

LUNAR PRODUCTION DRILLING USING WATERWITCH. G. R. Baiden¹, G. P. Barnhard² and B. R. Blair³, ¹CEO, Penguin Automated Systems Inc., Sudbury, Ontario, Canada, <gbaiden@penguinasi.com>, ²XISP Inc. 8012 MacArthur boulevard, Cabin John, MD 20818 <barnhard@barnhard.com>, ³NewSpace Analytics, Denver, CO.

Introduction: This paper will describe a collaborative partnership to define and implement improved technologies for lunar regolith processing mechanisms and end-to-end process flow engineering required for the recovery of volatiles and other resources (i.e., intended end products), a system-of-systems to implement said improved methodology (i.e., context), and specific mechanisms for Lunar Regolith Processing (e.g., WATERWITCH), which is a necessary element to accomplish the same.

This work is germane to the development of In-Situ Space Resource Utilization (ISRU) applications such as space-based rocket propellant production, oxygen and water production for space Environmental Control and Life Support Systems (ECLSS), lunar structure development, and space manufacturing from non-terrestrial resources.

Technical Concept: The end-product of this partnership is envisioned to be an instrumented scalable robotically compatible protoflight tool, with the necessary integrated process flow analysis support to allow for effective operation in the intended environment. The objective is to make the protoflight system available for accommodation on one or more anticipated lunar payload opportunities.

Based on successful testing in the lunar environment, the goal would be to create commercial opportunities for scaled systems executable as a public/private partnership between NASA and XISP-Inc in conjunction with its consortium partners.

Relevance and Alignment: The ability to successfully mine lunar regolith for volatiles and ice would provide the resources essential for economical operations and human lunar habitation. A ready supply of oxygen and water is essential for life. The secondary products associated with the preprocessed regolith may prove instrumental in facilitating construction and the further separation of metals and other elements.

XISP-Inc seeks to create public private partnerships to define and execute Technology Development, Demonstration, and Deployment (TD 3) missions to foster Cislunar space development, which aligns with NASA's strategic goals for expanding capabilities and opportunities in space. The TD 3 missions are intended to leverage the rapidly evolving U.S. commercial space industry, as well as academia, non-profit organizations, other government agencies and/or laboratories, allied international government space agencies, exuberant billionaires, and other motivated individuals with specialized skills/resources in orchestrated efforts to rise to the challenge of creating a vibrant Cislunar development ecosystem

benefiting both commercial and government use of space.

Commercial Impact: The public private partnership will focus on advancing commercially developed Lunar Regolith Processing & End-to-end Process Flow Engineering that can benefit both the commercial and government use of space.

The general availability of non-terrestrial sources of water and oxygen will be transformative with respect to Cislunar space development, both for propulsion purposes and for supporting human habitation requirements. The ability to provide a ubiquitous supply of non-terrestrial water and oxygen is essential for the cost effective support of human life, and preprocessing the regolith to make it more tractable to work with when and where needed is mission enhancing if not enabling for all aspects of Cislunar development.

