No.

Ministry of Roads, Transport, Construction and Urban Development
Government of Mongolia

Preparatory Survey
on
the Project for Clean Energy Promotion
using
Solar Photovoltaic System
in
Mongolia

June 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.

IDD
JR
10-051

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on the Project for Clean Energy Promotion using Solar Photovoltaic System in Mongolia.

JICA sent to Mongolia a survey team from July 28th to August 26th and November 1st to December 7th, 2009.

The team held discussions with the officials concerned of the Government of Mongolia, and conducted a field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Mongolia in order to discuss a draft outline design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Mongolia for their close cooperation extended to the teams.

June 2010

Kazuhiro YONEDA
Director General, Industrial Development Department
Japan International Cooperation Agency

Letter of Transmittal

June, 2010

We are pleased to submit to you the preparatory survey report on the Project for Clean Energy Promotion using Solar Photovoltaic System in Mongolia.

This survey was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from June 2009 to June 2010. In conducting the survey, we have examined the feasibility and rationale of the project with due consideration to the present situation of Mongolia and formulated the most appropriate outline design for the project under Japan's Grant Aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Tomoyasu FUKUCHI
Project manager
Preparatory Survey team on
the Project for Clean Energy Promotion using Solar Photovoltaic System
Nippon Koei Co., Ltd.

Summery

1. Contents of the Project

In Mongolia, rural electrification, stabilization of power supply in the rural area and reduction of air pollution created by coal-fired thermal energy plant in Ulaanbaatar are targeted through the renewable energy promotion program. Furthermore, implementing this program is expected to result in energy savings. The National Policy was established in 2005 to manage the National Renewable Energy Program. In January 2007, the Renewable Energy Law of Mongolia was likewise adopted and executed, establishing the framework for the implementation and promotion of renewable energy.

The renewable energy sector belongs to the Ministry of Mineral Resources and Energy. The ministry is an important policy- and decision-making agency for renewable energy, both in terms of technical matters and implementation. The Energy Authority was established in March 2009 under the ministry. Alternatively, the Renewable Energy Department is implementing the projects in accordance with the Renewable Energy Law of Mongolia issued on January 11, 2007.

This project promotes awareness of the PV system, builds technical experience on PV system and grid-connection, and promotes mitigation of GHG emission by providing PV system and related equipment at the site near a trunk road along the airport in Ulaanbaatar, the capital of Mongolia. The project also promotes the interconnection of power generation using “clean” renewable energy to the central grid system, which depends on coal thermal. It also presents countermeasures against air pollution and climate change.

In this assistance plan, from the procurement to the implementation stage, the project implementing agency, its responsible department, and responsible organization of Mongolia are as follows.

- Responsible Organization: Ministry of Roads, Transport, Construction and Urban Development (MRTCUD)
- Implementing Agency: Civil Aviation Authority of Mongolia (CAAM)
  Responsible Section: Electricity Supply Section
- Cooperation Agency: Ministry of Mineral Resources and Energy

The PV system will connect to the sub-station (No.3B S/S) which is 300 m away, connected to the 6 kV line and consuming power within the premises of the airport. The remaining surplus power will flow towards the grid network of Ulaanbaatar Electricity Distribution Network Company (UBEDN). Feed-in-tariff is based on the power purchase agreement (PPA) contract between CAAM and UBEDN.

2. Result of Survey

The term of the dispatch of the study team was as follows.

- 1st Site Survey: July 28th to August 26th
- 2nd Site Survey: November 1st to December 7th
- 3rd Site Survey March 1st to March 6th

From the Mongolian side, the installation of the system was requested for the Chinggis Khaan International Airport facility. However at present, the construction plan for new international airport is in progress and after its completion, most of the main functions will be transferred to the newly built international airport. The completion of the new international airport is targeted within 2015. If the PV system is installed at the Chinggis Khaan International Airport, then the implementation of design criteria for site selection described as (1) realization of long term demonstration impact will not be possibly fulfilled as targeted. Thus, aside from the Chinggis Khaan International Airport, the

open space between said airport and the trunk road running next to the airport is selected as an option to fulfill the site selection criteria (1) to (4). This serves as an alternative to the requested installation site.

Design Criteria
Basic Concept (Site Selection)
(1) Realization of long term demonstration impact
(2) Securing enough space for installation
(3) Existence of distribution network for interconnection
(4) For smooth O/M near by existence of Implementing Agency
Basic Concept (Facility Selection)
(1) Anticipation of demonstration impact
(2) Anticipation of surplus power sales

The decided installation capacity of 300 kWp is the same as per requested assistance cooperation. The required installation area for the PV system of 300 kWp capacity is around 4,000 m^2 for crystalline and around 7,900 m^2 for amorphous type modules. The recorded annual average power consumption of airport facility in 2008 is around 791 kW. Considering this, reverse power sales toward the existing grid are expected even though time is limited to generate surplus power during low power consumption.

3. Implementation Schedule

The total period from the initial stage of planning, preparation of drawings for inspection, execution of works until the project hand over is planned to be completed within 13 months. It is proposed to perform civil construction works during the first year and the installation of components in the succeeding year. This is because concrete casting is only possible from March 15 to October 15, under the provision of local laws.

Location Map

Source: Central Intelligence Agency (CIA)

Abbreviations

A/P	Authorization to Pay
B/A	Banking Arrangement
CAAM	Civil Aviation Authority of Mongolia
CDM	Clean Development Mechanism
DM	Deutsche Mark
DNA	Designated National Authority
E/N	Exchange of Notes
EIA	Environmental Impact Assessment
EUR	Euro
GHG	Green House Gas
IEC	The International Electrotechnical Commission
IEE	Initial Environmental Evaluation
IEEE	The Institute of Electrical and Electronics Engineers, Inc.
JEC	Japanese Electrotechnical Committee
JIS	Japanese Industrial Standards
JPY	Japanese Yen
MNT	Mongolia Tugrik
O/M	Operation & Maintenance
PPA	Power Purchase Agreement
PV	Photovoltaic
S/S	Substation
TTS	Telegraphic Transfer Selling
UBEDN	Ulaanbaatar Electricity Distribution Network Company
USD	U.S. Dollar

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Chapter 1 Background of the Project

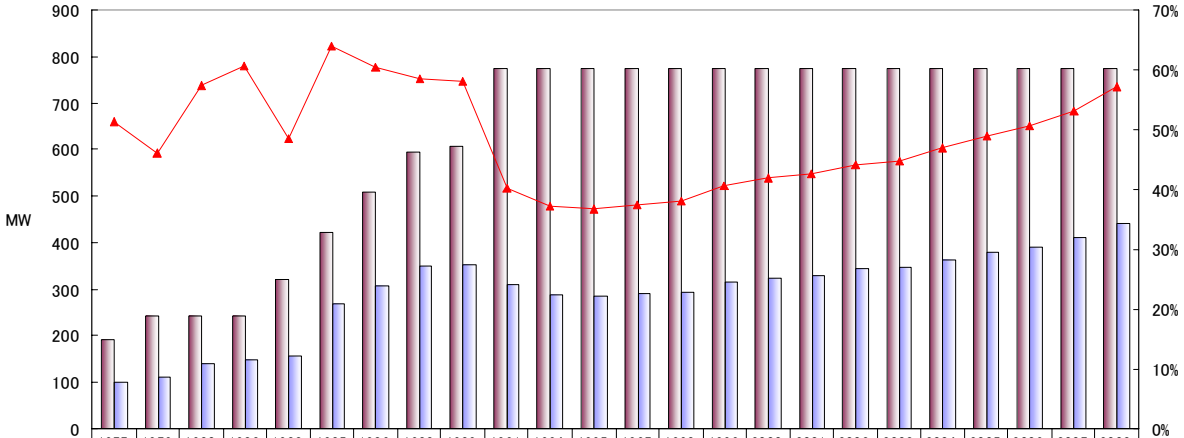
1-1 Present Condition and Needs of the Concerned Sectors

1-1-1 Present Condition and Needs

(1) Power Sector

The energy sector covers the power and heat supplies in Mongolia. Both of them depend on the coal produced in Mongolia. There are three electric power systems, namely: east, west and central, and all are connected to the Russian power grid. The main power source of the central system, which is the largest among the three, is the Ulaanbaatar Thermal Power Plant No. 4 (500 MW Coal Thermal). This plant provides both power and heat. The central system also receives power from the Russian grid during peak demand. Thermal power plant has less capacity to control power output; therefore, the power grid within Mongolia should have the capacity to control the power output.

Figure 1-1-1-1 illustrates the installed capacity and the rate of operation of the central electric power system.



	1977	1979	1980	1982	1983	1985	1986	1988	1989	1991	1994	1995	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Capacity	194	244	244	244	321.5	421.5	509.5	595.5	607.5	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3	774.3
Operation	99.5	112.2	139.8	147.9	155.8	269.4	307.4	348.2	352.8	311.4	288.0	283.7	289.7	293.8	314.5	325.0	330.7	342.5	346.5	363.7	379.0	391.9	410.3	442.2
Op. rate	51%	46%	57%	61%	48%	64%	60%	58%	58%	40%	37%	37%	37%	38%	41%	42%	43%	44%	45%	47%	49%	51%	53%	57%

Source: Energy Statistical Indicator 2008, Energy Authority (2008 data are estimates)

Figure 1-1-1-1 Installed Capacity and Operation of the Central Electric Power System

In terms of demand, the power demand in Ulaanbaatar City is expected to reach more than 1,300 MW in 2030[1] because of increasing power and heat demands caused by economic growth and urbanization. Considering this expectation, additional power supply capacity of 900 MW is required to meet the long-term increasing demand. In response, the Government of Mongolia has planned to increase its generation capacity in its “Energy Sector Development Strategy (2002-2010)”. For sustainable management of the sector, the government plans the following: 1) Improvement of financial strength and installation of private capital of/to power generation/transmission/distribution companies; 2) Improvement of organization/management scheme and human resource development of electricity company and energy regulatory authority; 3) Improvements in energy efficiency and promotion of energy conservation; and 4) Improvement of power selling price and scheme of tariff collection with a view to future privatization.

The generation unit price of the central electric power system is MNT40.79/kWh, which is around

[1] The Study on City Master Plan and Urban Development Program of Ulaanbaatar City (UBMPS) (JICA, 2009)

60% of the power tariff of MNT68.00/kWh. Other costs include the following: 1) transmission loss (MNT1.46/kWh), 2) transmission cost (MNT2.63/kWh), 3) distribution loss (MNT7.73/kWh), 4) distribution cost (MNT12.47/kWh), and 5) power feeding loss (MNT 2.92/kWh) in 2008.

(2) Renewable Energy Sector

In Mongolia, rural electrification, stabilization of power supply in the rural area and reduction of air pollution created by coal-fired thermal energy plant in Ulaanbaatar are targeted through the renewable energy promotion program. Furthermore, implementing this program is expected to result in energy savings. The National Policy was established in 2005 to manage the National Renewable Energy Program. In January 2007, the Renewable Energy Law of Mongolia was likewise adopted and executed, establishing the framework for the implementation and promotion of renewable energy.

The renewable energy sector belongs to the Ministry of Mineral Resources and Energy. The ministry is an important policy- and decision-making agency for renewable energy, both in terms of technical matters and implementation. The Energy Authority was established in March 2009 under the ministry. Alternatively, the Renewable Energy Department is implementing the projects in accordance with the Renewable Energy Law of Mongolia issued on January 11, 2007.

The National Renewable Energy Centre is a focal point for renewable energy dissemination in the rural areas. The centre was restructured in 2008 by the former Energy Department of the Ministry of Energy and Energy Research Center into a 100% owned national company.

(3) Climate Change Measure

Mongolia submitted its Instrument of Accession to the Kyoto Protocol to the UN Secretariat on December 15, 1999. In 2007, the head office of the Designated National Authority (DNA) for Clean Development Mechanism (CDM) was formed under the Ministry of Nature, Environment and Tourism to be responsible for greenhouse gas (GHG) mitigation.

The “Capacity Building for Development of Carbon Finance Projects,” supported by the World Bank’s “Japan Policy and Human Resource Development for Technical Assistance Program,” has been carried out since 2008 and has continued until the end of 2009. The project is expected to continue for one more year. The activities of the project include public relations of CDM in order to disseminate its merits and approval procedures.

So far, there are only three projects approved by the DNA in Mongolia and it is expected that private developers will get involved in CDM projects. There are no potential solar photovoltaic (PV) projects that intend to get CDM credit at this time; most of the potential electrification projects are wind power and hydropower projects.

1-1-2 National and Sector Development Plan

The National Renewable Energy Program 2005-2020 was resolved on 9 June, 2005. Its focus is to decrease air pollution and to achieve social economic sustainable development of rural areas by implementing renewable energy systems in Mongolia. The goal is for the share of renewable energy in national power generation to be 3-5% by 2010, and 20-25% by 2020.

The promotion scheme of introduction of renewable energy was arranged by Renewable Energy Law of Mongolia which is effective from January 2007; however there is no case of grid-interconnection of power generation facility by renewable energy under the law. This project will be the first case if grid-interconnection is realized under the law, therefore concerned agencies are much interested in this project.

1-1-3 Socio-Economic Conditions

Economic in Mongolia shows 10.2% growth in 2007 and this is the second highest growth rate after

economic recovery in 1994. Percentage of the private sector in GDP is 68.4% in 2007. Nominal GDP per capita in 2007 is USD 1,489, which is 4.6 times of one in 1993, which is the worst year after transition towards a market economy in 1990, however it is still 24% lower than USD 1946.9 in 1989, which is the year before transition towards a market economy.

Ratio of each industry in GDP has no big change during recent years. 29.2% was mining/manufacturing and construction, 22.8% was agriculture, wholesale and retail trade was 23.7% and others is 24.3% in 2007.

1-2 Background of the Grant Aid

(1) Background of the Grant Aid

In January 2008, Japan established the Cool Earth Partnership, which is an activity for developing countries that are aiming to achieve both GHG emission reductions and economic growth, and working to contribute to climate stability. Through this, Japan cooperates actively with developing countries to reduce GHG emissions, e.g., by enhancing energy efficiency. A new grant aid scheme named “Program Grant Aid for Environment and Climate Change” has been created in 2008 as a component of this package to support a developing country which is willing to contribute to climate stability but facing shortages in implementing capacity as well as funds.

As a policy of the Japanese Government, JICA decided to promote clean energy including renewable energy as a “co-benefit” cooperation case and utilize Japanese advanced technology including technology of the private sector.

As mentioned in the background, positive utilization of PV technology, in which Japan has high advantage, is required. Moreover, the Ministry of Foreign Affairs conducted surveys about the needs and ideas for the “Program Grant Aid for Environment and Climate Change” using PV power generation and other technology.

The “Program Grant Aid for Environment and Climate Change” aims to address climate change and other environmental challenges. The program intends to combine several components like equipment provision, capacity building and others. Because of this, the program is implemented with the dual aims of equipment provision and installation. However, the soft component is also implemented to establish the operation and maintenance scheme for the smooth operation of the provided equipment.

(2) Purpose of the Grant Aid

In Mongolia, rural electrification, stabilization of power supply in the rural area and reduction of air pollution created by coal-fired thermal energy plant in Ulaanbaatar are targeted through the renewable energy promotion program. Furthermore, implementing this program is expected to result to energy savings. The National Policy was established in 2005 to manage the National Renewable Energy Program. In January 2007, the Renewable Energy Law of Mongolia was likewise adopted and executed, establishing the framework for the implementation and promotion of renewable energy.

This project promotes awareness of the PV system, builds technical experience on PV system and grid-connection, and promotes mitigation of GHG emission by providing PV system and related equipment at the site near a trunk road along the airport in Ulaanbaatar, the capital of Mongolia. The project also promotes the interconnection of power generation using “clean” renewable energy to the central grid system, which depends on coal thermal. It also presents countermeasures against air pollution and climate change.

(3) Over all Plan

1) Responsible Organization

Ministry of Roads, Transport, Construction and Urban Development (MRTCUD)

2) Implementing Agency

Civil Aviation Authority of Mongolia (CAAM)

3) Cooperation Agency

Ministry of Mineral Resources and Energy

4) Installation Site of PV System

An open space of around 17,200 m^2 is the selected installation site for the PV system. This area is toward the east of the airport and lies between the trunk road running north to south and the fence of the Chinggis Khaan International Airport.

The PV system will connect to the sub-station (No.3B S/S) which is 300 m away, connected to the 6 kV line and consuming power within the premises of the airport. The remaining surplus power will flow towards the grid network of Ulaanbaatar Electricity Distribution Network Company (UBEDN). Feed-in-tariff is based on the power purchase agreement (PPA) contract between CAAM and UBEDN.

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

(1) National Target and Project Target

In Mongolia, the rural electrification, stabilization of power supply in rural areas, and diminishing the air pollution due to coal fired thermal energy plant in Ulaanbaatar are targeted by renewable energy promotion program. Furthermore, implementing the renewable energy program is expected to result in energy savings.

The National Policy was established in 2005 to manage the National Renewable Energy Program. Hence in January 2007, the Renewable Energy Law of Mongolia was adopted and executed, establishing the framework for the implementation and promotion of renewable energy.

The Government of Mongolia is taking parallel process to support the promotion of renewable energy policy and to establish institutional framework enthusiastically by introducing programs for actual achievements. From this concept, the photovoltaic power generation system (hereinafter referred to as PV system) is considered to be installed within the city of Ulaanbaatar, targeting the demonstration effect and promotion of renewable energy implementation scheme.

(2) Project Outline

The PV system and its related components are targeted to be installed under this assistance plan. To achieve the mentioned target, PV system is decided to be installed along the side of the trunk road passing next to the Chinggis Khaan Airport facility. The plan is to supply generated power to the airport and to the central grid distribution system through connection with the grid distribution network. From this, it is expected to reduce the electrical burden of the airport facility and promote renewable energy system as well as reduce Green House Gas (GHG) emission.

