supported after deployment. Work must be done to determine how best to deploy and maintain thin-film arrays. The same issues concerning stability in the space environment that were addressed for arrays with crystalline cells must now be addressed for thin-film arrays. As outlined in US Government Military Standard 1540C, the array must pass a number of qualification tests, including those for integrity and performance after exposure to elevated temperatures, radiation (particularly electrons and protons), thermal cycling, vibration and mechanical stress, and atomic oxygen.

The Air Force is leading a large, multidisciplinary team under the auspices of the Air Force Dual-Use Science and Technology program to develop a functional thin-film array for space within three years [49]. This program has the specific goals of demonstrating

1. a stabilized 10 to 15% AM0 efficient thin-film submodule;
2. submodule and module electrical architectures including bypass and blocking diode technology;
3. submodule and module mechanical interface architectures, module strength, and structural support requirements;
4. array support structure design for an array with a wide range of power levels;
5. space environment and thermal control protection/qualification standards for thin-film arrays.

This effort will culminate in the design of a-1 kW LEO and 20-kW GEO thin-film solar array.

10.5 SPACE SOLAR ARRAYS

Solar array designs have undergone a steady evolution since the Vanguard 1 satellite. Early satellites used silicon solar cells on honeycomb panels that were body-mounted to the spacecraft. Early space solar arrays only produced a few hundred watts of power. However, satellites today require low-mass solar arrays that produce several kilowatts of power. Several new solar array structures have been developed over the past 40 years to improve the array specific power and reduce the stowed volume during launch.

The most important characteristics of solar arrays required for space applications are

- high specific power (W/kg)
- low stowed volume (W/m^3)
- low cost ($/W)
- high reliability.

In addition, several proposed space missions have put other constraints on the solar arrays. Several proposed Earth-orbiting missions designed to study the sun require “electrostatically clean” arrays. Inner planetary missions and mission to study the sun within a few solar radii require solar arrays capable of withstanding temperatures above 450°C and functioning at high solar intensities (HIHT). Outer planetary missions require solar arrays that can function at low solar intensities and low temperatures (LILT). In addition to the near-sun missions, missions to Jupiter and its moons also require solar arrays that can withstand high-radiation levels.