MANAGING THE SPS ANTENNA POWER BEAM PERFORMANCE

Richard M. Dickinson
Transmitter Group Supervisor
Jet Propulsion Laboratory
Pasadena, CA 91103

ABSTRACT

The proposed satellite power system for importing nearly continuous solar-electric power from synchronous orbit, is to consist of a fleet of orbiting solar collector spacecraft, each of approximately 100 km^2 area. The 6.25 GWe power output is converted to 2.45 GHz microwaves and beamed to earth based rectenna collectors for conversion to high voltage ac or dc power, to feed into the electric utility transmission grid.

The microwave power beam subsystem operation and performance must be closely monitored and accurately controlled in order for the SPS to legitimately function in the international radio regulation framework (radio frequency interference and biological hazard) that may exist in the late 1990's.

We consider the various design characteristics and equipments of the transmitting active retrodirective array and the receiving rectenna that are necessary to be monitored and controlled in order to adequately manage the spacecraft RF power beam performance. The operating and maintenance strategies for coping with requirements for controlling beam pointing, beam shape, harmonics, noise, grating lobes and ionosphere nonlinearities are discussed. We speculate on the potential degree of precision of beam characteristics that may be required or achieved.

The instrumentation requirements for measuring or deriving the state of performance of the microwave subsystem are enumerated along with the control instrumentation necessary to effect changes in operating configuration, state or parameter values so as to initially achieve, better maintain or to restore performance to the defined acceptable state.

We conclude that there are potentially a range of controllable parameters that may be designed into the microwave subsystem in order to achieve the various radio regulatory requirements. However, extensive design tradeoff studies are necessary to properly select the optimum instrumentation, controls and operating and maintenance strategy. This is because the resulting effects on the overall system efficiency, availability and economics are also potentially severe. For example, the increased insertion loss, weight, power dissipation and decreased RF breakdown margin of the harmonic filters required to achieve protection of existing earth and space based radio services, may cost several per cent additional loss in power beam transmission efficiency.