PLURINATIONAL STATE OF BOLIVIA
Ministry of Hydrocarbon and Energy
Higher University of San Andrés
Administration of Airports and Auxiliary Services of Air Navigation

THE PREPARATORY SURVEY ON THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM IN THE PLURINATIONAL STATE OF BOLIVIA

Preparatory Survey Report

September 2013

Japan International Cooperation Agency

NIPPON KOEI CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) conducted the Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia.

JICA sent to Bolivia a survey team from February 12th to March 7th, 2013 and March 25th to April 17st, 2013.

The team held discussions with the officials concerned of the Government of Bolivia, 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 Bolivia from July 16th to July 27th, 2013 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 Bolivia for their close cooperation extended to the teams.

September 2013

Hidetoshi IRIGAKI
Director General,
Industrial Development and Public Policy Department
Japan International Cooperation Agency

Summary

Summary (Bolivia)

1. Country Overview

The Plurinational State of Bolivia (Bolivia) in South America is an inland state surrounded by five other nations, namely, Brazil (to its north and east), Argentina (south), Paraguay (south), Chile (west), and Peru (west). The country covers about 1.1 million km^2 and is the sixth largest country in Latin America. Its total population is 10.4 million (as of July 2013) and its population growth rate is 1.664%.

At present, as the soaring prices of prime commodities such as hydrocarbon resources and mineral products become principal factors, the economic indicators in Bolivia show good value. According to the World Bank, the gross national product (GNP) per capita of Bolivia was US$1,490 in 2008 and increased to US$2,020 in 2011. In 2008, the national fiscal balance showed a surplus because the prices of fossil fuel and mineral resources were high. In 2009, the economic growth slowed because of global economic recession. However, Bolivia showed the highest economic growth rate in South America and maintained a high growth rate from 2010 to 2012 when product market prices were still high.

2. Background of the Project and Outline

The Program Grant Aid for Environment and Climate Change of the Government of Japan (GoJ) is introduced as assistance to developing countries aimed at achieving both economic growth and reduction of greenhouse gas (GHG) emissions, and at contributing to achieving climate stability. As one measure, Japan established a new financial mechanism. Through this mechanism, Japan decided to cooperate actively with developing countries' efforts to reduce emissions and promote clean energy. At the same time, Japan extended assistance to developing countries suffering severely from adverse impacts caused by climate change. According to the initiative of this mechanism, the Japan International Cooperation Agency (JICA), in consultation with GoJ, decided to conduct a Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia.

In Bolivia in 2013, over 58.7% of the power output is generated by thermal power and 39.3% by hydraulic power in 2013. The rest of the power output (1.7%) is generated by biomass. In the same year, the total capacity of power generation in the national interconnected system (SIN) and isolated system (NI) has reached 1682.3 MW while thermal power has reached 1188.5 MW and hydraulic power reached 493.8 MW.

The Government of Bolivia (GoB) considers the promotion of research work and introduction of renewable energies in order to enhance national independence in energy.

The renewable energies other than solar include hydro, geothermal, biomass, and wind power. In the policy, the importance of the improving legal regulations on the installation of renewable energy system is described. Moreover, in the national alternative energies policy, it is important to develop renewable energy to increase self-sufficiency ratio of national energy over the medium term.

The objective of the power supply plan is to increase the electrification rate and exportation of electricity as a contribution to national economic development. There are geographical

differences on electrification rates in Bolivia. The target electrification rate in urban areas (except Pando, Beni, and Tarija) has reached 80%, whereas 50% in rural areas in 2010.

The Project on grid-connected solar photovoltaic (PV) system would contribute to the increase of power supply by renewable energy and reduction of GHG emission for power generation. Therefore, this project will contribute to the mitigation of climate change by Bolivia as a "cool earth partnership" country.

In the agreement requested by the GoB, the necessary equipment for a grid-connected solar PV system will be introduced in the project. The Ministry of Hydrocarbon and Energy (MHE) is the responsible organization while the Higher University of San Andrés (*Universidad Mayor de San Andrés*: UMSA) and the Administration of Airports and Auxiliary Services of Air Navigation (*Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea:* AASANA) acts as the implementing organizations for the project. The equipment should be procured according to necessity, adequacy, and sustainability of climate change mitigation. The plan consists of scheduled equipment procurement and soft component (technical assistance).

In this project, a 50 kW-capacity system will be introduced at the Cota Cota Campus of UMSA, Engineering Faculty in La Paz City while a 315 kW-capacity system will be introduced at the Viru Viru International Airport (VVI) in Santa Cruz, as a first grid-connected solar PV project in Bolivia. In addition, the project will contribute to technical training on solar PV systems and awareness-raising activities on environmental aspects.

3. Outline of Preparatory Survey and Project Contents

The JICA, in consultation with the GoJ, decided to conduct a Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia (herein referred to as the Project).

The preparatory survey was carried out from July 2009 to March 2010. However, project implementation for the first site became difficult because the utility plan of the site was changed. Therefore, a new project site was discussed with the GoB and a preparatory survey was conducted again.

With regard to the new candidate sites at the Cota Cota Campus of UMSA and VVI which were requested by the GoB, JICA sent the Preparatory Survey Team (herein referred to as the JICA Study Team) to Bolivia, and stayed in the country from 12 February 2013 to 7 March 2013. The JICA Study Team held discussions with concerned officials of GoB and conducted the first field survey for the selection of sites. A site survey was carried out for the two candidate sites, UMSA in La Paz City and Viru Viru International Airport (VVI) in Santa Cruz City.

Three choices for the project sites were considered as project candidate sites; (1) only in UMSA, (2) both in UMSA and VVI, (3) only in VVI. For the selection of sites, many discussions were carried out among concerned institutions. As a result, a plan to introduce solar PV in both UMSA and VVI was agreed. The first survey report was subsequently submitted to JICA.

