of about 1000 Wm^{-2}, at a module back-surface temperature of nominally 50°C, for at least 1000 h, with a resistive load near P_{max}, and low humidity [28, 39]. These conditions were chosen to approximate one year of outdoor exposure without the humidity or temperature cycling. Other thin-film module technologies may undergo reversible and irreversible changes during the first few hours of light exposure [29, 41, 42].

16.2.2 Alternative Peak Power Ratings

A variety of groups have suggested and adopted alternative rating schemes to compare module and system performance between the various PV technologies. These schemes are based on measurements of a module's performance in the field and on performing a regression analysis on the data. The site-specific power production is more relevant for bulk power generation than the power with respect to a particular theoretical reference spectrum and module operating temperature.

One popular method was adopted by Pacific Gas and Electric Company and the Photovoltaics for Utility-Scale Applications (PVUSA) project in California, USA, to rate and purchase PV systems. They perform a linear regression analysis on the actual measured system or module power produced (P), air temperature (T_a), wind speed (S), and total plane-of-array irradiance (E_{tot}) as measured with a pyranometer or radiometer:

$$P = P_{max}(E_{tot}, T_a, S) = E_{tot}(C_1 + C_2E_{tot} + C_3T_a + C_4S), \tag{16.3}$$

where C_1, C_2, C_3, and C_4 are the regression coefficients [32, 43]. The goal of performing a multiple regression analysis on the measured power to a fixed set of environmental conditions is to accurately represent the average power output under clear-sky conditions near midday at a given site. The power can be measured at the maximum direct-current (DC) power point, or on the DC side of the inverter, or at the alternating-current (AC) power out of the inverter. The last two power measurement locations will include some system losses. This site-specific rating scheme takes into account the different thermal characteristics of modules and spectral sensitivities since it is not referenced to a standard spectrum or module temperature. The power rating is evaluated using equation (16.3) at $T_a = 20°C$, $S = 1\ ms^{-1}$, and $E_{tot} = 1000\ Wm^{-2}$ for flat-plate collectors. For concentrators, the direct-normal incidence sunlight within a 5° or 5.7° field of view of 850 Wm^{-2} is used for E_{tot}. The difference between the fields of view is because an absolute-cavity radiometer has a 5° field of view and some less accurate but less expensive normal incidence pyrheliometers have a 5.7° field of view.

The primary advantage of basing the reference temperature on the air temperature is that the different thermal characteristics of the module, array, and system are included in the rating, and the power rating is closer to what is actually observed. The different spectral conditions at the different sites are also accounted for by not referencing the performance to a fixed spectrum, but rather, referencing the power to the actual spectrum that was incident on the module. If a PV reference cell is used to measure E_{tot}, then the power would be with respect to a reference spectrum at all light levels. Spectral mismatch issues associated with E_{tot}, measured with a thermal- or spectrally matched detector are discussed further in Section 16.3.1.