Paper ID: 28111
oral

66th International Astronautical Congress 2015

SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

Author: Dr. David Oh
Jet Propulsion Laboratory - California Institute of Technology, United States, david.y.oh@jpl.nasa.gov

Dr. Dan Goebel
Jet Propulsion Laboratory - California Institute of Technology, United States, Dan.M.Goebel@jpl.nasa.gov
Mr. Jay Polk
Jet Propulsion Laboratory - California Institute of Technology, United States, James.E.Polk@jpl.nasa.gov
Mr. Thomas Randolph
United States, thomas.m.randolph@jpl.nasa.gov
Dr. John Steven Snyder
United States, John.S.Snyder@jpl.nasa.gov

ADAPTATION OF COMMERCIAL ELECTRIC PROPULSION SPACECRAFT TO SOLAR SYSTEM EXPLORATION MISSIONS

Abstract

The dramatic success of Dawn its rendezvous with Vesta in 2012 and its upcoming rendezvous with Ceres this summer highlight the unique value that solar electric propulsion (SEP) has for solar system exploration. The recently launched Hayabusa 2 and the upcoming Bepi-Colombo mission are both enabled by SEP and many ambitious deep space mission concepts including missions to small bodies, Mars, and the outer planets are potentially enhanced or enabled by SEP technology.

The relatively high cost of electric propulsion and the need for large solar arrays remains a barrier to the use of SEP for exploration missions. However, since Dawn was first proposed in 2001, both solar power and electric propulsion (EP) technology have advanced substantially for Earth orbit applications. Electric propulsion is now a mature technology, used for stationkeeping, attitude control, and primary propulsion on over 100 operating satellites. Coupled with the now common use of 20kW+ solar arrays on communications spacecraft, commercial SEP systems originally developed for operations near Earth offer the performance needed for deep space, but with the benefit of relatively high production volumes that provide strong flight heritage at a relatively low cost.

This paper will describe the opportunities and challenges that come from adapting commercial SEP spacecraft to deep space missions. It begins by comparing the capabilities of commercial spacecraft built in the US and Europe to those used in deep space. It then discusses similarities and differences in environmental requirements and the implications these requirements have for different spacecraft subsystems. The adaptations required to GEO power systems to enable deep space operation are discussed. Operational constraints and the need for autonomous fault protection also play an important role in deep space. The impact of these constraints on the adaptation of commercial spacecraft is discussed. Programmatically, commercial and government spacecraft are often managed using different funding and procurement methods. The paper will consider the advantages and disadvantages of the fixed price contracting model used for many commercial spacecraft when applied to one-time exploration missions.

The paper describes different options for the adaptation of commercial SEP technology, including options that use only commercial hardware and "hybrid" options that combine commercial hardware

with hardware/software previously flown in deep space. It concludes that that adaption of commercial SEP hardware to deep space is viable and beneficial to solar system exploration missions.