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United States of America
and
India

Memorandum of Understanding between the United States National Aeronautics and Space Administration (NASA) and the Indian Space Research Organisation (ISRO) on cooperation concerning NASA's Miniature Synthetic Aperture Radar Instrument on ISRO's Chandrayaan - 1 Mission. Bangalore, 9 May 2006

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États-Unis d'Amérique
et
Inde

Mémorandum d'accord entre l'Administration nationale de l'aéronautique et de l'espace (NASA) des États-Unis et l'Organisation indienne de recherche spatiale (ISRO) relatif à la coopération concernant l'Instrument de miniature du radar à synthèse d'ouverture de la NASA sur la mission Chandrayaan-1 de l'ISRO. Bangalore, 9 mai 2006

Entrée en vigueur : *9 mai 2006 par signature, conformément à l'article 21*

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[ENGLISH TEXT – TEXTE ANGLAIS]

Memorandum of Understanding

between the United States

National Aeronautics and Space Administration (NASA)

and the

Indian Space Research Organisation (ISRO)

on Cooperation Concerning

NASA's Miniature Synthetic Aperture Radar Instrument

On

ISRO's Chandrayaan-1 Mission

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Preamble

The United States National Aeronautics and Space Administration (hereinafter referred to as NASA) and the Indian Space Research Organisation (hereinafter referred to as ISRO);

As the Parties to this Memorandum of Understanding (MOU) (hereinafter the Parties);

CONSIDERING that the United States and India have agreed upon a major initiative to enhance joint activities in space cooperation;

CONSIDERING ISRO's plan to fly a mission, Chandrayaan-1, designed to map the Moon from polar lunar orbit in 2007;

CONSIDERING the release of the Announcement of Opportunity by ISRO, calling for proposals from interested foreign investigators to fly instruments on Chandrayaan-1;

CONSIDERING the selection by ISRO of the "Mini-SAR: An Imaging Radar for the Chandrayaan-1 Mission" proposal to characterize and map the environment and deposits of the lunar polar regions;

RECOGNIZING the need for a mission to collect these data to understand better the nature and properties of the lunar polar regions, this information being critical to the future of humanity on the Moon; and

CONSIDERING that cooperation on such a mission would be beneficial to both nations and to future human activities on the Moon;

Have agreed as follows:

Article 1 - Purpose

This MOU sets forth the terms and conditions under which the Parties will cooperate on the Chandrayaan-1 Mission with regard to the Miniature Synthetic Aperture Radar (Mini-SAR) instrument.

Article 2 - Definitions

As used in this MOU, the following terms shall have the specified meanings:

2.1 "S-band radar data" is data as received from the Mini-SAR instrument, including sensor and housekeeping data.

2.2 "Payload resource evaluation data" is the portion of the S-band radar data composed of the instrument sensor data.

2.3 "Instrument housekeeping data" is engineering health and status data necessary

for the daily operation of the Mini-SAR instrument in flight as well as for providing surface location knowledge necessary to produce validated flight data products.

Article 3 - Mission Description and Participation

3.1 The primary objective of the Chandrayaan-1 Mission is to map key properties of the Moon from polar orbit to better understand its history, evolution, and current state. These objectives include the mapping of Polar Regions and their deposits to address the scientific and resource questions regarding the volatile content of the lunar poles.

3.2 The NASA-sponsored Miniature Synthetic Aperture Radar (Mini-SAR) instrument, selected by ISRO for flight on Chandrayaan-1 after an international solicitation and competition, is a collaboration between NASA and ISRO on the acquisition and interpretation of data from the Mini-SAR developed for NASA and flown by ISRO. The Mini-SAR instrument is to be designed, developed, fabricated, integrated and tested by the Naval Air Warfare Center (NAWC), with support from the Johns Hopkins University Applied Physics Laboratory (JHU/APL), and is to be provided to ISRO for integration and flight on the Chandrayaan-1 spacecraft by JHU/APL.

