

PROJECT ANNEX II
TO THE IMPLEMENTING AGREEMENT
BETWEEN
THE DEPARTMENT OF ATOMIC ENERGY
OF THE REPUBLIC OF INDIA
AND
THE DEPARTMENT OF ENERGY OF THE UNITED STATES OF
AMERICA
FOR COOPERATION
IN THE AREA OF ACCELERATOR AND PARTICLE DETECTOR
RESEARCH AND DEVELOPMENT FOR DISCOVERY SCIENCE
FOR
NEUTRINO PHYSICS COLLABORATION

The Department of Atomic Energy of the Republic of India (DAE) and the Department of Energy of the United States of America (DOE), hereinafter referred to as the "Parties":

ACTING pursuant to Article 3 of the Implementing Agreement between the Department of Atomic Energy of the Republic of India and the Department of Energy of the United States of America and a for Cooperation in the area of Accelerator and Particle Detector Research and Development for Discovery Science, signed at New Delhi on July 19, 2011, hereinafter referred to as the "Implementing Agreement";

DESIRING to establish a framework for cooperation in high energy physics and related applications, referred to as the "Neutrino Physics Collaboration", among DAE and DOE laboratories and collaborating institutions funded by DOE in the United States and agencies in India; and

NOTING that in Project Annex I to the Implementing Agreement, which entered into force on January 21, 2015, the Parties agreed to cooperate on High Intensity Superconducting Radio Frequency Linear Proton Accelerators (HISPA), development of which will support basic particle physics experiments and will offer opportunities for utilization of these accelerators in other basic research disciplines and applied areas for the advancement of science and technology in the Parties' countries,

Have agreed as follows:

Section 1 – Objective

- A. The objective of this Project Annex is to establish the framework for the Neutrino Physics Collaboration at the Fermi National Accelerator Laboratory (Fermilab) and India that is planned to be jointly developed by the Parties. The expected participants in the Neutrino Physics Collaboration are DAE and DOE national laboratories and universities in both countries.
- B. This Project Annex is subject to the terms and conditions of the Implementing Agreement, which is itself subject to the Agreement on Science and Technology Cooperation between the Government of the Republic of India and the Government of the United States of America, signed at Washington, D.C. on October 17, 2005 (the "S&T Agreement"), as extended. In the event of any conflict between the provisions of the S&T Agreement or the Implementing Agreement on the one hand and this Project Annex on the other hand, the provisions of the S&T Agreement and the Implementing Agreement shall govern.

Section 2 – Areas for Cooperation

Cooperation under this Project Annex may include, but is not limited to, the following areas:

- A. Scientific Cooperation
1. Research and Development and simulation of detectors
 2. Maintenance and operation of detectors
 3. Analysis and publication of data
 4. Training of graduate students and junior scientists
 5. Exchange of personnel for reviews
 6. Joint participation in the Neutrino Physics Collaboration between the Tata Institute of Fundamental Research (TIFR) and Fermilab, detailed terms for which will be set forth in a separate Memorandum of Understanding (MOU) between TIFR and Fermilab.
- B. Technical Cooperation
1. Detector technology for the Deep Underground Neutrino Experiment (DUNE), hosted by the United States
 - a. Liquid Argon Time Projection Chamber (TPC) components
 - b. Magnet design and fabrication
 - c. High precision charged particle tracking
 - d. Electromagnetic and hadron calorimeters
 - e. Muon detectors
 - f. High performance electronics
 - g. High performance computing
 - h. High power particle beam systems

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2. Detector technology for the India-based Neutrino Observatory (INO), hosted by India

- a. Cosmic ray shields
- b. Gas purification and recirculation and alternate gas mixtures
- c. High performance electronics and data acquisition systems
- d. Systems integration
- e. Liquid Argon/Xenon test system and detector components for INO and dark matter
- f. Coherent Neutrino detector for supernova neutrinos
- g. Cryogenic Indium detector for solar neutrinos

C. Development of Technical Information

The Parties plan to develop, either independently or jointly, physics experiments design and parameters, specifications and design tolerances of components, technical requirements, and infrastructure requirements, in conformance with applicable safety and building code standards.

The development of technical information is planned to be done within the framework of the Collaboration Governance Plan to be jointly developed by the Parties' Principal Coordinators designated pursuant to Article 4 of the Implementing Agreement.

D. Conditions on the Areas of Cooperation

- 1. Jointly-owned technical information, technologies and hardware can be shared between the Parties. Except as provided in paragraph D.2, the Parties shall exclude from their cooperation technologies or hardware whose transfer is restricted by the export control requirements of either the United States or India.
- 2. If either Party believes it is desirable to share export-controlled information, technologies or hardware associated with an activity listed in Section 2.A or 2.B above, the Parties shall consult with each other to ensure that their collaborative activities comply with applicable export control requirements of the exporting Party's country.

