MEMORANDUM OF UNDERSTANDING

Between the

Institute for High Energy Physics

and

Brookhaven National Laboratory

and

Lawrence Berkeley National Laboratory

on

Collaboration on the Daya Bay Experiment

Version 1.0
29 January 2008

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Preamble

The Daya Bay Experiment will study neutrino oscillations and measure the mixing angle θ_{13} with high precision. The experiment will use the Daya Bay Nuclear Power Plant Complex as a source of electron antineutrinos and a set of detectors to be located under the adjacent mountains in a series of underground experimental halls to detect the antineutrino flux and energy spectrum at multiple distances from the source. The Daya Bay experiment will be designed and built (Construction Project phase) and operated (Operations phase) by the collaborating institutions (The Daya Bay Collaboration). The Daya Bay Collaboration by-laws provide a framework for the governance of the collaboration, within which an international project management team is responsible for the oversight of the project construction.

The Daya Bay Experiment is in furtherance of the Agreement Between the Government of the United States of America and The Government of the People's Republic of China on Cooperation in Science and Technology (Treaty and Other International Acts--TIAS 9179) (hereinafter, the Treaty) that was signed on January 31, 1979, amended on April 30, 1991 and extended on April 21, 2006 for 5 additional years. The provisions of the Treaty are legally binding on any and all activities carried out by the parties, and any agreement in conflict therewith will be inapplicable.

This Memorandum of Understanding (MOU) provides a formal framework for collaboration between the two lead U.S. laboratories (LBNL and BNL) and the lead Chinese Lab (IHEP) participating in the Daya Bay Experiment. The Parties recognize that the Daya Bay experiment is an exciting and important experiment that must be designed, constructed and operated in a successful, timely manner. The Parties intend to make their best effort to collaborate in a congenial and constructive manner for the successful design and construction of the detector system, data taking and analysis, and for the ultimate success of the experiment. This MOU does not constitute a legal or contractual obligation on the part of any Party, but rather reflects the Parties' current intentions.

Article I
Definitions

The following definitions pertain to this agreement:

MOU – Memorandum of Understanding – a document reflecting an understanding between parties on their expectations, but not a legally binding agreement.
DOE – The US Department of Energy, Office of High Energy Physics – the primary US funding agency for the Daya Bay Project
CAS – The Chinese Academy of Sciences – the primary source of funding in China for the Daya Bay Project
MoST – The Ministry of Science and Technology – another major source of funding in China for the project

IHEP – Institute of High Energy Physics, Beijing, China – a CAS supported Laboratory
BNL – Brookhaven National Laboratory, Upton, New York – a DOE Contractor Lab
LBNL – Lawrence Berkeley National Laboratory, Berkeley, California – a DOE Contractor Lab
Parties to this Agreement (Parties) – The three Labs named above (IHEP, LBNL and BNL).
Daya Bay Experiment - The international experiment to be constructed and operated in Southern China to measure the neutrino mixing angle θ_{13} to very high precision ($\sin^2 2\theta_{13} = 0.01$).
Daya Bay Collaboration - The collaboration of scientists that will utilize the Daya Bay Experiment to achieve this precision measurement
Daya Bay Nuclear Power Plant – The nuclear power plant operated by the China Guangdong Nuclear Power Group (CGNPG) in southern China that provides the source of electron antineutrinos to be used in performing the experiment and which is the site for the experiment
Construction phase – the design, fabrication, assembly and initial testing portion of the project
Operations phase – the commissioning, data-taking and maintenance portion of the project
US Daya Bay Project – the formal US-DOE project for constructing the US portion of the experiment
International Daya Bay Project – the overall project whose objective it is to design and construct the Daya Bay Experiment.
Standards Based Management System – US (BNL) computer based set of standards for safety management

Article II
Scope of this MOU

This MOU covers construction and operation of the Daya Bay Experiment and the analysis of the resulting data. However, this MOU is only between the three "lead" Labs in the Daya Bay Experiment. The remainder of the collaborating institutions will create and sign MOUs with the three lead Labs as appropriate, which will be subordinate to this MOU, and will complete associated agreements as appropriate . Within the US, all collaborating institutions participating in the US Daya Bay Project will sign MOUs with either LBNL or BNL. Institutions outside the US will sign MOUs with IHEP.

Article III
Purpose of this MOU

The primary goal of this MOU is to establish a common understanding as to the methods, expectations and timescale for collaboration between the three lead Labs in the Daya Bay Experiment and to define the expected scope of anticipated deliverables of each country for the Construction Project phase of the Daya Bay Experiment. This MOU will also provide an initial framework for the operation and analysis phase of the experiment. It is

expected that this will evolve over time and be more fully captured in a later revision of this MOU.

Article IV
Daya Bay Collaboration By-Laws

The Parties understand that, in addition to the stipulations of this MOU, all members and member institutions in the Daya Bay Collaboration must abide by the most current Daya Bay Collaboration by-laws developed by the Institutional Board for the Daya Bay Collaboration.

Article V
Daya Bay Collaboration Membership

The current members of the Daya Bay Collaboration are defined by the Daya Bay Collaboration list assembled and approved by the IB (Institutional Board). The current member institutions are listed below:

Beijing Normal University
Brookhaven National Lab*
California Institute of Technology*
Charles University
Chengdu University of Science & Technology
China Guangdong Nuclear Power Group
Chinese University of Hong Kong
Dongguan Polytechnical University
George Mason University*
University of Hong Kong
Illinois Institute of Technology*
Institute of High Energy Physics
Iowa State University*
Joint Institute of Nuclear Research
Kurchatov Institute
Lawrence Berkeley National Lab*
Nanjing University
Nankai University
Taiwan University
Chiao Tung University
United University
Princeton University*
Rensselaer Polytechnic Institute*
Shenzhen University
Tsinghua University
University of California at Berkeley*
University of California at Los Angeles*

University of Houston*
University of Illinois at Urbana-Champaign*
University of Science & Technology of China
University of Wisconsin at Madison*
Virginia Polytechnic Institute and State University*
Zhongshan University

* The US institutions

Article VI
Contributions to the Construction

The Parties to this MOU understand that the U.S institutions participating in the Daya Bay Experiment will make the following contributions to the construction of the experiment (subject to congressional appropriations and approval). The precise list of their anticipated deliverables is shown in Appendix A. It is this list that forms the scope of the US cost and schedule baseline. This was reviewed in January 2008 at the time of the US DOE CD-2/3a review. The list below provides a summary overview of the scope of anticipated U.S. institution deliverables.

- Antineutrino Detector (AD):
  - design and approximately 50% of the fabrication costs of the Acrylic Vessels
  - materials (Gd complex, Bis-MSB, etc), processing equipment and critical expertise for the production of the normal and Gadolinium loaded Liquid Scintillator
  - Photo-Multiplier Tubes (PMT) with bases, cables and high-voltage power supplies
  - PMT support system (PMT mounts and ladder structures)
  - portions of the system for measuring physical properties and monitoring systems
  - the filling system for precisely filling the AD's with the 3 liquids
  - overflow tanks and N_2 cover gas system for maintaining an inert gas environment inside the ADs
  - portions of necessary tools and equipment for the assembly and installation of ADs
  - some of the necessary safety equipment elements for the AD system

- Muon System:
  - PMTs, bases, cables and high-voltage power supplies
  - PMT support structures
  - water pool liner system
  - N_2 cover gas & pool cover system
  - water purification system for the water pools
  - high-voltage and gas mixing and control system for the Resistive Plate Chambers (RPCs)

    - portions of necessary tools and equipment for the assembly and installation of PMTs
    - components of the safety elements for the Muon System (e.g., flammable gas detection in gas mixing rooms, ODH monitoring systems)

- Calibration System:
    - automated deployment system for radioactive & LED sources
    - monitoring system

- Integration & Installation:
    - Transporter (AGV) system for moving the assembled, and then filled, antineutrino detectors
    - Some installation & test equipment for activities in the Surface Assembly Building and experimental halls (e.g., rigging equipment, meters and o-scopes, hand tools)
    - Financial support for some of the installation manpower on site at Daya Bay contracted by IHEP.