3.3 The Chandrayaan-1 Mission is conceived, designed, built and flown by ISRO. This Indian mission is aimed at expanding the scientific knowledge about the Moon, and is to provide, through the independent initiative and effort of India, an exceptional international contribution to planetary research. The NASA Mini-SAR instrument on the Indian Chandrayaan-1 spacecraft has been accepted in exchange for the joint sharing of the collected scientific final data products. The Chandrayaan-1 spacecraft, integrated and tested under ISRO responsibility, is to carry the Mini-SAR instrument, which is to be operated by the plan and procedure that will be provided by a resource evaluation and engineering team at JHU/APL during the Chandrayaan-1 Mission. The Payload Operations Center (POC), which is to prepare the plan and procedure to operate the instrument in flight, process and archive the data to the NASA international Planetary Data System (PDS), is to be located at JHU/APL. The POC is a ground system comprising two primary subsystems (a) a command/sequence generation subsystem for instrument operations, and (b) a data processing subsystem for calibrating and processing raw scientific flight data of the lunar surface (the Indian Space Science Data Center (ISSDC) is to also have a POC Data Processing Subsystem replica (delivered by JHU/APL) to mutually process collected raw scientific and resource-related flight data).

3.4 Mini-SAR is to map both poles from 80 degrees latitude poleward in both right- and left-circular polarizations at a resolution of 150 m (75 m/pixel). The poles are to be mapped in both left- and right-look directions to minimize ambiguities.

3.5 In order to develop and sequence Mini-SAR operating commands, Mini-SAR instrument engineering health and status raw flight data is required, as well as other ISRO supplied ancillary data, e.g., ephemeris data, metadata indicating where the instrument bore sight/alignment is relative to the spacecraft, and spacecraft clock correlation data (initial and as updated). These data streams are to be transmitted upon receipt electronically between the POC and the ISSDC.

3.6 The Chandrayaan-1 spacecraft is planned to operate for a nominal period of 2 years. The satellite is to be operated by ISRO throughout the life of the mission. The U.S. Mini-SAR Team is to plan and command the Mini-SAR instrument by providing commands to the ISRO satellite control center for uplink. Following Mini-SAR instrument raw flight data collection both the U.S. resource evaluation and ISRO science teams are to mutually oversee the production of fully calibrated and processed data products. Both teams are to have replicas of the fully integrated and tested POC ground system (hardware, software, and related documentation) for processing the raw flight data. Upon receipt of the Mini-SAR instrument raw flight data from the spacecraft, the ISSDC is to electronically transmit a complete set of Mini-SAR instrument raw flight data to the POC. Both teams are to process the Mini-SAR raw flight data mutually and simultaneously. Fully calibrated and processed Mini-SAR flight data are to then be shared and reconciled between the two teams. Any improvements of processing POC software, and processed data products are to be mutually transferred and shared between the two teams as this occurs. Fully processed final data products that have been mutually scientifically validated and mutually agreed upon by both teams, are to be distributed in a timely manner to the international scientific community via public domain Planetary Data Systems (PDSs). This data production process is to be continuous throughout the Chandrayaan-1 Mission. The focus of this effort is on those aspects related to topography, shadow, and ice and information necessary for future exploration of the lunar poles. Scientific/resource evaluation data repository/publication is to then occur in the public domain.

3.7 Payload resource evaluation data and data products are to be made available to the Chandrayaan-1 ISRO science team and the broader international user community according to the policies outlined in Article 16.

Article 4 - ISRO Responsibilities

To implement this collaborative effort, ISRO shall use reasonable efforts to:

4.1 Provide the overall systems engineering function for the Chandrayaan-1 Mission, including developing overall satellite system specifications, and developing, jointly with NASA and its related entity, JHU/APL, an Interface Control Document (ICD) which will define the Chandrayaan-1/Mini-SAR instrument hardware/software interfaces.

4.2 Provide spacecraft engineering, develop a spacecraft configuration document, establish requirements for overall spacecraft-level payload interface testing, plan and conduct spacecraft-level payload interface tests, evaluate test results to certify flight readiness, and provide a mutually agreed upon Chandrayaan-1/Mini-SAR instrument ICD.

4.3 Support integration of the Mini-SAR instrument onto the Chandrayaan-1 spacecraft, perform spacecraft-level functional and environmental testing, and launch the spacecraft from the Indian launch facility.

4.4 Support end-to-end, system-level testing by performing functional tests of the Chandrayaan-1 spacecraft, including interface testing to and from the POC with NASA-provided data archival centers.

4.5 Provide spacecraft-level ground support equipment and qualified personnel at appropriate sites to support payload and system integration, testing, launch, and operations.

4.6 Receive, process, archive and provide to JHU/APL raw and processed Mini-SAR instrument and related spacecraft data upon receipt, as specified in the Chandrayaan-1/Mini-SAR Implementation Plan; provide JHU/APL with instrument-generated telemetry and spacecraft telemetry, as needed, to assess the health and safety of the Mini-SAR instrument, in agreed-upon formats; retain this data to enable it to be rerequested by JHU/APL, if needed; provide JHU/APL with "geometry," e.g., Space, Planet, Instrument, Camera-matrix, and Events kernel data, as needed; and receive Mini-SAR instrument commands and integrate them into the overall command load to be sent to the Chandrayaan-1 spacecraft.