Section 3 – Participating Organizations

Each Party may invite other government agencies and organizations and private organizations in its country to participate in cooperative activities under this Project Annex, at the participating organizations' own expense and subject to such terms and conditions as the Parties may specify.

Section 4 – Forms of Cooperation

Cooperative activities undertaken pursuant to this Project Annex may include, but are not limited to, the following:

A. Development and Exchange of Technical Information and Experiences, and Collaborative Visits

The Parties plan to develop, jointly or independently, technical design of the items listed in Section 2. Design and experience developed by the Parties under this Project Annex are to be exchanged. The Parties are to arrange collaborative visits. These visits may address research and development programs for the items listed in Section 2.

B. Technology Development

The Parties plan to explore the need for demonstrations in order to show the technical and economic feasibility of the technologies in areas of cooperation set out in Section 2.

C. Ownership of Assets

1. All equipment purchased by the DAE for use in the Indian scientific program shall be the property of the Government of India.
2. All equipment purchased by DOE for use in the United States scientific program shall be the property of the United States Government.
3. Unless otherwise mutually agreed by the Parties in writing, the Parties agree that all DOE-owned equipment sent to DAE by DOE as a part of their collaboration under this Project Annex shall become the property of, and title pass to the Government of India in the event and at the time it has been installed as a functional component of a DAE facility or a DAE collaborating institution's facility in India.
4. Unless otherwise mutually agreed by the Parties in writing, the Parties agree that all DAE-owned equipment sent to DOE by the DAE as a part of their collaboration under this Project Annex shall become the property of, and title pass to the United States Government in the event and at the time it has been installed as a functional component of a DOE facility or a DOE collaborating institution's facility in the United States.

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D. Intellectual Property

1. Except as provided in paragraph D.2, the protection and allocation of intellectual property, and the treatment of business-confidential information, shall be governed by Annex I to the S&T Agreement.
2. The Parties may share or transfer jointly-owned intellectual property outside the territories of their respective countries only if, and to the extent, authorized by the export control restrictions of the exporting Party's country.

E. Professional Training

The Parties plan to explore the need to train their respective professionals in the areas listed in Section 2.

F. Contributions from the Parties:

1. The Parties intend to make scientific knowledge and in-kind contributions to each other's scientific programs, as described in Section 2.
2. The engineering resources, design, manufacturing and supply of detector hardware from the DAE to DOE, amounting up to \$US10 million (standard DOE accounting practice in terms of 2017 US Dollars), are the planned in-kind contributions from the DAE over the years 2017-2021.
3. The detector and physics design, technology, supporting infrastructure, knowledge transfers and associated hardware from DOE to Indian institutions, matching the Indian contribution of up to \$US10 million (standard DOE accounting practice in terms of 2017 US Dollars), are the planned in-kind contributions from DOE.
4. After the joint (DAE-DOE) review of the progress made through 2021, and if future Neutrino projects receive the requisite approvals in both the United States and India, the DAE and DOE would consider making subsequent plans of further in-kind contributions to the programs under this Project Annex, which shall be documented in subsequent Project Annexes pursuant to Article 3 of the Implementing Agreement or amendments to this Project Annex in accordance with Section 6.B.
5. The itemized list and schedule of deliverables from both sides shall be decided and agreed to by the Principal Coordinators.

Section 5 – Management

- A. The Technical Coordinators designated pursuant to Article 4 of the Implementing Agreement shall jointly plan the technical approach for accomplishing the objective of this Project Annex, and shall be responsible for the collaborative program, schedule, and coordination. The Technical Coordinators shall also make progress reports at the Principal Coordinators' meetings to be held at mutually agreed sites, preferably annually.
- B. Each Party shall exercise due care of budget, schedule, safety and other applicable requirements in carrying out all the work under this Project Annex.

Section 6 – Entry into Force, Amendment, and Termination

- A. This Project Annex shall enter into force upon signature by the Parties and remain in force so long as the Implementing Agreement remains in force.
- B. This Project Annex may be amended by written agreement of the Parties, so long as the Implementing Agreement remains in force.
- C. The Parties may terminate this Project Annex at any time by mutual agreement in writing. Alternatively, either Party may terminate this Project Annex upon six (6) months advance notice in writing to the other Party.

DONE at New Delhi, in duplicate in the English language, this 16 day of April 2018.

Sekhar Basu

FOR THE DEPARTMENT OF ATOMIC
ENERGY OF THE REPUBLIC
OF INDIA:

शेखर बसु / Sekhar Basu
सचिव / Secretary

परमाणु ऊर्जा विभाग / Department of Atomic Energy
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FOR THE DEPARTMENT OF
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OF AMERICA: