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Status and application of the five United Nations treaties on outer space

Activities being carried out or to be carried out on the Moon and other celestial bodies, international and national rules governing those activities and information received from States parties to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies about the benefits of adherence to that Agreement

Note by the Secretariat

1. At the forty-sixth session of the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space, in 2007, the Working Group on the Status and Application of the five United Nations Treaties on Outer Space agreed that the Secretariat should prepare a background paper on activities being carried out or to be carried out on the Moon and other celestial bodies, international and national rules governing those activities and information from States parties to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies about the benefits of adherence to that agreement (A/AC.105/891, para. 44 and annex I, para. 12). The Secretariat made available the required information in a note contained in document A/AC.105/C.2/L.271 and Corr.1.

2. At the forty-seventh session of the Subcommittee, in 2008, the Working Group considered the note by the Secretariat (A/AC.105/C.2/L.271 and Corr.1) and requested the Secretariat to prepare a supplement to that document which would provide supplementary information on activities on the Moon that member States were undertaking or planned to undertake and would be based on information already submitted to the Working Group (A/AC.105/917, para. 43 and annex I,

* A/AC.105/C.2/L.285.

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para. 12). The Secretariat made available the required information in an addendum (A/AC.105/C.2/L.271/Add.1).

3. At the fiftieth session of the Subcommittee, in 2011, the Working Group requested the Secretariat to prepare, for the fifty-first session of the Subcommittee, in 2012, an updated version of its note contained in document A/AC.105/C.2/L.271 and Corr.1 (A/AC.105/990, para. 31 and annex I, para. 10).

4. The present document contains an updated version of the note and includes up-to-date information about projects which were completed or being implemented.

II. Activities

5. China has begun the Chang'e programme for exploring the Moon and is investigating the prospect of lunar mining, specifically looking for the isotope helium-3 for use as an energy source on Earth. China launched the Chang'e-1 robotic lunar orbiter on 24 October 2007. Originally planned for a one-year duration, the Chang'e-1 mission was very successful and ended up being extended for another four months. On 1 March 2009, Chang'e-1 was intentionally impacted on the lunar surface, completing the 16-month mission. The Chang'e-1 mission had four major goals:

(a) Obtaining three-dimensional images of the landforms and geological structures of the lunar surface so as to provide a reference for planned future soft landings. The orbit of Chang'e-1 around the Moon was designed to provide complete coverage, including areas near the north and south poles not covered by previous missions;

(b) Analysing and mapping the abundance and distribution of various chemical elements on the lunar surface as part of an evaluation of potentially useful resources on the Moon;

(c) Probing the features of the lunar soil and assessing its depth, as well as the amount of helium-3 present;

(d) Probing the space environment between 40,000 km and 400,000 km from the Earth, recording data on the solar wind and studying the impact of solar activity on the Earth and the Moon.

6. Chang'e-2 is a Chinese unmanned lunar probe that was launched on 1 October 2010 as a follow-up to the Chang'e-1 lunar probe. Chang'e-2 is part of the first phase of the Chinese lunar exploration programme, and conducted research from a 100-km lunar orbit in preparation for a 2013 soft landing by the Chang'e-3 spacecraft. After completing its primary objective, the probe left lunar orbit for the Lagrangian point L2 to test the Chinese tracking and control network. It entered orbit around L2 on 25 August 2011 and is expected to remain there until the end of 2012.

7. The Moon Impact Probe developed by the Indian Space Research Organisation (ISRO), India's national space agency, was a lunar probe that was released by the agency's Chandrayaan-1 lunar remote sensing orbiter, which itself was launched on 22 October 2008 aboard a modified version of the agency's Polar Satellite Launch Vehicle. The Moon Impact Probe separated from the moon-orbiting Chandrayaan-1

on 14 November 2008 and crashed, as planned, into the lunar south pole after a controlled descent. The Probe struck the Shackleton crater, releasing underground debris that could be analysed by the orbiter for the presence of water ice. On 25 September 2009, ISRO announced that the Probe had discovered water on the Moon just before impact. The completed mission's objectives were: (a) to construct a complex spacecraft with 11 scientific instruments; (b) to place the spacecraft in a circular orbit around the Moon by orbit-raising manoeuvres from a near-Earth orbit; (c) to place the flag of India on the Moon; (d) to carry out imaging operations and collect data on the mineral content of the lunar soil; and (e) to set up a deep-space tracking network and implement operational procedures for travel into deep space.