4.7 Perform system-level testing between the spacecraft and the ISRO ground system, including joint testing with the POC.

4.8 Provide the spacecraft support necessary for the Mini-SAR instrument to perform on-orbit calibration activities, as agreed, after launch and according to a schedule defined in the Chandrayaan-1/Mini-SAR Implementation Plan, to verify the performance achieved in lunar orbit by the Mini-SAR instrument, and such that the POC can provide calibrated data products to NASA, ISRO and the international community.

4.9 Arrange with the appropriate Indian research organizations to support and prepare the Indian and other international members of the science teams and Indian and other international users to analyze and validate the Chandrayaan-1 non-Mini-SAR payload resource evaluation data and related data products and publish their findings in accordance with Articles 8, 16, and 17; in particular, in archiving and/or making available, as appropriate, Chandrayaan-1 science data products to the scientific community.

4.10 Inform NASA and JHU/APL promptly of any technical or programmatic problems which may affect overall Mini-SAR instrument and POC development and operations, schedule, cost, or technical performance.

4.11 Provide mutual access to the Mini-SAR instrument flight data products from Chandrayaan-1. If deemed of interest for scientific analysis of Mini-SAR instrument data, the Parties may agree to provide mutual access to correlative data products from other missions.

4.12 Agree with NASA to investigate the issues related to coordinated measurements between Chandrayaan-1 and NASA's Lunar Reconnaissance Orbiter Mission (LRO), specifically, the possibility of conducting a bistatic imaging and far-side gravity experiment using compatible equipment on both spacecraft, which would be studied scientifically and operationally, and if feasible, incorporated into a joint operational plan.

4.13 Place the science data of the other Chandrayaan-1 instruments into the public domain for use by the international science and space technology community.

4.14 ISRO shall provide appropriate transmit filtering of its X-band downlink signal to preclude any harmful interference into deep space earth station receiving operations in the 8400 – 8450 MHz band in compliance with the Space Frequency Coordination Group (SFCG) Recommendation REC 21-2R2 and Decision 25-1.

Article 5 - NASA Responsibilities

To implement this cooperative project, NASA shall use reasonable efforts to:

5.1 Provide Mini-SAR instrument and Chandrayaan-1/Mini-SAR instrument interface system engineering and develop overall Mini-SAR and POC system specifications and requirements documents which will define the Chandrayaan-1/Mini-SAR instrument interfaces, including those to the POC that demonstrate compliance with mission requirements.

5.2 Develop, in coordination with ISRO, an ICD which will define the Chandrayaan-1/Mini-SAR instrument hardware/software interfaces.

5.3 Provide requirements for overall payload-level testing, the planning and conduct of payload system-level tests, evaluation of test results and certification of payload flight readiness.

5.4 Design, fabricate, assemble, and test the Mini-SAR instrument.

5.5 Provide information on Mini-SAR instrument interfaces to the Chandrayaan-1 spacecraft.

5.6 Design, fabricate, and test the NASA-provided ground system.

5.7 Design, fabricate, and test the NASA POC and install a replica at ISSDC.

5.8 Perform end-to-end Mini-SAR instrument and POC system-level testing.

5.9 Transport the payload to the ISRO-designated site, in preparation for satellite integration.

5.10 Provide payload ground support equipment including a payload simulator and qualified personnel at appropriate sites to support satellite and system integration, testing, launch, and operations.

5.11 Provide the necessary plan and procedure to ISRO to carry out Mini-SAR instrument flight operations and instrument management.

5.12 Perform Mini-SAR instrument evaluation and calibration activities, as agreed, after launch and according to a schedule defined in the Chandrayaan-1 Project Plan, to verify the performance achieved on-orbit by the Mini-SAR and provide results to ISRO.

5.13 Process and archive all Mini-SAR instrument data and make the payload resource data and related flight data products available to ISRO, in a timely manner and in accordance with Article 16.

5.14 Support the U.S. resource evaluation team members in analyzing and validating Mini-SAR flight data and related data products and in publishing their findings, in accordance with Articles 7, 16, and 17.

5.15 Inform ISRO promptly of any Mini-SAR technical or programmatic problems which may affect overall Chandrayaan-1 Mission schedule, cost, or technical performance.