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

(i) Scope of Assistance Plan: Grid-connected PV system with large capacity is the first of its kind in Mongolia. Hence, most of the required components and installation works are included in the scope of assistance plan.

(ii) Site Selection: The basis of site selection are as follows: (1) Longer and wider demonstration impact (2) Enough installation space for planned large capacity (3) Nearby existing grid distribution network for grid connection (4) Nearby existence of implementation agency considering smooth support of operation management.

(iii) Facility Outline: The realization of reverse power sales through grid interconnection is the basic concept. Thus, (1) there is a possibility for grid connection (not too large) and achievement of maximum demonstration impact, and (2) the generated power is established to supply energy to airport facility and reverse flow of surplus power towards grid distribution network is realized.

(2) Natural Conditions

The construction and installation works such as the civil and outdoor activities will not possibly materialize during the winter season. Therefore, construction and installation is planned and scheduled considering these facts. Furthermore, it is essential to consider that it can withstand severe winter conditions and temperature of below minus 30o Celsius at the time of project design.

(3) Social Economic Environment

There are noted cases of robbery. To avoid such situation to the maximum extent, these shall be considered from the planning stage.

(4) Basic Policy for Supply / Construction

The basic design for construction of concrete foundations and buildings are based on Mongolian Standards or Russian Standards, which is normal practice in Mongolia. The designs of equipment are based on international standards like IEC and IEEE. However, considering that the PV system is a product of Japan, the standard components shall be designed in accordance with JIS and JEC.

(5) Policy for Local Contractor

There are several standalone PV systems which have capacity of tens to hundreds kWp, however there is no grid-connected PV system and the PV system by this project will be first case in Mongolia. Therefore there is some part of accumulated technical/practical experience. National Renewable Energy Center, which is a government agency and installed 90% PV module in Mongolia, shows desire to acquire technologies through this project.

The construction of concrete foundations, installation of equipment and components under the supervision of a Japanese consultant, is possible. On the other hand, local consultants also have the ability to supervise the installation works under the support of a Japanese consultant. Therefore, utilization of local contractors, under the supervision of Japanese technical experts and consultants, is planned.

(6) Policy for Operation and Maintenance (O/M)

The Civil Aviation Authority of Mongolia (CAAM) has experience in implementing PV system and can manage and perform basic O/M. However, grid-connected PV system with large capacity is the first of its kind in Mongolia and to operate the system smoothly, technical know-how on initial startup, O/M process and application procedure of grid-connected system shall be covered through soft component activities under the assistance plan.

(7) Policy for Equipments and Facility

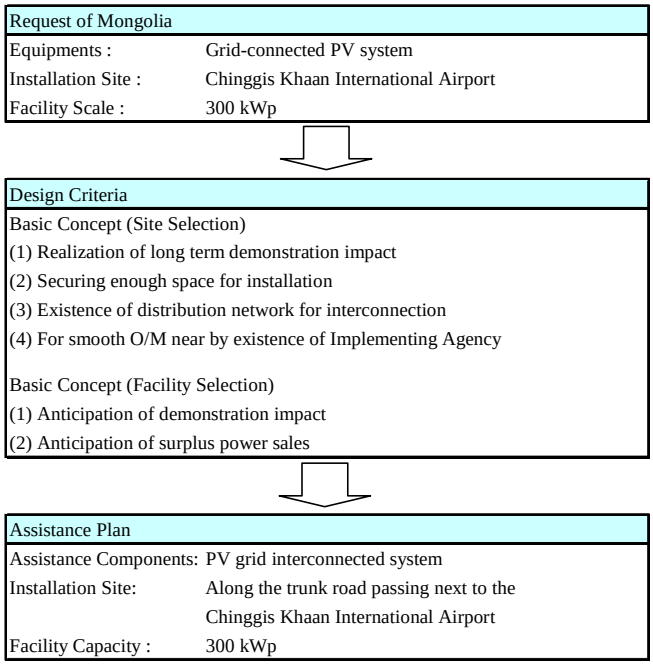
To gain long-term demonstration impacts from the installed grid-connected PV system, selection of equipment and related components are based on strong built and longer durability. Furthermore, the equipment and components are selected to ensure high accuracy and quality, targeting an absolute model of grid-connected PV system under the assistance plan.

(8) Policy for Construction Works and Supply

The construction of foundations and civil works are scheduled in accordance with Mongolian civil construction standard, considering that the installation site lies at a severely cold region. It is thus decided that the components under the assistance plan shall be supplied from Japan. In winter, the execution of outdoor and civil engineering works is not possible. Therefore, such works are scheduled to start in the first year while other installation works will be set for the succeeding year.

2-2-2 Basic Plan (Construction Plan / Equipment Plan)

For the requested assistance from Mongolia, the basic design policy for deciding the plan and based on the results gained, the assistance plan is summarized in Figure 2-2-2-1 below.



Source: JICA Study Team

Figure 2-2-2-1 Contents of Japanese Assistance Plan

From the Mongolian side, the installation of the system was requested for the Chinggis Khaan International Airport facility. However at present, the construction plan for new international airport is in progress and after its completion, most of the main functions will be transferred to the newly built international airport. The completion of the new international airport is targeted within 2015. If the PV system is installed at the Chinggis Khaan International Airport, then the implementation of design criteria for site selection described as (1) realization of long term demonstration impact will not be possibly fulfilled as targeted. Thus, aside from the Chinggis Khaan International Airport, the open space between said airport and the trunk road running next to the airport is selected as an option to fulfill the site selection criteria (1) to (4). This serves as an alternative to the requested installation site.

The decided installation capacity of 300 kWp is the same as per requested assistance cooperation. The required installation area for the PV system of 300 kWp capacity is around 4,000 m^2 for crystalline and around 7,900 m^2 for amorphous type modules. The recorded annual average power consumption of airport facility in 2008 is around 791 kW. Considering this, reverse power sales toward the existing grid are expected even though time is limited to generate surplus power during low power consumption.

(1) Overall Plan

The open space with an area of around 30,000 m^2 is the selected installation site for the PV system. It is situated towards east of the airport which lies between the trunk road running north to south, and the fence of the Chinggis Khaan International Airport. The open space is suitable for installation of PV system as it is on a level ground without high storey buildings or obstacles within the surroundings that form shadows. The installed PV system can be possibly viewed from the road and expected to have a high demonstration impact. The installed PV system is considered as one of the components of CAAM which will execute regular O/M as it also does to other equipment/components within the facility of airport.

The selected land for installation is under the control of Ulaanbaatar Municipality. In September 2009, CAAM submitted the application for acquisition of the land, which is already under process.

The PV system will connect to the Sub-station (No.3B S/S) 300 m away to the connecting 6kV line

and will supply power to the airport premises. The surplus power will flow towards the grid network of Ulaanbaatar Electricity Distribution Network Company (UBEDN). Consequently, the feed-in-tariff shall be based on Power Purchase Agreement (PPA) contract between CAAM and UBEDN.

(2) Equipment Plan

The outline of equipment procurement is summarized in Table 2-2-2-1 below.

Table 2-2-2-1 List of Components (Unit Price above JPY 1,000 Thousand)

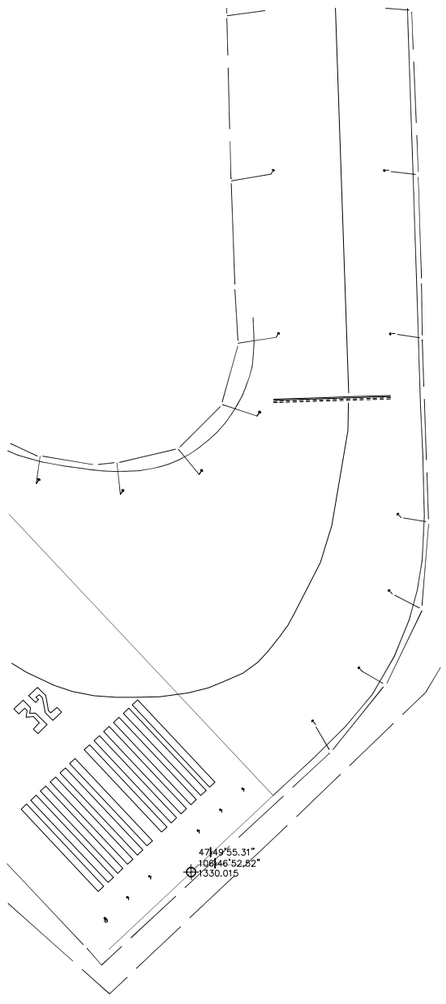
Components	Specification	Qty.	Unit	Purpose
PV module	300kWp (Total capacity)	1	Set	To generate power by receiving sunlight
PV structure	Galvanized finishing	1	Set	To support PV module at required height and angle
Power Conditioner	Total 300kW, Indoor Self standing with grid interconnecting facility and safety protection device	6	Unit	To convert DC voltage to AC voltage, with protection device
Display board	Outdoor display board of size W 1,200 x L 800 mm	1	Set	To display PV power generation system information
Meteorological Monitoring system	Pyranometer, Thermometer, Anemometer / Wind Vane, Data recording unit	1	Set	To observe and transfer meteorological data for record purposes
Data Collecting system	Computer, Software, Printer, UPS	1	Set	To record and manage the PV power generation and meteorological information data
Indoor type 6kV switchboard	Self-standing indoor type, 3 Phase 3 Wire, 6kV, 50 Hz	1	Unit	To accommodate 6kV grid interconnecting power panel with breaker and protection device
Indoor type 400V distribution board	Self-standing indoor type, 3 Phase 4 Wire, 400V, 50 Hz	1	Unit	To accommodate 400V panel for connection to the system with breaker
Interconnecting Panel	Self-standing Indoor Type, 3Phase 4Wire, 400V, 50 Hz	1	Unit	To connect several power conditioners to the main system
Step up Transformer	6kV/400V, Dry and indoor type, 3Phase 4 Wire, Y-Y connection	1	Unit	To step up AC voltage from 400V to 6kV

Source: JICA Study Team

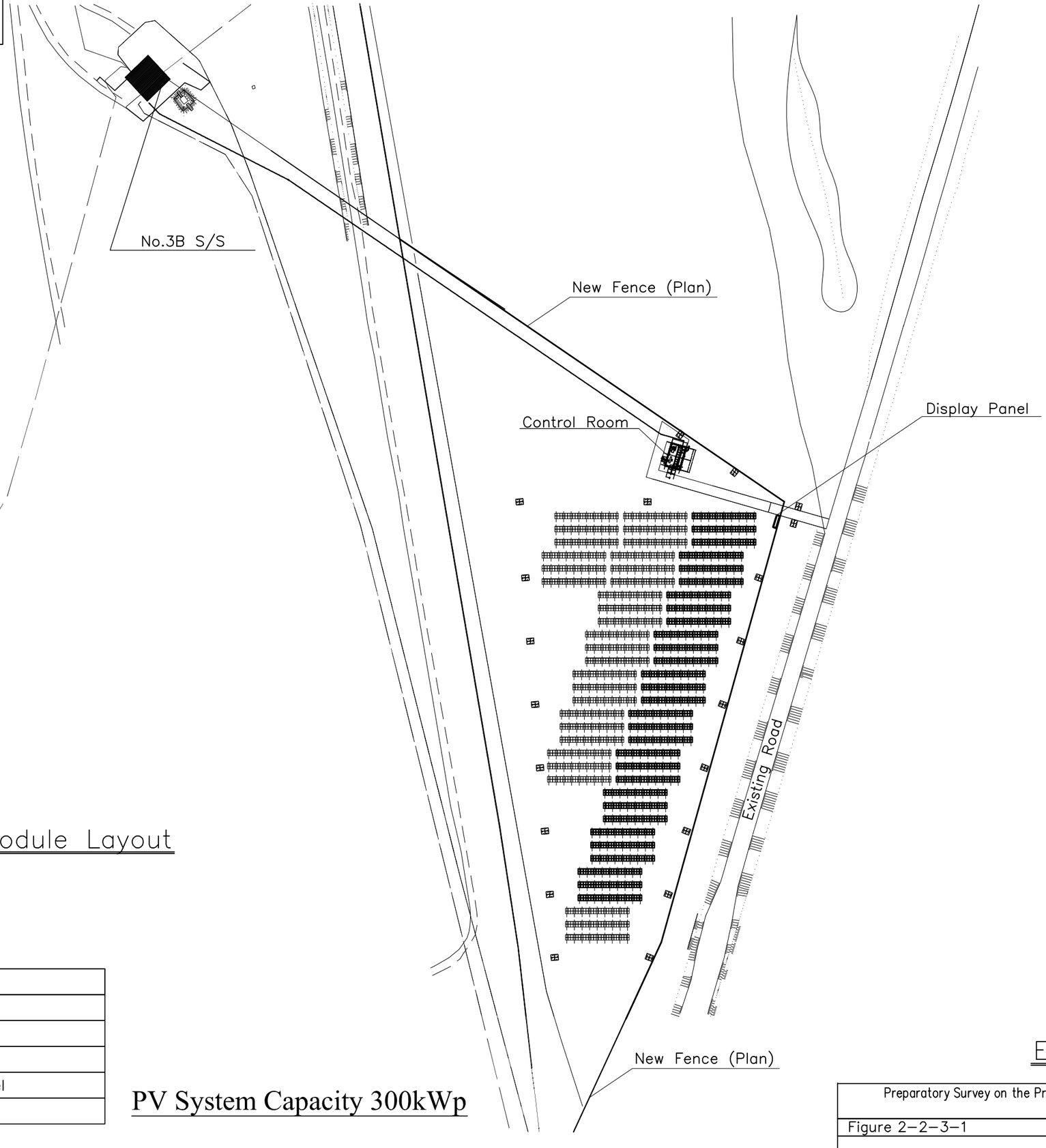
2-2-3 Outline Design Drawing

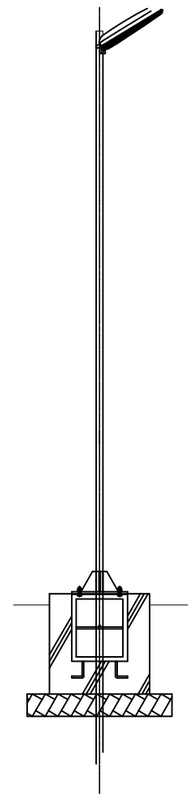
The overall PV system layout, PV system single line diagram, concrete foundation structure and PV structural plan, plan and sections of control room indicating location of distribution board and fence drawings are shown in Figure 2-2-3-1 to 2-2-3-5.

For Reference



PV module Layout





Exterior LED Light

Legend	
	Exterior LED Light
	Power Line
	Fence (Existing)
	Amorphous PV Panel
	Crystalline PV Panel

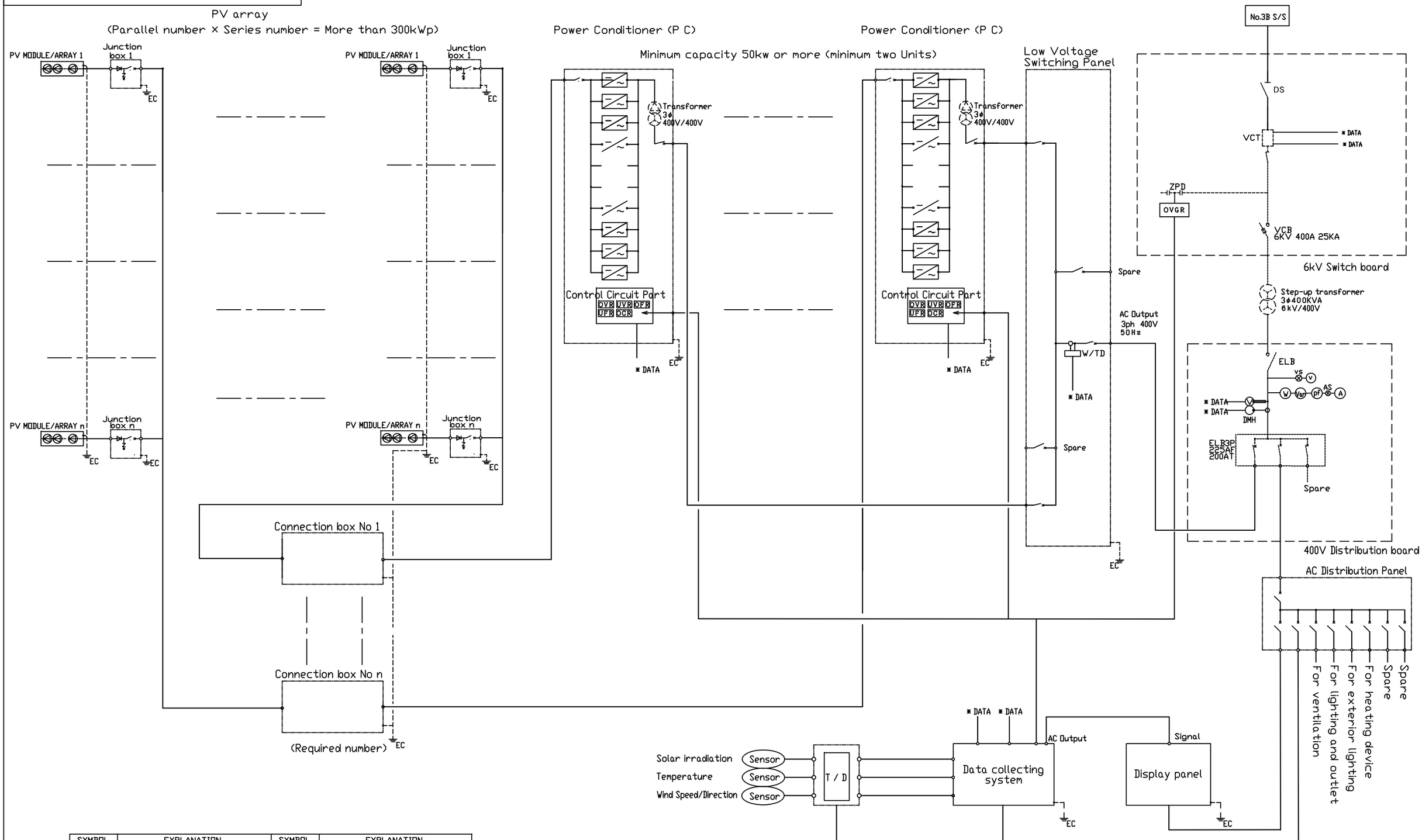
PV System Capacity 300kWp

Preparatory Survey on the Project for Clean Energy Promotion Using Solar Photovoltaic System in Mongolia

