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PHOTOVOLTAIC TEST AND DEMONSTRATION PROJECT FOR THE  
NATIONAL PHOTOVOLTAIC CONVERSION PROGRAM

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Abstract

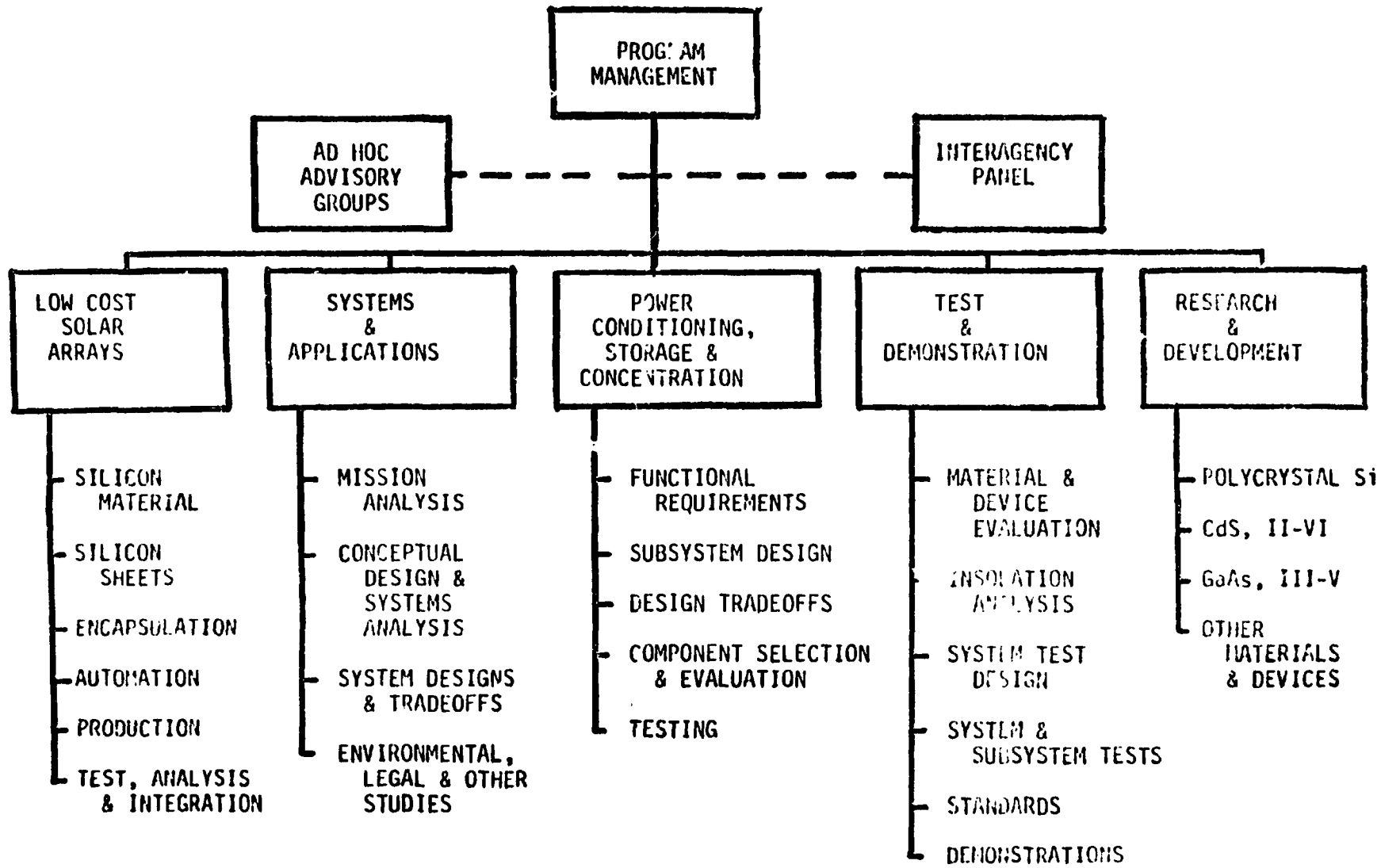
As part of the overall effort to develop ways of utilizing solar energy as a national energy source, the Energy Research and Development Administration (ERDA) has established the National Photovoltaic Conversion Program. The overall objective of this program is to develop low-cost reliable photovoltaic systems suitable for a variety of terrestrial applications, and to stimulate the creation of a viable industrial capability to provide them. The program, now being implemented, is composed of several interrelated yet separate projects. Each project addresses a major segment of the effort required to achieve the program objective.