The second survey was then carried out from 25 March 2013 to 17 April 2013. Then, the draft outline design report was prepared in Japan based on the discussions, field survey, and technical examination of the second survey result. In order to explain and consult with the concerned officials of the GoB regarding the components of the draft final report, JICA dispatched the JICA Study Team from 16 July 2013 to 27 July 2013.

It is clarified that the dimensional area of the candidate site in UMSA can be smaller than expected for the installation of the solar PV system because of the influence of shadows. Therefore, three sites were suggested by the Bolivian side. The JICA Study Team selected the feasible site based on the following concerns of the project formulation policy:

1) Showcase effect

2) Introduction of advanced technology and know-how of Japan

3) Establishment of sustainable operation and maintenance (O&M) structure

The Project is carried out based on the framework of the Environmental Program Grant Aid by the GoJ. The main equipment to be procured, which includes installation and testing, are the PV module and mounting structure, power conditioner, and step-up transformer with medium-voltage equipment.

The table below shows the generation capacity of the PV system and necessary ground area.

Capacity of PV System and Necessary Land Area

	Area (m^2)	Capacity (kW)
UMSA	1,060	50
VVI	10,000	315
Total	11,060	365

Source: JICA Study Team

Main equipment such as PV module, power conditioner, and transformer are to be purchased from Japan.

It is necessary to prepare the plan for procurement of spare parts for continuous operation. For this project, spare parts are not available locally. Therefore, it is necessary to procure them from Japan. As for PV modules, 3% of total quantities have to be procured as spare parts due to shortened shutdown periods during lightning or equipment breakdown. Power conditioner is the most important component of the PV system. In this project, one complete set of power conditioner with a unit capacity, which is mentioned in the single line diagram, will be supplied as a spare unit. Additional surge protection devices, fans and filters will be procured as spare parts. As for medium voltage equipment, each type of arrester (3 phases), protection relay and meters will be procured.

4. Implementation Schedule and Cost

The Exchange of Notes (E/N) for this Project has been signed on March 19, 2010. The bidding process to determine the contractor takes four months after a Consultant has been recommended by JICA. After contract signing with the contractor, the entire procedure would take 11.5 months from the development of drawings and design and manufacturing of documents, to the completion of the works.

The estimated cost of the project implementation of the Japanese side is ¥439 million.

The demarcated cost of the Bolivian side is estimated to be around ¥3,940,000 for site preparation and leveling (UMSA: ¥ 3,290,000, VVI: ¥ 650,000).

5. Project Evaluation

1) Conformity with the National Strategy on the Energy Sector

The National Development Plan 2006-2010 of Bolivia specifies the promotion of research work and the introduction of renewable energies in order to enhance national energy independence. The strategies are written in “Policy 3 Sovereignty and Energy Independence” under Item 5.3.3 “Power” of Chapter 5 “Industry of Bolivia” in the National Development Plan of Bolivia.

Renewable energies mentioned as part of the strategy are, solar photovoltaic (PV) energy, hydroelectric energy, geothermal energy, biomass energy, wind energy, etc. In the policy, the importance of the improvement of legal regulations governing the installation of renewable energy is described. Moreover, the importance of the development of renewable energies in order to provide a medium-term increase in the energy supply is mentioned in the national alternative energy policy. Thus, this Project is in conformity with the national energy policy.

2) Showcase effect

The installed capacity of the solar PV system in Cota Cota Campus of UMSA is small at 50 kW because the project site is surrounded by buildings and trees. However, showcase effect is expected to continue in the long term because the system will be used for educational purposes. For VVI, the number of customers of the facility is around 1.5 million people per a year. The installed capacity of the airport is high at 315 kW. Showcase effect can be increased by putting a display monitor which shows operational conditions of the generation system near the entrance of the airport terminal building.

3) Introduction of Advanced Technology and Know-how of Japan

Bolivia’s experiences are mainly on independent small-scale solar systems in rural areas but none on the installation of a grid-connected solar PV system. Moreover, grid-connected solar PV systems are commonly disseminated in Japan. In this Project, advanced technologies of Japan such as solar PV systems and grid-connected technologies can be applied.

4) Establishment of Sustainable O&M Structure

In the Project, the person in-charge of O&M will be trained by the manufacturer's engineer under the soft component program because there is limited experience on O&M of grid-connected solar PV system in the country. Technical transfer will be conducted with UMSA and AASANA/SABSA as counterpart and implementing organization. The establishment of a sustainable O&M structure will be expected to promote renewable energy projects.

5) Influence on the Environment

Construction works are carried out at UMSA and VVI. Therefore, it is important to consider measures for noise and safety protection in and around the project sites. There will be no influence to the surrounding conditions if the site is enclosed with fences and danger plate signs are properly placed around the construction site. In addition, human resource development for environmental education with regard to PV systems will be carried out in the soft component.

As mentioned in the above key issues, the adequacy of implementation in an environmental program grant aid by the GoJ is of great significance to this Project.

(1) Quantitative Benefits

The supply of power output and reduction of carbon dioxide (CO_2) emission are considered as quantitative benefits of the project implementation. The details are as shown in the table below.

Effective Index and Target Value

Index	Standard Value (2013)	Target Value(2016) (3 years after project completion)
Annual Estimated Power Output (MWh/year)	0	454 MWh/year
CO_2 Emission (t/year)	0	277 t/year

Source: JICA Study Team

Annual CO_2 reduction is calculated by multiplying the reduction of CO_2 emission per unit (kg･CO_2/kWh) with annual energy production (kWh/year).