Figure 2-2-3-1

PV System Layout Drawing

For Reference



SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
OVR	Over Voltage Relay	ZPD	Hivoltage Ground Relay
UVR	Under Voltage Relay	OVGR	Over Voltage Ground Relay
OFR	Over Frequency Relay	VCB	Vacuum Circuit Breaker
UFR	Under Frequency Relay	V	Volt Meter
EC	Earth Connection	W	Watt Meter
T/D	Transducer	ELB	Earth Leakage Breaker
DS	Disconnection Switch	VCT	Valtage Current Transformer
W/TD	Watt Transducer		

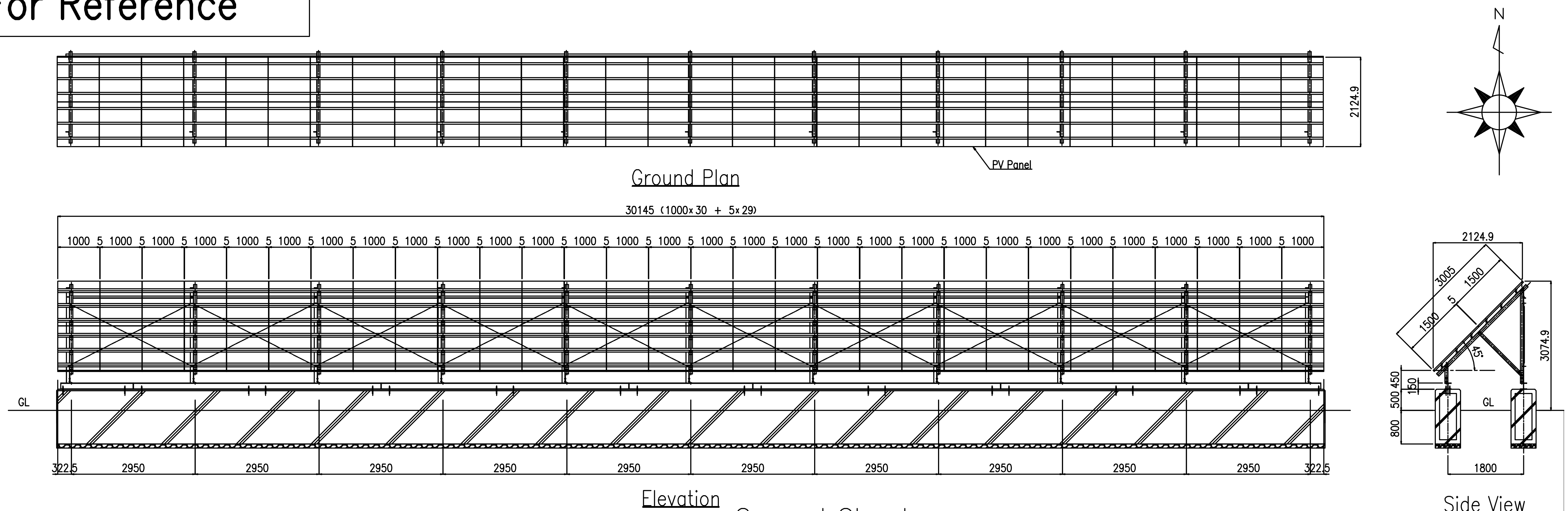
PV System Capacity 300kWp

Preparatory Survey on the Project for Clean Energy Promotion Using Solar Photovoltaic System in Mongolia

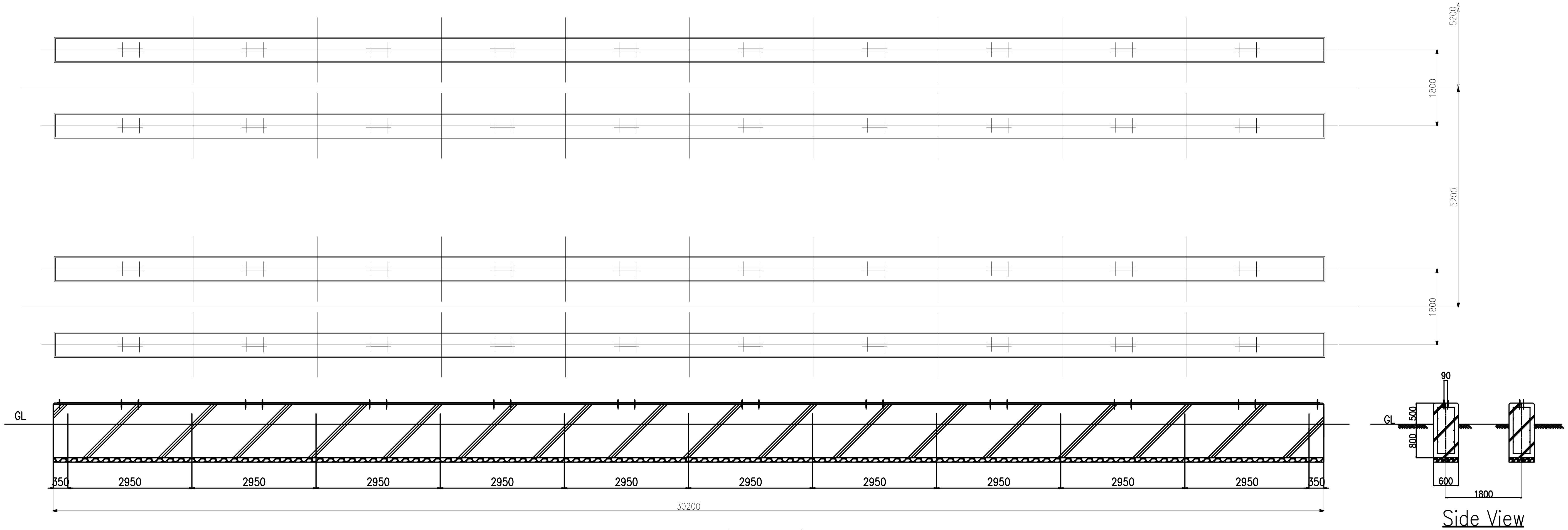
Figure 2-2-3-2

PV System Single Line Diagram

For Reference



Support Structure



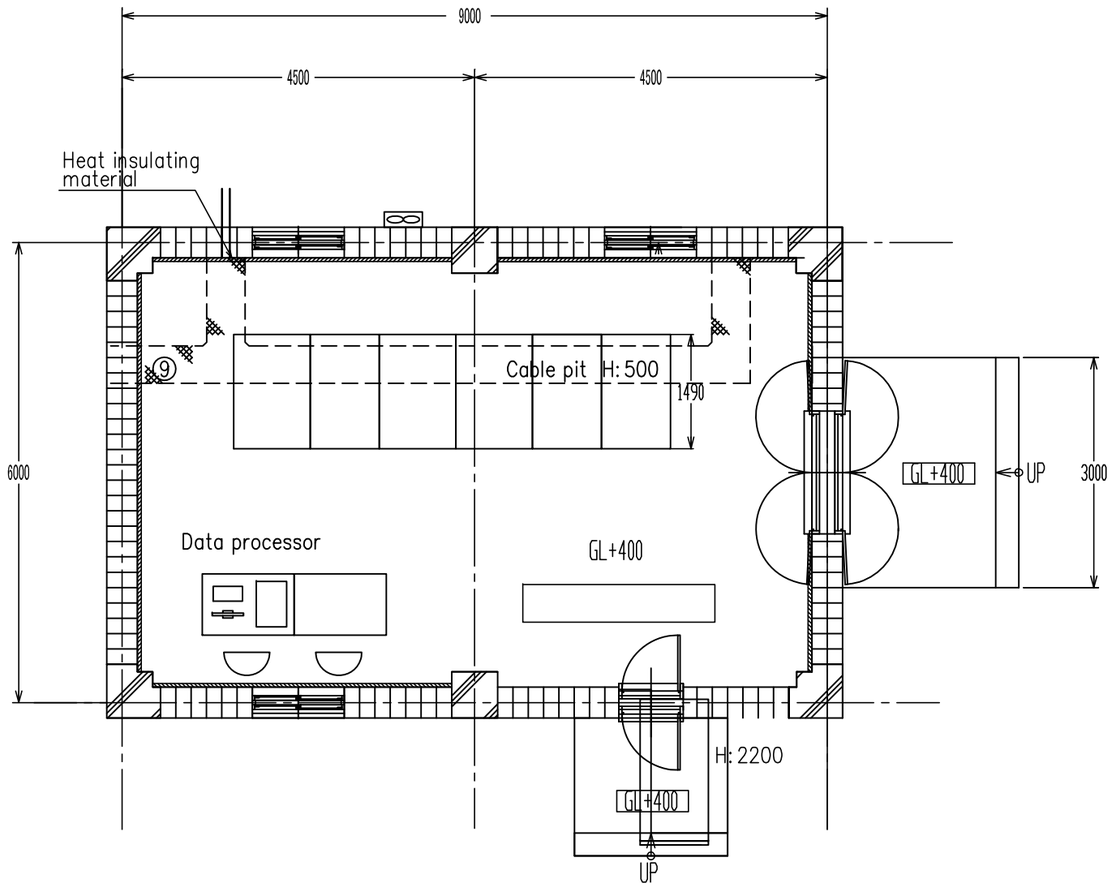
Concrete Base (Elvation)

Preparatory Survey on the Project for Clean Energy Promotion Using Solar Photovoltaic System in Mongolia

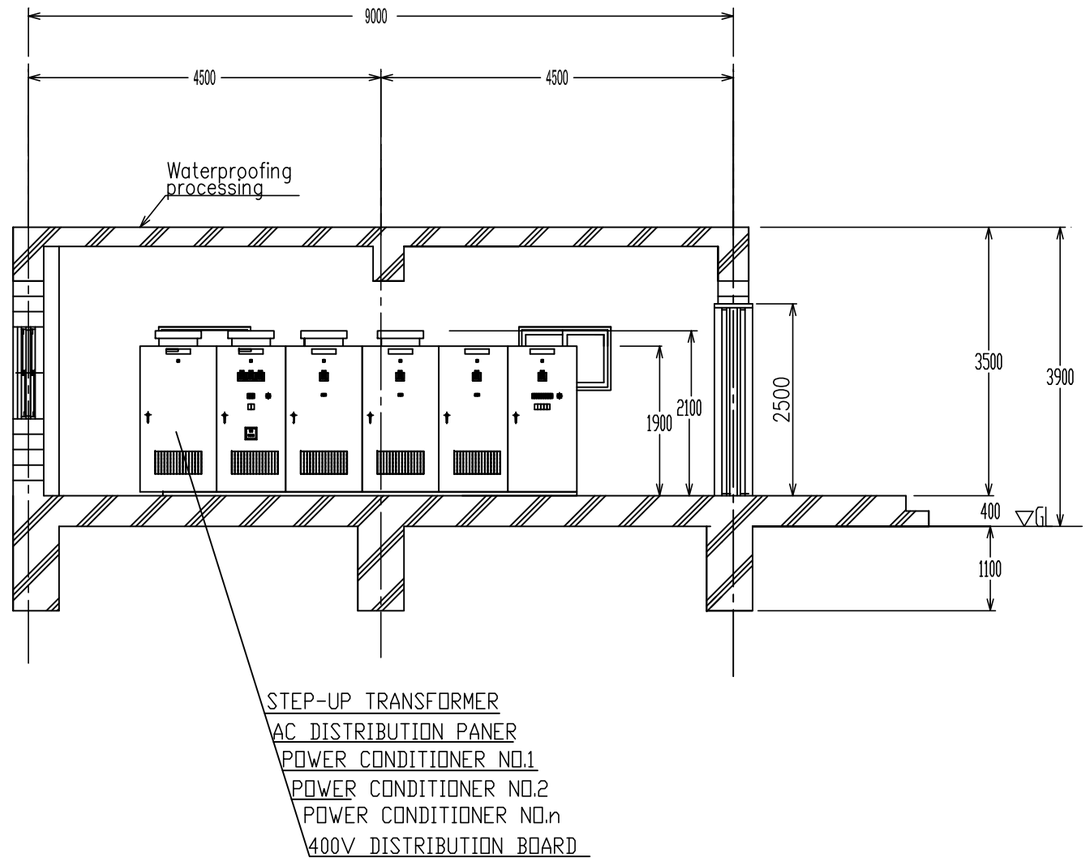
Figure 2-2-3-3

PV Foundation and Strucure Details

For Reference



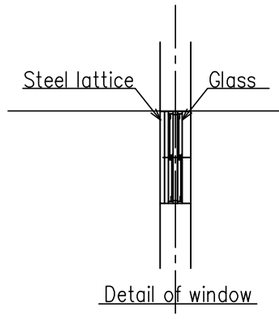
Scale 1/80



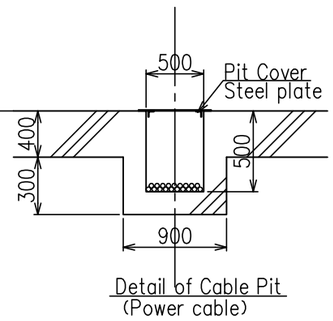
Scale 1/80

Remarks

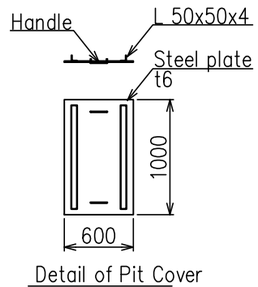
1. This building shall be constructed in accordance with the law of Mongolia "The Building Standard Act."
2. Necessary equipment such as fire extiguisher etc. shall be prouided by the building contractor in addition to the desk, and Chairs.
3. The finishing outer surface and color shall be similar to the airport of Mongolia building.



Detail of window



Detail of Cable Pit
(Power cable)



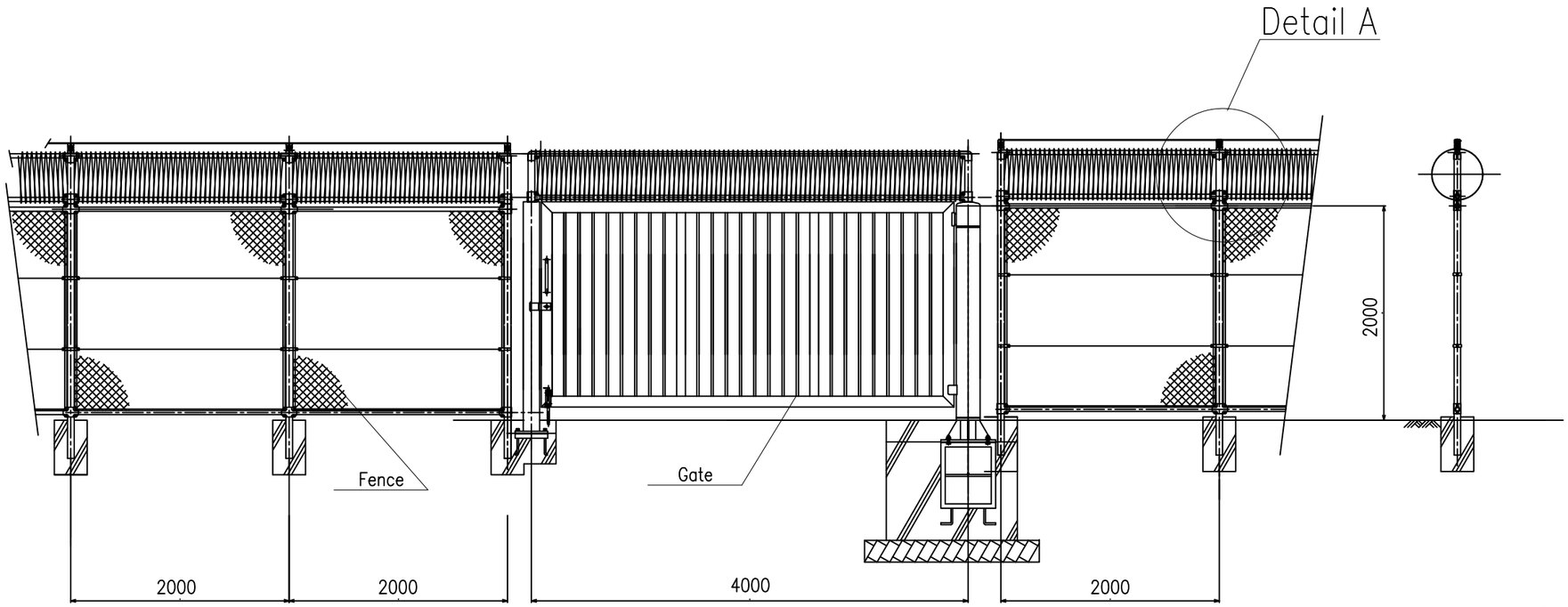
Detail of Pit Cover
(Power cable)

Preparatory Survey on the Project for Clean Energy Promotion Using Solar Photovoltaic System in Mongolia

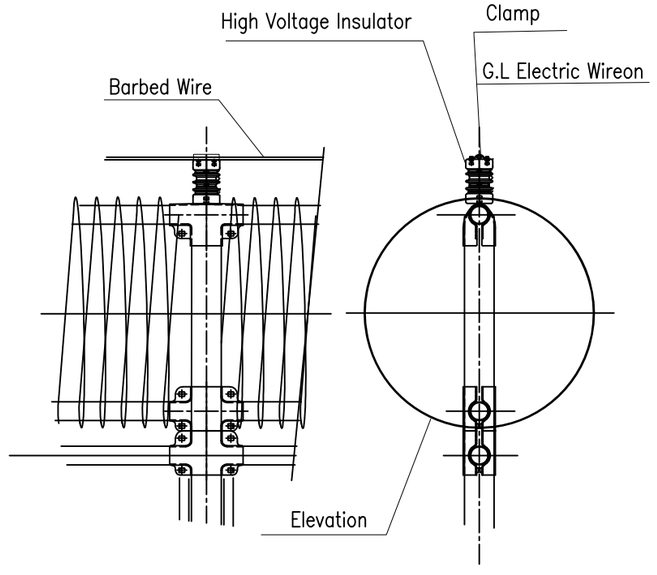
Figure 2-2-3-4

Control House Plane and Sectional Plan

For Reference



Fence and Gate



Detail A

Preparatory Survey on the Project for Clean Energy Promotion Using Solar Photovoltaic System in Mongolia

Figure 2-2-3-5

Fence and Gate Detail

2-2-4 Implementation Plan

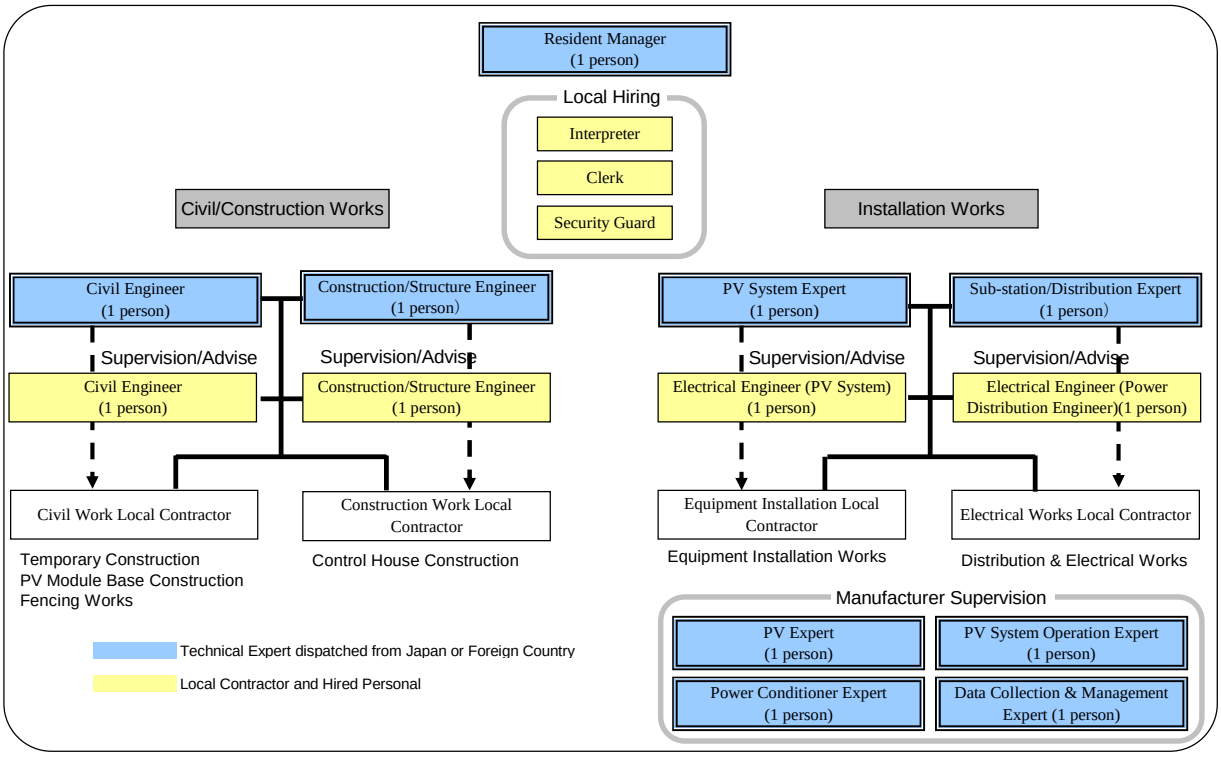
2-2-4-1 Implementation Policy

The basic policy for procurement/execution under the assistance plan is as follows.

- Demonstration Impact: To accelerate the demonstration impact, components are also included in the procurement plan. To view the details of the grid-connected PV system operating status and information, a display panel is included in the equipment procurement plan. On the display panel, five items will be displayed, i.e., the main related condition for power generation such as the (1) solar insolation (2) ambient temperature, and as power output (3) generated power (kW) (4) accumulated power (kWh), and (5) expected possible amount of reduction of carbon dioxide by the generated power.
- Measurement and Quantification of Assistance Plan: For the continuous measurement, data recording and management device is included in the procurement of equipment to record meteorological and power generation data. From the measured data using precision instruments, the technical impacts of the assistance plan will be possibly measured and quantified.
- Guarantee of Durability: Since storage of battery is not essential in grid-connected system, the electric circuit is the unit most possibly subjected to higher damage probability. The most possible cause of circuit failure is due to the induced spike voltage from lighting and switching action. The countermeasures to prevent this induced spike voltage invading the electric circuit are considered to the possible extent. Such measures involve installation of arrester, earthing works and fence that function as lightning rod.

The selection procedure for local assistance and dispatching of Japanese technical experts for the project is summarized as follows:

- Local Consultant and Construction Company: Both are supposed to be in the field of electricity and civil engineering works, and will work as assistants under the Japanese consultant and technical experts of the project.
- Japanese Technical Experts: The grid-connected PV system is the first case to be introduced in Mongolia. Hence, dispatching Japanese technical experts is essential to cover the fields like PV system, sub-station and distribution, civil and construction works. The administrative structure of procurement contractor is as shown in Figure 2-2-4-1.



Source: JICA Study Team

Figure 2-2-4-1 Structure of Procurement Contractor

The dispatched Japanese technical export as a residence manager needs to cover the entire field like PV system, sub-station and distribution, civil and construction works. Besides, the operation management and initial start up is part of the tasks of the supplier's technical expert.

In this assistance plan, from the procurement to the implementation stage, the project implementing agency, its responsible department, and responsible organization of Mongolia are as follows.

- Responsible Organization: Ministry of Roads, Transport, Construction and Urban Development (MRTCUD)
- Implementing Agency: Civil Aviation Authority of Mongolia (CAAM)
  Responsible Section: Electricity Supply Section
- Cooperation Agency: Ministry of Mineral Resources and Energy

2-2-4-2 Implementation Conditions

The main points of concern for construction and procurement are as follows:

- Period for Concrete Works: The period for concrete work is allowed only from March 15 to October 15 by the Mongolian Law. Therefore, commencement of construction and civil (concrete base) works is planned until October 15 of the first year while installation of components will begin from March 15 of the succeeding year.
- Ground Freezing: In winter, the ground heaves up due to freezing expansion. Therefore, to prevent the partial upheaval of the PV structure base and control house, building of continuous ferroconcrete base is considered.
- Safety Management of Material and Equipment: Basically, fence is also constructed during the first year together with other civil works. In the succeeding year, the equipment and components delivered will be kept inside the constructed fence under the regular airport security of CAAM, in order to protect these against robbery attempts or accidents.

2-2-4-3 Scope of Works

This is the first case of a grid-connected PV system to be implemented in Mongolia. Hence, the procurement, construction and installation works are planned to be covered by this assistance plan. Other essential works, like securing land for installation, application and processing for grid interconnection, arrangement of entrance permission in the airport, and so on, are the responsibility of Mongolia.

In general, fencing of the site is the responsibility of the recipient country, but in this plan, the lightning protection function is included with the fence. Therefore this is also included under the assistance plan.

2-2-4-4 Consultant Supervision

The outline of procurement management and construction plan is as follows:

- Basic Concept: Since implementation of the grid-connected PV system is Mongolia' first experience, procurement management and supervision works are planned for the entire construction period under this assistance plan.
- Notes of Priority: Due to the restriction in the working period, concrete works for the first year require an elaborate working schedule and reliable supervision. The assurance of whether works will be completed within a limited time needs to be judged carefully and the decision for interrupting such works is very important.
- Management Structure: The resident management system is adopted to manage the continuous work process from procurement to the end of construction period, as mentioned in the basic policy.
- Contents of Work and Specialty: The fundamental activities related to civil works like concrete foundation, fence construction, construction of control house, and so on, during the first year are managed by the civil engineer acting as a resident manager. In the succeeding year, the installation of the PV module, power conditioner and grid-interconnection will take place. For this, the resident manager needs to be knowledgeable in grid-interconnection, not just as an electrical engineer. Furthermore, the PV power generation specialist needs to be on site as his presence is indispensable during inspection of concrete foundation for the PV structure, installation of the PV module, and final inspection of installation and operation test.

2-2-4-5 Quality Control Plan

To manage the quality control of construction works, supply of construction materials and equipment, the following procurement inspection works are planned to be executed under this assistance plan.

(1) Inspection of Drawings

Submission of drawings for the construction equipment under this execution procurement plan is required from the supplier, while verification of the conformity of the materials with specifications well as the quality according to the contract is executed by the consultant.

(2) Factory Inspection

The concept is that the inspection of procured components is executed at the factory before shipment packing. The main equipment such as the switch panel and distribution board, PV module, power conditioner and others are subject to acceptance test at the factory before shipment, witnessed by the consultant to confirm compliance with the approved drawings and specifications.

(3) Inspection before Shipment

A third party inspection is executed to confirm if the procured component, packed materials and loads are as per the procurement document for shipment.

(4) Field Inspection

The inspection of construction and installation components is to be performed at the installation site. The inspection of individual equipment and complete system is executed under the presence and responsibility of the procurement contractor. The inspection at the field is witnessed by the consultant's personnel in charge and the designated person from the Recipient country.

2-2-4-6 Procurement Plan

(1) Origin of Material

Basically, materials of the PV system are selected considering durability, securing high accuracy and quality as in the procurement of equipment. The supply of materials and components like construction materials for civil works are locally procured while others are procured from Japan.

The countries where the main equipment will be procured are summarized in Table 2-2-4-1.

Table 2-2-4-1 Countries where Main Equipment will be Procured

Material List	Procurement Country (Country of Origin)		
	Local	Japan	Third Country
PV Module		X	
Power Conditioner		X	
Step up Transformer		X	
Insulation Transformer		X	

Source: JICA Study Team

In the case of civil and construction works, there are very few materials available in Mongolia. Most of the materials are sourced from China or Russia, which is the normal practice in the country. Therefore, locally available construction materials will be locally procured under this assistance plan.

(2) Transportation Route

All required equipment and components for this assistance plan are products of Japan. The transportation routes from Japan to the site, process and shipment duration are summarized in Table 2-2-4-2.

Table 2-2-4-2 Shipment Plan

Transportation Route	Shipment Step	Shipment Duration
Port of Japan		
|	Sea Shipment	6 to 10 Days
China / Port of Tianjin		
|	Railroad Transportation	20 to 30 Days
Mongolia / Ulaanbaatar		
|	Land Transportation	1 Day
Installation Site		

Source: JICA Study Team

(3) Components for Replacement and Tools

The components and parts of the PV system are difficult and complicated to repair locally, and may influence largely the system's operation. In case of damage or breakdown, the components and accessories for replacement are as mentioned below:

(i) PV Module (3%[2] of Total)
(ii) Power Conditioner (1 unit)

[2] For the replacement of module for accidental break down. The possibility of break down may be whole string. The actual number of module at one string is depends upon the system deigning, normally one strings contains around 10 to 15 module. It will be around 3% of the whole capacity if several strings are considered for replacement.

Even though it may not influence the PV system largely, the following items, which might differ depending on the manufacturer and may not be obtained easily, are also subject for replacement to realize a long-term smooth operation.

(iii) Fuses
(iv) Display Lamp of Control Panel
(v) Circuit Breakers
(vi) Meteorological Instruments (Thermometer, Pyranometer, Anemometer/Wind Vane)

The following tools for daily O/M are also required.

(i) Pressure Resistance Tester
(ii) Insulation Resistance Tester
(iii) Clamp Meter
(iv) Multi-meter

(4) Warranty

A warranty period of one year is required for supplied components, equipment and facility.

2-2-4-7 Operation Guidance Plan

After the finalization of installation, technical transfer to the system operator designated to perform daily O/M is planned. The method of operation adjustment of each individual component, initial start up and O/M are executed by the supplier/manufacturer's expert. The operation and other technical know-how of the complete PV system are executed under the soft component program.

Table 2-2-4-3 summarizes the specialty of experts, contents of technology transfer and implementation period.

Table 2-2-4-3 Initial Operation Guide and Management Plan

Specialty of Expert	Contents of Technology Transfer	Implementation Period
PV Technology Expert	Basic know-how of PV technology, daily operation and maintenance	Around 2 Weeks
Power Conditioner Expert	Initial start up, operation producer, emergency management, fault findings and initialization, daily operation and maintenance	Around 2 Weeks
Data Collection and Management Expert	Initial start up, management of data, fault finding, daily operation and maintenance	Around 2 Weeks
PV System Operation Expert	Initial start up, operation method, emergency management, daily operation and maintenance, fault finding and restoring	Around 2 weeks

Source: JICA Study Team

2-2-4-8 Soft Component (Technical Assistance) Plan

Application of grid-connected PV system in utilizing renewable energy resource under this assistance plan is the first case in Mongolia. There is no such experience in Mongolia in the past that are related to the smooth operation of grid-connected PV system. Thus, to execute the system installation smoothly and with the aim of sustaining efficient and stable operation, provision of support under the soft components is deemed necessary.

The proposed contents of the soft components are summarized and attached in the soft component plan.

2-2-4-9 Implementation Schedule

The implementation schedule is summarized in Table 2-2-4-4.

Table 2-2-4-4 Implementation Schedule

(Detail Design)

Months	0	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Domestic Works														
2 Site Survey														

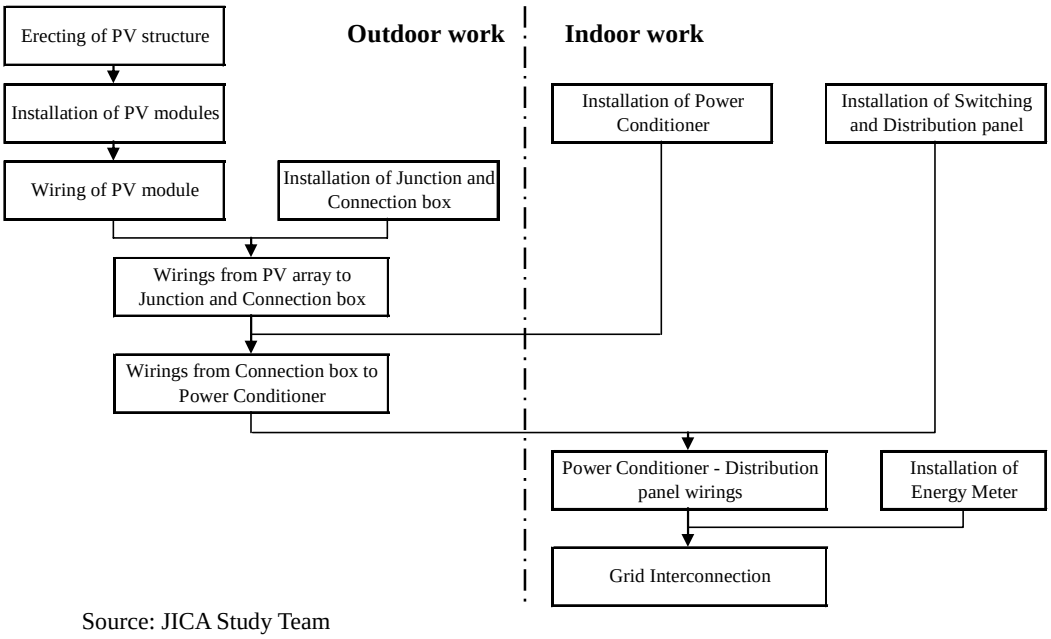
(Procurement & Implementation)

Months	0	1	2	3	4	5	6	7	8	9	10	11	12	13
1 Designing & Approval														
2 Structure Manufacturing														
3 Equipment Manufacturing														
4 Shipment, Inland Transport & Entry														
5 Civil & Construction Work														
Temporary Works														
Fencing Works														
PV Structure Concrete Base Works														
Construction of Control House														
6 Equipment Installation Works														
PV Structure Erecting Works														
PV Module Installation Work														
Sub-station Equipment Installation														
Other Works														
7 Commissioning														
8 Inspection, Completion and Hand Over														

: Site Works : Domestic Works : Site or (and) Domestic Works

The total period from the initial stage of planning, preparation of drawings for inspection, execution of works until the project hand over is planned to be completed within 13 months. It is proposed to perform civil construction works during the first year and the installation of components in the succeeding year. This is because concrete casting is only possible from March 15 to October 15, under the provision of local laws.

The installation work is divided into outdoor and indoor works; the complete flow is presented in Figure 2-2-4-2 below.



Source: JICA Study Team

Figure 2-2-4-2 Installation Work Flow

2-3 Obligation of Recipient Country

For the execution of this assistance plan, the obligations of the Mongolian government are as follows:

(i) Acquisition of land for system installation by CAAM.
(ii) Acquisition of the electricity sale license and agreement with UBEDN for realization of reverse power sales.
(iii) The procedure for environmental and social consideration
(iv) Securing entrance permits to the airport for the persons concerned.
(v) The bank commissioned to establish an account in Japan and procedure for this assistance plan.
(vi) The arrangement on tax exemption for materials supplied, process of entry of materials and domestic transportation.
(vii) The required legal action for entry and sojourn to Mongolia, for Japanese and third country experts involved in this assistance plan.
(viii) The exemption on taxes for equipment and service parts and necessary purchases for the Japanese experts engaged in this assistance plan.
(ix) The smooth and appropriate management of supplied equipment.
(x) The necessary expenses, except those from the Grant Aid of Japan.
(xi) The assistance and cooperation to solve any conflicts that may transpire between the inhabitants and third person while executing this assistance plan.

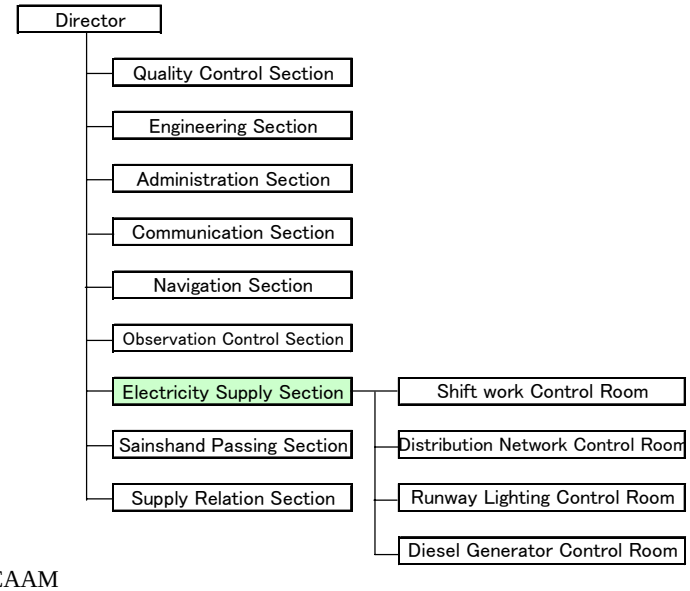
2-4 Project Operation Plan

In this project, administration and maintenance operation is planned to be implemented by CAAM.

CAAM has experience on PV system used to supply power for communication facilities in a local domestic airport. The Technical Supply Division, Communication Department of CAAM performs the management of those installed systems, and they have gained experience and knowledge in basic management and maintenance.

In this assistance plan, the grid-connected PV system supplies power to the airport facility. Thus, the Electricity Supply Section of the Technical Department will perform the O/M works. Even though the scale of PV system is large and operates by connecting to the grid network of the airport facility, it is judged that they can perform O/M works smoothly with appropriate technology transfer.

The organization chart of the Technical Department and Electricity Supply Section is shown in Figure 2-4-1 while the necessary maintenance management items are summarized in Table 2-4-1.



Source: CAAM

Figure 2-4-1 Organization Chart of Technology Support Division, Electricity Supply Section

CAAM is looking forward to the introduction of the PV system at the local airport facility in the future. For this, the training session on PV systems is scheduled to be set up and started with this project.

The instruments and replacement parts related to the O/M management are procured under this assistance plan. A soft component is executed for the technical personnel of the CAAM, to transfer the technical know-how on procured instruments and to respond (troubleshoot) during system break down.

The main inspection items on management and maintenance is summarized in Table 2-4-1.

Table 2-4-1 Main Items of Management and Maintenance

Contents of Inspection	Type of Inspection	Item for Inspection
General inspection (Once in a month)		
PV Array	Visual	・Damage, Corrosion, Lose Connections
Junction and Connection Boxes	Visual	・Damage, Corrosion ・Damage of Cable Connections
Power Conditioner	Visual	・Damage and Corrosion ・Damage of Cable Connections ・Ventilation ・Odd Sounds, Odor, Vibration, Overheating ・Fault / Error Lamp ・Operating Condition
Regular Inspection (Annually, but if any abnormal defect is observed, then inspection and maintenance are carried out)		
PV Array	Visual	・Disorder, Color Change, Cracks of Cables ・Tightness of Earth Connection Terminal
Junction and Connection Boxes	Visual	・Disorder, Color Change, Cracks of Cables ・Tightness of Earth Connection Terminal
	Measurement and tests	・Insulation Resistance Test ・Measurement of Outputs
Power Conditioner	Visual	・Disorder, Color Change, Cracks of Cables ・Plugging of Ventilation Filter
	Measurement and Test	・Power generation and display condition ・Operation and Error test

Source: JICA Study Team

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

The initial costs of procurement, shipment, installation and so on are covered by this assistance plan.

(1) Estimation Condition

(i) Estimate Period: December, 2009
(ii) Exchange Rate: USD 1.00 = JPY 93.97, MNT 1.00 = JPY 0.065
The estimation is based on the average exchange rate for six months from June 1, 2009 to November 30, 2009. The rate of Mongolian Tugrik (MNT) to Japanese Yen (JPY) is based on the announced rate of the Bank of Mongolia, while the rate of U.S. dollar (USD) is the TTS rate announced by the Bank of Tokyo-Mitsubishi UFJ.
(iii) Construction Period: As mentioned in the execution schedule
(iv) Others: The accumulation of estimation is based on the administrative system of the Japanese Grant Aid.

(2) Cost Sharing of Mongolia

Table 2-5-1-1 shows the breakdown of the cost share of Mongolia.

Table 2-5-1-1 Estimated Overall Project Cost Share of Mongolia

Cost Item	Amount
1. Land Acquisition	MNT 272 million (JPY 17.68 million)
2. Construction of Gate	MNT 1.8 million (JPY 0.12 million)
Total	MNT 273.8 million (JPY 17.8 million)

Source: JICA Survey Team

Besides the above-mentioned costs, expenses like the Banking Arrangement (B/A) procedure, Authorization to Pay (A/P) and import permit shall also be covered by the Mongolian side.

To ensure effective management of the system after completion of its installation, a new gate needs to be constructed for smooth access from inside the airport facility by removing a portion of the existing fence. During the period of system installation, the mentioned gate for access is not considered. After the completion of the project, a new gate for access is built to ensure the security of the airport facility. However, if the access to the PV installation site from inside the airport facility is judged to be an obstacle to the daily operation management or airport security, construction of the proposed new gate at the existing fence will not be done.

2-5-2 Operation and Maintenance Cost

The yearly maintenance management expenses for grid-connected PV system are calculated as shown on Table 2-5-2-1.

Table 2-5-2-1 Maintenance Management Expenses of PV Grid Interconnected System

Item	Yearly Maintenance / Management Cost
1. Routine Administrative Cost	MNT 9,600,000 (JPY 624 thousand)
2. Equipment (Reserve Fund) Expenses	MNT *,***,*** (JPY *** thousand)
3. Land Possessory Cost	MNT 22,440,000 (JPY 1,458 thousand)
Total	MNT **,***,*** (JPY *,*** thousand)

Source: JICA Study Team

Basically, the grid-connected PV system is maintenance-free and therefore, the required frequency of daily O/M management is minimal. In actual practice, the requirements on O/M management at the engineering level is assumed to be 0.5 of their salary per month while the section chief for executive work level is assumed to be 0.2 of their salary per month. Since the salary of engineer and section chief is around MNT 1,000,000 and MNT 1,500,000 per month, respectively, the total salary expense is MNT 9.6 million (= (1.0 x 0.5 + 1.5 x 0.2) x 12 months) per year.

The parts or components of the grid-connected PV system that are required for replacement in the short-term are not included. Therefore, replacement costs are not calculated by piling the components or parts cost. Instead, the O/M and administrative management expenses are assumed to be covered by the amount of savings from the electric bills of the Chinggis Khaan International Airport. Hence, it is the amount of payment being possibly reduced by the generated power from installed grid-connected PV system. If it is not necessary to procure any equipment or parts, the savings can be allotted for replacement of components in the future, and as reserved fund for emergency breakdown of equipment or parts.

2-6 Other Relevant Issues

Since the temperature is below zero from November to March even during the daytime, and sometimes reaches 40 degrees below zero in the winter season, the following matters should be taken into consideration for the implementation of the project:

- Equipment should work in cold climate and this should be mentioned in the specification.
- Concrete placement work should not be planned from 15th October to 14th March since the work is prohibited by the law.
- The effect of ground freeze is considered when foundation for the PV array supporting structure is designed since ground is frozen during the winter making it uneven.
- Heat insulation design should be applied to the control house, where the control equipment will be installed, to raise the temperature to above zero even during the winter.

Apart from the above issues related to cold climate, the following matters should also be considered:

- Since there is no experience in grid-connection and power purchase by reverse power flow to the grid, it is necessary to support CAAM through technical training/soft component by specialists from manufacturer/consultants during technical meetings and negotiations of PPA with UBEDN.
- The project site is located next to the airport and equipment installed under this project is planned to be managed as part of the airport facilities. Thus, laws and regulations for aviation security are also considered in setting the specification, installation and operation/management.
- The project site is owned by Ulaanbaatar City. Therefore, reporting to the city office as well as correspondence/compliance with its instructions will be necessary.

Chapter 3 Project Evaluation and Recommendations

3-1 Project Effect

(1) Direct Impact

Power generation by the PV system will be 336 MWh/year.

= 4.1 kWh/m^2-day x 300 kWp x 365 days x 0.75 (System Efficiency)
(4.1 kWh/m^2-day: Average Solar Insolation at the Site (NASA data))
(http://eosweb.larc.nasa.gov/cgi-bin/sse/)

1) Reduction of Electricity Cost

Yearly power consumption of the Chinggis Khaan Airport was 6,926,220 kWh in 2008. The 336,000 kWh to be generated by the PV system is around 4.9% of this power consumption. The estimated electricity cost reduced by the PV system is MNT25,132,800 (Approximately JPY1.63 million/year = 336,000 kWh x MNT74.8/kWh).

2) Reduction of CO_2 Emission

The power supply to the Chinggis Khaan Airport comes from the central power grid network. 90% of power generation to the network depends on coal-fired power generation. The CO_2 emission factor of the central power grid network is 1.560 t-CO_2/MWh, which is calculated in PDD of Salkhit Wind Park CDM. Estimated reduction of CO_2 emission by the PV system will be 524 t-CO_2/year (= 336 MWh/year x 1.560 t-CO_2/MWh).

3) Demonstration Impact

In 2008, there are 599,566 airport users. The effect of the project will be informed to domestic and international passengers at the publication booth, which will be newly installed.

(2) Indirect Impact

1) Promotion of Renewable Energy

This project is the first case of grid connection under the Renewable Energy Law of Mongolia. Therefore, familiarization and promotion of power generation through renewable energy and power trade with power grid are expected. Additionally, the soft component done as a part of this project can serve as capacity development for engineers not only on the PV power generation side but also on the grid side since the component contains technology transfer of operation/maintenance of grid-connected PV system and trouble shooting.

2) Awareness

Through the soft component implemented as part of this project, the role of the PV system and countermeasures against global warming will be well recognized. Also, the thinking of people regarding effective energy use will be improved.

3-2 Recommendation

This project is the first grid-connected PV project in Mongolia. Therefore, there are lots of problems to be solved. The following are the major problems and their recommendations:

Problems

- There is no current technical standard for grid-connected PV system.
- There is no available technician for grid-connected PV system.

- There is no existing scheme and organization to promote renewable energy

Recommendation

- It is necessary to establish technical standard for grid-connected PV system[3].
- It is necessary to develop training manuals for engineers.
- It is necessary to organize environmental scheme and organization for promoting activities using the installed facilities.

[3] Technical design for this project is based on Japanese technical standards, however it is important to establish technical standard for grid-connection to promote introduction of renewable energy in Mongolia effectively.

Appendices

1. Member List of the Study Team
2. Study Schedule
3. List of Parties Concerned in the Recipient Country
4. Minutes of Discussions
5. Soft Component (Technical Assistance) Plan

1. Member List of the Study Team

Mr. Tomoyasu FUKUCHI	Consultant Team Leader / Grid-Connection PV System
Mr. Deepak Bista	Deputy Consultant Team Leader / PV System Technology
Mr. Sadatsugu TORIBAMI	Equipment and Facility Planning
Mr. Tsutomu MORI	Procurement Planning / Cost Estimation (1)
Ms. Mika MATSUMURA	Environmental and Social Considerations / Evaluation of Greenhouse Gas Reduction

2. Study Schedule

Mr. Tomoyasu FUKUCHI Consultant Team Leader / Grid-Connection PV System

- 1st Site Survey: July 28 to August 11, 2009
- 2nd Site Survey: November 16 to December 7, 2009
- 3rd Site Survey: March 1 to March 6, 2010

Mr. Deepak Bista Deputy Consultant Team Leader / PV System Technology

- 1st Site Survey: August 1 to August 11, 2009

Mr. Sadatsugu TORIBAMI Equipment and Facility Planning

- 2nd Site Survey: November 16 to November 27, 2009

Mr. Tsutomu MORI Procurement Planning / Cost Estimation (1)

- 1st Site Survey: August 2 to August 26, 2009
- 2nd Site Survey: November 1 to December 7, 2009
- 3rd Site Survey: March 1 to March 6, 2010

Ms. Mika MATSUMURA Environmental and Social Considerations / Evaluation of Greenhouse Gas Reduction

- 2nd Site Survey: November 16 to November 27, 2009

3. List of Parties Concerned in the Recipient Country

Ministry of Roads, Transportation, Construction and Urban Development	NEMEKHBAYAR Dashbaljir	General Director	Finance and Investment Department	(976-11) 329865
Civil Aviation Authority of Mongolia	ITGEL Sakhiya	General Director	Economic Regulation and International Cooperation Department	(976-11) 282018
Civil Aviation Authority of Mongolia	OTGONBAYAR Samdan	Director	Technical Supply Division	(976) 99005208 (Mobile)
Civil Aviation Authority of Mongolia	DORJSUREN Nanzad	Head	Technical Supply Division Communication Section	(976) 99113508 (Mobile)
Civil Aviation Authority of Mongolia	BATMUNKH Tsedensodnom	Engineer	Technical Supply Division Electricity Supply Section	(976) 99097364 (Mobile)
Civil Aviation Authority of Mongolia	ENKHBAT Navaantseden	Project Director	New Ulaanbaatar International Airport Construction Project	(976-11) 342192
Ministry of Mineral Resources and Energy	TSERENPUREV Tudev	General Director	Energy Policy Department	(976-21) 267804
Ministry of Mineral Resources and Energy	TUMENJARGAL Makhbal	Officer	Energy Policy Department	(976-21) 262981
Energy Authority	GANKHUU Purevjav	Deputy Director		(976-11) 341432
Energy Authority	BATBAYAR Chadraa	General Manager	Renewable Energy Department	(976) 99093511 (Mobile)
Energy Authority	PUREVDORJ Galsantseren	Senior Specialist	Renewable Energy Department	(976-11) 341371 (329)
Energy Authority	URNUKHBAYAR Bira	General Manager	Energy Department	(976-11) 342359
National Renewable Energy Center	ENEBISH Namjil	Executive Director		(976) 99115665 (Mobile)
Energy Regulatory Authority	MUNKHTULGA Munkhuu	Head	Licensing Department	(976-11) 319317
Ulaanbaatar Electricity Distribution Network Company	PUNTSAGNOROV N.	Deputy Director		(976) 99100351 (Mobile)
Ministry of Nature Environment and Tourism	Ms. TSENDSUREN Batsuuri	Head	CDM DNA	(976)51-266314
Ministry of Nature Environment and Tourism (Consultant)	Mr. MUNKHJARGAL Begzsuren	Project Procurement Specialist	Japan PHRD Grant for Technical Assistance Program	(976)51-266314

4. Minutes of Discussions

"Minutes of Discussions" are attached in following pages.

1st Site Survey / Memorandum of Understanding of Technical Matter

2nd Site Survey / Memorandum of Understanding of Technical Matter

3rd Site Survey / Minutes of Discussion

MEMORANDUM OF UNDERSTANDING ON TECHNICAL MATTER

FOR

PREPARATORY SURVEY ON THE PROJECT FOR CLEAN ENERGY PROMOTION USING SOLAR PHOTOVOLTAIC SYSTEM IN MONGOLIA

among
JICA Consultant Survey Team
and
Civil Aviation Authority of Mongolia

Ulaanbaatar
August 24, 2009

Mr. Tomoyasu FUKUCHI
Team Leader,
JICA Consultant Survey Team
Nippon Koei Co., Ltd.

24/Aug/09

Mr. Sakhiya ITGEL
General Manager for
Economic Regulation and Cooperation
Civil Aviation Authority of Mongolia

The Consultant Survey Team (the Consultant Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Tomoyasu FUKUCHI, continuously stayed in Ulaanbaatar for the further survey on technical matter after the official survey team of JICA left Ulaanbaatar on August 7, 2009. The Consultant Team, and Civil Aviation Authority of Mongolia (CAAM) jointly conducted the further survey and discussed the technical matter of the Project for Clean Energy Promotion Using Solar Photovoltaic System (the Project). The three parties confirmed the mutual understanding on the Project as shown below. The Consultant Team will leave Ulaanbaatar on August 26, 2009.

1. **Installation Site :**
   The Consultant Team and CAAM confirmed the installation site where is shown in Attaachment-1

   The site is the property of Ulaanbaatar City. CAAM will obtain the necessary permission and /or take the necessary procedure in due form for installation of PV system.

2. **Installation Capacity :**
   The installation capacities of PV panel are 300kWp.

   The Consultant Team will prepare the initial design of the Project based on the above installation capacity. The Consultant Team, however, will report the existence of the space in which it is available to install PV panel beyond the capacity of 300 kWp at the site to JICA.

3. **Grid Connection and Synchronization :**
   The PV system will be connected to 6 kV line at the substation No.3 in Chinggis Khaan International Airport (the Airport) and synchronized with the grid line. The surplus electricity generated by the PV system will supply to distribution line of Ulaanbaatar Electricity Distribution Network Company (UEDN) through the power system of the Airport.

   The PV system will be designed to supply electricity only when being synchronized with the grid electricity. The PV system will not be synchronized with any emergency and/or back-up power sources like the emergency diesel generator of the Airport.

4. **Stockyard :**
   The place of the stockyard to store the materials and equipment to be installed at the sites will be designated. The stockyard shall be secured good access, security, and space enough to work for loading and unloading, and inspection of them. The required space will be informed during the next site survey.

5. **License of Generation :**
MCAA will be necessary to obtain the license of generation from Energy Authority under renewable energy low immediately after the design of the PV system being finalized. MCAA also will be necessary to obtain the agreement for reverse power flow form the power system of the Airport to grid line immediately after the license of generation being obtained.

6. **Access Permit to the Airport :**
The Consultant Team will request CAAM to issue the access permit to the Airport for next survey. CAAM will issue the permit for the Consultant Team including the local staffs and vehicles in the next survey period.

7. **Next Site Survey :**
The next site survey is scheduled to be conducted from the end of October to the end of November 2009 for around one month.

End

Attachment

1. Installation Site of PV System

<Attachment-1>

MEMORANDUM OF UNDERSTANDING ON TECHNICAL MATTER

FOR

PREPARATORY SURVEY ON THE PROJECT FOR CLEAN ENERGY PROMOTION USING SOLAR PHOTOVOLTAIC SYSTEM IN MONGOLIA

between
JICA Consultant Survey Team
and
Civil Aviation Authority of Mongolia

Ulaanbaatar
December 4, 2009

Mr. Tomoyasu FUKUCHI
Team Leader,
JICA Consultant Survey Team
Nippon Koei Co., Ltd.

Mr. Sakhiya ITGEL
General Manager for
Economic Regulation and Cooperation
Civil Aviation Authority of Mongolia

The Consultant Survey Team (the Consultant Team) of the Japan International Cooperation Agency (JICA), which is headed by Mr. Tomoyasu FUKUCHI, conducted the 2nd survey on technical matter from November 1st to December 7th, 2009. The Consultant Team, and Civil Aviation Authority of Mongolia (CAAM) jointly conducted the 2nd survey and discussed the technical matter of the Project for Clean Energy Promotion Using Solar Photovoltaic System (the Project). The two parties confirmed the mutual understanding on the Project as shown below.

1. **Site Survey:**

The Consultant Team carried out the detailed survey as follows at the Site.

- Soil survey by boring at two points in the Site
- Measurement of grounding resistance at two points in the Site
- Correcting and analysis of electricity data at some transformers in the Airport

The Consultant will design in detail the PV system based on the results of the above survey.

2. **Right-of-Possession of the Site :**

The Consultant Team confirmed that CAAM has made the procedure for obtaining the right-of-possession of the Site. CAAM explained to the Consultant Team that the application of the right-of-possession has been approved by the local government.

3. **Primary Environmental Impact Assessment :**

CAAM will apply for primary environmental impact assessment by the end of December 2009. The Consultant Team will provide the information of the design in December 2009, if necessary.

4. **License of Selling Electricity:**

CAAM will apply for the license of selling surplus electricity generated by PV system to Ulaanbaatar Electricity Distribution Network Company (UEDN). The Consultant Team will provide the necessary information for the application of the license in January 2010.

5. **Soft-Component (technical assistance) :**

Two parties discussed the contents of soft-component and concluded that the effective contents of the soft-component are shown blow.

- Training for analysis method of electricity data, and utilization of the result for operation and maintenance
- Training for analysis method of meteorological data corrected by logging

system and operating data of PV system, and utilization of the result for operation and maintenance

- Training for recovery method at power failure of the grid, and troubleshooting at the PV system failure
- Supporting for education activities on the PV system through seminar and site visit to authorities concerned such as UEDN and Energy Authority
- Supporting for education activities on renewable energy and global warming to the students of the senior level at elementary school and/or the level at junior high school

6. Next Site Survey :

The next site survey is scheduled to be conducted at the end of January 2010 for around one week.

End

Minutes of Discussions
on
the Preparatory Survey (Outline Design)
on
The Project for Introduction of Clean Energy by Solar Electricity Generation System
in
Mongolia

(Explanation on Draft Final Report)

In December 2009, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Preparatory Survey Team on the Project for Clean Energy Promotion Using Solar Photovoltaic System (hereinafter referred to as "the Program") in Mongolia, and through discussions, field survey and technical examination of the results of the survey in Japan, JICA prepared a Draft Final Report of the Outline Design.

In order to explain and to consult with the concerned officials of the Government of Mongolia on the component of the Draft Final Report, JICA sent Mongolia the Preparatory Survey Team for Draft Final Report Explanation (hereinafter referred to as "the Team"), which is headed by Mr. Atsumu Iwai, Deputy Representative of JICA Mongolia Office, from 1st March 2010 to 5th March 2010.

As a result of discussion, both sides confirmed the main items described on the attached sheets.

ULAANBAATAR, 5, March, 2010

Mr. Atsumu Iwai
Leader
Preparatory Survey Team
Japan International Cooperation Agency

Mr. Dashbaljir NEMEKHBAYAR
Director General
Finance and Investment Department
Ministry of Roads, Transport, Construction and Urban Development
(Responsible Ministry)

Mr.KHURENBAATAR Baavgai
Director General
Department of Development Finance and Cooperation
Ministry of Finance

Mr. Gombosuren DAVAA
Director General
Civil Aviation Authority of Mongolia
(Implementing Organization)

Mr. Tudev TSERENPUREV
Director General
Energy Policy Department
Ministry of Mineral Resources and Energy

ATTACHMENT

1. Components of the Draft Final Report

The Mongolian side agreed and accepted in principle the components of the Draft Final Report explained by the Team.

2. Program Grant Aid for Environment and Climate Change of the Government of Japan

The Mongolian side understood components of the Minutes of Discussion signed by both sides on 7th August, 2009 (hereinafter referred to as "the previous M/D"), and would take the necessary measures confirmed on the previous M/D for smooth implementation of the Program following procedures of the Program Grant Aid for Environment and Climate Change of the Government of Japan as shown in **Annex-1**.

3. Confirmation of progress made for the previous M/D

3.1. Project site and capacity of PV module

Both sides confirmed that project site is the area adjacent to Chinggis Khaan International Airport and the capacity of PV module is 300 kWp.

3.2 Purpose of the Program

Both sides confirmed that the purpose of the program is to promote clean energy development in Mongolia. In this context, both sides also confirmed the importance of visibility of the program. Both side agreed to take all the necessary measures for the placement of information panels to sustain visibility.

3.3 Official permission to set the PV system on the site for the Program

Both sides confirmed completion of necessary procedures for official permission from related organizations to set the PV system in the project site.

4. Items of Equipment to be procured

The Team explained that the items of equipment to be procured as shown in **Annex-2** based on the result of the Preparatory Survey conducted in August and November to December, 2009.

5. Procurement Process of the Program

Both sides reconfirmed that procurement process would be managed by the Procurement Agent (hereinafter referred to as "the Agent") with necessary consultation by the Consultative Committee (hereinafter referred to as "the Committee"). And both sides also reconfirmed roles of the Agent as follows;

(1) The Agent renders the services stipulated in the provisions of the G/A as well as the E/N for the Program;
(2) The Agent will undertake the procurement procedure necessary for the Program according to the provisions of the G/A and E/N and any other concerned guidelines
(3) JICA will provide the draft Final Report and Final Report of Preparatory Survey (Outline Design)to the Agent; and

(4) The Agent will commence the procurement according to the contents of the Final Report of the Outline Design.

The Team explained that if tender price exceeds the amount agreed on G/A and E/N, quantity or/and items of the equipment would be reduced until the cost for the Program comes down to the amount agreed on G/A and E/N.

The Mongolian side agreed that if there is a remaining amount of the cost for the Program after tenders, additional items of equipment would be procured based on priorities which were set in the Final Report.

The Mongolian side also understood that decision on addition or reduction of the equipment to be procured would be made through necessary consultation among members of the Committee.

6. Project Cost

The Mongolian side agreed that the cost for the Program should not exceed the upper limit of amount agreed on in G/A and E/N. Both sides also confirmed that the cost for the Program contains procurement cost of equipment including spare parts, the cost for transportation up to the site for the Program, installation cost, the Agent fee, Consultant fee, and the cost for soft component for the technical support of operation and maintenance of equipment.

7. Confidentiality of the Program

Detailed specifications of the Facilities

Both sides confirmed that all the information related to the Program including detailed drawings and specifications of the facilities and equipment and other technical information shall not be released to any outside parties before conclusion of all the contract(s) for the Program.

Confidentiality of the Cost Estimation

The Team explained the cost estimation of the Program as described in **Annex-3**. Both sides agreed that the cost for the Program Estimation should never be duplicated or released to any outside parties before tender for the Program. Both side understood that the cost for the Program Estimation attached as Annex-3 is not final and is subject to change by the result of examination through revision of the Outline Design Study.

8. The Consultative Committee

The Mongolian side understood that the MRTCUD will chair the Committee in order to facilitate consultation and procurement process. The Terms of Reference of the Committee was settled in G/A.

The members of the Committee are as follows:

(1) Representative(s) of Ministry of Roads, Transport, Construction and Urban Development (MRTCUD): Chair
(2) Representative(s) of Civil Aviation Authority of Mongolia (CAAM)
(3) Representative(s) of Ministry of Finance
(4) Representative(s) of Ministry of Mineral Resources and Energy(MMRE)

(5) Representative(s) of JICA Mongolia Office

The first meeting of the Committee shall be held after the signing of the contract between the Agent and the consultant. Further meetings shall be held upon request of either the Mongolian side or the Japanese side. The Procurement Agent may advise both sides on the necessity to call a meeting of the Committee.

9. Other Relevant Issues

9.1. Undertakings required by the Recipient Country

The Team requested the Mongolian side to abide by the following undertakings by the Mongolian side in addition to major undertakings described in the previous M/D. The Mongolian side agreed to do so.

(1) Land usage for PV system

The owner of the land for the following equipment and materials for PV system is Ulaanbaatar Municipality. At once after signing this Minutes of Discussion, CAAM will take necessary measures to obtain the right-of-possession of the land usage for the program.

1) for PV Modules
2) for underground cables between equipments
3) for Power house
4) for Temporary stockyard

(2) Generated Energy by PV system

The Mongolian side confirmed that CAAM will consult with Energy Regulatory Authority on the procedure for acquiring the license for power trading by the end of March, 2010. The purchased tariff of power generated by PV system shall be determined by the end of December, 2010 by Mongolian side. The Japanese side shall assist the Mongolian side through soft component during the implementation of the Program.

(3) Environmental and Social Considerations

The Mongolian side confirmed that CAAM will apply for primary environmental impact assessment immediately after signing this Minutes of Discussion. The Mongolian side will report to JICA the result of the primary environmental impact analysis by the end of April, 2010.

(4) Application of the Related Laws and Regulations

The Mongolian side agreed the structural design for the installation of PV system shall comply with the Architectural Regulation in Japan and Mongolia.

Electrical design for Grid-connected PV system should be done in accordance with JIS/IEC and Mongolian National Standard (MNS).

The Mongolian side agreed that the CAAM shall be responsible for the application of related laws and regulations for the operation of the PV system for interconnection with the distribution lines before commissioning of the Program. The Japanese side shall assist the

Mongolian side to introduce necessary procedures through soft component during the implementation of the Program.

(5) Customs and Tax Exemption

The Mongolian side agreed that the MRTCUD shall be responsible for the exemption and/or reimbursement of all customs, tax, levies and duties incurred in Mongolia for the implementation of the Program.

(6) Assignment of Counterpart Personnel

1) Overall project management

The Mongolian side assigned following personnel for overall project management and coordination in each organization.

MRTCUD : Mr. Dashbaljir NEMEKHBAYAR, Director General
Finance and Investment Department
Ministry of Roads, Transport, Construction and Urban Development

CAAM :Mr. Dorjsuren Nanzad, Chief, Communication and Navigation Services, Civil Aviation Authority

2) Soft Component

The Mongolian side agreed to assign necessary personnel in accordance with the soft component plan proposed by the Team.

The Mongolian side shall inform the name of the Counterpart Personnel from the followings to JICA Mongolia office at the first consultative committee on April 2010:

- staff from MRTCUD
- staff from CAAM
- staff from MMRE

9.2. Ownership and Operation and Maintenance (O&M) Responsibilities of Equipments

The Mongolian side has confirmed that the CAAM is the owner of Equipment and responsible for Operation and Maintenance (O&M) of Equipments. Team explained that the Mongolian side was requested to secure necessary budget and personnel for the O&M of Grid-connected PV system procured and installed under the Program.

9.3 Further topic of discussions in the Consultative Committee

Both side agreed to discuss on the following topics through the Consultative Committee to keep the sustainability of the project.

- Monitoring and evaluation system to confirm the visibility of this project.
- Further introduction of PV system in Mongolia using the result of this project as well as the soft component activities.
- Creating capacity for operation and maintaining the equipment

<List of Annex>

T.D

Annex-1 Program Grant Aid for Environment and Climate Change of the Government of Japan

Annex-2 List of Equipments

Annex-3 Project Cost Estimation (Confidential)

Program Grant Aid for Environment and Climate Change
of the Government of Japan
(Provisional)

The Grant Aid provides a recipient country (hereafter referred to as "the Recipient") with non-reimbursable funds to procure the facilities, equipment, and services (engineering services and transportation of the products, etc.) for economic and social development of the country under principles in accordance with relevant laws and regulations of Japan. The Grant Aid is not supplied through the donation of materials as such.

Based on "Cool Earth Partnership" initiative of the Government of Japan, the Program Grant Aid for Environment and Climate Change (hereafter referred to as "GAEC") aims to mitigate effects of global warming by reducing GHGs emission (mitigation; e.g. improvement of energy efficiency) and to take adaptive measures (adaptation; e.g. measures against disasters related to climate change, including disaster prevention such as enhancing disaster risk management).GAEC may contain multiple components that can be combined to effectively meet these needs.

1. Procedures for GAEC

GAEC is executed through the following procedures.

Preparatory Survey 1	Preparatory Survey for project identification conducted by Japan International Cooperation Agency (JICA)
Application	Request made by a recipient country
Appraisal & Approval	Appraisal by the Government of Japan and Approval by the Cabinet
Determination of Implementation	The Notes exchanged between the Government of Japan and the Recipient Country
Grant Agreement (hereinafter referred to as the "G/A")	Agreement concluded between JICA and the Recipient
Preparatory Survey 2	Preparatory Survey for design conducted by JICA
Implementation	Procurement through the Procurement Agency by the Recipient

Firstly, if the candidate project for a GAEC is identified by the Recipient and the Government of Japan, the Government of Japan (the Ministry of Foreign Affairs) examines it whether it is eligible for GAEC. When the request is deemed appropriate, JICA, in consultation with the Government of Japan, conducts the Preparatory Survey (hereafter referred to as "the Survey") on the candidate project as Phase 1 of the Survey with Japanese consulting firms.

Secondly, the Recipient submits the official request to the Government of Japan, while the appropriateness, necessity and the basic components of the Program are examined in the course of Phase 1 of the Survey,

Thirdly, the Government of Japan appraises the Program to see whether it is suitable for Japan's GAEC, based on the Survey report prepared by JICA, and the results are then

submitted to the Cabinet for approval.

Fourthly, the Program, once approved by the Cabinet, becomes official with the Exchange of Notes (E/N) signed by the Governments of Japan and the Recipient.

Fifthly, JICA engages Grant Agreement (G/A) with the Recipient and executes the Grant by making payments of the amount agreed in the E/N and strictly monitors that the funds of the Grant are properly and effectively used.

Procurement Management Agent is designated to conduct the procurement services of products and services (including fund management, preparing tenders, contracts) for GAEC on behalf of the Recipient. The Agent is an impartial and specialized organization that will render services according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the Agreed Minutes ("A/M").

2. Preparatory Survey

1) Contents of the Survey

The purpose of the Preparatory Survey (hereafter referred to as "the Survey"), conducted by JICA on a requested project (hereafter referred to as "the Project"), is to provide the basic document necessary for the appraisal of the Project by the Government of Japan. The contents of the Survey are as follows:

- Confirmation of background, objectives, and benefits of the Project and institutional capacity of agencies and communities concerned of the Recipient necessary for project implementation.
- Evaluation of relevance of the Project to be implemented under the Grant Aid Scheme for Environment and Climate Change from a technical, social, and economic point of view.
- Confirmation of items agreed upon by both parties concerning the basic concept of the Project.
- Preparation of the design of the Project and reference document for tender.
- Estimation of cost for the Project.

The contents of the original request will be modified, as found necessary, in the design of the Project according to the guidelines of Japan's Grant Aid scheme.

The Government of Japan requests the Government of the Recipient to take whatever measures necessary to ensure its responsibility in implementing the Project. Such measures must be guaranteed even if they may fall outside the jurisdiction of the implementing organization of the Recipient. This has been confirmed by all relevant organizations of the Recipient through the Minutes of Discussions.

2) Selection of consulting firms

For the smooth implementation of the Survey, JICA will conduct the Survey with registered consulting firms. JICA selects the firms based on proposals submitted by firms with interest in implementing the Survey. The firms selected will carry out the Preparatory Survey and prepare a report, based on the terms of reference set by JICA.

3. Implementation of GAEC after the E/N

1) Exchange of Notes (E/N)
The content of GAEC will be determined in accordance with the Notes exchanged by the two Governments concerned, in which items including, objectives of the project, period of execution, conditions and amount of the Grant Aid are confirmed.

2) Details of Procedures
Details of procedures on procurement and services under GAEC will be agreed between the authorities of the two governments concerned at the time of the signing of the G/A.

Essential points to be agreed are outlined as follows:
a) JICA will supervise the implementation of the Project.
b) Products and services will be procured and provided in accordance with JICA's "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change."
c) The Recipient will conclude a contract with the Agent.
d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal points of "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change"
a) The Agent
The Agent is the organization, which provides procurement of products and services on behalf of the Recipient according to the Agent Agreement with the Recipient. The Agent is recommended to the Recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement
The Recipient will conclude the Agent Agreement, in principle, within two months after the signing of the G/A, in accordance with the A/M. The scope of the Agent's services will be clearly specified in the Agent Agreement.

c) Approval of the Agent Agreement
The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement will be submitted to JICA by the Recipient through the Agent. JICA confirms whether the Agent Agreement is concluded in conformity with the E/N, A/M, and G/A and the Procurement Guidelines for the Program Grant Aid for Environment and Climate Change then approves the Agent Agreement.

