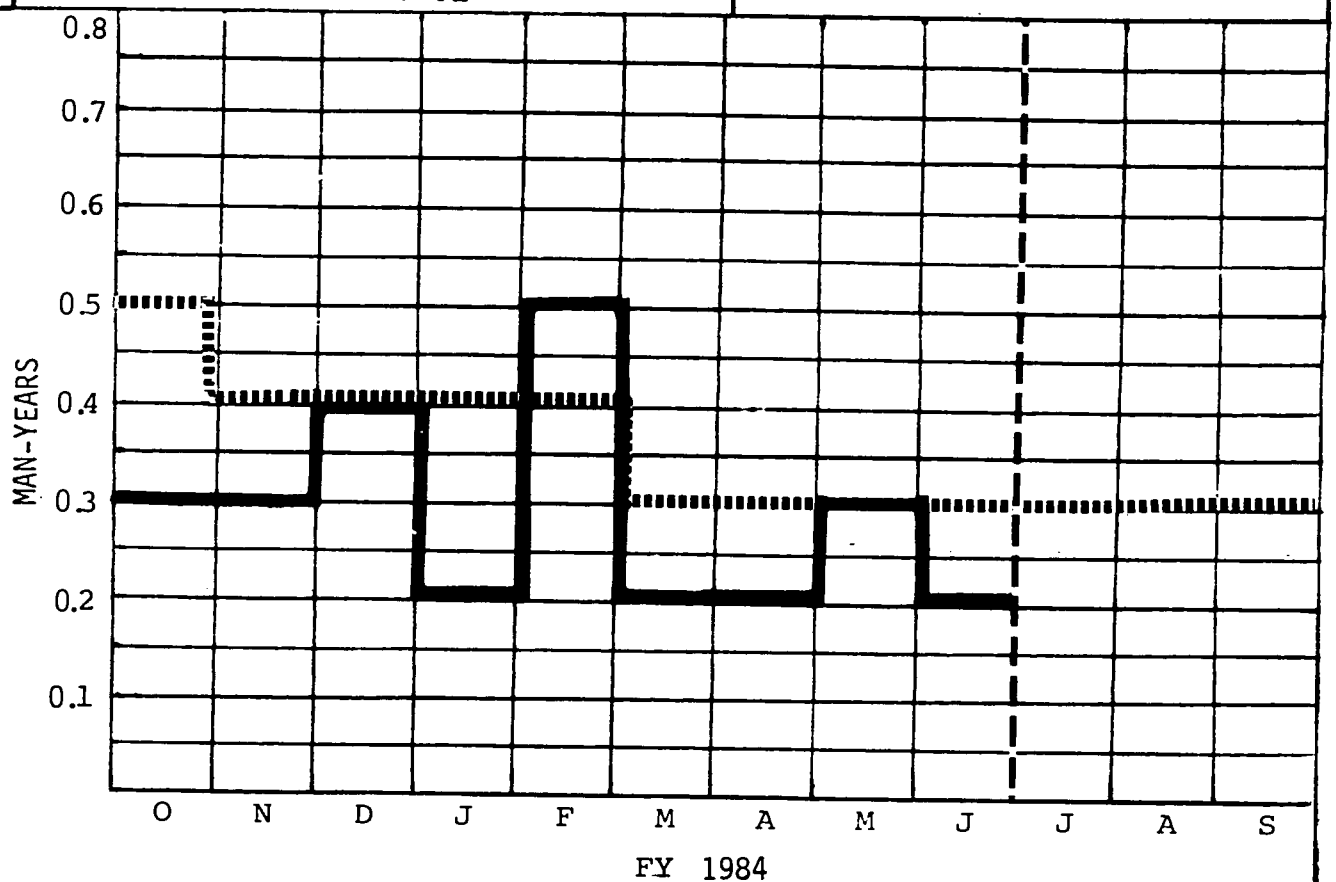
RTOP 776-54-01

STATUS AS OF July 1, 1984 (DATE) (INITIALS)

AID REIMBURSABLE

MANPOWER (M-YRS)

| | |
|---|---|
| FY80 | 6.0 |
| FY81 | 5.4 |
| FY82 | 4.1 |
| FY83 | 4.5 |




| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PLAN | 0.5 | 0.4 | 0.4 | 0.4 | 0.4 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| ACTUAL | 0.3 | 0.3 | 0.4 | 0.2 | 0.5 | 0.2 | 0.2 | 0.3 | 0.2 | | | |
| CUMULATIVE | 20.6 | 20.9 | 21.3 | 21.5 | 22.0 | 22.2 | 22.4 | 22.7 | 22.9 | | | |

NASA Form 1301 (MAY 66)



GPO 910-430

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