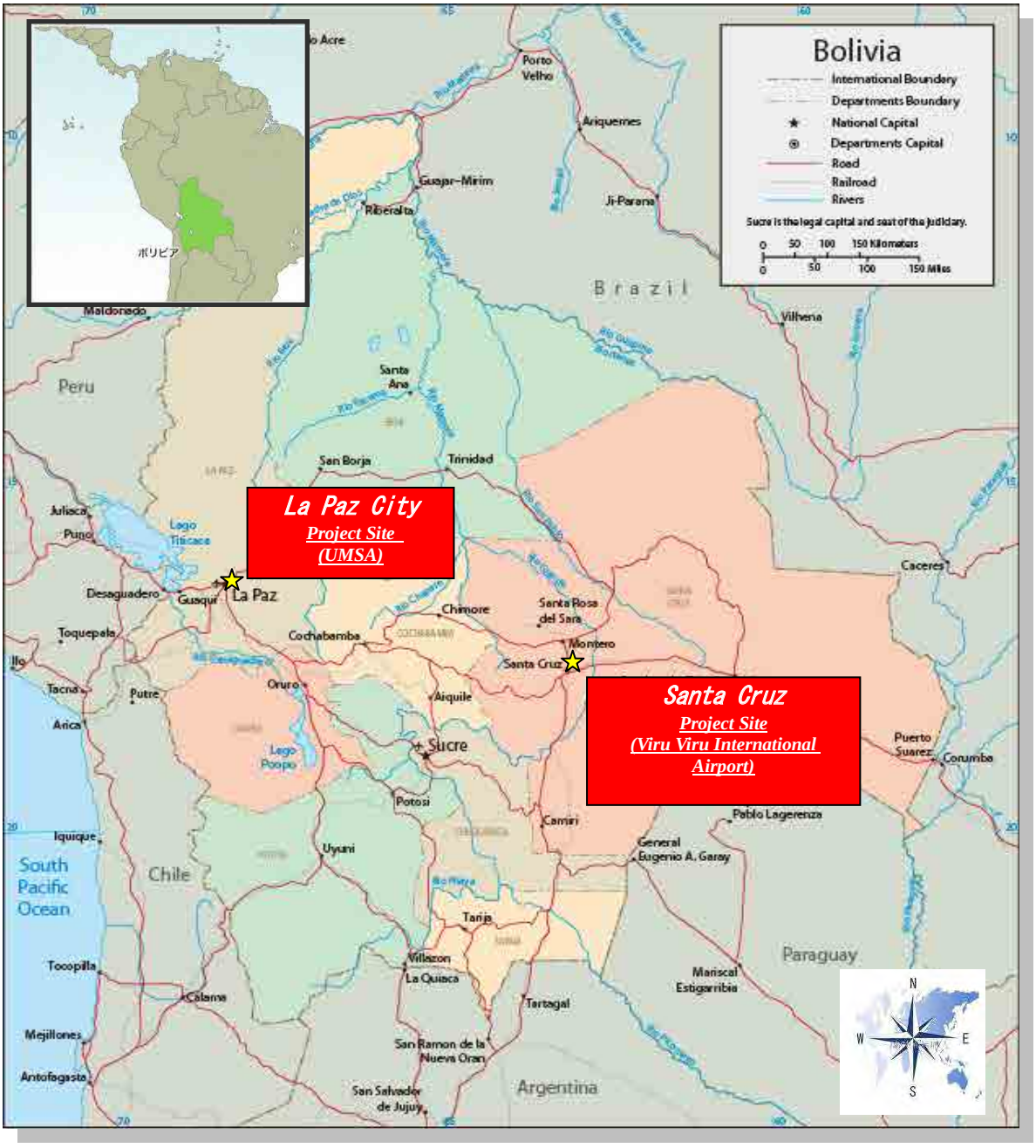
The unit of CO_2 reduction shall apply the values that are calculated and used in hydroelectric power generation business (Rio Taquesi Hydroelectric Power Project) of Sud-Yungas City of La Paz.

(2) Qualitative Benefits

The qualitative benefits are expected as follows: (1) introduction of renewable energy, (2) demonstration effect, and (3) raising of awareness.

As mentioned above, the relevance and effectiveness of the project implementation are confirmed.

Location Map（La Paz, Santa Ctuz in Bolivia）



THE PREPARATORY SURVEY ON
THE PROJECT
FOR
INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM
IN
BOLIVIA

PREPARATORY SURVEY REPORT

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FIGURE LIST

ABBREVIATIONS

A/A	:	Agent Agreement
AASANA		Administration of Airports and Auxiliary Services of Air Navigation (Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea)
ABC	:	Administradora Boliviana de Carreteras (Bolivian Road Administration)
AC	:	Alternate Current
ACB	:	Air Circuit Breaker
AE	:	Electricy Supervision and Social Control Authority (Fiscalización y Control Social de Electricidad
ANSI	:	American National Standards Institute
A/P	:	Authorization to Pay
B/A	:	Banking Arrangement
BDA		Blanket Disbursement Authorization Comprehensive Authority to Pay
Bs	:	Bolivianos
CDM	:	Clean Development Mechanism
CNDC		National Load Dispatching Committee (Comité Nacional de Despacho de Carga)
COP	:	Conference of the Parties
CT	:	Current Transformer
CV	:	cross-linked polyethylene vinyl sheathed (cable)
CVT	:	Current Voltage Transformer
CVV		Control-use Vinyl insulated Vinyl sheathed (cable)
CVVS	:	Control-use Vinyl insulated Vinyl sheathed annealed copper tape (cable)
DC	:	Direct Current
DER	:	Directional Earth-fault Relay
DS	:	Disconnecting Switch
EEIA		Estudio de Evaluacion de Impacto Ambiental (Evaluation study of EIA)
EIA	:	Environmental Impact Assessment
E/N	:	Exchange of Notes
ENDE	:	Empresa Nacional de Electricidad
ES	:	Earthing Switch
FA	:	Ficha Ambiental
FCA	:	Ferroviaria Andina
FEP	:	Perfluoro (ethylene-propylene) plastic pipe for underground cable
FIT	:	Feed in Tariff
FNDR	:	Fondo Nacional de Desarrollo Regional
FO	:	Ferroviaria Oriental
FONDESIF	:	European Financial System Development and Support to the Productive Sector
FOB	:	Free on Board
F/S	:	Feasibility Study
G/A	:	Grant Agreement
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facility
GHG	:	Greenhouse Gas
GMLP	:	Municipal Government of La Paz
GNI	:	Gross National Income
GPOBA	:	Global Partnership on Output-Based Aid
GTZ	:	Deutsche Gesellschaft für Technische Zusammenarbeit
GVT	:	Grounding Voltage Transformer
GWP	:	Global Warming Potential
IT	:	Information technology
IDB	:	Inter-American Development Bank

