SPACE EXPLORATION SYMPOSIUM (A3)
Interactive Presentations (IP)

Author: Mr. Alexander Linossier
Technische Universität Berlin, Germany

SYSTEM CONCEPT FOR IN-SITU CASING GENERATION IN A DEEP LUNAR BOREHOLE

Abstract

The Lunar Mission One project aims to drill up to 100m below the south lunar pole. The considerably deeper target depth compared to past and existing exploration missions that include a drilling capability creates unique issues regarding long-term borehole stability. The challenges are exacerbated by the relatively unknown geological and structural composition of the lunar regolith and bedrock immediately beneath the drilling site. Current casing technologies used throughout the oil and gas industry rely almost exclusively on heavy steel casing to provide long-term borehole stability, as there is little to no drive to reduce system mass, and the primary task of the casing is pressure containment of pressures sometimes exceeding 5000psi. In a system that does not require pressure containment, a number of other methods of increasing borehole stability while drilling, such as chemical mixes or pressure control, may also find use as a long-term lunar solution. The mass and space restrictions on any lunar landing mission severely limit the amount of steel or other casing that can be brought from Earth; deeper extra-terrestrial boreholes instead may require the use of in-situ resource utilisation (ISRU) technologies in order to provide long-term stability. The current terrestrial casing and borehole stability technologies are contrasted for their applicability to a lunar drilling mission, and potential changes are suggested that may allow them to be used without significantly increasing the total system mass. ISRU solutions, however, result in a much lower system mass, and allow other scientific payloads to be carried that increase the return of the mission. A brief overview of the ISRU technologies that apply to lunar material is provided as background. A comparison of the various ISRU techniques results in a primary and secondary system concept that rely on different technologies. The impact of these system concepts on the drilling assembly design and ground system is also assessed, as the casing generation system will be integrated into the drill string for all drilling operations. Preliminary estimates of system mass and power requirements, and physical dimensions, inform currently progressing project design work.