5.16 Provide mutual access to the Mini-SAR instrument flight data products from Chandrayaan-1. If deemed of interest for scientific analysis of Mini-SAR instrument data, the Parties may agree to provide mutual access to correlative data products from other missions.

5.17 Provide support to JHU/APL to configure its 18 m ground station to allow its use by the Chandrayaan-1 Mission. Upon request by ISRO, this station may be used for tracking, commanding, receipt of housekeeping telemetry, and receipt of science data.

Article 6 – Project and Program Management

6.1 A Chandrayaan-1/Mini-SAR Joint Steering Group (JSG) shall be established to provide implementation oversight for the collaborative effort. The Chandrayaan-1/Mini-SAR JSG shall be composed of senior-level NASA and ISRO representatives involved in the development of the Chandrayaan-1/Mini-SAR collaborative effort. The JSG shall review the effort's implementation status, resolve implementation conflicts, and provide institutional resources to ensure timely delivery of collaborative effort elements.

6.2 The NASA Mini-SAR Principal Investigator (PI) function is a shared responsibility between NAWC and JHU/APL. The NASA Program Manager shall provide end-to-end Mini-SAR oversight in consultation with the Chandrayaan-1 Project Director and is the NASA official responsible for the success of the project.

6.3 The Mini-SAR Project Manager shall prepare, in close coordination with the ISRO Chandrayaan-1 Project Director, the Chandrayaan-1 Mini-SAR Implementation Plan, which shall then be subject to approval by the Parties. In case of conflict between this Chandrayaan-1 Mini-SAR Implementation Plan and the MOU, the MOU shall prevail. This plan shall detail how the Mini-SAR contribution to the Chandrayaan-1 Mission will be accomplished, including mission planning, instrument development and delivery, rough description of the interfaces (to be more specifically defined in an Interface Control Document), data flow and downlink options, conduct of mission operations, and data delivery. The delivery process and timeline for Mini-SAR data from ISRO shall be defined.

6.4 The Parties shall act in accordance with the schedules to be defined in the Chandrayaan-1 Mini-SAR Implementation Plan and to avoid changes that will have a negative effect on the other Party with regard to scientific return, implementation approach, cost, and/or schedule, and where they cannot be avoided, to minimize these negative effects. To the extent that changes made by NASA or ISRO to the Chandrayaan-1 Mini-SAR Implementation Plan cause schedule or other problems that go beyond either Party's program constraints, the Mini-SAR Project Manager and ISRO Chandrayaan-1 Project Director shall discuss potential options to address such problems and submit their proposal to NASA and ISRO Management.

Article 7 – U.S. Resource Evaluation Team

7.1 The U.S. Resource Evaluation Team, formed by the NASA Mini-SAR PI, shall be responsible for the resource evaluation management of the Mini-SAR experiment on the Chandrayaan-1 Mission. The Mini-SAR U.S. Resource Evaluation Team shall be the principal scientific and technical forum for instrument oversight, validation of resource data, and initial resource data evaluation studies.

7.2 Additionally, the Mini-SAR U.S. Resource Evaluation Team may select scientists or other specialists with an expertise in the area, to perform resource data evaluation. The Parties reserve the right to establish guest investigator programs for validation and resource data evaluation studies.

7.3 The Mini-SAR PI shall be responsible for the development of the scientific and technical aspects of the Mini-SAR experiment and for assuring that the resource data products are effectively used and that the results are expeditiously produced and made available, according to Article 16. The Mini-SAR PI shall also be responsible for coordinating Mini-SAR resource evaluation requirements with the other U.S. resource evaluation team organizations.

Article 8 – ISRO Chandrayaan-1 Science Working Team

8.1 The ISRO Chandrayaan-1 Science Working Team, formed by ISRO, shall be responsible for the science management of the Chandrayaan-1 Mission. The ISRO Science Team consists of scientists from ISRO and other Indian research institutions, as well as the PIs from each of the international guest payloads. The ISRO science team shall be the principal scientific forum for mission oversight, mission validation of science data, and initial mission-level science data evaluation studies.

8.2 Additionally, the ISRO Science Team may select scientists with relevant expertise to perform science data evaluation. The Parties reserve the right to establish guest investigator programs for validation and science data evaluation studies for their respective instruments.

8.3 The ISRO science team shall be responsible for the development of the scientific aspects of the Chandrayaan-1 Mission and for assuring that the mission-level science data products are effectively used and that the results are expeditiously produced and made available, according to Article 16. They shall also be responsible for coordinating mission-level science requirements with the other international science team organizations.

