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ACTIVE THERMAL CONTROL SYSTEM FOR PERSPECTIVE VENUSIAN LANDER

Abstract

Abstract for C2.7 session. After practically a twenty-year break, the interest of exploration of Venus was renewed around the world. High-grade new results were received by European spacecraft Venus Express what works in a polar orbit of Venus since 2006. In May, 2010 the Japanese space agency sent space vehicle "Akatsuki " for studying Venus. Scientific program for Venus researches exists at present in Russia with launching in 2016 spacecraft "Venus - D", including orbiter, lander and, probably, balloons and subsatellite. NASA also has plans to realize a mission to Venus named SAGE at the end of the current decade. The purpose of this work is a demonstration of a possibility of active cooling system application on a board of venusian lander for superlong scientific researches, like a seismic activity study of a planet or research of a climate. When we speak about superlong duration of stay on a Venus surface, we mean duration in some months. It is an incredibly complicated problem. The temperature at a Venus surface is approximately 480, and pressure nearby 92 bar. The Soviet landers in 70-80 years of 20-th century have lived on a Venus surface about 1 hour. They used passive thermal system, based on of phase change material application what absorbed heat from outside. It is proposed to use the refrigerating machine, working on a return recuperative Brayton cycle, with argon as a coolant. The refrigerator consists of turbomachine (compressor and expander) and two heat exchangers. Scheme is open and coolant (argon) circulates inside lander. Lander looks like a pressurized sphere. Turbomachine and one heat exchanger are located inside sphere. Second heat exchanger is located outside. Temperature in a pressurized sphere is supported at a level 90 - 110^{o}. Cooling system compensates nearby 120 W external heat leakage and 20 W from onboard equipment. Required electric capacity of cooling system is about 1000 W. Reduction of this value may be achieved due to improvement of thermal protection and also due to high-temperature electronics application (200 and more). In conclusion we can say that future missions to Venus have to plan on completely new principles of building lander service systems. And long stay on the surface is possible only with active cooling system.