8. The Selenological and Engineering Explorer (SELENE), better known in Japan by its nickname "Kaguya", after the legendary Japanese Moon princess, was the second Japanese lunar orbiter spacecraft. Produced by the Institute of Space and Astronautical Science and the National Space Development Agency, both now part of the Japan Aerospace Exploration Agency (JAXA), the spacecraft was launched on 14 September 2007. After successfully orbiting the Moon for a year and eight months, the main orbiter was intentionally crashed onto the lunar surface near the Gill lunar crater on 10 June 2009. The mission's main objectives were to: (a) study the origins of the Moon and its geologic evolution; (b) obtain information about the lunar surface environment; and (c) perform radio science, especially precise measurement of the Moon's gravity field. The main achievements of the mission were: (a) improved lunar global topography maps, detailed altitude and geological data which is provided to Google for free to make Google Moon 3-D; (b) a detailed gravity map of the far side of the Moon; and (c) the first optical observation of the permanently shadowed interior of the Shackleton crater at the lunar south pole.

9. Okina (formerly Rstar) and Ouna (formerly Vstar) were Japanese-made octagonal prisms to support radio science. Okina relayed radio communications between the main orbiter and the Earth when the orbiter was behind the Moon. This allowed, for the first time, the direct Doppler shift measurements needed to precisely map the gravitational field of the lunar far side; previously, the far-side gravity field could only be inferred by near-side measurements. The relay satellite impacted the lunar far side near the Mineur D crater on 12 February 2009.

10. The Lunar Crater Observation and Sensing Satellite (LCROSS) was a robotic spacecraft operated by the National Aeronautics and Space Administration (NASA) of the United States of America. The mission was conceived as a low-cost means of determining the nature of hydrogen detected at the polar regions of the Moon. The main LCROSS mission objective was to look for the presence of water ice in a permanently shadowed crater near a lunar polar region. It was successful in discovering water in the southern Cabeus crater. The satellite was launched together with the Lunar Reconnaissance Orbiter (LRO) on 18 June 2009, as part of the shared Lunar Precursor Robotic Program, the first American mission to the Moon in more than 10 years. Together, LCROSS and LRO form the vanguard of the return of NASA to the Moon, and are expected to influence decisions of the Government of the United States on whether to colonize the Moon. LCROSS was designed to collect and relay data from the impact and debris plume resulting from the launch vehicle's spent Centaur upper stage (and data-collecting Shepherding Spacecraft)

striking Cabeus crater near the south pole of the Moon. Centaur impacted successfully on 9 October 2009 at 1131 hours UTC. The Shepherding Spacecraft descended through Centaur's ejectate plume and collected and relayed data, impacting six minutes later, at 1137 hours UTC.

11. LRO is a NASA robotic spacecraft currently orbiting the Moon on a low 50 km polar-mapping orbit. The LRO mission is a precursor to future manned missions to the Moon by NASA. To that end, a detailed mapping programme will identify safe landing sites, locate potential resources on the Moon, characterize the radiation environment and demonstrate new technology. The probe will make a 3-D map of the Moon's surface and has provided some of the first images of Apollo equipment left on the Moon. The first images from LRO were published on 2 July 2009, showing a region in the lunar highlands south of Mare Nubium (Sea of Clouds). LRO and LCROSS are the first missions launched as part of the Vision for Space Exploration programme of the United States.