Article 9 – Mission Reviews, Integration, and Flight Readiness

9.1 To implement the Mini-SAR experiment, there will be a series of interface reviews to evaluate the readiness of the flight and ground segments to proceed to implementation, integration, test, and final launch preparation. Representatives from both Parties shall attend these reviews. Both Parties shall furnish engineering and programmatic data and shall participate in payload to spacecraft interface reviews, as mutually agreed. As required, as a result of these reviews, the Chandrayaan-1/Mini-SAR instrument ICD shall be updated accordingly.

9.2 NASA and ISRO shall jointly make a final determination of the overall readiness to proceed with integration of the payload to the spacecraft and the readiness of

the payload for flight.

Article 10 - Exchange of Personnel

Each of the Parties shall facilitate the movement of persons necessary to implement this MOU into and out of its country subject to its laws and regulations. To facilitate coordination related to the Chandrayaan-1 Mission, the Parties may exchange a limited number of liaison visits from each Party, at times and under conditions as mutually agreed by the NASA Mini-SAR Project Manager and ISRO Chandrayaan-1 Project Director, pursuant to necessary administrative authorizations. In the event of such an exchange, each Party shall provide necessary office space and administrative support at the host location, including such additional support services as may be agreed by the Parties. Salary and all other personnel expenses and living and travel expenses, shall be borne by the employing Party of the liaison(s) throughout the duration of their assignment.

Article 11 - Funding

Each Party shall bear the costs of discharging its respective responsibilities under this MOU, including travel and subsistence of each Party's personnel and transportation of its own equipment and associated documentation. The obligations of the Parties under this MOU are subject to their respective funding procedures and the availability of appropriated funds.

Article 12 - Customs and Taxes

Each Party shall facilitate the arrangement of free customs clearance and waiver of applicable duties and taxes for equipment and related goods necessary for the implementation of this MOU. Such facilitation of arrangements shall be fully reciprocal. In the event that any customs fees and/or taxes of any kind are still levied on the equipment and related goods for implementation of this MOU, after seeking to obtain the appropriate free customs clearance and waiver of applicable duties and taxes, such customs fees and/or taxes shall be borne by the Party of the country levying the fees and/or taxes.

Article 13 - Ownership of Elements and Equipment

For the purposes of this MOU, each Party shall retain ownership of elements and equipment it furnishes to the other Party. Any equipment not launched into space shall be returned to the furnishing Party expeditiously, as mutually agreed. Each Party shall transport its equipment to the designated delivery points, as specified in the Chandrayaan-1/Mini-SAR Implementation Plan, and, where appropriate, from such delivery points, when the equipment is to be returned to the furnishing Party.

Article 14 - Transfer of Goods and Technical Data

The Parties are obligated to transfer only those technical data (including software) and goods necessary to fulfill their respective responsibilities under this MOU, in accordance with the following provisions, notwithstanding any other provision of this MOU:

14.1 All activities of the Parties shall be carried out in accordance with their national laws and regulations, including those pertaining to export control and the control of classified information.

14.2 The transfer of technical data for the purpose of discharging the Parties' responsibilities with regard to interface, integration, and safety shall normally be made without restriction, except as provided in paragraph 14.1 above.

14.3 All transfers of goods and proprietary or export-controlled technical data are subject to the following provisions. In the event a Party or its related entity (e.g., contractor, subcontractor, grantee, cooperating entity) finds it necessary to transfer goods or to transfer proprietary or export-controlled technical data, for which protection is to be maintained, such goods shall be specifically identified and such proprietary or export-controlled technical data shall be marked. The identification for goods and the marking on proprietary or export-controlled technical data shall indicate that the goods and proprietary or export-controlled technical data shall be used by the receiving Party or related entities only for the purposes of fulfilling the receiving Party's or related entity's responsibilities under this MOU, and that the identified goods and marked proprietary technical data or marked export-controlled technical data shall not be disclosed or retransferred to any other entity without the prior written permission of the furnishing Party or its related entity. The receiving Party or related entity shall abide by the terms of the notice and protect any such identified goods and marked proprietary technical data or marked export-controlled technical data from unauthorized use and disclosure. The Parties to this MOU shall cause their related entities to be bound by the provisions of this Article related to use, disclosure, and retransfer of goods and marked technical data through contractual mechanisms or equivalent measures.

14.4 All goods exchanged in the performance of this MOU shall be used by the receiving Party or related entity exclusively for the purposes of the MOU. Upon completion of the activities under the MOU, the receiving Party or related entity shall return or, at the request of the furnishing Party or its related entity, otherwise dispose of all goods and marked proprietary technical data or marked export-controlled technical data provided under this MOU, as directed by the furnishing Party or related entity.

