SUMMARY OF THE CONTRACTED DELIVERIES OF NASA PAYLOADS TO THE MOON VIA COMMERCIAL LUNAR PAYLOAD SERVICES (CLPS). Commercial Lunar Payload Services (CLPS) Project Office[1] and Exploration Science Strategy and Integration Office (ESSIO)[1] [1]National Aeronautics and Space Administration (corresponding author: brent.garry@nasa.gov)

Introduction: NASA's Commercial Lunar Payload Services (CLPS) initiative allows rapid acquisition of lunar delivery services from US companies for payloads that advance capabilities for scientific, technological, or commercial development of the Moon [1]. In conjunction with instrument development efforts within NASA, academia, international partners, and commercial industry, a considerable variety of payloads have been delivered to CLPS vendors or are in the process of development. A total of 10 task orders (TOs) have been awarded with at least 2 new TOs expected to be awarded in 2024 via a competitive process among a pool of 14 companies that will result in lunar landings at sites widely distributed across the surface of the Moon, including the south polar region and the farside.

Individual task order awards cover end-to-end commercial payload delivery services, including payload integration, launch from Earth, landing on the surface of the Moon and mission operations. Many CLPS landers will carry a laser retroreflector array payload (some passive, others active) to create a suite of fiducial markers on the lunar surface. In addition to delivering the NASA payloads, the CLPS vendors are carrying additional commercial payloads that are operated independently from the NASA payload suites. A successful landing of the first CLPS lander will help prove out the CLPS model for commercial payload deliveries to the lunar surface.

TO2-IM: Awarded to Intuitive Machines (IM), their first mission (IM-1) is scheduled to land near Malapert A in the South Polar region in 2024 using their Nova-C lunar lander. IM-1 will carry payloads that will focus on plume-surface interactions with Stereo Cameras for Lunar Surface Studies (SCALPSS), space weather and lunar surface interactions and radio astronomy (ROLSES), precision navigation technologies through doppler lidar (NDL), a communication and navigation node for future autonomous navigation technologies (Lunar Node 1), and a laser retroreflector (LRA).

TO2-AB: Awarded to Astrobotic, Peregrine Mission-1 launched on January 8, 2024. The landing area, Sinus Viscositatis, is a newly named region of mare that embay the Gruithuisen Domes. The Peregrine 1 mission is carrying NASA payloads that will conduct a wide range of surface investigations. The lunar exosphere and gases released by regolith with be explored by the Peregrine Ion-Trap Mass Spectrometer (PITMS). The thermal properties of the lunar regolith with be examined by the Near-Infrared Volatile Spectrometer System (NIRVSS) and the hydrogen content of the near subsurface will be examined by the Neutron Spectrometer System (NSS). The radiation environment will be measured by the Linear Energy Transfer Spectrometer (LETS). A laser retroreflector (LRA) will establish a known location marker.

TO PRIME-1: Awarded to Intuitive Machines, their second mission (IM-2) is scheduled to land in the south polar region using their Nova-C lander. The Polar Resources Ice Mining Experiment-1 (PRIME-1) is an in-situ resource utilization demonstration on the Moon. PRIME-1 comprises The Regolith and Ice Drill for Exploring New Terrain (TRIDENT) and the Mass Spectrometer Observing Lunar Operations (MSOLO) to measure volatile content of subsurface materials to 1-meter depth. This delivery will also include an LRA, a small Lunar Outpost rover to test a wireless network, and a μ-hopper demonstration that will hop to several locations enroute to hopping into (and out of) a permanently shadowed region (PSR). The hopper will take images and Lunar RADiometer (LRAD) thermal IR measurements of surface brightness temperature, mm to cm-scale surface roughness, and thermal inertia.

TO 19C: Awarded to Masten Space Systems; the payloads are now being re-manifested on other TOs.

TO 19D: Awarded to Firefly Aerospace, the Blue Ghost 1 (BG1) mission is scheduled to land in Mare Crisium [2] in mid 2024 using their Blue Ghost lander. The BG1 mission will deliver 10 NASA payloads [3] that will investigate heat flow of the lunar interior with the Lunar Instrumentation for Subsurface Thermal Exploration with Rapidity (LISTER) and plume-surface interactions (SCALPSS), as well as test regolith sampling technologies with Lunar PlanetVac (LPV). Payloads will also acquire X-ray images of Earth's magnetosphere using the Lunar Environment heliospheric X-Ray Imager (LEXI) and constrain the temperature structure and thermal evolution of the Moon by studying crustal electric and magnetic fields with the Lunar Magnetotelluric Sounder (LMS). The Regolith Adherence Characterization (RAC) will look at dust adherence on different materials and BG1 will be the first use of the Global Navigation Satellite System (GNSS) in transit to the Moon and on the lunar surface by the Lunar GNSS Receiver Experiment (LuGRE). The Radiation Tolerant Computer System (RadPC) will test a radiation tolerant computer system, the Electrodynamic Dust Shield (EDS) will perform dust

mitigation experiments using electrodynamic fields, and the Next Generation Lunar Retroreflector (NGLR) will reflect very short laser pulses from Earth-based lunar laser ranging observatories.

