

DEPARTMENT OF THE AIR FORCE
REGIONAL CIVIL ENGINEER, WESTERN REGION (AFESC)
630 SANSOME - ROOM 1316
SAN FRANCISCO, CALIFORNIA 94111-2278

ROEN (Styve/556-0542)
1988

18 Feb

SUBJECT: Engineering Technical Letter (ETL) 88-2: Photovoltaic
Applications

CESPD-ED-PM
WESTNAVFACENCOM (Code 09A2D.3)

CENPD-EN-TE
OICC TRAVIS (Code 09A2)

1. Authority: The subject ETL is authorized in accordance with AFR 8-7, Air Force Engineering Technical Letters (ETL) dated 9 January 1986, and is to be implemented accordingly.

2. Implementation: This ETL applies to all owned buildings at Air Force installations and activities accomplished by either appropriated or non-appropriated funds, where part or all of electrical power generation or distribution, maintenance, and operations costs are funded from appropriated funds and were not beyond 2% design on 21 Jan 88. Because of the current high cost of PV systems, only remote facilities should be considered for these types of power sources. On occasion, PV systems may be cost effective in non-remote locations. Additions to existing facilities must meet stated criteria. Alterations solely for energy conservation must meet the criteria for the Energy Conservation Investment Program (ECIP).

A.R. MARTINS, Chief
Airlift, Logistics & Training Br
Engineering & Construction Division

1 Atch
AF ETL 88-2, dtd 21 Jan 88

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ALMAJCOM/DEE/DEP/DEM	AFRCE-WR	AFRCE-CR	AFRCE-ER
AFRCE-BMS	AFRCE-SAC	AFIT/DET/DEM	HQ
AFCC/DEM			
HQ AFRES/DE	AAFES/ENC	ANGSC/DEE	HQ
AFESC/DEM			
NAVFAC CODE 04/05	1100 ABG/DE	CEEC-ES	HQ
USAFA/DEMA			

1. Purpose. This ETL:

a. Is authorized in accordance with AFR 8-7, Air Force Engineering Technical Letters (ETL) dated 9 January 1986, and is to be implemented accordingly. Waivers will be processed in accordance with the procedures established by the Model Installation Program.

b. Implements the National Defense Authorization Act for Fiscal Year 1987, P.L. 99-661, Para 2690, which states that "the primary fuel (or energy) source to be used in any new heating (or power generating) system constructed on lands under the jurisdiction of the military department is the most cost effective fuel (or energy) for that heating (or power generating) system over the life cycle of the system."

c. Implements the Military Construction Codification Act, of 10 USC 2857, for photovoltaics (PV).

(1.) Requires design of all (reference paragraph 5 for further explanation) new facilities to include consideration of solar energy systems where they have the potential for significant savings of fossil-fuel-derived energy.

(2.) Requires consideration be given to electric energy systems powered by photovoltaic solar systems.

(3.) Authorizes additional scope and cost per square foot of the project for the solar application(s) "by such amount as may be necessary

for
such purpose...in addition to any other administrative increase in cost
per
square foot or variation in floor area authorized by law."

(4) Requires contracts for construction to include solar system
installation when proven cost effective during the design process.

d. Establishes guidelines for preliminary photovoltaic solar
assessments
by the Host Major Command.

e. Establishes design guidelines for the designer.

f. Establishes guidelines for the design manager to input data into a design solar screen in the Program, Design, and Construction (PDC) system.

g. Provides guidance to the construction manager on inspection and acceptance of the photovoltaic solar system.

2. Background: Photovoltaic systems have been proven in the private sector to be simple installations successful in remote areas of Western and third World countries. These systems can be successfully installed and operated within CONUS and overseas bases. Little maintenance is required to operate these systems. A decision whether or not to install them should consider all benefits to be derived as a result of their installation, and not prematurely deleted by over concern of maintenance requirements. Reference atch 1 for several reports of photovoltaic installations in remote locations. Photovoltaics can be used to power many types of applications. Some of these are listed on atch 5. Details of some installations are on atch 6.

3. Effective Date. This ETL is effective starting with those projects which have not reaches the 2 percent design concept stage as of the date of this letter.

4. Referenced documentation: Applicable referenced publications are as follows:

a. Solar Powered Security Lighting System, Technical Memorandum No. M-56-87-03, Naval Civil Engineering Laboratory, Port Hueneme, CA.

b. Energy Prices and Discount Factors for Life-Cycle Cost Analysis, Annual Supplement to NBS Handbook 135 and NBS Special Publication 709, 1987 Edition, June 1987, NBSIR 85-3273-2 (Rev. 6/87).

c. Sections of the International Solar Energy Society, Inc., Solar '87, Proceedings of the 1987 Annual Meeting, July 11 - July 16, 1987, Portland, Oregon, The American Solar Energy Society, Inc., and the Solar Energy Society of Canada, Inc.

d. Reference atch 2 for definitions.

e. Reference atch 4 for a presentation on the fundamentals of a photovoltaic system electrical design.

f. Reference atch 7 for information on the state-of-the-art in

photovoltaics.

5. Implementation: This ETL applies to all owned buildings at Air Force installations and activities accomplished by either appropriated or non-appropriated funds, where part or all of electric power generation or

distribution maintenance and operations costs are funded from appropriated funds. Because of the current high cost of PV systems, only remote facilities should be considered for these types of power sources. On occasion, PV systems may be cost effective in non-remote locations. Additions to existing facilities must meet stated criteria. Alterations solely for energy conservation must meet the criteria for the Energy Conservation Investment Program (ECIP).

a. Programming Requirements. The requirements for including photovoltaic applications in project are:

(1) Preliminary Solar Assessments.

