Table 20.8 Temperature coefficients for module and cell temperature estimation, for two typical module designs

Type	T_1 [°C]	T_2 [°C]	b	ΔT [°C]
Glass/cell/glass	25.0	8.2	−0.112	2
Glass/cell/tedlar	19.6	11.6	−0.223	3

Laboratories proposed [63] a two components thermal model given by

$$T_c = T_m + \frac{G_{eff}}{G^*}\Delta T, \text{ where } T_m = T_a + \frac{G_{eff}}{G^*}[T_1 \exp(b \cdot \omega_S) + T_2] \tag{20.78}$$

In this equation, T_m is the back-surface module temperature, in °C; ω_S is the wind speed measured at standard 10 m height, in m.s^{-1}; T_1 is an empirical coefficient determining the upper temperature limit at low wind speeds; T_2 is an empirical coefficient determining the lower temperature limit at high wind speeds; b is an empirical coefficient determining the rate at which the module temperature drops as wind speed increases and ΔT is also an empirical coefficient related to the temperature gap along the back encapsulation material. Table 20.8 gives the parameters found to have good agreement with measured temperatures, for two different module types.

However, the real usefulness of all these second-order corrections (equations 20.74–20.77) for temperature and wind speed is far from clear, because wind speed is difficult to predict, and also because cell temperature errors becomes more tolerable when translated into PV module power generation. For example, for a solar cell operating around 50°C, an error of 20% on the estimation of its cell temperature (≈10°C) reflects in an error of only 0.4% (≈10°C × 2.3(mV/°C)/600 mV) in the estimation of the corresponding power.

20.11 RELIABILITY AND SIZING OF STAND-ALONE PV SYSTEMS

The merit of a stand-alone PV system depends on how reliably it supplies electricity to the load. It is customary to quantify this reliability in terms of the Loss of Load Probability (*LLP*), defined as the ratio between the energy deficit and the energy demand, both referring to the load, over the total operation time of the installation. Thus,

$$LLP = \frac{\int_t \text{energy deficit}}{\int_t \text{energy demand}} \tag{20.79}$$

It should be noted that, because of the random nature of solar radiation, the value of *LLP* is always greater than zero, even if the PV system never actually breaks down. The available literature shows a large consensus over the expression of reliability in terms