TO 20A (VIPER): Awarded to Astrobotic, their Griffin Mission-1 is scheduled to land near Nobile crater in the lunar south polar region in 2024 using their Griffin lunar lander. The Volatiles Investigating Polar Exploration Rover (VIPER) is a solar and battery powered rover that will characterize the distribution and physical state of lunar polar water and other volatiles in cold traps to evaluate the potential for future in-situ resource utilization at the South Pole. VIPER will operate over multiple lunar days and will be capable of traversing into PSRs. Subsurface volatile sampling will be accomplished by a one-meter drill (TRIDENT) paired with MSolo [4]. Hydrogen abundances in the near subsurface will be measured by the Neutron Spectrometer System (NSS) and at the surface volatiles and mineralogy will be investigated using the Near-Infrared Volatiles Spectrometer System (NIRVSS).

TO CP-11: Awarded to Intuitive Machines, their IM-3 mission is scheduled to land at the Reiner Gamma swirl using their Nova-C lunar lander. Payloads include the first Payloads and Research Investigations on the Surface of the Moon (PRISM) suite, Lunar Vertex [5], which has a magnetometer, camera, and an electron and ion spectrometer on the lander, along with a small rover carrying a second magnetometer and a multispectral microscope. Lunar Vertex will study the properties of the Reiner Gamma swirl and its mini-magnetosphere. Three small autonomous rovers (CADRE), each instrumented with ground penetrating radar, will complete a technology demonstration on swarm robotics. There are two international payloads: a high-energy particle detector (LUSEM) from the Korea Astronomy and Space Science Institute (KASI), funded by the Ministry of Science and ICT of Korea (MSIT) and the MoonLIGHT Pointing Actuator (MPAc), a laser retroreflector developed by the National Institute for Nuclear Physics (INFN-LNF), funded by the European Space Agency (ESA) that will make high resolution Earth-Moon distance measurements.

TO CP-12: Awarded to a team led by Draper, the ispace Series-2 lander is scheduled to land in the outer ring of Schrödinger Basin on the lunar far side in 2025. NASA payloads include long-lived seismometers in the Farside Seismic Suite (FSS) to study tectonic activity within the deep lunar interior and micrometeorite impact flux and the Lunar Interior Temperature and Materials Suite (LITMS) which has a drill to measure heat flow (LISTER) and four Lunar Telluric Currents (LTC) electrodes to investigate electrical conductivity in the near sub-surface. The Lunar Surface Electromagnetics Experiment (LuSEE-Lite) will characterize the lunar ionosphere, lunar dust transport, and the make measurements of the electromagnetic and electrostatic environment of the lunar surface.

TO CP-21: Landing at the Gruithuisen Domes to investigate their composition and origin, CP-21's NASA payloads include: the Lunar Vulkan Imaging and Spectroscopy Explorer (Lunar-VISE) investigation, which consists of a suite of five instruments with some mounted on a mobile rover, the Heimdall imaging suite [6], the Sample Acquisition, Morphology Filtering & Probing of Lunar Regolith (SAMPLR) robotic arm, a Radio-wave Observations at the Lunar Surface of the photoElectron Sheath (ROLSES) radio telescope, the Photovoltaic Investigation on the Lunar Surface (PILS) experiment, and the Neutron Measurements at the Lunar Surface (NMLS).

TO CP-22: Landing site is in the south polar Mons Mouton region. U.S. payloads include the NASA PRISM payload, Lunar Explorer Instrument for space biology Applications (LEIA) science suite, which will study the biological response of yeast to the lunar environment and measure the radiation levels at the lunar surface, the Lunar Compact Infrared Imaging System (L-CIRiS), a multispectral imaging radiometer designed to measure mineralogical and thermophysical measurements on the lunar surface, the Surface and Exosphere Alterations by Landers (SEAL) that will constrain the chemical response of the lunar regolith to the lander and characterize the lunar exosphere at the surface, and the Fluxgate Magnetometer (MAG) to characterize the vector magnetic field of the Moon at low altitudes and on the surface The Package for Resource Observation and in-situ Prospecting for Exploration, commercial exploration and Transportation (PROSPECT) is sponsored by ESA to assess the potential use of resources for human exploration at a given location.

TO CS-3: Awarded to Firefly Aerospace, the LuSEE-Night experiment will land at the farside mid-latitudes in 2025. Low-frequency radio astronomy with standalone operations through the night will be performed. This task order will also include the deployment of the Lunar Pathfinder orbiter built by Surrey Satellite Technology Ltd. sponsored by ESA.

TO CP-32: This future task order will deliver the Dating an Irregular Mare Patch with a Lunar Explorer (DIMPLE) suite to Ina to investigate lunar volcanism.

References: [1] Bussey, B. *et al*. (2019) *AGU Fall Meeting*. PA54B-11. [2] Nagihara, S. *et al*. (2022) *LPSC LIII*, 1390. [3] Banks, M. E. *et al*. (2022) *LPSC LIII*, 2846. [4] Colaprete, A.D., *et al*. (2019) *AGU Fall Meeting*, P34B-03. [5] Blewett, D. *et al*. (2022) *LPSC LIII,* 1131. [6] Yingst, R. A., *et al*. (2020) *LPSC LI,* 1439.