Estimating Standalone System Size

This procedure provides a good estimate of how powerful a photovoltaic system is needed to support a given electrical load at a specific site. Before finalizing a system design, we recommend contacting your Solarex sales representative for sizing confirmation. Confirmation is advised:

- Particularly for systems with arrays larger than 1000 watts;
- Because microclimate zones may cause site conditions to differ substantially from area climate records;
- For any system whose reliability requirement is critical or where reliability/cost tradeoffs are an important issue.

This procedure is for sizing a "standalone" PV system, one which supports a load with no other power source. At a minimum, such systems include a PV array, a storage battery, and required switchgear and wiring. Most also include a system control device, particularly in situations where the load varies significantly from one day to another, and where the battery should be protected against overcharge or overdischarge.

This procedure uses two tools:

- Solarex's World Design Insolation map, which shows worldwide insolation to the extent it has been reliably recorded;
- an Excel workbook which helps a user calculate his average daily electrical load and, using solar data from the Design Insolation map, determine the size of PV system needed to support it. To use this workbook, named *Sizing Workbook.xls*, you must download it from the CD into Excel on your computer. When using the four worksheets which comprise this workbook, note the following data entry conventions.

Data Entry Conventions

Lines on which you may enter (in most cases, for meaningful results, *must* enter) values are shaded blue.

Lines which include approximations, such as 85% inverter efficiency, are shaded pink. If you have data which is more accurate than these approximations, you may override the entries in these fields.

Lines with no color coding are "locked" to prevent alteration of the sizing formulas.

Step 1: Calculate daily load

Download *Sizing Workbook.xls* from the CD into Excel on your computer. Split your computer screen so you can see these instructions and Excel simultaneously, or toggle between the two programs. *Sizing Workbook.xls* includes two load calculation spreadsheets: *DC Load Calc* for calculating the daily energy

use of DC loads, *AC Load Calc* for calculating energy use by AC loads. Enter the load wattages (which may be printed on the unit's nameplate) and daily runtimes. Each sheet will accept up to 15 separate loads. The total from each sheet is automatically forwarded to the *Array Sizing* worksheet, which calculates required PV array power.

Step 2: Size Array

Using the calculated load, solar data, and the characteristics of the module you select, the *Array Sizing* worksheet determines the number of modules required and the array's series/parallel configuration. Many of the lines are completed automatically. Enter values in lines 5, 7, 9, 11, and 13 using the instructions below.

Line	Instruction
5	Enter your system nominal voltage (must be a multiple of 12 volts.)
7	This factor provides a generally accepted margin (20%) for energy losses within the system and for variation of the solar resource. Increase the factor for systems with critical reliability requirements, extreme energy losses, and at sites with high solar variation. Under certain conditions, the factor may be decreased.
9	Refer to World Design Insolation map for design insolation. Enter the value on Line 9.
11	Enter the I_{mp} (current at maximum power) value, in amperes, for the selected module on Line 11. Solarex manufactures modules with I_{mp} ranging from 0.08A to 7A in 12-volt nominal configuration. Usually, the appropriate module for an array is the one which provides the required current with the minimum number of parallel modules.
13	Round the number of parallel modules recommended on Line 12 up to the next whole number.
14	The number of modules in series necessary to provide charging voltage appropriate for the system voltage entered on Line 5.

Step 3: Size Battery

The Battery Sizing sheet recommends battery capacity based on site latitude. Make entries on Lines 7 and 8 based on your site latitude and the instructions below.

Line	Instruction
7	Enter the number of days of reserve capacity you desire.
8	To obtain reasonable lifetime from lead-acid batteries, they should not be discharged beyond a certain point: 50% of full charge for "shallow-discharge" batteries, 20% of full charge for "deep-discharge" types. Enter the factor for the battery you prefer; the factor adjusts nominal battery capacity to usable capacity, producing a battery recommendation in nominal (manufacturer's nameplate) energy capacity.

The function of the battery is to provide energy at night and during periods of subnormal insolation. Many factors affect the size of battery required for an application, including battery type, site temperatures, desired battery lifetime, frequency of battery servicing, and rate of discharge. In addition, battery capacity may, within limits, be “traded off” against array size: the larger the array in a system, the smaller the battery required. If you require accurate analysis of these factors and precise optimization of system performance, or if you are considering using a battery other than the lead-acid type, contact your Solarex representative.