Article 15 - Intellectual Property

15.1 For the purposes of this Article, "Related Entity" includes, but is not limited to,

contractors, subcontractors, grantees, or cooperating entities (or any lower tier contractor, subcontractor, grantee, or cooperating entities) of a Party.

15.2 PATENTS

15.2.1 Nothing in this Agreement shall be construed as granting, either expressly or by implication, to the other Party any rights to, or interest in, any inventions of a Party or its Related Entities made prior to the entry into force of, or outside the scope of, this Agreement, including any patents or other forms of protection (in any country) corresponding to such inventions.

15.2.2 Any rights to, or interest in, any invention made in the performance of this Agreement solely by one Party or any of its Related Entities, including any patents or other forms of protection (in any country) corresponding to such invention, shall be owned by such Party or, subject to paragraph 15.2.4 of this Article, such Related Entity.

15.2.3 It is not anticipated that there will be any joint inventions made in the performance of this Agreement. Nevertheless, in the event that an invention is jointly made by the Parties in the performance of this Agreement, the Parties shall, in good faith, consult and agree as to: a) the allocation of rights to, or interest in, such joint invention, including any patents or other forms of protection (in any country) corresponding to such joint invention; b) the responsibilities, costs, and actions to be taken to establish and maintain patents or other forms of protection (in any country) for each such joint invention; and c) the terms and conditions of any license or other rights to be exchanged between the Parties or granted by one Party to the other Party.

15.2.4 With respect to any invention created in the performance of this Agreement and involving a Related Entity, allocation of rights between a Party and its Related Entity to such invention, including any patents or other forms of protection (in any country) corresponding to such invention, shall be determined by such Party's laws, regulations, and applicable contractual obligations.

15.3 COPYRIGHTS

15.3.1 Nothing in this Agreement shall be construed as granting, either expressly or by implication, to the other Party any rights to, or interest in, any copyrights of a Party or its Related Entities created prior to the entry into force of, or outside the scope of, this Agreement.

15.3.2 Any copyrights in works created solely by one Party or any of its Related Entities, as a result of activities undertaken in performance of this Agreement, shall be owned by such Party or Related Entity. Allocation of rights between such Party and its Related Entities to such copyrights shall be determined by such Party's laws, regulations, and applicable contractual obligations.

15.3.3 For any jointly authored work, should the Parties decide to register the

copyright in such work, they shall, in good faith, consult and agree as to the responsibilities, costs, and actions to be taken to register copyrights and maintain copyright protection (in any country).

15.3.4 Subject to the provisions of Articles 14 and 17, each Party shall have an irrevocable, royalty free right to reproduce, prepare derivative works, distribute copies to the public, and perform publicly and display publicly, and authorize others to do so on its behalf, any copyrighted work resulting from activities undertaken in the performance of this Agreement for its own purposes, regardless of whether the work was created solely by, or on behalf of, that Party or jointly with the other Party, and without consulting with or accounting to the other Party.

Article 16 – Instrument Flight Data Policy

Access to Chandrayaan-1 and Mini-SAR instrument flight data shall be as follows:

16.1 The Parties shall release scientific data from the Mini-SAR to the international scientific community after a period of no longer than 12 months. The 12-month data validation and verification period begins with the receipt of the data from the spacecraft.

16.2 Data produced by the Mini-SAR instrument shall be jointly reduced and analyzed by the Mini-SAR Resource Evaluation Team and scientists of ISRO.

16.3 In all cases, the Parties shall provide immediate access to all Mini-SAR instrument flight data and data products, free of charge, for members of the teams, as well as designated representatives of team members, including associates, staff and coworkers. The Parties shall also provide, free of charge, payload flight data and data products necessary to the scientists selected for validation. The Parties shall have the right to use the data (processed and unprocessed) at any time for support of their respective responsibilities but shall not prejudice the PIs and Co-Is' first publication rights, which are established in accordance with paragraph 16.1 above.

16.4 After the 12-month validation and verification period, the Parties shall make the data from the Mini-SAR, including required calibration and spacecraft data, available to the international scientific community in a form suitable for analysis.

16.5 NASA shall make flight data products available to the public and the international community in standard Planetary Data System (PDS) format after the appropriate flight data calibration and validation. In order to promote rapid access to flight data products, some preliminary data products shall be archived after initial verification, but prior to full validation, and made available to all users at no more than the cost of fulfilling the user request.

