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THE HISTORY OF SOLAR THERMAL POWER IN SPACE APPLICATIONS

Abstract

The purpose of this paper is to discuss the history of solar thermal power generation, otherwise known as solar dynamics, for space applications. Solar dynamics can generate large amounts of energy by focusing thermal energy from the sun onto a pipe with a heat transfer fluid, that can be connected to a mechanical turbine or other energy conversion method to produce power and uses thermal storage to store excess energy. Early scientists and engineers, such as Hermann Oberth, Hermann Noordung (pen name for Herman Potocnik), and Wernher von Braun, published their conceptual ideas on the use of solar dynamics in space applications using large mirrors with various power conversion cycle types in articles, while later development efforts published manufacturing and test reports. But despite multiple technology advancement projects and ground-based testing, solar dynamics has never flown in space, partially due to lack of integration funding. Mission applicability contributed as solar dynamics is limited to areas with strong insolation, longer mission times, power needs above 1 kW and high orbits to avoid drag.

Overall, solar dynamics has been investigated as a power system for space for many decades, but the advancement of photovoltaics and nuclear power, paired with the limited mission effectivity of solar dynamics, has made the use of solar dynamic power systems for space applications challenging. Modern technology advances on terrestrial solar dynamics systems have increased the energy capacity and invested in new molten salt mixtures which have a lower melting point. It remains to be seen whether these advances can be applied to the NASA Artemis Moon 2 Mars Programs for power systems on the Moon or Mars surfaces, due to other constraints like dust contamination, permanently shadowed regions, and size and mass restrictions outside of Low Earth Orbit.