IDTR	:	Decentralized Infrastructure for Rural Transformation
IEA	:	International Energy Agency
IEC	:	International Electro-technical Commission
IEE		Initial Environmental Examination
IEEE	:	Institute of Electrical and Electronics Engineers
IMF	:	International Monetary Fund
IP	:	International Protection (standards)
IPCC	:	Intergovernmental Panel on Climate Change
IPP	:	Independent Power Producer
JCS	:	Japan Cable Standard
JEC	:	Japanese Electromechanical Committee (standards)
JEM	:	Japan Electrical Manufacturers' (standards)
JICA	:	Japan International Cooperation Agency
JIS	:	Japan Industry Standard
KFW	:	Kreditanstalt für Wiederaufbau
LA		Lightning Arrester
LED	:	Light Emitting Diode
MCCB	:	Molded Case Circuit Breaker
MD	:	Minutes of Discussions
MDF	:	Main distribution frame
MHE	:	Ministry of Hydrocarbon Enegy (Ministerio de Hidrocarburos y Energía)
MMAYA	:	Ministerio de Medio Ambiente y Agua (Ministry of Environment and Water)
MNACC	:	The national mechanism for climate change adaptation
NASA	:	National Aeronautics and Space Administration
NDP	:	National Development Plan
NEC	:	National Electrical Code
NGO	:	Non Governmental Organization
O&M	:	Operation and Maintenance
OCR	:	Over Current Relay
OCGR	:	Over Current Ground-fault Relay
ODA	:	Official Development Assistance
OFR	:	Over Frequency Relay
ONAN	:	Oil immersed, natural flow, air cooling system
ONAF	:	Oil immersed, natural flow, forced air cooling system
OVGR	:	Over Voltage Ground-fault Relay
OVR	:	Over Voltage Relay
PC	:	Power Conditioner
PC	:	Personal computer
PF	:	Power Factor
PNCC	:	National Climate Change Program
PPA	:	Power Purchase Agreement
PV	:	Photovoltaic
PWM	:	Pulse Width Modulation
SA	:	Surge Arrester
SABSA		Bolivia Airport Sevices S. A. (Servicios Aeroportuarios de Bolivia S.A)
SENAMI		National Weather Service and Hydrology (Servicio Nacional de Meteorologia e Hidrologia)
SHS	:	Solar Home System
SIN	:	National Interconnected System

SNC		Servicio Nacional de Caminos (National highway service)
SPC	:	Steel plate cold rolled
SPHC	:	Steel plate hot rolled commercial
SS	:	Steel structure
T/D	:	Transducer
TR	:	Transformer
UFR	:	Under Frequency Relay
UMSA		Higher University of San Andrés (Universidad Mayor de San Andrés)
UNDP	:	United Nations Development Program
UNCED	:	UN Conference on Environment and Development
UNFCCC		UN Framework Convention on Climate Change
UPS		Uninterruptible Power Supply
USAID		United States Agency for International Development
UVR		Under Voltage Relay
WB		World Bank
WB PHRD		World Bank Policy and Human Resource Development (Fund)
WTO		World Trade Organization
XLPE		Cross-linked polyethylene (cable)
ZCT		Zero-phase Current Transformer

UNIT

Distance	mm	:	Millimeters
	cm	:	Centimeters (10.0 mm)
	m	:	Meters (100.0 cm)
	km	:	Kilometers (1,000.0 m)
	feet	:	12 inch = 0.30303 meter
Square measure	cm^2	:	Square-centimeters (1.0 cm x 1.0 cm)
	m^2	:	Square-meters (1.0 m x 1.0 m)
	km^2	:	Square-kilometers (1.0 km x 1.0 km)
	ha	:	Hectare (10,000 m^2)
	acre	:	1 acre=4,046.86 Square-meters
Cubic measure	cm^3	:	Cubic-centimeters (1.0 cm x 1.0 cm x 1.0 cm)
	m^3	:	Cubic-meters (1.0 m x 1.0 m x 1.0 m)
Weight	g	:	grams
	kg	:	kilograms (1,000 g)
	ton	:	Metric ton (1,000 kg)
	kN/m^2	:	kilo Newton per Square meters
	kgf/cm^2	:	kilo grams foot per Square-centimeters
Time	sec.	:	Seconds
	min.	:	Minutes (60 sec.)
	hr.	:	Hours (60 min.)
Currency	BZ$	:	Belize Dollars
	US$	:	United State Dollars
	J¥	:	Japanese Yen
Electricity	V	:	Volts (Joule/coulomb)
	kV	:	Kilo volts (1,000 V)
	A	:	Amperes (Coulomb/second)
	kA	:	Kilo amperes (1,000 A)
	Ω	:	Ohm
	MΩ	:	Mega-ohm
	Hz	:	Hertz
	W	:	Watts (active power) (J/s: Joule/second)
	kW	:	Kilo watts (10^3 W)
	MW	:	Mega watts (10^6 W)
	Wh	:	Watt-hours (watt x hour)
	kWh	:	Kilo watt-hours (10^3 Wh)
	MWh	:	Mega watt-hours (10^6 Wh)
	GWh	:	Giga watt-hours (10^9 Wh)
	VA	:	Volt-amperes (apparent power)
	kVA	:	Kilo volt-amperes (10^3 VA)
	MVA	:	Mega volt-amperes (10^6 Wh)
	var	:	Volt-ampere reactive (reactive power)
	kvar	:	Kilo volt-ampere reactive (10^3 var)
	Mvar	:	Mega volt-ampere reactive (10^6 var)
	Wp	:	Watt-peak
	kWp	:	Kilo Watt-peak

