course that the additional elements associated with the concentrator can withstand the high-radiation environment as well. A different approach is to try and develop cells that are more radiation-resistant. Several of the materials that are being investigated for high-temperature/high-intensity missions have also shown good radiation resistance. However, these will not be suited to the high-radiation missions involving LILT. Many of the high-radiation NASA missions being considered occur at distances much greater than 1 AU. Thin films may offer a possibility since they have demonstrated some advantages with regard to radiation tolerance as previously mentioned, provided the problem of their low efficiencies are solved.

10.7 POWER SYSTEM FIGURES OF MERIT

There are many figures of merit that must be considered in developing an SSP system (i.e. specific mass, specific power, cost per watt, temperature coefficients, and anticipated radiation degradation of the solar cells used).

The radiation hardness and the temperature coefficients for the III-V multijunction cells are significantly better than Si cells, as previously discussed. This leads to significantly higher EOL power level for a multijunction cell as compared to a Si cell. This is shown in Table 10.8, where the BOL cell efficiencies at room temperature and the typical EOL cell efficiencies for LEO and GEO operating temperatures and radiation environments are presented.

The difference in radiation degradation can have a huge impact on power system design. For example, if the area for a typical rigid panel is approximately 8 m^2 and the area of a typical solar cell is 24 cm^2, using a panel packing factor of 0.90 will allow the panel to have 3000 cells. Under GEO conditions, this panel populated with high-efficiency Si cells will produce 1.2 kW of EOL power. The EOL power could almost be doubled to 2.2 kW if it were populated with SOA triple-junction cells.

Table 10.8 A comparison of relative radiation degradation of 75-μm multijunction cells and high-efficiency Si under GEO and LEO operation [52]

Solar cell technology	BOL efficiency @ 28°C [%]	EOL efficiency on orbit [%]
GEO conditions (60°C) – 1-MeV, 5E14 e/cm^2		
HE Si	14.1	12.5
2J III-V	20.9	20.0
3J III-V	23.9	22.6
LEO conditions (80°C) – 1-MeV, 1E15 e/cm^2		
HE Si	13.4	10.6
2J III-V	19.7	18.1
3J III-V	22.6	20.3