The Agent Agreement concluded between the Recipient and the Agent will become effective after the approval by JICA in a written form.

d) Payment Methods
The Agent Agreement will stipulate that "Regarding all transfers of the fund to the Agent, the Recipient will designate the Agent to act on behalf of the Recipient and issue a Blanket Disbursement Authorization ("the BDA")to conduct the transfer of the fund (hereinafter referred to as "the Advances") to the Procurement Account from the Recipient Account.

The Agent Agreement will clearly state that the payment to the Agent will be made in Japanese yen from the Advances and that the final payment to the Agent will be made when the total remaining amount become less than three percent (3%) of the Grant and its accrued interests excluding the Agent's fees.

e) Products and Services Eligible for Procurement

Products and services to be procured will be selected from those defined in the G/A.

f) Firm and Consultant
The firm and consultant who would contract with the Agent shall be Japanese Nationals.

The consultants that will be employed to do detail design and supervise the work for the Project, however will be in principle, Japanese nationals recommended by JICA for the purpose of maintaining technical consistency with the Study.

g) Method of Procurement
When conducting the procurement, sufficient attention will be paid to transparency in selecting the firms and for this purpose, competitive tendering will be employed in principle.

h) Tender Documents
The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured by GAEC.

The rights and obligations of the Recipient, the Agent and the firms supplying products and services should be stipulated in the tender documents to be prepared by the Agent. Aside from this, the tender documents will be prepared in consultation with the Recipient.

i) Pre-qualification Examination of Tenderers
The Agent may conduct a pre-qualification examination of tenderers in advance of the tender so that the invitation to the tender can be extended only to eligible firms. The pre-qualification examination should be performed only with respect to whether the prospective tenderers have the capability of concluding the contracts.

For this, the following points should be taken into consideration:
(1) Experience and past performance in contracts of similar kind
(2) Financial credibility (including assets such as real estate)
(3) Existence of offices and other items to be specified in the tender documents.
(4) Their potentialities to use necessary personnel and facilities.

j) Tender Evaluation
The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

Those tenderers which substantially conform to the technical specifications and other stipulations of the tender documents will be judged in principle on the basis of the submitted price, and the tenderer who offers the lowest price will be designated as the successful tenderer.

The Agent will submit a detailed evaluation report of tenders to JICA for its information, while the notification of the results to the tenderers will not be premised on the confirmation by JICA.

k) Additional procurement
If there is any remaining balance after the competitive and/or selective tendering and/or direct negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:
(1) Procurement of same products and services

When the products and services to be additionally procured are identical with the initial tender and a competitive tendering is judged not efficient, additional procurement can be conducted by a negotiated contract with the successful tenderer of the initial tender.

(2) Other procurements
When products and services other than those mentioned above in (1) are to be procured, the procurement should be conducted through competitive tendering. In this case, the products and services for additional procurement will be selected from among those in accordance with the G/A.

l) Conclusion of the Contracts
In order to procure products and services in accordance with the guideline, the Agent will conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment
The contract will clearly state the terms of payment. The Agent will make payment from the "advances," against the submission of the necessary documents from the firm on the basis of the conditions specified in the contract. When the services are the object of procurement, the Agent may pay certain portion of the contract amount in advance to the firms on the conditions that such firms submit the advance payment guarantee worth the amount of the advance payment to the Agent.

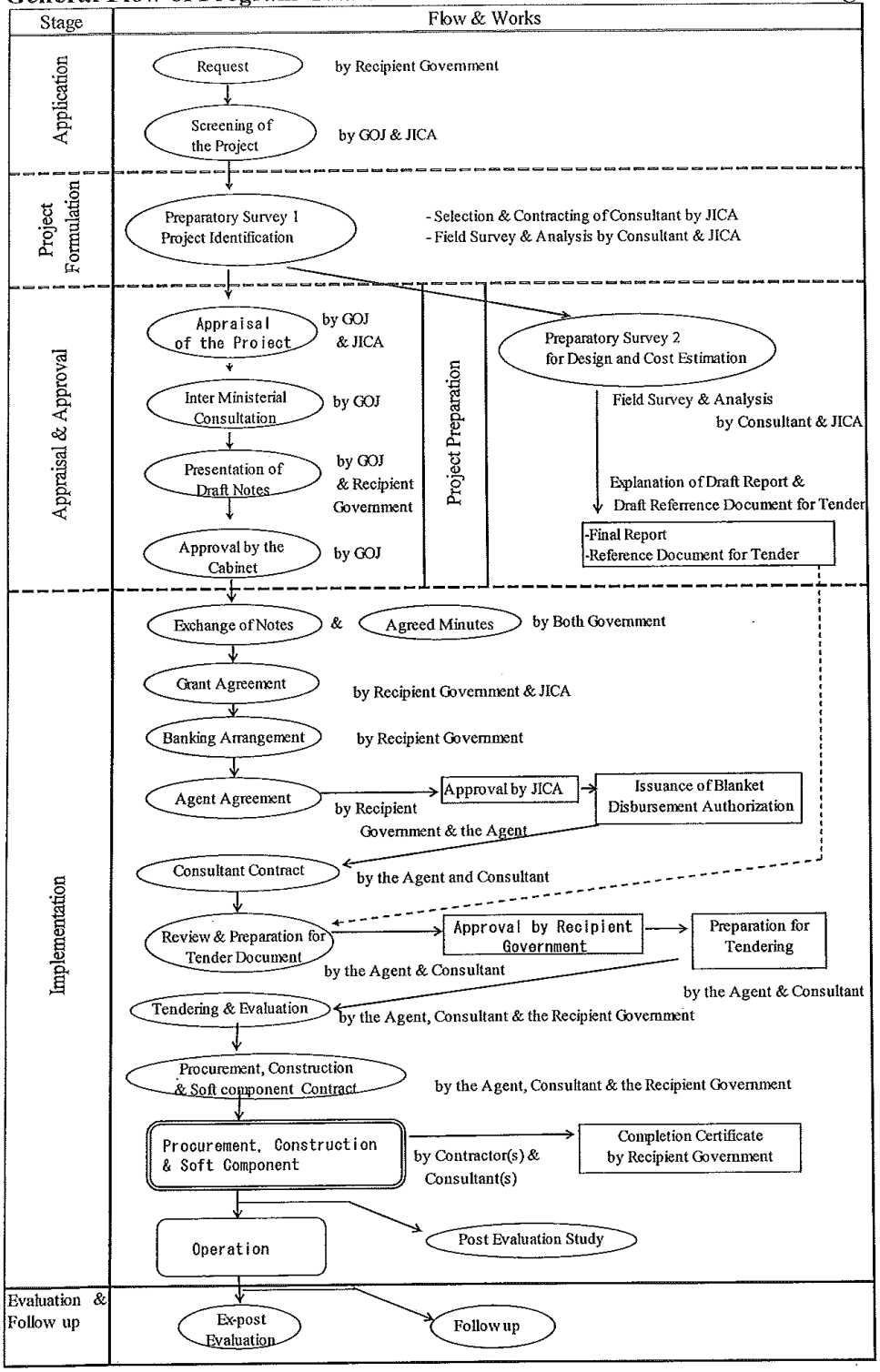
4) Undertakings required by the Government of the Recipient Country
In the implementation of the Grant Aid Project, the Recipient is required to undertake necessary measures as the following:

a) To secure land necessary for the sites of the Project and to clear, level and reclaim the land prior to commencement of the Project.
b) To provide facilities for distributing electricity, water supply and drainage and other incidental facilities in and around the sites.
c) To ensure all the expense and prompt execution for unloading, customs clearing at the port of disembarkation and domestic transportation of products purchased under the Grant Aid,
d) To ensure that customs duty, internal taxes and other fiscal levies that may be imposed in the Recipient with respect to the purchase of the Components and the Agent's services will be exempted by the Government of the Recipient.
e) To accord all the concerned parties, whose services may be required in connection with supply of the products and services under the contracts, such facilities as may be necessary for their entry into the Recipient and stay therein for the performance of their work.

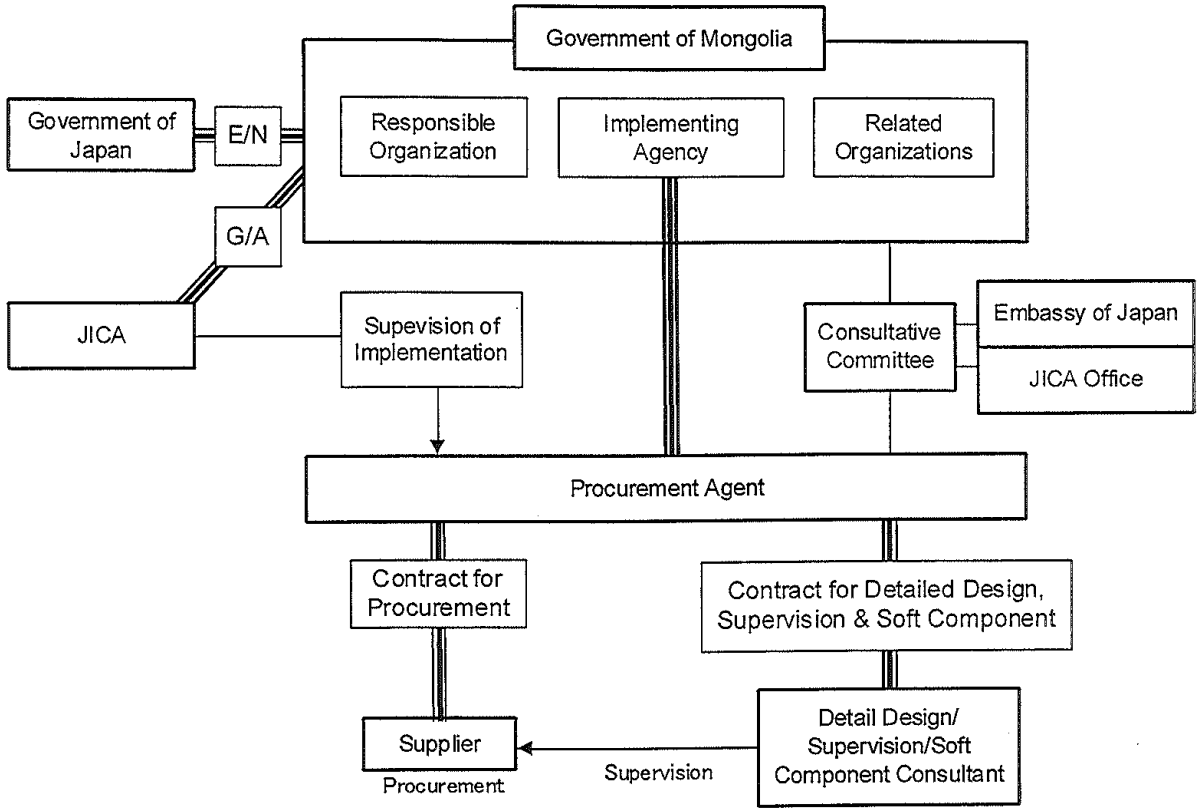
5) "Proper use of funds"
The Recipient is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign personnel necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

6) "Export and Re-export" of products
The products purchased under the Grant and its accrued interest will not be exported or re-exported from the Recipient.

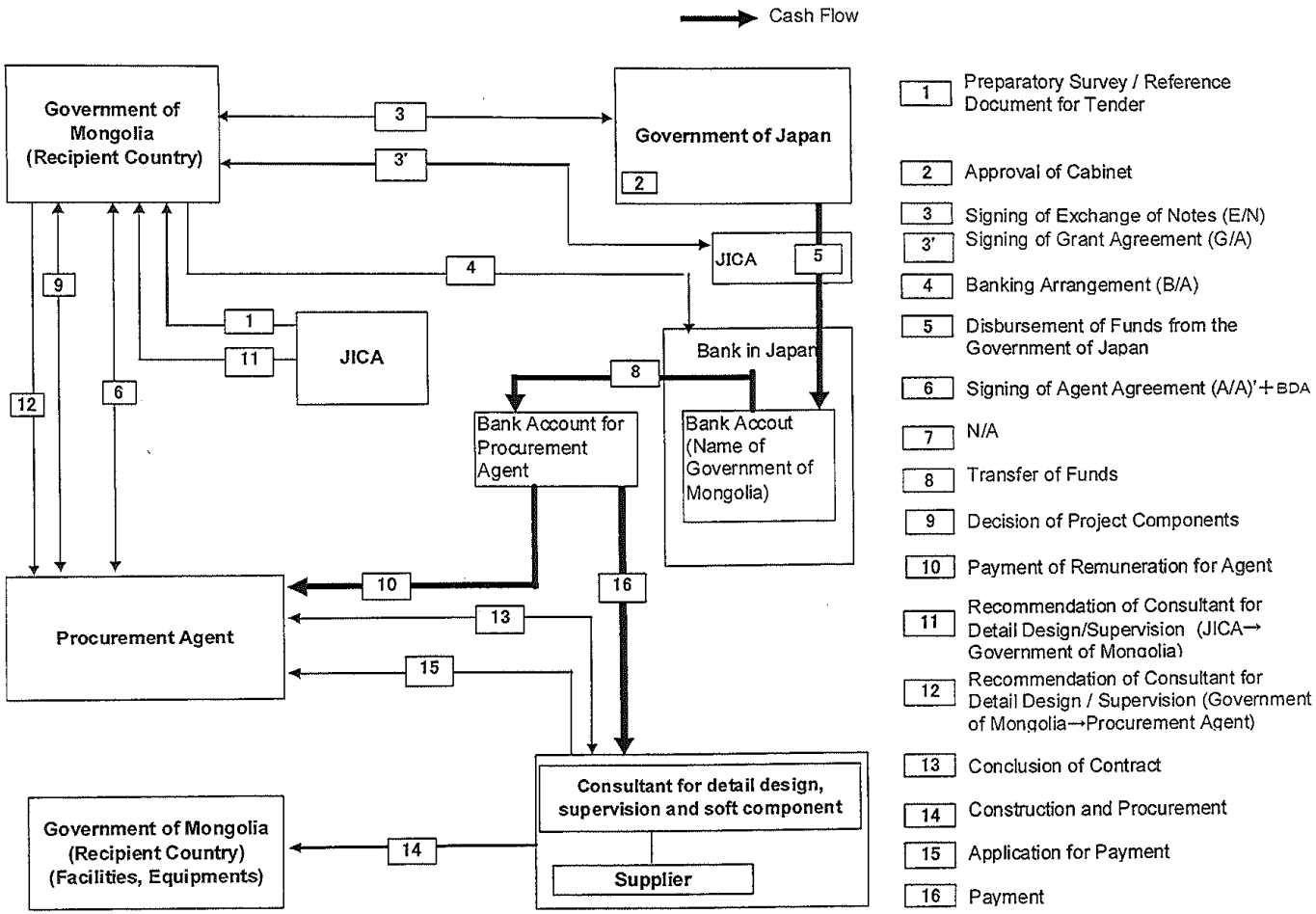
General Flow of Program Grant Aid for Environment and Climate Change



Project Implementation System



Flow of Funds for Project Implementation



List of Major Equipments

1-1 List of Major Equipments
The following table shows a list of equipments procured under the Program.

No.	Name of Components	Main Specification	Unit	Qty.
1	PV module	300kWp (Total capacity)	Set	1
2	PV structure	Galvanized finishing	Set	1
3	Power Conditioner	300kW (Total), Indoor Self standing with grid interconnecting facility and safety protection device	Lot	1
4	Display panel	Out door display panel of size W 1,200 x L 800 mm	Set	1
5	Meteorological Monitoring system	Pyranometer、Thermometer、Anemometer/Wind Vane、Data recording unit	Set	1
6	Data Collecting system	Computer, Software, Printer, UPS	Set	1
7	Indoor type 6kV switchboard	Self standing indoor type, 3 Phase 3 Wire, 6kV, 50 Hz	Unit	1
8	Indoor type 400V distribution board	Self standing indoor type, 3 Phase 4 Wire , 400V, 50 Hz	Unit	1
9	Interconnecting Panel	Self standing Indoor Type, 3Phase 4Wire , 400V, 50 Hz	Unit	1
10	Step up Transformer	6kV/400V, Dry and indoor type, 3Phase 4 Wire, Y-Y connection	Unit	1

5. Soft Component (Technical Assistance) Plan

“Soft Component (Technical Assistance) Plan” is attached in following pages.

Soft Component Plan
(Mongolia)

1. Background of Soft Component Plan

This project promotes awareness of the PV system, builds technical experience on PV system and grid-connection, and promotes mitigation of GHG emission by providing PV system and related equipment at the site near a trunk road along the airport in Ulaanbaatar, the capital of Mongolia. The project also promotes the interconnection of power generation using “clean” renewable energy to the central grid system, which depends on coal thermal. It also presents countermeasures against air pollution and climate change.

In Mongolia, there are two different energy sources i.e., electricity and heat, which are supplied through locally available coal as fuel. On the other hand, the "Renewable Energy Law" was enacted in January 2007 as a framework for promoting renewable energy. This law defines that feed-in tariff is intended to oblige the power grid to purchase the electricity generated from renewable energy sources at a fixed price. This tariff system targets to promote the introduction of renewable energy with grid connection.

However until now, grid connection of power generation utilizing renewable energy has not yet been realized under this law. If the photovoltaic power generation system (PV system) planned under this Japanese assistance is put into practice, this will be the first actual example of a grid-connected, renewable energy resource.

Considering the above situation, there is no accumulated experience in the proper operation of grid-connected PV system in Mongolia. Therefore, it is necessary to conduct a soft component aiming at supporting the smooth start up of the project and ensuring its sustainability.

In particular, technical supports for (1) Existing Grid and PV System, (2) Grid Connection and Power Purchase Agreement (PPA), (3) Data Analysis of Data Logger, (4) Power Restoration and Failure Recovery Technique and (5) Awareness Campaign are required.