Chapter 1
BACKGROUND OF THE PROJECT

CHAPTER 1 BACKGROUND OF THE PROJECT

1.1 Current Situation and Background

1.1.1 Current Situation and Problems

(1) Implementation Setup

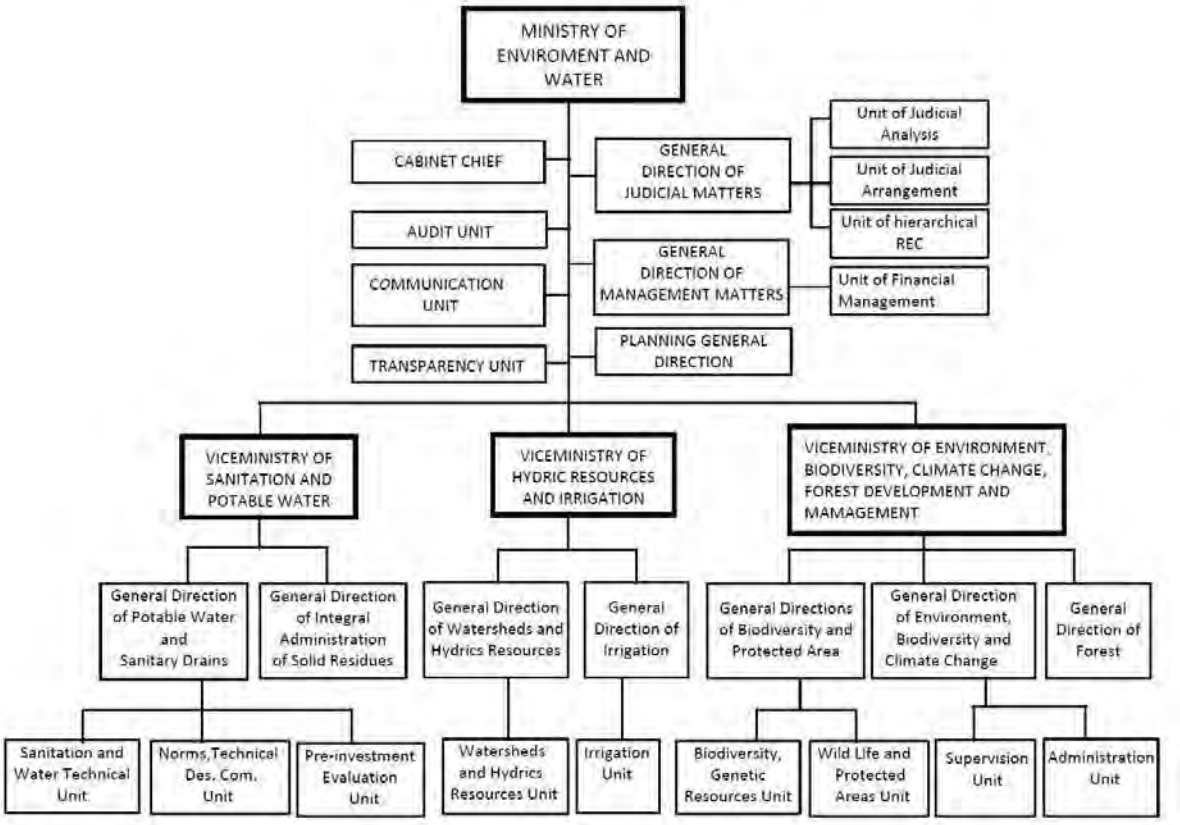
In Bolivia, activities to prevent global warming were launched at the Global Environmental Summit held in Rio de Janeiro, Brazil in 1992. In 1995, the National Climate Change Program (*Programa Nacional de Cambios Climáticos:* PNCC) was developed under the Ministry of Environment and Water (*Ministerio de Medio Ambiente y Agua*: MMAyA) in accordance with the United Nations Framework Convention on Climate Change (UNFCCC). The PNCC researched appropriate methodologies for emission reduction of greenhouse gas (GHG) effect and mitigation of climate change. Moreover, PNCC prepared the National Action Plan on Climate Change (2004-2009) in June 2004. On the basis of the action plan, a mitigation plan for climate change was developed by the Ministry of Development and Planning (*Ministerio de Planificación del Desarrollo: MPD*), the Ministry of Rural Development and Land (*Ministerio de Desarrollo Rural y Tierras*) and MMAyA.

1) Organization for Climate Change

The Ministry of Development Planning (*Ministerio de Planificacion del Desarrollo:* MPD) is the responsible organization in Bolivia that is in charge of UNFCCC and other related activities on mitigation of climate change. The Vice-Ministry of Environment, Biodiversity, Climate Change, Forest Development and Management (*Viceministerio de Medio Ambiente, Biodiversidad y Cambios Climáticos y Gestión y Desarrollo Forestal*: VMA) is working on the arrangement of activities on the mitigation of climate change. The Ministry of Rural Development and Land is responsible of the land, forest and agriculture sectors.