- Joint Project Management control and oversight

Additionally, many detector elements will be cooperatively developed:

- the front-end and trigger electronics design for both the antineutrino and muon systems
- portions of online and onsite data production facility
- many of the infrastructure items (e.g., online and offline software)
- system design integration
- installation and test planning

The Parties to this MOU understand that institutions from China and other countries and regions participating in the Daya Bay Experiment will make the following contributions to construction of the experiment. IHEP intends to oversee and arrange for the contributions from China and other countries and regions to be delivered in a timely fashion. The precise list of anticipated deliverables from institutions from China and other countries and regions is also shown in Appendix A. The list below provides a summary overview of the scope of anticipated deliverables from institutions from China and other countries and regions.

- Civil construction of the facility and infrastructure for the Daya Bay Experiment at the Daya Bay Nuclear Power Plant
    - Surface Buildings
    - Experimental Halls
    - Auxiliary Halls (AD filling and water storage halls)

    - Tunnels
    - Utilities for the above (power, water piping, lights, HVAC, clean-rooms, etc)
    - Safety Systems for the above
    - Computer and voice communications systems for the above

- Antineutrino Detector (AD):
    - The stainless steel outer vessels
    - approximately 50% of the fabrication costs of the Acrylic Vessels
    - materials (LAB, Mineral Oil, PPO, etc), processing equipment and critical expertise for the production of the normal and Gadolinium loaded Liquid Scintillator
    - LS storage tanks & liquid stirring mechanism in Hall No. 5 and related facility infrastructure and utilities for LS filling and mixing
    - portions of the system for measuring physical properties and monitoring systems
    - portions of necessary tools and equipment for the assembly and installation of ADs

- Muon System:
    - RPC detectors
    - RPC support structure
    - pipes for purified water connecting experimental halls and the central water purification system
    - complex tyvek film for water barriers
    - portions of necessary tools and equipment for the assembly and installation of Muon detectors

- Calibration system:
    - manual calibration system
    - LED calibration system for the Automated Calibration Boxes
    - radioactive sources for both Automated and Manual Calibration Systems

- Readout electronics, trigger, DAQ system and onsite data production facility
    - readout electronics for PMTs and RPCs
    - trigger and clock system
    - DAQ hardware, coordination and software
    - Slow control system including integrating all safety systems
    - Portions of onsite data production facility
    - Electronics infrastructure including racks and crates

- Integration & Installation:
    - Overhead heavy crane in experimental halls and surface assembly building
    - Clean rooms for detector assembly

    - Portion of tools and equipment for assembly and installation
    - Neighborhood Electric Vehicles for transporting people and small items from the surface down into the Experimental Halls
    - Technical and manpower support onsite

- Joint Project Management control and oversight

Article VII
Contributions to the Operations

The specific details of operations contributions will be worked out in a later revision as an amendment to this MOU, and later agreements as appropriate, but the concept for funding operating costs is intended to be as follows. It is anticipated that some elements of operating costs will be put in a "general fund" category to be shared appropriately (prorated to the number of eligible voters in Daya Bay elections, or to the number of authors to Daya Bay physics papers, to be determined later) between the collaborating countries and that other elements will be borne directly by the country that constructed the subsystem element.

Examples of general fund type elements may include: Consumables (N2 and RPC gas, power, water, water filters, resin bed materials, etc), onsite operations and maintenance staff, onsite management, transportation and administrative staff, emergency response team costs, data storage media and network/link costs.

Examples of directly funded operating expenses may include: Repairs to RPC chambers that are beyond the capability of the onsite maintenance/repair staff (this will be a PRC cost), Repairs to the PMT system that are beyond the capability of the onsite maintenance/repair staff (this will be a US cost), etc.

Initial operations may begin as early as the end of calendar 2009. The Parties understand that the collaborating US institutions, utilizing their DOE-HEP Daya Bay Operations support funding, will contribute towards the repair and operation of the US scope deliverables listed in Article VI and Appendix A as well as to the general fund when operations begin.

In addition, the US collaborators intend to pay for rental of apartments for use when on site for shifts or maintenance, to pay for necessary additional safety staff for training and inspection if required and above and beyond that deemed necessary by remainder of the collaboration (see Article XVI), and to pay for travel, insurance and other miscellaneous expenses as appropriate.

The Parties understand that the collaborating institutions from China and other regions will contribute towards the repair and operation of the scope of deliverables from China and other regions listed in Article VI and Appendix A, through funding from China and other regions.

Additionally, collaborators from China and other countries and regions anticipate paying for rental of apartments for use by their staff, for necessary additional safety staff for training and inspection if required and above and beyond that deemed necessary by the remainder of the colloboartion (see Articl XVI), and for travel, insurance, and other miscellaneous expenses as appropriate. IHEP will also provide the appropriate contribution to the general fund.

A preliminary list of the common operation and maintenance expenses (general fund expenses) will be developed and attached to future revisions of this MOU document. The list is subject to funding agency review and approval. Once approved, it may be revised as appropriate with the approval by the Daya Bay Executive Board and the agencies. If approved by the Daya Bay Executive Board and the agencies, "in-kind" contributions are an acceptable method of meeting the anticipated contribution obligations.

Article VIII
Responsibilities

- Construction funding:
    - The Parties understand that the US institutions participating in the Daya Bay Experiment will obtain the necessary funding to satisfy the US contributions described in Article VI, and that each US member institution will obtain proper funding to participate in the experiment commensurate with its commitments.
    - The Parties understand that the institutions from China and other countries and regions participating in the Daya Bay Experiment will obtain necessary funding to satisfy the contributions from China and other countries and regions described in Article VI, and that each such member institution will obtain proper funding to participate in the experiment commensurate with its commitments.
    - All funding will be subject to the availability of appropriated funds from the member institutions' respective governmental funding agencies.

- On site operations and maintenance funding:
    - The Parties understand that the US institutions participating in the Daya Bay Experiment will be responsible for operating and maintaining the items specified in Article VII and the proper sharing of common maintenance cost
    - The Parties understand that the institutions from China and other countries and regions participating in the Daya Bay experiment will be responsible for operating and maintaining the items specified in Article VII and the proper sharing of common maintenance cost.
    - All funding will be subject to the availability of appropriated funds from the member institutions' respective governmental funding agencies.

- Shifts: The Parties understand that all institutions and members must satisfy their institutional and personal shift quotas defined by the Daya Bay Executive Board or related collaboration guidelines.
- Data Analysis: All members will be strongly encouraged to take part in the Daya Bay data analysis as well as all other collaboration activities.
- Meeting Attendance: Senior members of the groups should make their best effort to attend collaboration meetings and sub-group meetings related to their work.
- Supervision: Senior members of the groups will make their best effort to supervise their students and postdocs while they are at Daya Bay.

Article IX
Rights and obligations

Following execution of this or another MOU and admission to the Daya Bay Collaboration in accordance with the Daya Bay Collaboration By-Laws, US Daya Bay Collaboration institutions and members will have all the rights as full Daya Bay collaborators specified in the Daya Bay Collaboration By-Laws so long as they remain Daya Bay Collaboration members in good standing.

Subject to safety and security requirements, members of the Daya Bay Collaboration will also have all the rights of full access to the Daya Bay Experiment at the Daya Bay Nuclear Power Plant for fulfilling their obligations (shifts). In the case of violation of the rights, IHEP will represent any member of the Daya Bay collaboration to arbitrate with the Daya Bay Nuclear Power Plant.

All members of the Collaboration will also have equal access to the data obtained in the Daya Bay experiment and the common analysis tools. Data on the reactor power and the geology of the experimental site will be available to all collaborators in appropriate form for analysis of the data in a timely fashion.

Article X
Personnel

IHEP intends to provide information necessary to allow and facilitate the involvement of the US participants. LBNL and BNL intend to facilitate access of Chinese collaborators to the US within US Government guidelines. Each of the Parties shall be responsible for supporting its own personnel (salary, allowances, insurance, travel costs) working on the Daya Bay project.

The Parties will conform to the rules for conduct and safety in force at the institution where the work is performed. This includes work performed at the Daya Bay Nuclear Power Plant that will be conducted under the rules and regulations specified in Article XV and Article XVI of this agreement. IHEP will provide qualified personnel to serve as

local safety coordinators at the Daya Bay Experiment while personnel are on site during construction and operations.

Article XI
Equipment

The Parties understand that the US collaborating institutions will retain ownership of the experimental equipment they supply unless the ownership has been transferred to IHEP under a written agreement of the Parties. IHEP and the US lead Labs will use their best efforts to ensure that the equipment conforms to the safety standards of the Daya Bay Experiment and CGNPG. The equipment will remain available for use by the Daya Bay Experiment until the completion of the experiment unless otherwise agreed by the Parties. Funding for operations, maintenance and decommissioning related to US owned equipment will be the responsibility of the US institutions participating in the Daya Bay Experiment.

Article XII
Customs Exemption

It is the understanding of the Parties that Chinese duty and tariffs will not be applied to the US supplied equipment. Each Party shall make its best efforts to exempt or limit from taxation and customs duties the equipment referred to in this MOU.

Article XIII
Schedule – timeframe

Below are listed several key intended project and experimental operations milestones. It is the intent of the Parties to meet these milestones to the best of their abilities and for the parties to negotiate new milestone dates if it appears any will be missed by more than a month.
Begin Site Civil Construction – November 2007
Project Funding Secured by all parties – March 2008
Begin Assembly of Experimental Equipment at Daya Bay near site – October 2008
Begin Commissioning of Detectors at the Daya Bay near site – September 2009
Begin Physics Data Taking with Full Experiment – December 2010
Experimental Operations will conclude on or around September 2016

Article XIV
Reviews

The P arties understand that reviews will occur at regular intervals during the design, prior to initiating construction, and before commencing operation, of any major piece of experimental equipment. These reviews will be conducted by the International Daya Bay Project team and the Daya Bay Collaboration with additional consultants from outside the Collaboration when needed. The recommendations of the review committees and the action items generated during these reviews will be tracked and addressed as appropriate.

Article XV
Environmental Compliance

IHEP intends to take responsibility for ensuring that the Daya Bay Experiment complies with all appropriate environmental regulations that must be followed while on CGNPG property. IHEP will also be responsible to provide a local safety coordinator who will monitor the collaborations activities at the Daya Bay Experiment and on CGNPG property for environmental compliance. The US Labs will assist IHEP in meeting environmental regulations.

The local safety coordinator will report any environmental issues or near misses to the project managers and project safety officers. The managers and safety officers will decide if any additional actions or reporting is necessary.

Article XVI
Safety and Health

The Parties understand that IHEP will have primary responsibility for safety at the Daya Bay Experiment and that the Director of IHEP has the ultimate responsibility to ensure that all local safety and health regulations at the Experiment and on CGNPG property are satisfied. The Daya Bay Collaboration has developed an Integrated Safety Management (ISM) Plan and is responsible to establish safety practices, following this plan, which meet or exceed the local requirements. The experimental equipment and work practices will be reviewed using the BNL Standards Based Management System (SBMS). IHEP intends to complete an additional review to help ensure that the SBMS regulations are sufficient to meet local safety regulations. The international collaboration may ultimately adopt more or less stringent regulations than those of the BNL SBMS for the Experiment if it is deemed that they satisfy the local regulations for CGNPG property and do not substantially increase the risk to worker safety and health. Worker safety and health practices will be monitored by the local safety coordinator.

The Parties understand that the local safety coordinator will report all safety or health incidents or near misses to IHEP, the project managers and the project safety officers. The project managers and safety officers will decide if any further actions or reporting is necessary.

The Parties understand that the civil construction of the facility and utilities are the responsility of IHEP. The potential interface between the civil construction and experimental construction will be monitored by the local safety coordinator to ensure that members of the Daya Bay Collaboration are not put at risk by the civil construction activities.

The Parties understand that work carried out under this MOU at any site other than Daya Bay and CGNPG will comply with the safety and health regulations appropriate to that site. (See Article X.)

In addition, the Parties understand that US institutions may require additional safety training or inspection to comply with US requirements. In that event, the US institutions intend to pay for the staff needed to provide that training or inspection. (Article VII)

Article XVII
Joint Project Management Organization

The International Daya Bay Project Management Organization is shown below in Figure 1.

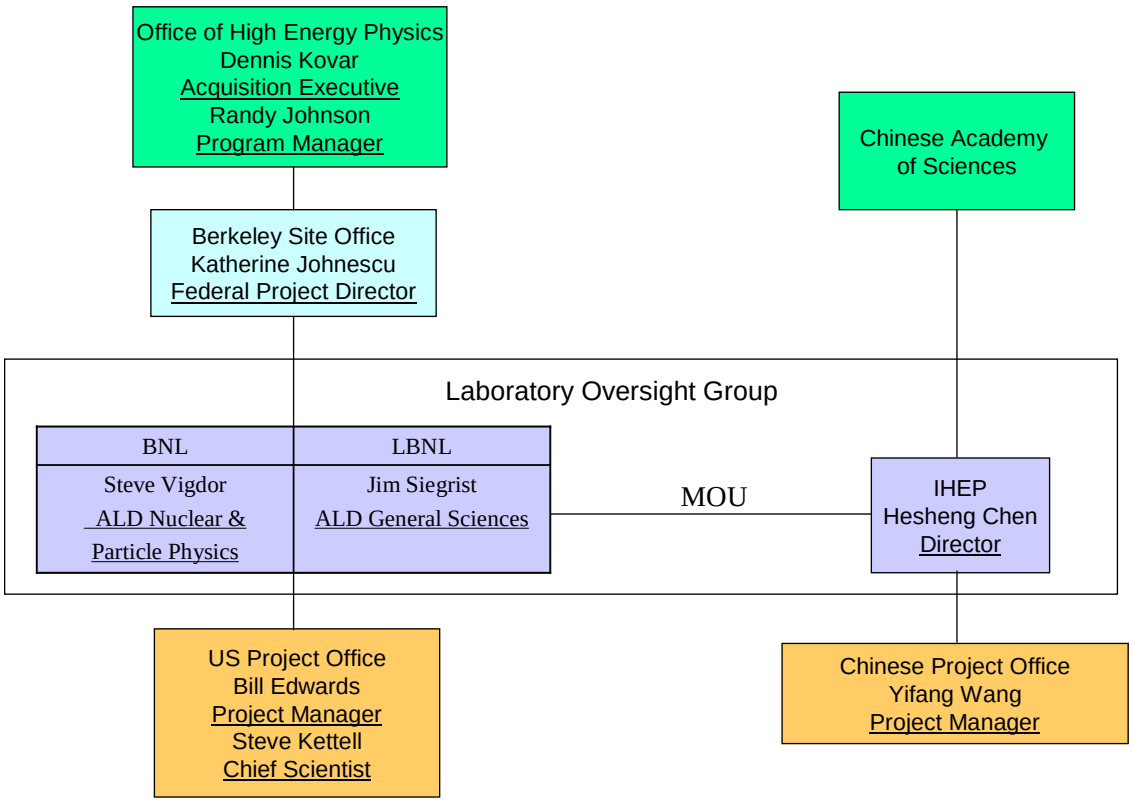

Figure 1 - International Daya Bay Project Organization

The two Project Offices report to, in addition to the Daya Bay Collaboration, the Laboratory Oversight Group (LOG), which oversees their effort in the execution of the Project and provides support in the form of personnel and facilities under its control. The LOG also has charged the Project Advisory Panel (PAP) to review the Project on a regular basis and to provide key insight and recommendations to the Project Offices.

Given the contributions provided by each of the Parties to this MOU as outlined in Article VI above, and the financial responsibility inherent in these, the Parties intend that any significant increases in cost due to directed increases in project scope, or reductions in scope that are due to cost increases, will be discussed with the LOG and the International Finance Committee (IFC) prior to committing additional funding. By the same token, major/significant cost increases and overruns will be discussed and accepted by the International Daya Bay Project team prior to committing funding to these items.

Article XVIII
Intellectual Property & Publications

The Parties intend to notify each other, in a timely fashion, of any inventions or copyright works resulting from the Daya Bay Experiment. Rights to all intellectual property shall be governed by Annex I of the Treaty.

Regarding publications, the Parties intend to notify each other in a timely fashion, in advance of any publication of scientific results that come about due to the operation of the Daya Bay Experiment. The Parties also intend to notify each other in advance of any publication of a detailed technical description of any part of the experimental apparatus – for example a NIM article. The Parties will abide by the Publication Guidelines provided in the Daya Bay Collaboration By-Laws and the intellectual property rights in Annex I of the Treaty.

Article XIX
Liability for Damages

In the event that injuries or damages are incurred in the course of, or arising out of, the activities carried out under this Agreement and its protocols, each Party will accept, to the extent authorized by its national law, liability caused by its action or inaction for damages arising from cooperative activities under this MOU and will consult with each other on appropriate methods of settlement.

Article XX
Amendments

The Parties understand that they may amend this MOU by written mutual consent.

Article XXI
Disputes

The Parties will consult with each other on any dispute arising under this MOU and will use their best efforts to resolve any such dispute through mutual agreement resulting from such consultation. If this fails they may, at their option submit the dispute to a mutually agreeable form of dispute resolution such as conciliation or mediation.

Article XXII
Duration

This MOU will become effective upon signature of all Parties. It will terminate on the day when the Daya Bay Collaboration dissolves or a future MOU that replaces the current one is signed. Any Party desiring to withdraw from this MOU will provide the other Parties at least three (3) months notice.

Appendix A – MS Excel File – Daya Bay Deliverables List_v6

WBS	TASK/ELEMENT NAME	Component or Assy	Quantity (incl spares)	Responsible Institution	Responsible Lab	Respons Mgr
Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
1	***Daya Bay Project***					
1.1	**Antineutrino Detector**			IHEP, UW, LBNL. BNL	IHEP/LBNL	Cao/Heeger
1.1.1	Detector Tank			IHEP	IHEP	J Cao
1.1.1.1	SS vessel		8	IHEP	IHEP	J Cao
1.1.1.2	SS Support structure		8	IHEP	IHEP	J Cao
1.1.1.3	SS lifting structure		2	IHEP	IHEP	J Cao
1.1.1.4	Reflection board (ESR)		16	IHEP	IHEP	J Cao
1.1.2	Acrylic Vessels			UW, TU(Taiwan)	LBNL, IHEP	K. Heeger
1.1.2.1	Prototype Acrylic Vessels			UW	LBNL	K. Heeger
	3m dia	Component	1	TU (Taiwan)	IHEP	B Hsiung
	4m dia	Component	1	UW	LBNL	K. Heeger
1.1.2.2	Production Acrylic Vessels			UW, Taiwan	LBNL, IHEP	K. Heeger
	Production Acrylic Inner Vessels (8 - 3m diam)	Assembly	8	TU (Taiwan)	IHEP	B Hsiung
	Production Acrylic Outer Vessels (8 - 4m diam)	Assembly	8	UW	LBNL	K. Heeger
1.1.3	LS and MO Production				BNL, IHEP	M. Yeh
1.1.3.1	Procurement and Testing of Chemical and Purification				BNL, IHEP	M. Yeh
1.1.3.1.2	Procurements of Carboxylic Acids	Raw Chemical Material	1 ton	BNL	BNL	M. Yeh
1.1.3.1.3	Other Chemical Procurements			BNL	BNL	M. Yeh
	Gadolinium-Chloride	Raw Chemical Material	750 Kg	BNL	BNL	M. Yeh
	bis-MSB	Raw Chemical Material	7 Kg	BNL	BNL	M. Yeh
1.1.3.1.4	Chemical Equipmemt Purchase			BNL	BNL	M. Yeh
	Extraction Column	Equipment Assy	multiple pieces	BNL	BNL	M. Yeh
	Vacuum Distillator	Equipment Assy	multiple pieces	BNL	BNL	M. Yeh
	Equipment for GdCl3 Purification		as required	IHEP	IHEP	J Cao
	Equipment for Gd compound		as required	IHEP	IHEP	J Cao
	Argon or Nitrogen		as required	IHEP	IHEP	J Cao
1.1.3.3	Mixing in LS Hall				BNL, IHEP	M. Yeh
1.1.3.3.1	Liquid Processing System				BNL, IHEP	M. Yeh
	Vacuum drying system (scope slide 2)	Equipment Assy	1	BNL	BNL	M. Yeh
	Filtration and Centrifugation	Equipment Assy	multiple pieces	BNL	BNL	M. Yeh
	LS Mixing equipment		as required	IHEP	IHEP	J Cao
	Clean room and Fume Hood	Equipment Assy	multiple pieces	BNL	BNL	M. Yeh
1.1.3.3.2	Chemical Monitoring System				BNL, IHEP	M. Yeh
	Chemical Instruments (UV, attenuation-length, light y	Equipment Assy	multiple pieces	LBNL	BNL, LBNL	M. Yeh
1.1.3.4	LAB (Chinese purchase)		400T	IHEP	IHEP	J Cao
1.1.3.5	Fluors (Russia)		1400Kg	JINR	IHEP	J Cao
1.1.3.6	Mineral Oil (Chinese purchase)		360T	IHEP	IHEP	J Cao
1.1.3.7	Surface Liquid Handling		as required	IHEP	IHEP	J Cao
1.1.3.8	Underground Liquid Handling		as required	IHEP	IHEP	J Cao
	LAB/oil storage 200 T		3	IHEP	IHEP	J Cao
1.1.3.9	Liquid Transport Tanks		1	IHEP	IHEP	J Cao
1.1.4	PMT AD Mechanical Systems			LBNL, UW	LBNL	K. Heeger
1.1.4.1	AD PMT mounts	components	1600	LBNL	LBNL	S. Virostek
1.1.4.2	AD PMT ladders	components	65	LBNL	LBNL	S. Virostek
1.1.4.3	AD PMT cable penetrations and routing			UW	LBNL	J. Cherwinka
	feedthru drybox assembly	assembly	66	UW	LBNL	J. Cherwinka
	feedthru flange to SSV	component	66	UW	LBNL	J. Cherwinka
	cables and connectors	assembly	1600	UW, UCLA	LBNL	J. Cherwinka
1.1.5	System for Measuring Physical Detector Properties			UW, China	LBNL, IHEP	T. Wise
1.1.5.1	Target Mass Measurement System & Detector Filling			UW	LBNL	T. Wise
	reference tank targert mass measurement	assembly	1	UW	LBNL	T. Wise
	filling system	assembly	1	UW	LBNL	T. Wise
1.1.5.2	Overflow Tanks & Target Mass Monitoring			UW, China	LBNL, IHEP	T. Wise
	LS & GdLS Overflow tanks	assemblies	8	UW	LBNL	T. Wise
	Liquid level sensors for target mass monitoring	assemblies	24 sets	UW, China	LBNL, IHEP	T. Wise
	CCD Visual Monitoring	assembly	8 sets	IHEP	IHEP	J Cao
	Gate Valves for each port	components	25	UW	LBNL	T. Wise
	AV position monitoring	components	8	UW	LBNL	T. Wise
1.1.5.3	Acrylic Vessel Geometry & Position Monitoring			UW, China	LBNL, IHEP	T. Wise
1.1.6	Lifting & Transport			IHEP	IHEP	
	SSV Lifting Structure - 125T	assembly	1	IHEP	IHEP	J Cao
	SSV Lifting Structure - 30T	assembly	1	IHEP	IHEP	J Cao
1.1.7	Materials Compatibility and Low Background countin	service		BNL	BNL	M. Yeh
1.1.7.1	Material Compatability	service		BNL	BNL	M. Yeh
1.1.7.2	Low Background counting	service		BNL, LBNL	BNL, LBNL	M. Yeh
	Low Background counting facility (1.1.4.4)	equipment	1	IHEP	IHEP	J Cao
1.1.8	Other AD Systems			UW, China	LBNL, IHEP	T. Wise
1.1.8.1	tilt and motion monitoring	assembly	1	UW, China	LBNL, IHEP	T. Wise
1.1.8.2	temperature monitoring	assembly	8	UW, China	LBNL, IHEP	T. Wise
1.1.8.3	cover gas systems and regulation for Hall 5 and EH	assembly	4	UW	LBNL	T. Wise
1.1.8.4	removable detector insulation for transport and stora	assembly	2	UW	LBNL	T. Wise
1.1.9	Subsystem Management	service		UW	LBNL	K. Heeger
1.1.9.1	scheduling and costing			UW	LBNL	K. Heeger
1.1.9.2	management and supervision			UW	LBNL	K. Heeger
1.1.9.3	travel			UW	LBNL	K. Heeger
1.1.9.4	computing, phone, software etc.			UW	LBNL	K. Heeger
1.1.10	Planning&Integration	service		UW	LBNL	K. Heeger
1.1.10.1	developing AD assembly process			UW	LBNL	K. Heeger
1.1.10.2	fabrication of scale AD model for assembly planning			UW	LBNL	K. Heeger

WBS	TASK/ELEMENT NAME	Component or Assy	Quantity (incl spares)	Responsible Institution	Responsible Lab	Respons Mgr
Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
1.1.10.3	writing bilingual documentation for AD assembly process			UW	LBNL	K. Heeger
1.1.10.4	safety analysis and documentation			UW	LBNL	K. Heeger
1.1.10.5	preparing SAB for AD assembly			UW	LBNL	K. Heeger
1.1.10.6	test run of AD assembly process in SAB			UW	LBNL	K. Heeger
1.1.10.7	travel for AD integration engineers			UW	LBNL	K. Heeger
1.1.11	Assembly of AD#1 and AD#2			UW	LBNL	K. Heeger
1.1.11.1	AD#1 and AD#2 assembly in SAB			UW	LBNL	K. Heeger
1.1.11.2	AD#1 and AD#2 assembly in SAB complete			UW	LBNL	K. Heeger
1.1.11.3	AD#1 and AD#2 transport underground			UW	LBNL	K. Heeger
1.1.11.4	AD#1 and AD#2 filing in Hall 5			UW	LBNL	K. Heeger
1.1.11.5	AD#1 and AD#2 transport to experimental Halls			UW	LBNL	K. Heeger
1.1.11.6	AD#1 and AD#2 installation in experimental halls			UW	LBNL	K. Heeger
1.1.11.7	travel for technical project personnel during AD#1,#2 assembly			UW	LBNL	K. Heeger
1.2	**Muon System**			BNL/IHEP	BNL/IHEP	Littenberg/Yang
1.2.1	Resistive Plate Chambers			China, Princeton, VT, Houst	IHEP, BNL	L. Littenberg
1.2.1.1	RPC Panels			China		
	RPC Bare Chamber (1.2.3.1)	Assembly	3504m2	IHEP/Charles Univ	IHEP	C Yang
	RPC Assembly (4 Layers, 3 Halls - 1.2.3.2)	Assembly	3504m2	IHEP/Charles Univ	IHEP	C Yang
	RPC Top Support Structure	Assembly	3	IHEP/Charles Univ	IHEP	C Yang
	RPC Support Rolling System	Assembly	3	IHEP	IHEP	C Yang
1.2.1.1.11	RPC Q/C station			Houston	BNL	L. Littenberg
	NIM Crate 300W	commercial equipment	2	Houston	BNL	K.Lau
	NIM Crate 600W	commercial equipment	2	Houston	BNL	K.Lau
	CAMAC Crate 600W	commercial equipment	1	Houston	BNL	K.Lau
	CAMAC Crate controller	commercial equipment	1	Houston	BNL	K.Lau
	NIM Module: Discriminator	commercial equipment	5	Houston	BNL	K.Lau
	NIM Module: Mixed Logic unit	commercial equipment	1	Houston	BNL	K.Lau
	NIM Module: AND/OR Logic unit	commercial equipment	2	Houston	BNL	K.Lau
	NIM Module: Majority Logic unit	commercial equipment	5	Houston	BNL	K.Lau
	CAMAC Module: Scaler	commercial equipment	1	Houston	BNL	K.Lau
	Cable Assy	assembly	300	Houston	BNL	K.Lau
1.2.1.2	RPC Gas System	System/Assy	1 prototype +3 prod	Princeton	BNL	K.Lau
1.2.1.2.1	Final RPC Gas System Design			Princeton	BNL	K.Lau
1.2.1.2.2	FDR/PRR			Princeton	BNL	K.Lau
1.2.1.2.3	Procure components for DB			Princeton	BNL	K.Lau
1.2.1.2.4	Assembly RPC Gas system for DB			Princeton	BNL	K.Lau
1.2.1.2.5	Safety Assessment			Princeton	BNL	K.Lau
1.2.1.2.6	Test Gas System			Princeton	BNL	K.Lau
1.2.1.2.7	Ship DB gas system			Princeton	BNL	K.Lau
1.2.1.2.8	DB gas system arrival at DB			Princeton	BNL	K.Lau
1.2.1.2.9	Purchase remaining components			Princeton	BNL	K.Lau
1.2.1.2.10	Assemble LA and Far Gas Systems			Princeton	BNL	K.Lau
1.2.1.2.11	Test LA and Far Gas Systems			Princeton	BNL	K.Lau
1.2.1.2.12	Ship LA Gas system			Princeton	BNL	K.Lau
1.2.1.2.13	LA Gas system arrives at SAB			Princeton	BNL	K.Lau
1.2.1.2.14	Ship Far Gas system			Princeton	BNL	K.Lau
1.2.1.2.15	Far Gas system arrives at SAB			Princeton	BNL	K.Lau
	Ship all gas systems			Princeton	BNL	K.Lau
	turn-key mixing system	assembly	3	Princeton	BNL	K.Lau
1.2.1.3	RPC Support Structure			China	IHEP	C Yang
1.2.1.4	RPC High Voltage System			VT	BNL	K. Lau
	Mainframes -- MPOD EC-HV	System/Assy	3	VT	BNL	K. Lau
	HV Module, 16-channel	System/Assy	30	VT	BNL	K. Lau
	HV cable assy, 18m	System/Assy	378	VT	BNL	K. Lau
1.2.2	PMT Supports			BNL	BNL	V.Issakov
1.2.2.1	Preliminary Design of PMT Supports			BNL	BNL	V.Issakov
1.2.2.2	Final Design of PMT Supports			BNL	BNL	V.Issakov
1.2.2.3	FDR/PRR Review of PMT Suppts			BNL	BNL	V.Issakov
1.2.2.4	PMT Support Material	Assembly		BNL	BNL	V.Issakov
	Unistrut U-channel, in feet	Raw Material	13000	BNL	BNL	V.Issakov
	Unistrut Fittings & Hardware (all)	Component	1	BNL	BNL	V.Issakov
	Support Pads	Component	158	BNL	BNL	V.Issakov
	Link Pads	Component	104	BNL	BNL	V.Issakov
	Wall and Floor anchors (all)	Component	1	BNL	BNL	V.Issakov
	Tyvek, White Covering (in m^2)	Raw Material	3236	BNL	BNL	V.Issakov
1.2.2.5	PMT Mounts	Component	1000	BNL	BNL	V.Issakov
1.2.2.6	Ship DB Near Hall PMT Supports to SAB			BNL	BNL	V.Issakov
1.2.2.7	PMT supports for DB Near arrive at SAB			BNL	BNL	V.Issakov
1.2.2.8	PMT supports for LA Hall shipped to SAB			BNL	BNL	V.Issakov
1.2.2.9	PMT supports for LA Hall arrive at SAB			BNL	BNL	V.Issakov
1.2.2.10	PMT supports for Far Hall shipped to SAB			BNL	BNL	V.Issakov
1.2.2.11	PMT supports for Far Hall arrive at SAB			BNL	BNL	V.Issakov
1.2.3	Oxygen Difficiency Hazard System			China	IHEP	
1.2.3.1	ODH system design			China	IHEP	C Yang
1.2.3.2	ODH system	Hall System	4	China	IHEP	C Yang
	This is all Chinese scope, part of Civil.			China	IHEP	C Yang
1.2.3.3	ODH system fabrication & testing			China	IHEP	C Yang
1.2.3.4	Shipping of ODH system elements to SAB			China	IHEP	C Yang
1.2.3.5	ODH system arrives at SAB			China	IHEP	C Yang
1.2.3.6	DB Near Hall Beneficial Occupancy			China	IHEP	C Yang

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Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
1.2.4	Pool Liner			BNL	BNL	V.Issakov
1.2.4.1	Procure Pool Liner Materials			BNL	BNL	V.Issakov
1.2.4.2	Ship Pool Liner Materials to SAB for DB Hall	Assembly		BNL	BNL	V.Issakov
	Wall and floor coating, gallons	Wall and floor coating, ga	1131	BNL	BNL	V.Issakov
	Seam sealer, linear meters	Seam sealer, linear mete	392	BNL	BNL	V.Issakov
	Spraying equipment	Spraying equipment	1	BNL	BNL	V.Issakov
1.2.4.3	DB Hall Pool Liner Materials arrive at SAB			BNL	BNL	V.Issakov
1.2.4.4	Package & ship LA Hall Pool Liner Materials			BNL	BNL	V.Issakov
1.2.4.5	LA Hall Pool Liner Materials arrive at SAB			BNL	BNL	V.Issakov
1.2.4.6	Far Hall Pool Liner Materials shipped to SAB			BNL	BNL	V.Issakov
1.2.4.7	Far Hall Pool Liner Materials arrive at SAB			BNL	BNL	V.Issakov
1.2.5	Water System			RPI	BNL	J.Napolitano
1.2.5.1	Final Spec & Dsgn of Water Sys			RPI	BNL	J.Napolitano
1.2.5.2	FDR/PRR Review of Water Sys			RPI	BNL	J.Napolitano
1.2.5.3	Procure components for makeup & DB water sys			RPI	BNL	J.Napolitano
1.2.5.4	Manufacture Makeup & DB water system components			RPI	BNL	J.Napolitano
1.2.5.5	Pre-Operational Safety Assessment	**will this be shipped as an assembly** on a skid?		RPI	BNL	J.Napolitano
1.2.5.6	Makeup Water System	Assembly	2	RPI	BNL	J.Napolitano
	Pipe, 2" Polypropylene	Component	8000 feet	IHEP	IHEP	C Yang
1.2.5.8	DB Hall Water System	Assembly	1	RPI	BNL	J.Napolitano
1.2.5.10	Procure LA Hall Water Sys. Components			RPI	BNL	J.Napolitano
1.2.5.11	Manufacture LA water system componenets			RPI	BNL	J.Napolitano
1.2.5.12	Pre-operational Safety Assessment for LA Hall Water System			RPI	BNL	J.Napolitano
1.2.5.13	LA Hall Water System	Assembly	1	RPI	BNL	J.Napolitano
1.2.5.15	Procure Far Hall Water Sys. Components			RPI	BNL	J.Napolitano
1.2.5.16	Manufacture Far Hall Water Sys. Components			RPI	BNL	J.Napolitano
1.2.5.17	Pre-operational Safety Assessment for Far Hall Water System			RPI	BNL	J.Napolitano
1.2.5.18	Far Hall Water System	Assembly	1	RPI	BNL	J.Napolitano
1.2.6	Subsystem Management			BNL	BNL	L.Littenberg
1.2.6.1	FY08 Subsystem Management			BNL	BNL	L.Littenberg
1.2.6.2	FY09 Subsystem Management			BNL	BNL	L.Littenberg
1.2.6.3	FY10 Subsystem Management			BNL	BNL	L.Littenberg
1.2.7	Muon PMT calibration system			VT	BNL	J.Link
1.2.7.1	Muon PMT Calibration Preliminary Design			VT	BNL	J.Link
1.2.7.2	Muon PMT Calibration Final design			VT	BNL	J.Link
1.2.7.3	Muon PMT Calibration Sys Procurement & Testing			VT	BNL	J.Link
1.2.7.4	Muon PMT Calibration Sys Packing & Shipping			VT	BNL	J.Link
1.2.7.4	Muon PMT Calibration Sys Packing & Shipping	Assembly		VT	BNL	J. Link
	LEDs	Component	130	VT	BNL	J. Link
	LED Driver Boards	Component	52	VT	BNL	J. Link
	Inductor	Component	130	VT	BNL	J. Link
	Al Chasis for LED Driver Board	Component	52	VT	BNL	J. Link
	SHV Bulkhead Jack	Component	107	VT	BNL	J. Link
	BNC Bulkhead Jack	Component	341	VT	BNL	J. Link
	BNC Cable Plug	Component	130	VT	BNL	J. Link
	RG-58 Coax. Cable (1000 ft. rolls)	Component	30	VT	BNL	J. Link
	LED Diffuser Balls	Component	130	VT	BNL	J. Link
	HV Supply	Component	3	VT	BNL	J. Link
	LV Supply	Component	3	VT	BNL	J. Link
	SHV Cable Assemblies	Component	55	VT	BNL	J. Link
	BNC Cable Assemblies	Component	55	VT	BNL	J. Link
1.2.7.5	Muon PMT Calibration Sys Arrives at SAB			VT	BNL	J.Link
1.2.8	Reflectors for AD's			RPI	BNL	P.Stoler
1.2.8.1	Preliminary Design of Reflectors			RPI	BNL	P.Stoler
1.2.8.2	Final Design of Reflectors			RPI	BNL	P.Stoler
1.2.8.3	Procurement of Reflector Material			RPI	BNL	P.Stoler
1.2.8.4	Fabrication of Reflectors			RPI	BNL	P.Stoler
1.2.8.5	Pack & Ship Reflectors	Assembly		RPI	BNL	P. Stoler
	SS 90-degree rolled segments	Component	32	RPI	BNL	P. Stoler
	SS threaded studs, all	Component	1	RPI	BNL	P. Stoler
	SS grommets, all	Component	1	RPI	BNL	P. Stoler
	SS wing nuts, all	Component	1	RPI	BNL	P. Stoler
	SS weights and lugs, all	Component	1	RPI	BNL	P. Stoler
	Tyvek (in $m^{2)}$	Component	960	RPI	BNL	P. Stoler
	Misc. tools and materials, all	Component	1	RPI	BNL	P. Stoler
1.2.8.6	Reflectors arrive at SAB			RPI	BNL	P.Stoler
1.2.9	Pool cover			BNL	BNL	V.Issakov
1.2.9.1	Preliminary design for pool cover			BNL	BNL	V.Issakov
1.2.9.2	Final design of pool cover			BNL	BNL	V.Issakov
1.2.9.3	Procurement of cover material			BNL	BNL	V.Issakov
1.2.9.4	Fabrication of cover material			BNL	BNL	V.Issakov
1.2.9.5	Pack & ship cover material	Assembly		BNL	BNL	V.Issakov
	Quantities shown are for all four pools. These are from the cost book:			BNL	BNL	V.Issakov
	Pool cover material (in $m^{2)}$	Raw Material	832	BNL	BNL	V.Issakov
1.2.9.6	Cover material arrives at SAB			BNL	BNL	V.Issakov
1.3	**Calibration & Monitoring**			Caltech	LBNL/IHEP	McKeown/Leung
1.3.1	Automated Calibration System			Caltech	LBNL	R. McKeown
1.3.1.1	units 1-24			Caltech	LBNL	R. McKeown
	Assembled Automated Calibration Boxes	Assembly	24	Caltech	LBNL	R. McKeown

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Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
	Cable Assemblies and Cable Conduits	Components	As needed	Caltech	LBNL	R. McKeown
	Calibration Utility Drybox	Assembly	8	Caltech	LBNL	R. McKeown
	Automated Calibration Box Control System (compute	System	3	Caltech	LBNL	R. McKeown
	2 inch PMT's and mounting hardware	Components	48	Caltech	LBNL	R. McKeown
	Mineral Oil LED monitoring system	Assembly	8	Caltech	LBNL	R. McKeown
1.3.2	Radioactive Sources (list types)	Components	16		IHEP	Y Wang
1.3.3	Manual Calibration System	Assembly	1		IHEP	Y Wang
	Mechanical Assembly		1		IHEP	Y Wang
	Radioactive Sources (list types)		2		IHEP	Y Wang
1.3.4	LED Calibration System	Assembly	8	HKU	IHEP	J Leung
1.3.5	Water Veto Calibration Syst	Assembly	3	IHEP	IHEP	Y Wang
1.4	**Electronics & Online**			Various	IHEP	X Li
1.4.1	PMT Readout				IHEP	X Li
	PMT Readout Design Consulting			IIT/LBNL	LBNL	C. White
1.4.1.1	AD PMT FEE Board		105		IHEP	X Li
1.4.1.2	Muon PMT FEE Board		66		IHEP	X Li
1.4.1.3	Trigger Daughter Board		200		IHEP	X Li
1.4.2	Trigger and Clock				IHEP	X Li
1.4.2.1	Trigger Boards				IHEP	X Li
1.4.2.1.1	Trigger Board		24		IHEP	X Li
1.4.2.1.2	Master Local Clock Board		2		IHEP	X Li
1.4.2.1.3	GPS Antenna & Receiver Board		2		IHEP	X Li
1.4.2.1.4	Fan-in & Fan-out Board		6		IHEP	X Li
1.4.3	RPC Readout				IHEP	X Li
	RPC Readout Consulting			IIT/LBNL	LBNL	C. White
1.4.3.1	RPC FEC Card		200		IHEP	X Li
1.4.3.2	RPC RPM Card		15		IHEP	X Li
1.4.3.3	RPC VME Card		5		IHEP	X Li
1.4.3.4	RPC Cables and Pwr Supply		1		IHEP	X Li
1.4.4	DAQ and Online				IHEP	X Li
	DAQ and Online Consulting			IIT/LBNL	LBNL	C. White
1.4.4.1	DAQ Hardware				IHEP	X Li
1.4.4.1.1	VME Crates		21		IHEP	X Li
1.4.4.1.2	VME Controllers		21		IHEP	X Li
1.4.4.1.3	9U/6U Interface Card		21		IHEP	X Li
1.4.4.1.4	Electronics Racks with CANbus control		16		IHEP	X Li
1.4.4.1.5	Rittual Cooling Unit for electronics racks		16		IHEP	X Li
1.4.4.1.6	Computer Racks		3		IHEP	X Li
1.4.4.1.7	Readout Computers		9		IHEP	X Li
1.4.4.1.8	Rack Computer Monitor/Keyboard		3		IHEP	X Li
1.4.4.1.9	KVM Switch		3		IHEP	X Li
1.4.4.1.10	Switch (24 ports)		3		IHEP	X Li
1.4.4.1.11	Optical transceiver		3		IHEP	X Li
1.4.4.1.12	Twisted Cable		8		IHEP	X Li
1.4.4.1.13	Optical Fiber (single mode, 12 wires)		3000		IHEP	X Li
1.4.4.1.14	Optical Fiber Connector Kits and installation		5		IHEP	X Li
1.4.4.2	Surface Online control & farm				IHEP	X Li
1.4.4.2.1	Online Control Computers		2		IHEP	X Li
1.4.4.2.2	Computer farm		20		IHEP	X Li
1.4.4.2.3	Storage Array Systems		8		IHEP	X Li
1.4.4.2.4	Hard Disk (500G)		100		IHEP	X Li
1.4.4.2.5	HBA card		4		IHEP	X Li
1.4.4.2.6	File server		4		IHEP	X Li
1.4.4.2.7	Switch		4		IHEP	X Li
1.4.4.2.8	Optical transceiver		5		IHEP	X Li
1.4.4.2.9	10kM network card		4		IHEP	X Li
1.4.4.2.10	Tape storage system		1		IHEP	X Li
1.4.4.2.11	Accessory				IHEP	X Li
1.4.4.3	Control Room infrastructure				IHEP	X Li
1.4.5	Slow Control and Monitoring				IHEP	X Li
	Monitoring & Control Consulting			IIT/LBNL	LBNL	C. White
1.4.5.1	Slow Control Hardware				IHEP	X Li
1.4.5.1.1	Racks		3		IHEP	X Li
1.4.5.1.2	Electronics Rack Monitoring		3		IHEP	X Li
1.4.5.1.3	Electronics Crate Monitoring interface card		3		IHEP	X Li
1.4.5.1.4	Hall temperature/humidity monitoring		3		IHEP	X Li
1.4.5.1.5	Detector hall Control Computers		3		IHEP	X Li
1.4.5.1.6	Rack Computer Monitor/Keyboard		3		IHEP	X Li
1.4.5.1.7	Surf. Control Computer		3		IHEP	X Li
1.4.5.1.8	Data Server + Disk Raid (2.0T)		1		IHEP	X Li
1.4.5.2	Slow Control Software				IHEP	X Li
1.4.5.2.1	LabVIEW Pro. Dev. Studio		1		IHEP	X Li
1.4.5.2.2	AntiVirus		5		IHEP	X Li
1.4.6	Subsystem Management			IHEP/IIT	IHEP	X Li
1.4.6.1	Electronics and Online Travel			IIT/LBNL	LBNL	C. White
1.4.6.2	Electronics and Online Shipping and M&S			IIT/LBNL	LBNL	C. White
1.5	**Offline**			IHEP/LBNL/BNL	IHEP/LBNL	Tull/Wang
1.5.1	Hardware, Networking & Data Transfer			LBNL	LBNL	C. Tull
1.5.1.1	LBNL Hardware			LBNL	LBNL	C. Tull

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Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
	100 processors & 20TB disk and 10Gb Ethernet and associated servers			LBNL	LBNL	C. Tull
1.5.1.2	BNL Hardware			BNL	BNL	C. Tull
	30 processors, 20TB disk and 1Gb Ethernet			BNL	BNL	C. Tull
1.5.1.3	IHEP Hardware			IHEP	IHEP	M Wang
	Computer Servers			IHEP	IHEP	M Wang
	Storage Array Systems			IHEP	IHEP	M Wang
	Hard Disk (500G)		313	IHEP	IHEP	M Wang
	HBA Card			IHEP	IHEP	M Wang
	File Server			IHEP	IHEP	M Wang
	Switch			IHEP	IHEP	M Wang
	10Km Network Card			IHEP	IHEP	M Wang
	Accessory			IHEP	IHEP	M Wang
1.5.2	Core Software Infra. & Data Mgmt			LBNL	LBNL	S.Patton
1.5.2.1	Framework Architect			LBNL	LBNL	S.Patton
1.5.2.2	Travel			LBNL	LBNL	S.Patton
1.5.3	Physics Simulation & Analysis			BNL	BNL	D.Jaffe
	IHEP Physics Simulation & Analysis			IHEP	IHEP	M Wang
1.5.4	Subsystem Test			LBNL	LBNL	C. Tull
1.5.4.1	FY08 Travel			LBNL	LBNL	C. Tull
1.5.4.2	FY09 Travel			LBNL	LBNL	C. Tull
1.5.4.3	FY10 Travel			LBNL	LBNL	C. Tull
1.5.5	Subsystem Management			LBNL	LBNL	C. Tull
1.5.5.1	L2 Management			LBNL	LBNL	C. Tull
1.5.5.2	Travel			LBNL	LBNL	C. Tull
1.5.5.3	Misc. Materials and Supplies					
1.6	**Civil Construction**			IHEP	IHEP	Zhang
1.6.1	Tunnels and Halls			IHEP	IHEP	Zhang
1.6.2	Geological Services			IHEP	IHEP	Zhang
1.6.3	Vibration Monitoring			IHEP	IHEP	Zhang
1.6.4	Management			IHEP	IHEP	Zhang
1.6.5	Quality Control			IHEP	IHEP	Zhang
1.6.6	Surface Lab			IHEP	IHEP	Zhang
1.6.7	Utilities & Safety Equipment			IHEP	IHEP	Zhang
1.7	**Installation Planning and Support**			BNL/IHEP	BNL/IHEP	Brown/Zhuang
1.7.1	Installation				BNL	R. Brown
1.7.1.1	Planning			BNL	BNL	R. Brown
1.7.1.3	Common Tools and Equipment			BNL	BNL	R. Brown
	Assorted Hand/Power Tools and Cabinet	Components	1 lot	BNL	BNL	R. Brown
	Security Cages	Components	5	BNL	BNL	R. Brown
	Rigging Gear & Cabinet	Components	1 lot	BNL	BNL	R. Brown
	Scissor Man-lift	Components	2	BNL	BNL	R. Brown
	Scaffolding and Ladders	Components	1 lot	BNL	BNL	R. Brown
	Personnel Protective Equipment	Components	1 lot	BNL	BNL	R. Brown
	Fall Protection Equipment	Components	1 lot	BNL	BNL	R. Brown
	Portable Jib, Gantry Cranes and Hoists	Components	1 lot	IHEP	IHEP	H Zhuang
	Lathe, Drill Press, Bandsaw, Grinder, Milling Machin	Components	1 ea	IHEP	IHEP	H Zhuang
	Machine Tool Cutters, Fixtures, Inspection Gauges	Components	1 lot	IHEP	IHEP	H Zhuang
	Forklift	Components	1	IHEP	IHEP	H Zhuang
	Metrology System and Equipment	Components	1	BNL	BNL	R. Brown
	Work Benches, Storage Cabinets, Desks, Chairs, Li	Components	1 lot	IHEP	IHEP	H Zhuang
	Welding and Brazing Equipment	Components	1 lot	IHEP	IHEP	H Zhuang
	Portable Class 100,000 Clean Room	Components	1	IHEP	IHEP	H Zhuang
	Assorted Portable Hydraulic Jacks	Components	1 lot	BNL	BNL	R. Brown
	Heavy Duty Carts, Dollys, Trailers	Components	1 lot	BNL	BNL	R. Brown
	Portable Air Compressor	Components	2	BNL	BNL	R. Brown
	Assorted Meteric Fasteners, Storage Bins	Components	1 lot	BNL	BNL	R. Brown
	Portable Power Washer	Components				
	Portable Dryer/Blower	Components				
1.7.1.4	Procedures and Documentation			BNL	BNL	R. Brown
1.7.1.5	Installation Supervision			BNL	BNL	R. Brown
1.7.2	AGV Transporter	Assembly	1	Caltech/BNL	LBNL	
1.7.3	Detector Test and Commissioning			BNL	BNL	R. Brown
1.7.3.1	Planning			BNL	BNL	R. Brown
1.7.3.2	Common Test Equipment			BNL	BNL	R. Brown
	Digital O-scopes and Probes	Commercial Equipment	3	BNL	BNL	R. Brown
	Fluke Digital-Volt-Meter	Commercial Equipment	1 lot	BNL	BNL	R. Brown
	Solder Rework Stations	Commercial Equipment	2	BNL	BNL	R. Brown
	Optical viewers	Commercial Equipment	2	BNL	BNL	R. Brown
	Electronic Test Benches and furniture	Components	2	IEHP	IHEP	H.Zhuang
	Assorted Electronic Hand Tools and Cabinets	Commercial Equipment	1 lot	IEHP	IHEP	H.Zhuang
	Digital Power Supply	Commercial Equipment	2	BNL	BNL	R. Brown
	Assorted wire, crimps, fuses, misc. stores	Components	1 lot	IEHP	IHEP	H.Zhuang
	Ultrasonic Board Cleaner	Commercial Equipment	1 lot	BNL	BNL	R. Brown
	Cable puller and reel supports	Commercial Equipment				
1.7.3.3	Procedures			BNL	BNL	R. Brown
1.7.3.4	Test Supervision			BNL	BNL	R. Brown
1.7.4	Subsystem Mangement			BNL	BNL	R. Brown
1.7.4.1	Management			BNL	BNL	R. Brown
1.7.4.2	Computers, Software & Supplies			BNL	BNL	R. Brown