2. Targets of the Soft Component

There are several standalone PV systems which have capacity of tens to hundreds kWp, however there is no grid-connected PV system and the PV system by this project will be first case in Mongolia. Therefore there is not enough accumulated technical/practical experience including PPA at present.

A certain amount of accumulated technical/practical experience is necessary for the smooth start up of the project. Accumulated technical/practical experience for trouble shooting, evaluation of generation performance and operational efficiency, starting up of same kind of grid-connected facility are also necessary.

The targets of the soft component, defined as those that should be achieved after a certain period from the completion of the project, are as follows:

(1) The implementing agency, Civil Aviation Authority of Mongolia (CAAM), is expected to operate the grid-connected PV system 1 smoothly while Ulaanbaatar Electricity Distribution Network Company (UBEDN) operates their distribution network together with the PV system connected to the grid without any hindrance.
(2) Generated power from the PV system shall be utilized at Chinggis Khaan Airport while the surplus power flows into the grid of UBEDN, which is called reverse power flow. The Power Purchase Agreement (PPA) between CAAM and UBEDN is made for the trading of the reverse power.
(3) The impact of this assistance of Japan to the project is quantified and measured effectively through the accumulated data. Based on the accumulated data and corresponding analysis results, the efficiency of PV system operation is improved and the planning of other grid-connected PV is effectively conducted.
(4) When there is a system failure, CAAM performs the necessary restoration works smoothly.
(5) The project becomes the model case for the introduction and promotion of renewable energy source as grid-connected renewable energy system.

3. Outcomes of the Soft Component

The outcomes of the soft component, defined as those that should be achieved upon its completion, are as follows:

(1) Existing Grid and PV System

The CAAM and UBEDN should both understand the following points:

(i) The composition of the existing distribution grid that is connected with PV system
(ii) The protection system of the existing distribution grid
(iii) The actual situation of power supply from the existing distribution grid
(iv) The quality of power supply of the existing distribution grid that connects to Chinggis Khaan Airport (fluctuation of voltage, frequency and so on)
(v) Basic knowledge on PV system
(vi) Protection and operating method of grid connected PV system

The soft component is executed at the introductory phase of the cluster of the five soft components to understand the composition of the existing grid and obtain basic knowledge on the PV system.

(2) Grid Connection and Power Purchases Agreement

To realize the reverse power sales of surplus power, CAAM submits the application of the license for the power sales to the Energy Regulatory Authority. Based on the application, the Energy Regulatory Authority provides the licenses to CAAM with the decided tariff for the reverse

[1] Grid-connected PV system means the PV system that is connected to, and operated with, the power grid. The electricity of the grid is Alternative Current (AC), while the electricity generated by the PV system is Direct Current (DC). Thus, DC electricity has to be converted to AC and this converted AC needs to be synchronized with the AC of the grid in order to connect the PV system to the grid. Furthermore, whenever there is failure of the PV system, that failure should not influence the grid. For this, the grid-connected PV system requires protection devices. In this manner, the grid-connected PV system needs more advanced technology as compared to the stand-alone PV system with battery.

power sales. CAAM and UBEDN will finalize the PPA between them under the basis of decided tariff.

Even if feed-in tariff is already enacted, this has not yet been utilized in actual practice. If an introductory example can be made, it will definitely help to promote planning of future projects as well as those in the pipeline. As a result, the realization of the reverse power sales with the support of the soft component can be realized as one of the most important outcomes.

(3) Data Analysis of Data Logger

The data logger is one of the components of the PV system that records data on solar insolation, generated power, generated energy, and so on. With the recorded data, the staff of CAAM will understand the (1) analysis method, (2) system management method from the analysis results, (3) methodology of utilizing data for further expansion of the project or applying the data for planning other PV systems.

(4) Power Restoration and Failure Recovery Technique

When the interconnected grid experiences black out due to some reasons, the PV system also stops supplying power to the grid automatically. When the system is restored, the PV system reconnects from the CAAM side without any problem. Moreover, the failure of the PV system is handled appropriately.

If soft component (1) is assumed to be a chapter of the basic theory, this shall also be put into practice. The training proceeds with the equipment installed and the trainees learning how to properly operate the system.

(5) Awareness Campaign

From the inspection tour with concerned personnel like ministers, policymakers, civil servants, technical experts and advisers, the knowledge and information of the PV system in actual practice is disseminated. The inspection tour to sites with PV systems is held targeting students of surrounding schools, and residents of surrounding areas who are willing to visit and desire to know about the PV system. Raising funds for the awareness campaign on renewable energy is planned utilizing a part of the saved money from the electricity tariff and reverse power sales.

4. Confirmation of Achievement

The method of confirming the achievement level is as follows:

(1) Existing Grid and PV System

The achievement level of the soft component is confirmed with the fulfillment of the (i) tariff of reverse power sales being finalized, (ii) power sales license being issued to CAAM, (iii) PPA being signed between CAAM and UBEDN, and finally, (iv) grid-connected renewable energy sources being utilized following the above PPA as a good example.

(2) Grid Connection and Power Purchase Agreement

The achievement level of the soft component is confirmed with the fulfillments of (i) the tariff of reverse power sales being finalized, (ii) power sales license being issued to CAAM, (iii) PPA being signed between CAAM and UBEDN, and finally (iv) grid-connected renewable energy sources being appeared following the above PPA as a good example.

(3) Data Analysis of Data Logger

The achievement level of the soft component is confirmed with the facts that the staff of CAAM is able to (i) analyze the collected data from the data logger, (ii) use the analysis results for maintenance purposes, and (iii) put the data and analysis results to practical use for the expansion plan of the project or for promotion of new grid-connected PV systems. At the end of the soft component, the achievement level is confirmed through a practical work test.

(4) Power Restoration and Failure Recovery Technique

The achievement level of the soft component is confirmed with the facts that the staff of CAAM are able to (i) restore the PV system appropriately during the training operation which involves simulated situation of power failure in the distribution network, and (ii) fix the failures appropriately during the training where occurrence of failure of the PV system is simulated. At the end of the soft component, the achievement level is confirmed through a practical work test.

(5) Awareness Campaign

The achievement level of the soft component is confirmed through a questionnaire survey executed at the time of inspection tour and querying the personnel of the concerned organization about their awareness.

5. Activities for the Soft Component (Input Plan)

(1) Existing Grid and PV System

(Japanese Side)

(a) Necessary Technology and Type of Profession: Power Facilities and PV Power Generation, Consultant.

(b) Required Expertise Level: The expert is required to be knowledgeable in overall electricity power management engineering, has general knowledge on distribution network and should be able to conduct lectures on grid-connected PV power generation systems.

(c) Execution Method: Preparation of handouts and operations manual, and consequently conduct training and initiate actual practice. The training and practice described for items (i) to (vi) in "3. Outcomes of the Soft Component" is executed. Especially, for item (iv), i.e., the quality of power supply of the existing grid that connects to Chinggis Khaan Airport (fluctuation of voltage, frequency and so on), the actual data recorded during the survey period should be used.

(d) Input from Resource Person (Number of experts and duration): Electrical and PV system expert: 1 expert for 2.0 man-months (M/M), estimated based on the following tasks:

- Preparation of training and handouts: 0.5 M/M
- The training and lecture will be executed considering the following topics:

(i) The composition of the existing grid network that connects with grid-connected PV system: 0.1 M/M

(ii) Protection system of the grid: 0.1 M/M

(iii) Power supply situation of the grid: 0.1 M/M

(iv) Quality of the electricity in Chinggis Khaan Airport supplied by the existing

grid: 0.2 M/M

(v) Basic knowledge on PV system: 0.1 M/M

(vi) Operation of grid-connected PV system and its protection system: 0.3 M/M

- Execution of evaluation test: 0.1 M/M
- Preparation of maintenance manual: 0.2 M/M
- Execution of appropriate maintenance practice: 0.3M/M

(Mongolian Side)

(e) Necessary Technology and Type of Profession: Electrical engineering, Consultant

(f) Required Technical Level: Senior engineer or equivalent professional (with technical background)

(g) Execution Method: Preparation of handouts, carry out training and practice

(h) Input from Resource Persons (Number of persons and duration): Consultant (1 person for 1.5 M/M); and Interpreter: (1 person for 1.5 M/M)

(i) Targeted Personnel: Staff of CAAM, UBEDN, and Energy Authority

(2) Grid Connection and Power Purchase Agreement

(Japanese Side)

(a) Necessary Technology and Type of Profession: Grid Operation/Power Management Expert, Consultant

(b) Required Expertise: The expert should be able to guide the management and institution of distribution grid network.

(c) Execution Method: Preparation of procedure manual on PPA and provide related practical support

(d) Input from Resource Person (Number of experts and duration): Grid operation/Power management expert: 1 person for 1.5 M/M, estimated based on the following tasks:

- Preparation of procedure manual: 0.5M/M
- Planned support for PPA is intended for the following tasks:

(i) Consultation with Energy Regulatory Authority: 0.1 M/M

(ii) Support on submitting application for power sales licenses: 0.1 M/M

(iii) Support on preparation of buyback tariff: 0.2 M/M

(iv) Support on the negotiation for PPA with UDNPC: 0.3 M/M

(v) Support on preparing the PPA document: 0.3 M/M

(Mongolian Side)

(e) Necessary Technology and Type of Profession: Power management engineer, consultant

(f) Required Technical Level: Senior Engineer or equivalent professional (with technical background)

(g) Execution Method: Preparation of procedure manual and execution of related support

(h) Input from Resource Person (Number of person and duration): Consultant (1 person for 1.0 M/M) and Interpreter (1 person for 1.0 M/M)

(i) Targeted Personnel: Staff of CAAM and UBEDN

(3) Data Analysis of Data Logger

(Japanese Side)

(a) Necessary Technology and Type of Profession: Data analysis/PV power generation expert, consultant

(b) Required Expertise: In addition to the knowledge on data analysis, familiarity with PV system is necessary

(c) Execution Method: Preparation of data logger operation manual, conduct of training and initiation of actual practice.

(d) Input from Resource Person (Number of expert and duration): Data analysis expert: 1 person for 1.5 M/M, estimated based on the following tasks:

- Preparation of users' manual on data logger: 0.5 M/M
- The target and input of the training on data logger operation is as follows:

(i) Understanding function and composition of data logger system: 0.1 M/M

(ii) Understanding applied software: 0.1 M/M

(iii) Understanding appropriate technique on data sampling and raw data processing: 0.1 M/M

(iv) Learning management process of recorded daily, weekly, monthly and annual data: 0.1 M/M

(v) Finding out the cause of fault that occurred based on the recorded data: 0.3 M/M

(vi) Selecting appropriate preset values of power conditioner and other equipment for effective operation based on the recorded data: 0.3 M/M

(vii) Utilizing recorded data for future promotion: 0.3 M/M

(Mongolian Side)

(e) Necessary Technology and Type of Profession: Data analysis/familiarity with computer operation

(f) Required Technical Level: Senior Engineer or equivalent professional (with technical background)

(g) Execution Method: Training and practice

(h) Input from Resource Person (Number of person and duration): Consultant (1 person for 1.0 M/M) and Interpreter (1 person for 1.0 M/M).

(i) Targeted Personnel: Staff of CAAM

(4) Power Restoration and Failure Recovery Technique

(Japanese Side)

(a) Necessary technology and type of profession: PV power generation, Consultant

(b) Required Expertise: Adequate knowledge on management, operation and maintenance of grid-connected PV system.

(c) Execution method: Preparation of manual, conduct of training and practice.

The manual will be prepared for the restoration of operation of grid-connected PV system when the existing grid experiences power breakdown. Practical training on restoration will be conducted using this procedure manual.

The manual will be prepared for the trouble shooting of PV system. The manual includes (i) method of specifying breakdown point of occurrence, (ii) method of replacement of component, and (iii) the information that should be passed on accurately to the manufacturers in Japan, in order to fix the defects.

(d) Input from Resource Person (Number of experts and duration): PV power generation expert: 1 person 1.2 M/M. estimated based on the following tasks:

- Preparation of restoration process manual: 0.5 M/M
- Training for restoration of operation: 0.3 M/M
- Training for finding faulty components and its replacement: 0.4 M/M

(Mongolian Side)

(e) Necessary Technology and Type of Profession: Electrical engineer, consultant
(f) Required Technical Level: Senior engineer or equivalent professional (with technical background)
(g) Execution Method: Manual preparation, conduct training and practice
(h) Input from Resource Person (Number of person and duration): Consultant (1 person 0.7 M/M) and interpreter (1 person 0.7 M/M)
(i) Targeted Personnel: Staff of CAAM and UBEDN

(5) Awareness Campaign

(Japanese Side)

(a) Necessary Technology and Type of Profession: Dissemination of renewable energy, consultant
(b) Required Expertise: Knowledgeable in awareness campaign of renewable energy
(c) Execution method: Preparation of awareness campaign pamphlet, execution of inspection tour, and provide support for planning awareness fund
(d) Input from Resource Person (Number of expert and duration): Renewable energy popularization management expert: 1 person for 0.8 M/M, estimated based on the following tasks:

- Preparation of pamphlet: 0.2 M/M
- Execution of inspection tour: 0.2 M/M
- Preparation of draft awareness promotion plan: 0.2 M/M
- Consultation and coordination for execution of awareness promotion plan with the related organizations: 0.2 M/M

(Mongolian Side)

(e) Necessary Technology and Type of Profession: PV power generation, consultant
(f) Required Technical Level: Senior engineer or equivalent professional (with technical background)
(g) Execution Method: Preparation of awareness pamphlet for dissemination and execution of inspection tour
(h) Input from Resource Person (Number of person and duration): Consultant: 1 person for 0.7 M/M; and interpreter: 1 person for 0.7 M/M
(i) Targeted Personnel: Staff of CAAM

6. Procurement of Input Resource of Soft Component

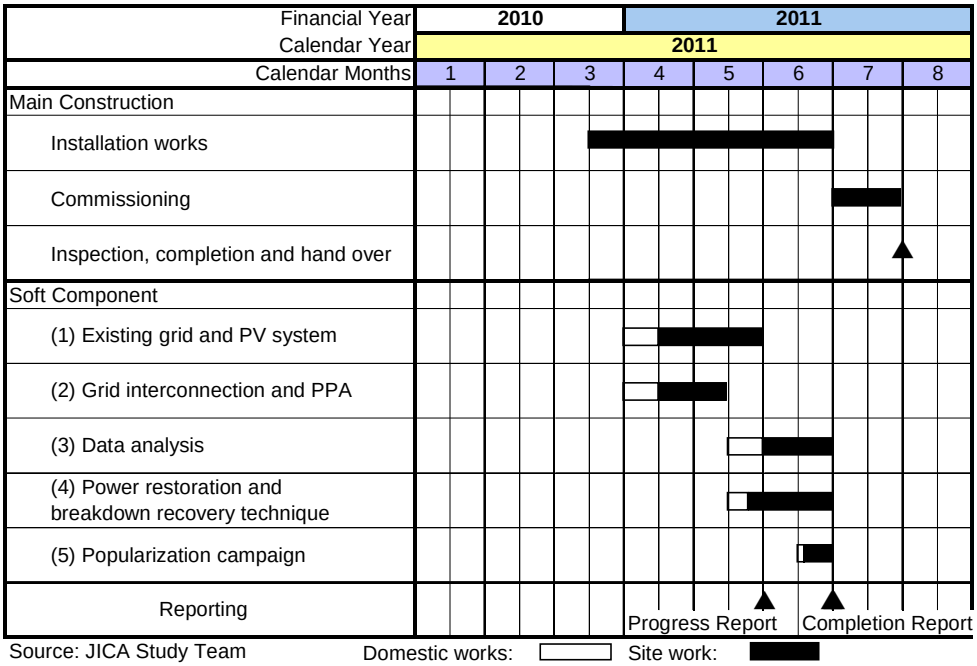
It is planned that Japanese consultant will be directly procured as resource person for providing input and conducting the soft component.

It is difficult to find local human resources who are able to conduct the soft component program in Mongolia because installation of the grid-connected PV system is the first case in the country. Therefore, local consultants shall only be employed to provide support to Japanese consultant.

7. Implementation Schedule of Soft Component

The implementation schedule is shown in the following chart.

Implementation Schedule of Soft Component



Execution of the soft components during the actual PV system installation will be much effective through witnessing and actual application of PV system. Therefore, it is planned to perform all the soft components during the period of actual installation of the PV system.

8. Reports and Documents

The reports and documents to be submitted are as follows:

(1) Text on the Existing Grid and PV System (Mongolian):	10 sets
(2) Manual for the Daily Operation and Maintenance of PV System (Mongolian):	10 sets
(3) Manufacturer's Manual on Grid Connection for PV System (English):	10 sets
(4) Application Manual on Data Logger (Mongolian):	10 sets
(5) Manual for Power Restoration and Breakdown Recovery (Mongolian):	10 sets
(6) Promotion and Awareness Campaign Pamphlet (Mongolian/English):	200 sets each
(7) Progress Report (English/Japanese):	3 sets each
(8) Completion Report (English/Japanese):	5 sets each

Due to the short implementation period of the soft component (5), the progress report of those will not be submitted.

9. Obligation of Implementing Agency of Recipient Country

In order to achieve the targets of the soft component, it is essential for CAAM and other related organizations to continue the activities based on the technology and knowledge learned during its implementation. Moreover, the technology and knowledge needs to be transferred or taken over continuously in the organizations.

One of the foreseen obstructions in the efficient execution of the above is the transfer of the staff who already learned the soft component, to other organizations. In such case, it is highly possible that related activities and transfer of technology and knowledge will be discontinued. In order to avoid such situation, CAAM needs to (i) determine the number of staff who will participate in the execution of each soft component, (ii) properly maintain the manuals and documents prepared during the implementation of the soft component, and (iii) carefully manage the technology and knowledge transfer in the organization.