

cally no sun at all will shine. On the moon, for example, the night is 14 earth days long. For this reason permanent lunar bases probably will have to use nuclear power, which is independent of the location of the sun.

Another mission where nuclear systems offer advantage is the manned orbiting stations. It is desirable to operate these stations at the relatively low altitudes of between 100 and 200 nautical miles to reduce the logistics costs of operating at higher altitudes and to minimize the natural radiation to which the stations at higher altitudes would be exposed. For these low orbits the smaller exposed area of nuclear power systems results in great reductions in the atmospheric drag and in the pounds of propellant required to keep the station in its assigned orbit. An unmanned scientific or defense system that has to operate close to the earth will similarly have the advantage of low atmospheric drag if nuclear power systems are used. A third important mission is the kind that requires large quantities of electric power. Because of its extreme compactness, the nuclear reactor heat source is the lightest and most convenient concept for electric power levels above a few tens of kilowatts.

Manned missions, of course, require more electric power than unmanned missions. To survive in the hostile environment of space, man must take along or generate within his spacecraft food to eat, water to drink, and oxygen to breathe. He needs electric power to preserve, prepare, and purify these; to light his cabin and to maintain it at a temperature and pressure he can tolerate; and to provide the energy needed for communication and for the hundreds of other mechanical operations required during the mission. A listing of electric power requirements for the long-lived manned space station now being studied by NASA indicates that at least 1 to 1½ kilowatts per man will be required in orbit.

The Gemini missions, being of only a few days duration, have used fuel cells and batteries for their primary electric power plants, but these become less attractive as primary power sources when mission times of several weeks are required. This is indicated in Figure 6. Mission power requirements from 30 watts to 100 kilowatts are plotted here vs. the length of time for these missions from 6 minutes to several years. Observe that the nuclear and solar power systems are better for long missions.