12. The Gravity Recovery and Interior Laboratory (GRAIL) is an American lunar science mission in the Discovery Program of NASA which will use high-quality gravitational field-mapping of the Moon to determine its interior structure. The two small spacecraft GRAIL A and GRAIL B were launched on 10 September 2011 aboard a single launch vehicle: 7920H-10, the most-powerful configuration of a Delta II. GRAIL A separated from the rocket about nine minutes after launch; GRAIL B followed about eight minutes later. They arrived at their orbits around the Moon 24 hours apart. The first probe entered orbit on 31 December 2011; the second followed on 1 January 2012. The main objectives of the mission are to: (a) map the structure of the lunar crust and lithosphere; (b) understand the asymmetric thermal evolution of the Moon; (c) determine the subsurface structure of impact basins and the origin of lunar mascons; (d) ascertain the temporal evolution of crustal brecciation and magmatism; (e) constrain the deep interior structure of the Moon; and (f) place limits on the size of the Moon's inner core. The data collection phase of the mission will last 90 days and will be followed by 12 months of data analysis. Results will begin to become available about 30 days after data collection begins. The knowledge acquired will aid understanding of the evolutionary history of the terrestrial planets.

13. The Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission, whose name alludes to the Titan goddess Themis, was originally a constellation of five NASA satellites designed to study energy releases from Earth's magnetosphere known as substorms, magnetic phenomena that intensify auroras near Earth's poles. Three of the original satellites remain in the magnetosphere, while two have been moved into orbit near the Moon. The latter two have been renamed Acceleration, Reconnection, Turbulence and Electrodynamics of the Moon's Interaction with the Sun (ARTEMIS) but are also referred to as ARTEMIS P1 (THEMIS B) and ARTEMIS P2 (THEMIS C). As of spring 2010, ARTEMIS P1 (THEMIS B) had performed two lunar flybys and one Earth flyby and was approaching insertion into a Lissajous orbit around a lunar Lagrange point. Lunar orbit insertion is targeted for April 2011. ARTEMIS P2 (THEMIS C) completed a lunar flyby, was on the inbound leg of the first of three deep-space excursions on its way to a Lissajous orbit and was targeted for lunar orbit in April 2011. On 22 June 2011, ARTEMIS P1 began firing its thrusters to move out of its kidney-shaped "libration" orbit on one side of the Moon, where it had been since

January of that year. As at 2 July, ARTEMIS P1 had achieved lunar orbit. ARTEMIS P2 moved into lunar orbit as at 17 July 2011. Along the way, the two spacecraft were the first ever to achieve orbit around the Moon's Lagrangian points.

14. The Russian Federation and India signed a 10-year cooperation agreement, beginning in December 2007, for the development of a shared space vehicle for Moon exploration which includes a lunar orbital module and a lunar lander with a mobile scientific laboratory. The agreement envisages the launch, using an Indian missile launching vehicle, of a satellite composed of a lunar orbital module and a lander. The Russian Federal Space Agency announced that its first unmanned flight would include a lunar orbiter that would fire 12 penetrators across diverse regions of the Moon to create a seismic network, which would be used to study the origin of the Moon. After firing the penetrators, the mother ship would deliver to the surface a polar station equipped with a mass spectrometer and a neutron spectrometer. The objective of the station is to detect water ice deposits in the polar zones of the Moon. The device, developed by Russian Federation scientists, will first be tested through the Lunar Reconnaissance Orbiter of NASA.

15. In September 2006, the Small Mission for Advanced Research in Technology (SMART-1), operated by the European Space Agency, ended successfully in a planned manoeuvre and impacted the lunar surface in the Lacus Excellentiae region. SMART-1 was used to test solar electric propulsion and other deep-space technologies while performing scientific observations of the Moon. Mission data will be used to help provide answers to questions about the origin of the Moon and search for ice in the craters at the Moon's south pole.

16. The lunar lander mission of the European Space Agency is to land in the mountainous and heavily cratered terrain of the lunar south pole, possibly in 2018. The region may be a prime location for future human explorers because it offers almost continuous sunlight for power and potential access to vital resources such as water ice. The "Phase-B1" study is taking place under the leadership of the European Aeronautic Defence and Space Company-Astrium (Bremen), and some of the key technologies will be developed and tested for the first time.