Source: Ministry of Development and Planning

Figure 1-1 Activities of MPD



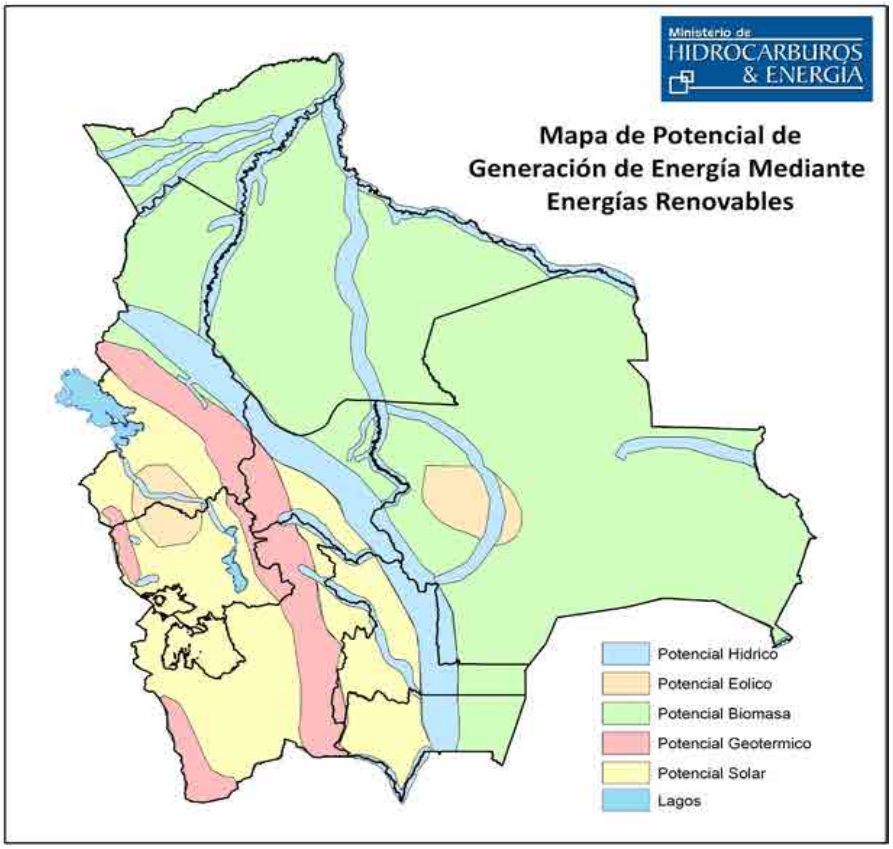
Source: MMAyA

Figure 1-2 Organizational Structure of the MMAyA

2）Renewable Energy

For the mitigation of climate change, it is important to consider the introduction of renewable energy technology to reduce emission of GHG, which aims to prevent further global warming. In the medium- and long-term energy policy of Bolivia, the importance of rural electrification and the improvement of the quality of electricity in urban areas are mentioned. Moreover, encouraging research work and introducing renewable energy are indicated in order to enhance self-reliability of national energy. As described above, it is considered that the installation of a power generation system using renewable energy is an option for climate change mitigation. It is possible to say that the improvement of electricity quality in urban areas and the increase of electricity rates in rural areas are political issues in Bolivia. In addition, these activities should be conducted taking into consideration GHG emission reduction and climate change mitigation.

Figure 1-3 shows the energy potential map of power generation for renewable energy prepared by Ministry of Hydrocarbons and Energy (*Ministerio de Hidrocarburos y Energia*: MHE). The map shows that solar potential is greater in highlands because more solar irradiation is available. On the other hand, irradiation is less in tropical regions.



Source: MHE (Plan De Universalizacion Bolivia Con Energia 2010-2025)

Figure 1-3 Development Potential of Renewable Energy

3) Solar Photovoltaics

Most of the installed photovoltaic (PV) systems are being used for rural electrification projects in Bolivia. According to the MHE, 16,940 PV systems (931 kW) have already been installed. Table 1-1 below shows the project budget for installed PV system in recent years.

Table 1-1 Budget of Solar PV Project

Organization	Financing (US$ million)	Project Title	Project Term
World Bank	5,804,983	Decentralized Infrastructure for Rural Transformation	2005-2011 Concluded on 27 May 2011
GPOBA	5,175,000	Decentralized Electricity for Universal Access	2007-2013 Concluded on 31 June 2013
Euro Solar	4,429,969	Implementación del Programa Euro-Solar en Bolivia	2007-2012 Concluded on December 2012
TOTAL	15,409,952		

Source: MHE

(2) Power Sector

In Bolivia in 2013, over 58.7% of the power output is generated by thermal power while 39.3% is generated by hydraulic power. The remaining power output of 1.7% is generated by biomass. In the same year, the total capacity of power generation in national interconnected system (SIN) and isolated system (NI) reached 1,682.3 MW. In the breakdown of the total capacity, thermal power plant capacity is 1,188.5 MW and hydraulic power plant capacity is 493.8 MW. Also, there is a small biomass power plant. In Bolivia, 25 hydropower stations and 12 thermal power stations are connected to the national interconnected system. In addition, 26 hydropower and thermal power stations are being operated as autonomous power sources. The power generating companies in Bolivia are as follows:

- Bolivian Power Company S.A. (COBEE)
- Company Guaracachi S.A. (EGSA)
- Utility Corani S.A. (CORANI)
- Electric Company Beautiful Valley S.A. (EVH)
- Electric Company Central Buleo Bulo S.A. (CECBB)
- River Electric Company S.A. (ERESA)
- Hydroelectric Boliviana S.A. (HB)
- Industrial and Commercial Energy Society Andina S.A. (SYNERGIA)
- Bolivia Development Services S.A. (SDB)
- Guabira Energia S.A. (GBE)

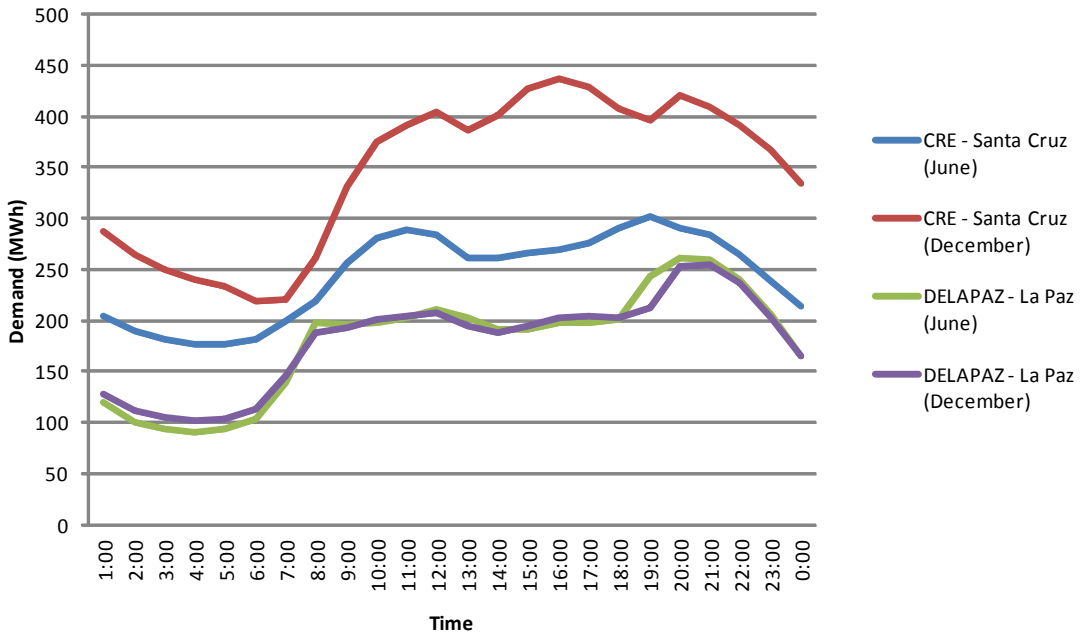
In 2012, the total length of 69 kV, 115 kV, and 230 kV transmission lines is 3,008 km. It was 2,400 km in 2007. the National Load Dispatching Committee (Comité Nacional de Despacho de Carga: CNDC） is the implementing agency for power quality control in the high voltage system of the National Interconnection System (Sistema Interconectado Nacional: SIN). The main power station and transmission lines are shown in Figure 1-4.

Source: CNDC

Figure 1-4 National Grid

1）Power Supply

Figure 1-5 below shows the daily load curve of Delapaz (La Paz) and CRE (Santa Cruz) in typical winter (3 June 2012) and summer (3 December 2012) in the southern hemisphere. In La Paz, there is a peak in the daily demand curve in the evening. It can be assumed because there are not many large-scale industries in La Paz. The figure shows that the difference in demand is small by seasons. On the other hand, there is a peak in the daily demand curve during daytime in Santa Cruz because industrial power demand is high.



Source: CNDC

Figure 1-5 Daily Load Curve (SIN)

Table 1-2 shows the maximum power potential of consumers (MW) of each distribution company from April 2012 to March 2013. Table 1-3 shows the monthly energy demand of consumers (GWh). Both tables show that there are no big seasonal differences in power demand in La Paz, and there are seasonal differences in Santa Cruz. In the comparison of power demand of each company, the demand in Santa Cruz is the highest followed by La Paz and third is Cochabamba. For other regions, power demand is low. There is inequity in power demand by region.

Table 1-2 Maximum Power Potential of Consumers (MW)

	2012									2013		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CRE – Santa Cruz	405.4	376.9	368.9	367.1	392.5	424.3	446	433.7	437.7	473.3	464.4	430.4
ELECTROPAZ – La Paz	267.5	270.9	274	274	271.8	268.5	267.6	266.1	269.7	265	273.4	274
ELFEC – Cochabamba	169.2	170.8	171.4	172.3	174.2	177.1	178.9	175.9	176	170.3	174.8	178.3
ELFEC – Chimoré	9.4	9.2	9.1	9.3	9.8	10.3	10.7	10.2	9.8	10	10	10.2
ELFEO – Oruro	53.5	52.8	49.7	53.3	53	51.3	52.7	53.5	52.5	53.2	53.4	55
ELFEO – Catavi	16.8	18.3	18.8	19.1	18.8	19.4	22.2	19.6	16.4	16.6	17.3	23.7
CESSA – Sucre	39	38.4	37.9	39	39.5	39.4	39.4	39.6	38.6	40.8	41.1	40.3
SEPSA – Potosí	40.7	41.1	41.6	42.4	42.8	41.6	40.8	41	40.6	40.6	42.9	44.1
SEPSA – Punutuma	7.1	7.4	8	8.1	7.8	7.3	7.3	6.6	6.3	6.5	6.5	8.2
SEPSA – Atocha	11.2	11.8	12.1	11.6	11.5	11	11	10.9	10.7	10.6	10.9	11.5
SEPSA – Don Diego	6.1	6.2	6.2	6.1	6.2	6.2	6	6.1	5.8	5.7	5.9	5.7
ENDE – Varios (2)	15.7	15.7	14.7	15	17.2	18.5	19.2	18.9	18.5	18.6	18.5	19.9
SAN CRISTOBAL – C. No Reg.	49.3	49.1	48.4	51.6	50.6	47.9	47.7	46.9	49.8	49.6	49.9	47.7
Otros – C. No Regulados	12.9	14.8	15	14.9	14.9	14.8	14.6	14.6	14.4	14.7	14.9	16.6
Varios (1)	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.4	2.2	2	2.1	2.1
TOTAL COINCIDENTAL	1,062.60	1,045.90	1,027.90	1,052.50	1,078.40	1,103.10	1,098.50	1,101.50	1,109.00	1,127.70	1,122.60	1,107.00