16.6 All S-band radar data, payload data and related flight data products, and

applicable ancillary data obtained from the Mini-SAR instrument shall be archived in the PDS and at the JHU/APL POC and the ISSDC. Copies of the Mini-SAR instrument flight data products shall be exchanged between the Parties.

16.7 The Mini-SAR Resource Evaluation Team members (including designated representatives) shall provide a report to the Parties on the results of their analysis and validation investigations and the results of their investigations on validated Mini-SAR instrument flight data.

16.8 Notwithstanding the termination of this MOU, any S-band radar data and payload data products, related flight data products, and applicable ancillary data obtained from the Mini-SAR instrument (as defined in the Chandrayaan-1/Mini-SAR Implementation Plan) shall be archived by NASA for at least 10 years after completion of the Chandrayaan-1 Mission, unless otherwise agreed by the Parties.

16.9 To enhance scientific and technical analysis of Mini-SAR instrument data, Announcements of Opportunity may be issued by the Parties.

16.10 The Parties note that NASA intends to include a Mini-SAR technology demonstration on the forthcoming LRO Mission. The Parties shall provide mutual access to the Mini-SAR flight data products from Chandrayaan-1 and the LRO Mission. The Parties shall agree on the terms of data access. If deemed of interest for scientific analysis of Mini-SAR data, the Parties may agree to provide mutual access to correlative data products from other missions.

16.11 Complementary data from ISRO-provided instruments on the Chandrayaan-1 Mission shall be made available, free of charge, to NASA Mini-SAR PI, upon request for the purpose of collaboration with ISRO.

16.12 Scientific data obtained by Chandrayaan-1 Mission are to be released to the international scientific community in a form suitable for analysis after a period that shall not exceed 1 year. This 1 year period shall begin with the receipt by the PIs/Co-Is of usable scientific data from the spacecraft in a form suitable for analysis. The period for producing usable scientific data should not nominally exceed 6 months following receipt of data from the spacecraft.

Article 17 - Publication of Public Information and Results

17.1 The Parties retain the right to release public information regarding their own activities under this Agreement. The Parties shall coordinate with each other in advance concerning releasing to the public information that relates to the other Party's responsibilities or performance under this Agreement.

17.2

17.2.1 The Parties shall make the final results obtained from the Chandrayaan-1 Mission available to the general scientific community through publication in appropriate journals or by presentations at scientific conferences as

soon as possible and in a manner consistent with good scientific practices.

17.2.2 Each Party shall have an irrevocable, royalty-free right to reproduce, prepare derivative works from, distribute to the public copies of, present publicly, and authorize others to do so on its behalf, the scientific information included in each such publication or presentation for its own purposes. The royalty-free right shall exist irrespective of any copyright protection applicable to each such publication or presentation.

17.2.3 Raw data, analyzed data and final results primarily obtained from the Chandrayaan-1 Mini-SAR science data, or other scientific information regarding results obtained from the implementation of this Agreement, shall be disclosed by the Party, or its investigators that collected the data, analyzed the data or generated the results, to the other Party prior to any publication or presentation. The first presentation/publication will be done jointly by designated scientists of the Parties.

17.3 The Parties acknowledge that the following data or information does not constitute public information and that such data or information shall not be included in any publication or presentation by a Party under this Article without the other Party's prior written permission: 1) data furnished by the other Party in accordance with Article 14 of this Agreement which is export-controlled, classified or proprietary; or 2) information about an invention of the other Party before a patent application has been filed covering the same, or a decision not to file has been made.

Article 18 – Liability

18.1 The purpose of this Article is to establish a cross-waiver of liability between the Parties and their related entities in the interest of encouraging participation in the exploration, exploitation, and use of outer space. This cross-waiver of liability shall be broadly construed to achieve this objective.

18.2 As used in this cross-waiver,

18.2.1 The term "Related Entity" means:

(i) a contractor or subcontractor of a Party at any tier;
(ii) a user or customer of a Party at any tier; or
(iii) a contractor or subcontractor of a user or customer of a Party at any tier.
"Contractors" and "subcontractors" include suppliers of any kind.

18.2.2 The term "damage" means:

(i) bodily injury to, or other impairment of health of, or death of, any person;
(ii) damage to, loss of, or loss of use of any property;
(iii) loss of revenue or profits; or
(iv) other direct, indirect, or consequential damage.

18.2.3 The term "payload" means any property to be flown or used on or in the launch vehicle.

18.2.4 The term "launch vehicle" means an object or any part thereof intended for launch, launched from Earth, or returning to Earth which carries payloads or persons, or both.

