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ELECTROMAGNETIC COMPATIBILITY OVERVIEW

K. C. Davis
Pacific Northwest Laboratory, P.O. Box 999, Richland, WA 99352

In the process of delivering 5 Gw of electrical power the SPS will, due to limitations of available technology, contribute undesired electromagnetic radiation over a broad spatial and spectral range. Because of the large power handled by SPS and the extreme sensitivity of some other electromagnetic systems, even a very small fractional loss from the SPS can have a major impact.

Assessment of the Electromagnetic Compatibility (EMC) impact of SPS has two major parts; determination of the emissions expected from SPS including their spatial and spectral distributions, and evaluation of theimpact of such emissions on electromagnetic systems including consideration of means for mitigating effects. Determination of SPS emissions is hampered by uncertainties in the design of the system and the unavailability of representative components for testing. Some aspects, such as the spatial distribution of microwave power at the intended transmitting frequency, can be computed with high assurance of accuracy. Other important values, such as power spectral densities for noise sidebands and harmonics, must be estimated or extrapolated from existing systems.

Evaluation of impacts is aided by the existence of well-developed techniques and a substantial body of data relevant to SPS EMC. The problem remains very large because of the number of potentially impacted systems. It has been necessary to select representative and/or important systems based on sensitivity to expected EMC emissions, proximity to proposed rectenna sites, or severity of consequences if affected. Specific testing of systems and equipment under conditions representing SPS exposure has been done to fill gaps in previous data and more is planned.

SPS EMC impacts fall into four major categories:

(1) Effects of High Microwave Power Densities on Electronic Systems:

These effects are expected only relatively near rectenna sites (within approximately 50 km) but in that area could affect a wide variety of systems including computers, controls, sensors and communications. Well-developed techniques exist to mitigate the expected effects and their effectiveness has been demonstrated in SPS-related tests. The major impact in this area may be the cost of modifications. Spacecraft transiting the microwave power beam are special cases but no insurmountable problems have been identified.

(2) Effects of High Power Levels at 2.45 GHz on Receiving Systems Operating at Other Frequencies:

These will be most severe near rectennas but could affect sensitive systems at large ranges if they are strongly coupled to SPS, e.g., by large upward-looking antennas. Most of the effects can be mitigated, for example by antenna modifications or addition of RF filters. Degradation may result in some cases and modification may be unacceptable for some systems. Rectennas will have to be sited to avoid sensitive facilities, e.g., Radio Astronomy and Deep Space Research by large ranges (100 km or more).

(3) Effects of SPS Emissions at Other Frequencies on Receiving Systems Operating At or Near Those Frequencies:

These emissions may cause problems throughout the hemisphere below SPS spacecraft since they would not be expected to have the same spatial distribution as the main power beam. Rectennas may also be a significant source of emissions at spurious frequencies. SPS spurious emissions are subject to stringent constraints in FCC and International Regulations, but there remains some concern that very sensitive receiving systems operating near 2.45 GHz or harmonics may experience interference.

(4) Effects of Scattered Sunlight from SPS Spacecraft:

Each spacecraft will, even if it scatters only 4% of the sunlight it intercepts, be brighter than any other object in the night sky except the moon (as bright as the planet Venus at its brightest). Sixty SPS spacecraft will have the effect of a fractionally illuminated moon always present in the night sky. This would cause substantial interference with ground-based astronomy and other scientific observations of the night sky requiring dark conditions. Mitigation would require substantially darker SPS spacecraft or relocation of a number of observational facilities to space.