

Lunar Innovation Park – Site Preparation Operational Analysis

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ABSTRACT

The Lunar Innovation Park (“Park”) is a sequence of missions designed to robotically lay the foundations for cislunar space resource-based economic activity and establish the initial elements of a permanent lunar outpost. The use of regolith as a bulk construction material to build infrastructure is an enabling feature of the Park. The Park includes six single-use bulk regolith prepared landing surfaces, with protective berms in a hub-and-spokes-shaped Industrial Area to emplace power, communications and other infrastructure. The Park also includes a prepared regolith site for a reusable launch/landing pad with durable surface built using a yet to be determined robotic construction technology. Excavation and site preparation operations are completed with two Infrastructure Pilot Excavators (IPEX) (formerly called In-Situ Resource Utilization (ISRU) Pilot Excavator (IPEX)) and a construction/logistics robot with swappable implements notionally called Construction Pilot Excavator (CPEX). The existing and desired capabilities of these robots are presented along with a discussion of the approach to supervised autonomous operations. This paper presents an excavator productivity model used to analyze site preparation operations with detailed descriptions of each operation and resulting metrics such as excavated mass, operations time, power consumption, number of dig-haul-dump cycles, and expected remaining robot service life. A sensitivity analysis was completed on selected characteristics of the Park design and site preparation operations that unveiled several dependencies that warrant further investigation including berm side slope stability and effects of natural surface features. Robotic construction of the regolith features of the Lunar Innovation Park appears to be feasible using the capabilities of IPEX and assumed capabilities of CPEX

excavation platforms with some refinements of the Park design and/or improvements to excavator expected life.