18.2.5 The term "Protected Space Operations" means all launch vehicle and payload activities on Earth, in outer space, or in transit between Earth and outer space done in implementation of this MOU. Protected Space Operations begins upon entry into force of this MOU and ends when all activities done in implementation of this MOU are completed. It includes, but is not limited to:

(i) research, design, development, test, manufacture, assembly, integration, operation, disposal, or use of launch or transfer vehicles, payloads, or instruments, as well as related support equipment and facilities and services;
(ii) all activities related to ground support, test, training, simulation, or guidance and control equipment and related facilities or services. "Protected Space Operations" excludes activities on Earth which are conducted on return from space to develop further a payload's product or process for use other than for launch vehicle-related activities necessary to complete implementation of this MOU.

18.3

18.3.1 Each Party agrees to a cross-waiver of liability pursuant to which each Party waives all claims against any of the entities or persons listed in sub-paragraphs (i) through (iii) of this section based on damage arising out of Protected Space Operations. This cross-waiver shall apply only if the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations. The cross-waiver shall apply to any claims for damage, whatever the legal basis for such claims, against:

(i) the other Party;
(ii) a related entity of the other Party;
(iii) the employees of any of the entities identified in sub-paragraphs (i) and (ii) above.

18.3.2 In addition, each Party shall extend the cross-waiver of liability as set forth in paragraph 18.3.1 of this section to its own related entities by requiring them, by contract or otherwise, to agree to waive all claims against the entities or persons identified in sub-paragraphs 18.3.1 (i)

through (iii).

18.3.3 For avoidance of doubt, this cross-waiver of liability includes a cross-waiver of liability arising from the Convention on International Liability for Damage Caused by Space Objects of March 29, 1972, where the person, entity, or property causing the damage is involved in Protected Space Operations and the person, entity, or property damaged is damaged by virtue of its involvement in Protected Space Operations.

18.3.4 Notwithstanding the other provisions of this Article, this cross-waiver of liability shall not be applicable to the following:

(i) claims between a Party and its own related entity or between its own related entities;
(ii) claims made by a natural person, his/her estate, survivors, or subrogees for bodily injury, other impairment of health or death of such natural person, except where the subrogee is a Party to this MOU or has otherwise agreed to be bound by the promises of this cross-waiver;
(iii) claims for damage caused by willful misconduct;
(iv) intellectual property claims;
(v) contract claims between the Parties based on the express contractual provisions of this MOU; or
(vi) claims for damage based on a failure of the Parties or their related entities to flow down the cross-waiver.

18.3.5 Nothing in this Article shall be construed to create the basis for a claim or suit where none would otherwise exist.

Article 19 – Registration of Space Objects

ISRO shall request that the Government of India register the Chandrayaan-1 spacecraft as a space object in accordance with the Convention on Registration of Space Objects Launched into Outer Space of January 14, 1975. Registration pursuant to this section shall not affect the rights or obligations of either Party or its Government under the 1972 Convention on International Liability for Damage Caused by Space Objects.

Article 20 – Settlement of Disputes

Any disputes not settled through the mechanisms provided in Article 6 (Project and Program Management), or any other issue concerning the interpretation or implementation of the terms of the MOU that cannot be resolved otherwise, shall be referred to the appropriate level of management of the Parties for consideration and joint amicable resolution.

Article 21 – Entry into Force, Duration, Amendment, and Termination

21.1 This MOU shall enter into force upon signature and remain in force until ten years after the Chandrayaan-1 spacecraft has been launched. This MOU may be amended and extended by written agreement of the Parties. Either Party may terminate this MOU at any time upon at least 12 months written notice to the other Party. In that event, the Parties shall endeavor to minimize negative impacts of such termination on other Parties.

21.2 Termination of the MOU shall not affect a Party's continuing obligations under Articles 6 (Project and Program Management), 13 (Ownership of Elements and Equipment), 14 (Transfer of Goods and Technical Data), 15 (Intellectual Property), 16 (Instrument Flight Data Policy), 17 (Publication of Public Information and Results), and 18 (Liability), unless otherwise agreed to by the Parties.

FOR THE UNITED STATES NATIONAL AERONAUTICS AND SPACE ADMINISTRATION:

Michael D. Griffin
Administrator

Date: 9 May 2006

Place: Bangalore, India

FOR THE INDIAN SPACE RESEARCH ORGANISATION:

G. Madhavan Nair
Chairman

Date: 9 May 2006

Place: Bangalore, India