(a) General. The Base or MAJCOM will perform a preliminary analysis to determine if a photovoltaic application is cost effective. The solar assessment is described in atch 8. The assessment procedure will eventually be incorporated into PDC to simplify the solar evaluation.

(b) If the Savings to Investment Ratio (SIR) for the photovoltaic application is one or greater, then include the application in the programming documents.

(2) Command Submittal DD Forms 1391.

(a) When the solar assessment shows photovoltaics to be cost effective, then the Base and/or MAJCOM ensures this requirement in the programming documentation. Include a separate line item under "Supporting Utilities" to read "Photovoltaics Application".

(b) Use \$20 per watt for the programming cost of photovoltaic applications. This includes the cost of the array, batteries, inverters (as required), and installation. Calculate the required wattage in atch 8.

(3) Project Book (PB). In section F., ELECTRICAL CONSIDERATIONS, Paragraph 1.0, other special power requirements, include the following information:

(a) General. When the solar assessment shows photovoltaics to be cost effective, then state "Photovoltaics will be analyzed by the designer." Base the cost of the photovoltaic system on \$20 per watt and include the array, batteries, inverter (as required), and installation.

(b) Site Description. Include information on the suitability of the terrain for installing the photovoltaic arrays on the roof of the building

or on the ground.

(c) Size. Include mention of the photovoltaic application and words such as, "The size will be optimized base on least life cycle study."

(4) Design Instruction (DI) in PDC. The MAJCOM ensures that the cost effective photovoltaic programmed amounts (PA) are included in the Command Submittals. This ensures not only that the Air Force complies with the first part of the solar law, but also that the Air Staff include the Solar PA in the initial DI.

b. Design Requirements. The design requirements for including photovoltaic applications in projects are as follows:

(1) Design Manager (DM):

(a) General.

1. Do not use the Solar PA to support any nonsolar part of the project.

2. Update the solar CWE at the 35 percent design stage and time of contract award to reflect the true cost of the solar application.

3. Do not design photovoltaic applications as additives in the projects because the law requires they be included in the construction contract if proven cost effective during the design analysis. They can be designed as stand alone systems which can easily be removed from the design before the 30 percent submittal, if proven not cost effective.

(b) CBD Announcement. Facilities in remote locations are prime candidates for photovoltaic applications. Therefore, the CBD announcement may need to include a requirement for A-E expertise in design of PV. Coordinate these types of announcements with the MAJCOM if the photovoltaic information is not contained in the DI, Command Submittal, or the PB.

(c) A-E Analysis Requirement. If the preliminary assessment indicates that photovoltaics is cost effective, or if the MAJCOM and the DM determine photovoltaics should be analyzed by the A-E firm, this satisfies the second part of the solar law: "If a solar system has the potential to save...energy."

(2) Designer. The Designer analyzes the photovoltaic application per attach 8 using actual design costs and energy savings in the calculations.

(a) If the design analysis indicates that the application

is
cost effective, then the application will become part of the basic
project.

(b) The designer determines the optimum size of the
photovoltaic
application based on a least life cycle cost analysis using atch 8,
rather
than using the Solar PA as a convenient stopping place to size the
system.

(c) At the 30 percent design stage, the A-E provides the following information on the photovoltaic application: Building energy consumed with and without the solar application in MBTU per year, the type(s) of fuel or energy displaced, the fuel costs in \$/MBTU, the type of energy analysis used to compute the energy savings, the first year savings due to the application, the SIR, the simple payback (yrs), the discounted payback (yrs), the current working estimate for the application (\$000), the solar scope in SF or array, and the specific type of photovoltaic application.

(3) Site Selection.

(a) Options for installing the system include ground mounting beside the facility or mounting directly on the wall or roof of the facility. Choose a site large enough to accommodate all system components, allowing close proximity of all components. Short distances between components reduces electrical line resistance.

(b) Site the array to receive maximum amount of direct sunlight. Shadows caused by brush, trees or other obstacles reduce array efficiency.

(c) Locate PV arrays on true north/south axis, facing south in the northern hemisphere, and north in the southern hemisphere for maximum solar collection.

(d) Locate arrays away from traffic patterns. Ground mounting requires fencing around the equipment to protect it. Ensure equipment accessibility for maintenance.

(e) Ensure proper electrical grounding.

(f) Design height of arrays above water or snow lines.

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(4) Overall Design. Ensure overall design conforms with manufacturer's design guidelines.

c. Construction Requirements. The requirements for accepting a solar system are:

(1) Contractor. The contractor provides six copies of: catalog data, an equipment and material list, maintenance instructions, operating instructions, performance curves, quality control test, shop drawings and wiring diagrams.

(2) Construction Manager (CM).

(a) Reference atch 11 for warnings and cautions in handling PV equipment.

(b) Reference atch 12 for PV system checkout procedures.

FOR THE CHIEF OF STAFF

CHARLES A. SIPPAL, COL, USAF
Chief, Engineering Division
Locations
Directorate of Engineering & Services

Applications

Assessment

Cautions

13 Atch
1. PV in Remote
2. Definitions for PV Applications
3. Solar
Screen
4. PV Fundamentals
5. PV Applications
6. PV Installations
7. State-of-the-Art
8. Preliminary
9. Day/Night Hours
10. Daily Energy Production
11. Warnings and
12. Construction Inspection
13. ETL Index

cc: OASD (A&L) C
AF/LEYS

NOTE: THE ATTACHMENTS NOTED CONTAIN NUMEROUS DIAGRAMS AND CANNOT BE
PLACED ON THE ELECTRONIC BULLETIN BOARD, SHOULD YOU DESIRE THEM PLEASE
ORDER THRU YOUR ASSIGNED PROJECT MANAGER. THANK YOU.