AFRL

SPACE POWER BEAMING

SPACE SOLAR POWER INCREMENTAL DEMONSTRATIONS AND RESEARCH PROJECT (SSPIDR)

WHAT IS IT?

SSPIDR is a series of integrated demonstrations and technology maturation efforts at the Air Force Research Laboratory (AFRL) Space Vehicles Directorate to develop space-based solar power collection and transmission capabilities.

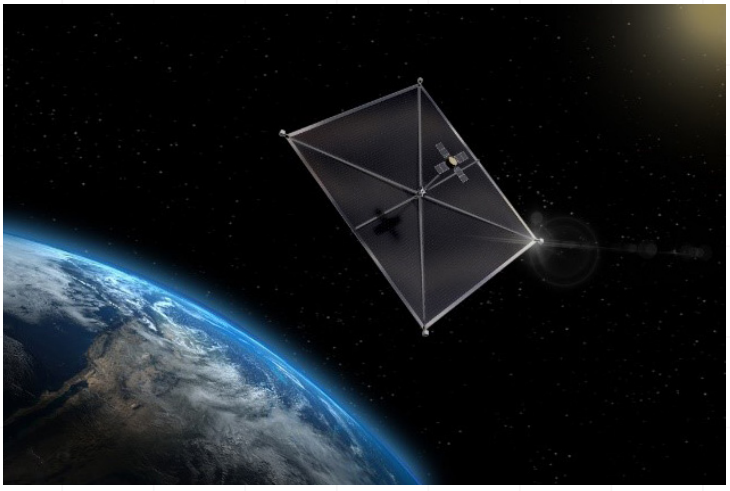
Space solar power beaming is not a new concept; yet until recently, the technology did not have a clear path forward. In collaboration with the Naval Research Laboratory (NRL) and primary industry partner, Northrop Grumman, AFRL established the SSPIDR project to rapidly infuse space technological innovations in collecting solar energy to provide uninterrupted, assured, and logistically agile power to expeditionary forces.

HOW DOES IT WORK?

The space solar power system that SSPIDR is developing will use a novel “sandwich tile”. The tile collects solar energy in space via photovoltaic cells, converts the solar energy into Radio Frequency (RF) and beams it to a receiving antenna on the ground. The receiving antenna, or rectenna, will then rectify the RF beam into useable power. However, building an operational space power beaming system presents many challenges, and it is these challenges that SSPIDR is working to address.

METHODOLOGY

The SSPIDR team examined the needs of an operational system and identified six critical technologies needing further research and development to make this system a reality. Scientists and engineers will explore these areas culminating in critical technology demonstrations that validate both the technology concepts and models for incorporation into an integrated system design.



The image depicts AFRL’s Space Solar Power Incremental and Demonstrations Research Project beaming solar power from space to earth. SSPIDR consists of several small-scale flight experiments that will mature technology needed to build a prototype solar power distribution system. (Image by AFRL)

THE INCREMENTAL DEMONSTRATIONS

SPIRRAL

The Space Power InfraRed Regulation and Analysis of Lifetime (SPIRRAL) experiment will explore solutions to the thermal challenges experienced by a space solar power beaming system. One promising solution is Variable Emissivity Material (VEM), which reduces extreme temperature swings. SPIRRAL will be flying

(Continued on page 2)

(Continued from page 1)

several samples of VEMs onboard the International Space Station and is slated to launch in early 2023.

ARACHNE

The keystone flight experiment in the SSPIDR project, Arachne, will demonstrate the sandwich tile and its ability to collect solar energy, convert it to RF, and beam it to a rectifying antenna on the ground from low earth orbit. A panel of nine sandwich tiles, under development by Northrop Grumman, will be flying on Arachne, which is expected to launch in 2025.

SPINDLE

The Space Power INcremental DepLoyable Experiment (SPINDLE) will explore the deployable structures technology element. A space-based solar power transmission system will require large orbiting structures, which calls for a solution for how to stow, deploy, or possibly even build these structures in space. SPINDLE is currently undergoing ground demonstrations, which will determine the path forward.

THE RESEARCH

The critical technologies driving the realization of a large scale system are Deployable Structures, Energy Generation, Thermal Management, Distributed Control, RF Beaming, and Metrology (beam forming). Additionally, SSPIDR pursues parallel technology paths – advancing multiple experimental possibilities to find the most innovative technological solution for further maturation efforts. These research advancements will feed into the development of the large-scale system.

WHY IS IT IMPORTANT?

AFRL's main mission is to develop and mature technologies to benefit the warfighter. Ensuring that a forward operating base receives power is one of the most dangerous parts of a ground operation. Convoys and supply lines, which are major targets for adversaries, are the usual methods to supply power. To use the solar power beaming system, a service member would simply set up a rectifying antenna to gain access to power, eliminating costly and dangerous convoys. Essentially, AFRL is enabling the relocation of those supply lines to space, which could save countless lives.

There is a high possibility that this technology could be a highly valued asset in the commercial sector as well. Much like the Global Positioning System (GPS), which started out as a military asset and transitioned to a technology now used by people everywhere, this solar power beaming system could transition to broader usage, providing solar energy regardless of weather, time of day, or latitude.

ABOUT AFRL

The Air Force Research Laboratory (AFRL) is the primary scientific research and development center for the Department of the Air Force. AFRL plays an integral role in leading the discovery, development, and integration of affordable warfighting technologies for our air, space, and cyberspace force. With a workforce of more than 11,500 across nine technology areas and 40 other operations across the globe, AFRL provides a diverse portfolio of science and technology ranging from fundamental to advanced research and technology development. For more information, visit: **www.afresearchlab.com**.