One of these projects, recently assigned to and now being developed by the Lewis Research Center of NASA, is concerned with conducting photovoltaic system tests and demonstrations covering a wide range of applications having national significance. Experience gained through this project will be used to evaluate emerging systems technology, provide systems-related guidance to the other projects of the program, and develop information for future photovoltaic program planning.

The project is divided into three basic activities. Objectives of the first activity, "Tests and Model System Demonstrations", are to determine the operating characteristics for a variety of photovoltaic conversion systems and subsystems and to confirm by tests and demonstrations that these systems can satisfy potentially attractive national applications. Solar cell modules for this activity will be provided by the Low Cost Silicon Solar Array Project being conducted by JPL for ERDA. In a similar manner, guidance in the selection of application categories for demonstration will be provided through mission and impact studies conducted by the Systems and Application Project of the national program. The second basic activity of the project is concerned with "Device Performance and Diagnostics". Objectives here are concerned with devising and developing the methodology, techniques, and equipment to make standardized measurements of solar cell and module performance and performance-related characteristics. This activity will therefore provide to the photovoltaic community a centralized source for standardized performance measurements and information of a reference and diagnostic nature. The third basic activity of the project will address the endurance of solar cell modules and arrays and the mechanisms affecting the materials of construction which induce performance degradation and failure. This activity will be carried out through accelerated and real time environmental testing, under conditions of intended use, of solar cell module materials of construction as well as complete modules. Laboratory investigations of methods of evaluating encapsulant material stability and degradation will be undertaken. Material and module samples for testing will be solicited from the photovoltaic community as well as being provided by the other projects of the national program.

Currently efforts in each of the three activity areas are being implemented through initial funding provided by ERDA. In addition, planning is going forward to more fully develop the basic project plans outlined to date and to identify new tasks which must be initiated through FY 76 and later ERDA funding to maintain the project schedule. Charts in the attached visual aid material indicate the basic project plans and tentative test and demonstration categories. As noted earlier in the systems test and demonstration activity, final selection of application categories will be guided by information from the Systems and Application Project of the national program.

NATIONAL PHOTOVOLTAIC CONVERSION PROGRAM



1/P2

## TEST AND DEMONSTRATION PROJECT

### MAJOR ACTIVITIES:

- TESTS AND MODEL SYSTEM DEMONSTRATIONS
- DEVICE PERFORMANCE AND DIAGNOSTICS
- ENDURANCE TESTING

## TESTS AND MODEL SYSTEM DEMONSTRATIONS

### OBJECTIVES:

- DETERMINE OPERATING CHARACTERISTICS FOR A VARIETY OF P/V CONVERSION SYSTEMS & SUBSYSTEMS
- CONFIRM BY TESTS & DEMONSTRATIONS THAT P/V SYSTEMS CAN SATISFY POTENTIALLY ATTRACTIVE APPLICATIONS HAVING NATIONAL IMPACT

## TESTS AND MODEL SYSTEM DEMONSTRATIONS

### TECHNICAL APPROACH:

- INITIAL TESTS EMPHASIZE LOW POWER LEVELS & SYSTEM SIMPLICITY
- INCREASE POWER LEVELS & SYSTEM FUNCTIONS BASED ON TEST RESULTS & ON-GOING STUDIES
- SOLAR CELL MODULES SUPPLIED BY "LCSSCA" ON REFERENCE CATEGORIES

TEST & MODEL SYSTEM DEMONSTRATION CATEGORIES\*

ERDA:

0.1 - 1.0 kW REMOTE APPLICATIONS

5 - 15 kW RESIDENTIAL

100 - 500 kW LOAD CENTERS

1 - 3 MW LOAD CENTERS

ERDA / DOD:

1 - 3 kW LOAD CENTER

3 - 12 kW LOAD CENTER

12 - 60 kW LOAD CENTER

LeRC TEST CAPABILITY:

UP TO 100 kW P / V SYSTEM TEST FACILITY

5-15 kW PROTOTYPE RESIDENCE

COMPONENT & SUBSYSTEM SUPPORT TESTING

\*REFERENCE CATEGORIES FOR PLANNING PURPOSES

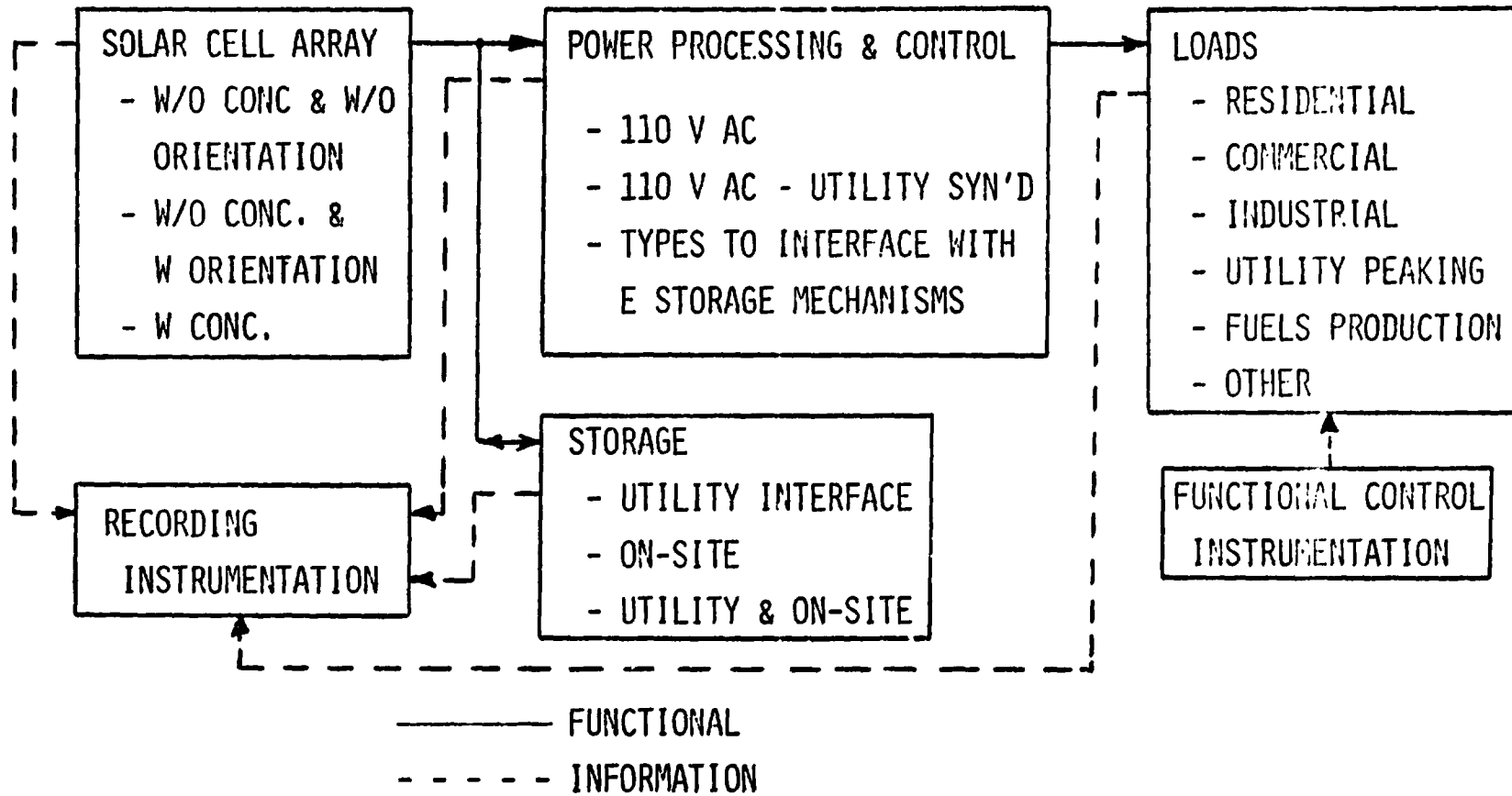
CANDIDATES FOR REMOTE APPLICATIONS

FY '76 & '77

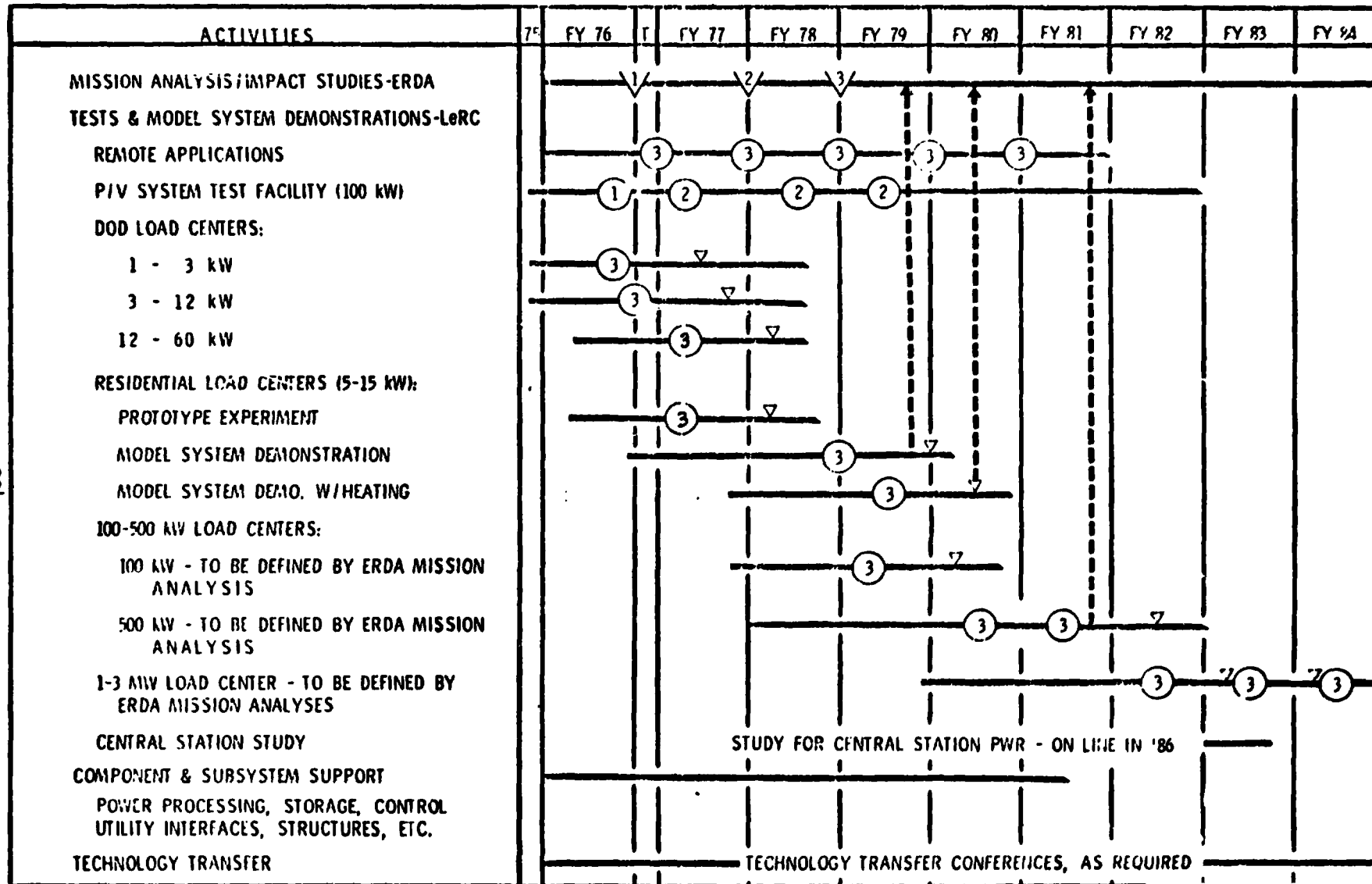
- U.S. COAST GUARD
  - 2ND DISTRICT (WESTERN RIVERS) (50)
  - 1ST DISTRICT (ATLANTIC-N.E.) (48)
  - REEF LIGHTS (7)
  - MAJOR LIGHT STATION (1)
  
- NOAA - RAMOS (40)
  
- U.S. GEOLOGICAL SURVEY
  - RIVER GAUGE STATION (100)
  - LANDSAT PLATFORM (20)
  
- OTHER POTENTIAL CANDIDATES
  - FAA (REMOTE NAVAIDS - BEACONS)
  - DOT (HIGHWAY AIDS-BARRIERS)
  - USDA - FOREST SERVICE (FIRE MON., COMM.)



PHOTOVOLTAIC SYSTEM TEST FACILITY



ERDA - TEST AND DEMONSTRATION PROJECT



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- ① INITIAL 10 kW CAPACITY READY
- ② 30 kW ADDED CAPACITY READY

- ③ START OF TESTING
- ▽ ERDA STUDIES COMPLETE

▽ REVIEW OF TESTS AND DEMOS.

