

N83 10515 D10-44

ROOFTOP APPLICATIONS

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PV Array Refinement and Innovation

- EFFECTIVE MOUNTING TECHNIQUES FOR NEW CONSTRUCTION AND RETROFIT
- AREA EFFICIENCY ENHANCEMENT
 - ARRAY COOLING
 - CELL INTERCONNECTION
 - FIXED REFLECTORS
- AMORPHOUS MATERIALS
 - REVOLUTIONARY OR EVOLUTIONARY MOUNTING?
- FULL-SCALE EXPERIMENTS ON RETROFIT APPLICATIONS

Power Conditioning Refinement and Innovation

- STANDARDS ON POWER QUALITY; VALIDATE EFFECTS
- INSPECTION AND CONTROLLED TEST PROCEDURES

Essential Research Needs: Rooftop Applications

<u>AREA</u>	<u>STATUS</u>	<u>NEED</u>
COST REDUCTION	<ul style="list-style-type: none"> • STALLED AT \$10/W 	<ul style="list-style-type: none"> • MODULE COSTS (PRICES) • FEDERAL POLICY ISSUES
UTILITY INTEGRATION	<ul style="list-style-type: none"> • RED HERRING (?) 	<ul style="list-style-type: none"> • EXPERIMENTS TO VERIFY ANALYSES
RELIABILITY	<ul style="list-style-type: none"> • ARRAYS ADEQUATE • POWER CONDITIONERS HAVE PROBLEMS • NEW UNITS PROMISING 	<ul style="list-style-type: none"> • ACCELERATED LIFE TESTING • LONG-TERM ENDURANCE DATA
PERFORMANCE PREDICTION	<ul style="list-style-type: none"> • PV POWER PRODUCTION ADEQUATE • SOILING, RESIDENTIAL LOADS UNDER STUDY 	
PV ARRAY	<ul style="list-style-type: none"> • ADEQUATE DESIGNS UNDER TEST • REFINEMENTS LIKELY 	<ul style="list-style-type: none"> • RETROFIT EXPERIMENTS • MOUNTING FOR AMORPHOUS (?)
POWER CONDITIONING	<ul style="list-style-type: none"> • DRAFT STANDARDS ABOUND • PRIVATE SECTOR ACTIVE 	<ul style="list-style-type: none"> • IMPLEMENT SUB-SYSTEM TEST PROCEDURES

System Cost Reduction

- PV MODULE PRICES NOT DECLINING
- RESIDENTIAL ELECTRICITY PRICES NOT INCREASING
- DISTRIBUTED GENERATION (PURPA) UNDER ATTACK

Research Areas: Rooftop Applications

- COST REDUCTION
- UTILITY INTEGRATION
- RELIABILITY
- PERFORMANCE PREDICTION
- PV ARRAY
- POWER CONDITIONING AND CONTROL

Electric Utility Integration

- DISTRIBUTION SYSTEM SAFETY VERIFICATION
- POWER QUALITY EFFECTS MEASUREMENTS
- FEEDER DESIGN TO ACCOMMODATE PV
- TEMPORAL AND SPATIAL INSOLATION EFFECTS
CAPACITY DISPATCH
TRANSMISSION
DISTRIBUTION

PV System Performance Prediction

- EXTEND AND VALIDATE SIMULATION TECHNIQUES
LOAD CHARACTERIZATION
SOILING AND SELF-CLEANING
- LONG-TERM ESTIMATES FOR ARBITRARY SITES
INTERPOLATION BETWEEN SOLMET TMY SITES
ENLIGHTENED CONSUMER CHOICES
UTILITY CAPACITY PLANNING
- SHORT- AND MEDIUM-TERM FORECASTS
UTILITY CAPACITY DISPATCHING
UTILITY SCHEDULED MAINTENANCE PLANNING

PV System Reliability

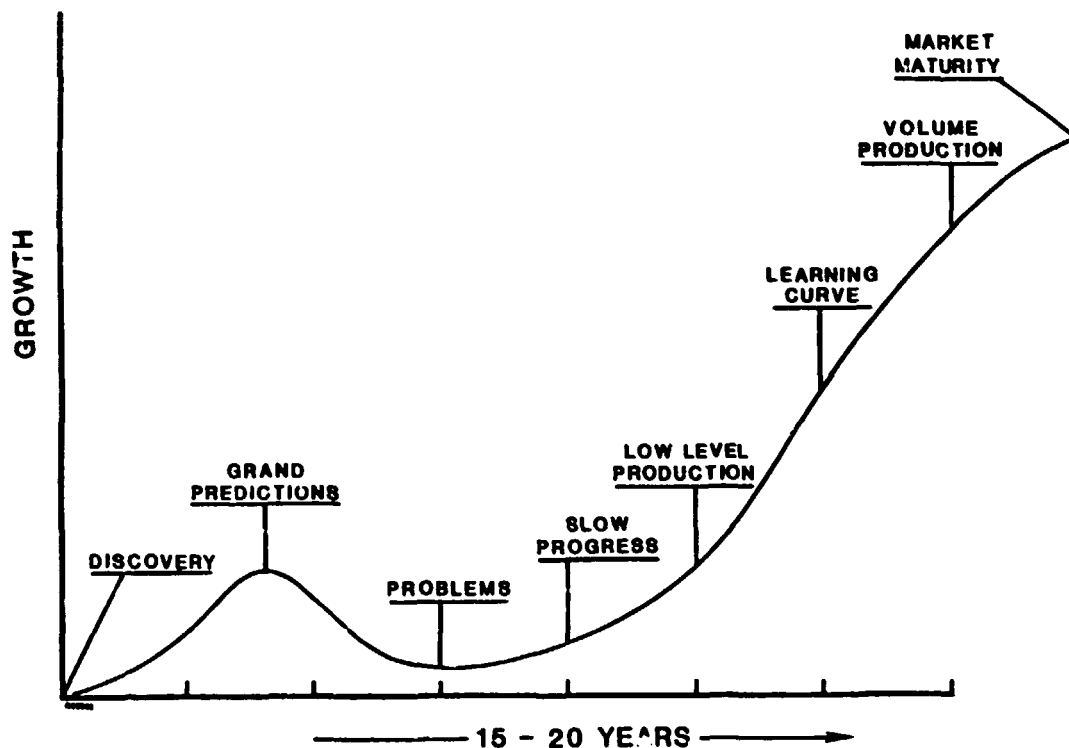
- **PV ARRAY ENDURANCE**
 - CLIMATE EXTREMES OVER MULTI-YEAR PERIODS**
 - DEVELOP AND VALIDATE ACCELERATED LIFE TESTING**
- **POWER CONDITIONER CONTROL**
 - WEATHER EXTREMES**
 - LOAD EXTREMES**
 - UTILITY VOLTAGE FLUCTUATIONS**

PV RESEARCH NEEDS: INDUSTRY PERSPECTIVE

SPIRE CORP.

R. Little

PV Product Growth Stages



E-O Technologies

15 YEAR CYCLE

- | | |
|-----------------------|-----------------------|
| • VIDEO DISCS | • SOLID STATE IMAGERS |
| • LED's | • AUTOMATIC BONDING |
| • HgCdTe IR DETECTORS | • FIBER OPTICS |
| • LATV | • E-BEAM LITHOGRAPHY |
| • BUBBLE MEMORIES | • FLAT PANEL DISPLAYS |
| • GaAs ELECTRONICS | |

L.A. MURRAY, ELECTRO-OPTICAL SYSTEMS DESIGN, OCTOBER 1981

PV Product Growth Stages