WBS	TASK/ELEMENT NAME	Component or Assy	Quantity (incl spares)	Responsible Institution	Responsible Lab	Respons Mgr
Key:	Items provided by the US (& shipped to China)	Items provided by China & its international partners				
1.7.4.3	Software Maintenance			BNL	BNL	R. Brown
1.7.4.4	Travel FY08			BNL	BNL	R. Brown
1.7.4.5	Travel FY09			BNL	BNL	R. Brown
1.7.4.6	Travel FY10			BNL	BNL	R. Brown
1.7.5	Installation and Test Plan			LBNL	LBNL	S Virostek
1.7.5.1	PMT Testing SAB, Transporter and Gd delivery			BNL	BNL	R. Brown
1.7.5.2	AD Installation			BNL	BNL	R. Brown
1.7.5.3	Muon Installation			BNL	BNL	R. Brown
1.7.5.4	Calibration System Installation			BNL	BNL	R. Brown
1.7.5.5	Electronics and DAQ Installation			BNL	BNL	R. Brown
1.7.5.6	Testing			BNL	BNL	R. Brown
1.8	**System Integration**			BNL/IHEP	BNL/IHEP	Brown/Zhuang
1.8.1	Mechanical Systems Integration			BNL	BNL	R. Brown
1.8.1.1	3-D Interface Controls			BNL	BNL	R. Brown
1.8.1.2	Installation Staging			BNL	BNL	R. Brown
1.8.1.3	Utilities Definition & Routing			BNL	BNL	R. Brown
1.8.2	Electrical Systems Integration			BNL	BNL	R. Brown
1.8.2.1	Utilities Definition			BNL	BNL	R. Brown
1.8.3	Experimental Assembly			BNL	BNL	R. Brown
1.8.3.1	Interface Definition			BNL	BNL	R. Brown
1.8.3.2	Installation Planning			BNL	BNL	R. Brown
1.8.4	Safety Systems Integration			BNL	BNL	R. Brown
1.8.4.1	Policy Definition & Controls			BNL	BNL	R. Brown
1.8.4.2	Safety Interlocks	Assembly		BNL	BNL	R. Brown
	Programable Logic Controller Systems	Components	1 lot	BNL	BNL	R. Brown
	ODH Monitors	Components	1 lot	BNL	BNL	R. Brown
	Flamable Gas Detectors	Components	1 lot	BNL	BNL	R. Brown
	High Sensitivity Smoke Detectors	Components	1 lot	BNL	BNL	R. Brown
	Rebreathers	Components	1 lot	BNL	BNL	R. Brown
	Portable Emergency Lighting	Components	1 lot	BNL	BNL	R. Brown
1.8.5	Subsystem Mangement			BNL	BNL	R. Brown
1.8.5.1	Management			BNL	BNL	R. Brown
1.8.5.2	Computers, Software & Supplies			BNL	BNL	R. Brown
1.8.5.3	Software Maintenance FY08			BNL	BNL	R. Brown
1.8.5.4	Software Maintenance FY09			BNL	BNL	R. Brown
1.8.5.5	Travel FY08			BNL	BNL	R. Brown
1.8.5.6	Travel FY09			BNL	BNL	R. Brown
1.8.5.7	Travel FY10			BNL	BNL	R. Brown
1.9	**PMT Systems**			LBNL	LBNL	B Edwards
1.9.1	design of cable penetration			UCLA, LBNL	LBNL	V. Ghazikhanian
1.9.2	PMT Signal HV Decouplers			LBNL	LBNL	J Joseph
	PMT Baseline Restoration Boards (multi-channel)	Component/piece	60	LBNL	LBNL	J Joseph
1.9.3	Photomultiplier System			LBNL	LBNL	B Edwards
1.9.3.1	PMT Procurement			LBNL		B Edwards
	8" PMTs for AD & Muon Systems	Component/piece	2250	LBNL	LBNL	B Edwards
1.9.3.2	Delivery and Inspection of PMTs			LBNL	LBNL	B Edwards
1.9.3.3	PMT Burn-in			LBNL	LBNL	S Virostek
1.9.3.4	PMT Testing			LBNL	LBNL	S Virostek
1.9.3.5	Packaging and Shipping PMTs			LBNL	LBNL	B Edwards
1.9.3.6	PMT Bases			LBNL	LBNL	J Joseph
	Bases for new & used Macro tubes	Component/piece	2800	LBNL	LBNL	J Joseph
	PMT Water-proof potting shells	Component/piece	950	LBNL	LBNL	S Virostek
	7m MO suitable cable & 60m water cable	Component/piece	2800	LBNL	LBNL	S Virostek
1.9.3.7	PMT HV System Purchases and Deliveries			LBNL	LBNL	V. Ghazikhanian
	Caen or equiv. HV mainframes & HV modules	Assy/Equipment	56 modules	LBNL	LBNL	J Joseph
	Cable assemblies for HV System	Component/piece	60	LBNL	LBNL	J Joseph
1.9.3.8	PMT Test Stands			UCLA, LBNL	LBNL	O Tsai
	Pre-production single channel test stand	Assembly	2	UCLA, LBNL	LBNL	O Tsai
	Production test stand	Assembly	1	UCLA, LBNL	LBNL	O Tsai
1.9.3.8.3	Infrastructure			LBNL	LBNL	S Virostek
	clean room	Assembly	1	LBNL	LBNL	S Virostek
	vacuum system	System	1	LBNL	LBNL	S Virostek
	degassing system	System	1	LBNL	LBNL	S Virostek
	magnetometer	Assy/Equipment	1	LBNL	LBNL	S Virostek
	digital camera	Assy/Equipment	1	LBNL	LBNL	S Virostek
	Epoxy	Organic Chemical	50Kg	LBNL	LBNL	S Virostek
	labling unit	Assy/Equipment	1	LBNL	LBNL	S Virostek
	scales	Assy/Equipment	2	LBNL	LBNL	S Virostek
1.10.	**Project Management**			IHEP/BNL/LBNL	IHEP/LBNL	Edwards/Wang
1.10.1	LBNL Project Management				LBNL	B Edwards
1.10.2	BNL Project Management				BNL	S Kettell
1.10.3	IHEP Project Management				IHEP	Y Wang