RADIOISOTOPE POWER SYSTEM EFFECTS ON SCIENCE INSTRUMENTS AND MEASUREMENTS.

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Introduction: Several mission concepts identified in the 2011 Planetary Science Decadal Survey were developed using Radioisotope Power Systems (RPS). Although many mission planners and science investigators acknowledge the benefit of using RPS for a variety of missions into deep space, some may have concerns about possible effects from RPS-induced conditions upon the scientific capabilities of their mission concepts. To address these concerns, this poster describes existing and potential future RPS designs and their potential radiation, thermal, vibration, electromagnetic interference (EMI), and magnetic-fields effects on representative science instruments and science measurements.

RPS-induced radiation effects on science instruments are of potential concern for instruments with optical detectors and instruments with high-voltage electronics. The two main areas of concern are noise effects on the instrument measurements, and long-term effects of instrument damage. Although RPS by their nature add to total radiation dose, their addition for most missions should be relatively small. For example, the gamma dose rate from one Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) would be an order of magnitude lower than the environmental dose rate at Mars, and would have a correspondingly lower contribution to instrument noise and to any permanent damage to payload sensors. Increasing the number of General Purpose Heat Source (GPHS) modules used in an RPS would be expected to increase the generated radiation proportionally; however, the effect of more GPHS modules is mitigated from a strictly linear relationship by self-shielding effects. The radiation field of an RPS is anisotropic due to the deviation of the modules from a point-source-geometry. Mitigation methods such as separation or application of spot shielding could be utilized to address the total radiation dose for particularly sensitive instruments.

A new, higher-power RPS could generate more heat per unit than current designs. However, the thermal impact to the flight system could be lessened with shading and pointing, if required by the mission concept. Alternatively, excess heat from RPS could prove beneficial in providing needed heat to spacecraft components and instruments in some thermal environments.

Vibration for a new higher-power Stirling Radioisotope Generator (SRG) would be expected to be similar to the recent Advanced Stirling Radioisotope Generator (ASRG) design. While vibration should be low, it must be considered and addressed during spacecraft and instrument design.

EMI and magnetic fields for new RPS concepts are expected to be low as for the current RPS, but must be considered and addressed if the mission includes sensitive instruments such as magnetometers.

The RPS effects on science instruments and measurements assessment conducted for this poster focused on orbiter instrument payloads for two representative mission concepts for deep space—a Titan Saturn System Mission (TSSM) and a Uranus Orbiter and Probe (UOP)—since both of these Decadal Survey concepts would include many diverse instruments on board.

This poster explains how the potential impacts of the current RPS and a new, higher-power RPS on science instruments and measurements were assessed and which impacts were addressed. Potential mitigation strategies are suggested against those impacts, which mission planners and science investigators could apply. Finally, this poster provides an overview of several topics that would benefit from further work.