## DEVICE PERFORMANCE AND DIAGNOSTICS

### OBJECTIVES:

#### PROVIDE FOR:

- ACCURATE AND REPRODUCIBLE MEASUREMENTS OF SOLAR CELL AND MODULE PERFORMANCE
- DIAGNOSTIC MEASUREMENTS ON SOLAR CELLS
- ESTABLISH MATERIALS DIAGNOSTICS INFORMATION CENTER(S)

## DEVICE PERFORMANCE AND DIAGNOSTICS

### TECHNICAL APPROACH:

- DEVISE A STANDARD ACCURATE. LABORATORY MEASUREMENT BASED  
ON A REPRESENTATIVE SOLAR TERRESTRIAL SPECTRUM
- ESTABLISH CELL AND MODULE STANDARD MEASUREMENT LABORATORIES  
AT LERC

## DEVICE PERFORMANCE AND DIAGNOSTICS

### MAJOR ACTIVITIES:

- WORKSHOPS AND COMMITTEES TO PROVIDE PHOTOVOLTAIC COMMUNITY  
INPUT FOR MEASUREMENT METHODS
- MEASUREMENT PROCEDURES MANUAL
- STANDARD METHODOLOGY FOR CELL AND MODULE REFERENCE PERFORMANCE  
MEASUREMENTS
- STANDARD CELL MEASUREMENT FACILITY
- CALIBRATION OF REFERENCE CELLS
- MODULE MEASUREMENT FACILITY
- DEVICE ELECTRICAL DIAGNOSTICS FACILITY

ERDA - TEST AND DEMONSTRATION PROJECT

ACTIVITIES	75	FY 76	T	FY 77	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84
DEVICE PERFORMANCE AND DIAGNOSTICS											
WORKSHOP	1	1									
MEASUREMENTS PROCEDURES MANUAL	2		3		3						
REFERENCE CONDITIONS AND METHODOLOGY		4		4							
STANDARD CELL MEASUREMENTS FACILITY	5				6						
CALIBRATED REFERENCE CELLS		7		8							
MODULE MEASUREMENTS FACILITY		5									
DEVISE ELECTRICAL DIAGNOSTIC FACILITY	5										
MATERIALS DIAGNOSTIC INFORMATION CENTER(S)		9									

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- |                                      |                                     |
|--------------------------------------|-------------------------------------|
| ① CONVENE WORKSHOP                   | ⑥ FACILITY IMPROVEMENTS OPERATIONAL |
| ② DISTRIBUTE INTERIM MANUAL          | ⑦ DISTRIBUTE INTERIM REF. CELLS     |
| ③ DISTRIBUTE UPDATED MANUAL          | ⑧ DISTRIBUTE UPDATED REF. CELLS     |
| ④ EVALUATE REFERENCE COND. & METHODS | ⑨ CENTER OPERATIONAL                |
| ⑤ FACILITY OPERATIONAL               |                                     |

## ENDURANCE TESTING

### OBJECTIVES:

- DETERMINE ENDURANCE OF SOLAR CELL MODULES, ARRAYS, AND COMPONENT MATERIALS OF CONSTRUCTION UNDER ENVIRONMENTAL CONDITIONS OF INTENDED USE
- DEVELOP METHODS OF EVALUATING FAILURE MECHANISMS AND PREDICTING MODULE ENCAPSULANT LIFE

## ENDURANCE TESTING

### TECHNICAL APPROACH:

- ESTABLISH CAPABILITY FOR ACCELERATED AND REAL TIME ENVIRONMENTAL TESTING
- TEST MODULES AND MATERIALS FROM "LCSSCA" PROJECT
- SOLICIT MODULES AND MATERIALS OF CONSTRUCTION FROM P/V COMMUNITY FOR EVALUATION
- CONDUCT INVESTIGATIONS OF ENCAPSULANT FAILURE MECHANISMS TO ESTABLISH PREFERRED METHODS OF PREDICTING LIFETIMES



ERDA - TEST AND DEMONSTRATION PROJECT

ACTIVITIES	75	FY 76	FY 77	FY 78	FY 79	FY 80	FY 81	FY 82	FY 83	FY 84
ENDURANCE TESTING										
ACCELERATED ENVIRONMENTAL TESTS	①									
REAL TIME ENVIRONMENTAL TESTS	①									
FAILURE MECHANISM STUDIES	②									

① FACILITIES AVAILABLE FOR MAT'L. EVAL.

② STUDIES INITIATED