Source: CNDC

Table 1-3 Power Demand of Consumers (GWh)

	2012									2013		
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
CRE – Santa Cruz	198	187.6	171.7	175.6	196	210.5	228.9	216.3	217.8	233.7	205	217.3
ELECTROPAZ – La Paz	122.4	129.6	126.7	131.9	130.7	126.7	132	125.1	131.5	130.1	118.2	132.4
ELFEC – Cochabamba	80	83.7	82.1	85.9	86.6	85.7	91.5	86.6	87.7	85.1	76.9	89.2
ELFEC – Chimoré	3.9	3.9	3.7	3.8	4.1	4.4	4.7	4.4	4.4	4.5	4.1	4.4
ELFEO – Oruro	25.4	25.1	23.1	25.9	25.3	23	25.6	25.3	27.5	28	24	28.3
ELFEO – Catavi	7.4	9.4	9.4	10	10	9.6	9.9	8.4	6.9	7.3	6.6	8.1
CESSA – Sucre	18.2	19.1	15.8	20	20.3	19.4	20.3	19.8	18.8	20.2	18.2	17.4
SEPSA – Potosí	21.9	23.3	23	23.8	23.2	22.8	23.6	21.8	23.1	22.7	21.2	24.9
SEPSA – Punutuma	3.3	3.3	3.3	3.8	3.7	3.2	3.4	3	2.9	3.1	2.7	3.3
SEPSA – Atocha	5.6	6	6	6.1	6	6	6	5.6	5.8	5.7	5.1	6.1
SEPSA – Don Diego	2.5	2.4	2.3	2.8	2.5	2.3	2.4	2.4	2.2	2.5	2.2	2.6
ENDE – Varios (2)	7.3	6.9	6.5	6.4	7.7	8.7	9.4	8.9	8.9	9.3	8.3	9.5
SAN CRISTOBAL – C. No Reg.	30.8	32.3	24.9	32.5	32.5	30.4	27.4	30.2	32.6	33.1	25.4	31.9
Otros – C. No Regulados	7.2	8.2	7.6	9	9.1	8.7	8.9	8.3	8.1	9.1	8	8.3
Varios (1)	0.7	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.7
TOTAL	534.5	541.6	506.9	538.3	558.6	562.1	594.6	566.6	578.8	595	526.5	584.4

Source: CNDC

2) Power Demand

Table 1-4 shows the national energy demand (GWh) and power demand (MW) of Bolivia based on the data from MHE. The data until 2011 are historical data, while data after 2012 have been estimated. Table 1-4 shows that power demand has stably been increasing. The future power demand is projected to increase at 6% to 9% per year.

Table 1-4 Power Demand

Year	Energy		Potential		Load Factor
	(GWh)	Tc	(MW)	Tc	
1997	2,988	8.1%	584		0.58
1998	3,204	7.2%	622	6.6%	0.59
1999	3,351	4.6%	644	3.5%	0.59
2000	3,377	0.8%	645	0.1%	0.6
2001	3,385	0.3%	647	0.3%	0.6
2002	3,532	4.3%	674	4.2%	0.6
2003	3,604	2.0%	684	1.5%	0.6
2004	3,771	4.6%	705	3.0%	0.61
2005	3,994	5.9%	759	7.7%	0.6
2006	4,306	7.8%	813	7.1%	0.6
2007	4,686	8.8%	895	10.1%	0.6
2008	5,138	9.6%	899	0.4%	0.65
2009	5,397	5.0%	939	4.5%	0.66
2010	5,814	7.7%	1,010	7.5%	0.66
2011	6,209	6.8%	1,087	7.6%	0.65
2012	6,740	8.6%	1,193	9.8%	0.64
2013	7,501	11.3%	1,307	9.5%	0.66
2014	8,207	9.4%	1,404	7.5%	0.67
2015	8,870	8.1%	1,512	7.6%	0.67
2016	9,452	6.6%	1,606	6.2%	0.67
2017	10,088	6.7%	1,708	6.3%	0.67
2018	10,720	6.3%	1,809	5.9%	0.68
2019	11,424	6.6%	1,921	6.2%	0.68
2020	12,184	6.7%	2,043	6.3%	0.68
2021	12,960	6.4%	2,166	6.0%	0.68
2022	13,786	6.4%	2,297	6.1%	0.69

Source: MHE (Plan Optimo de Expansión del Sistema Interconectado Nacional 2012-2022)

3）Power Tariff

There are different power tariff structures for each power distribution company in Bolivia. Table 1-5 shows the power tariff structure for general consumers of Delapaz, which covers La Paz City. Table 1-6 shows the power tariff structure of CRE which covers Santa Cruz City.

Table 1-5 Power Tariff for General Consumers (Delapaz)

Category of Consumption (kWh/Mon)	Unit Charge (Bs/kWh)
21-50 kWh	0.530
51-300 kWh	0.540
301-500 kWh	0.562
501 kWh and over	0.584

Source: JICA Study Team

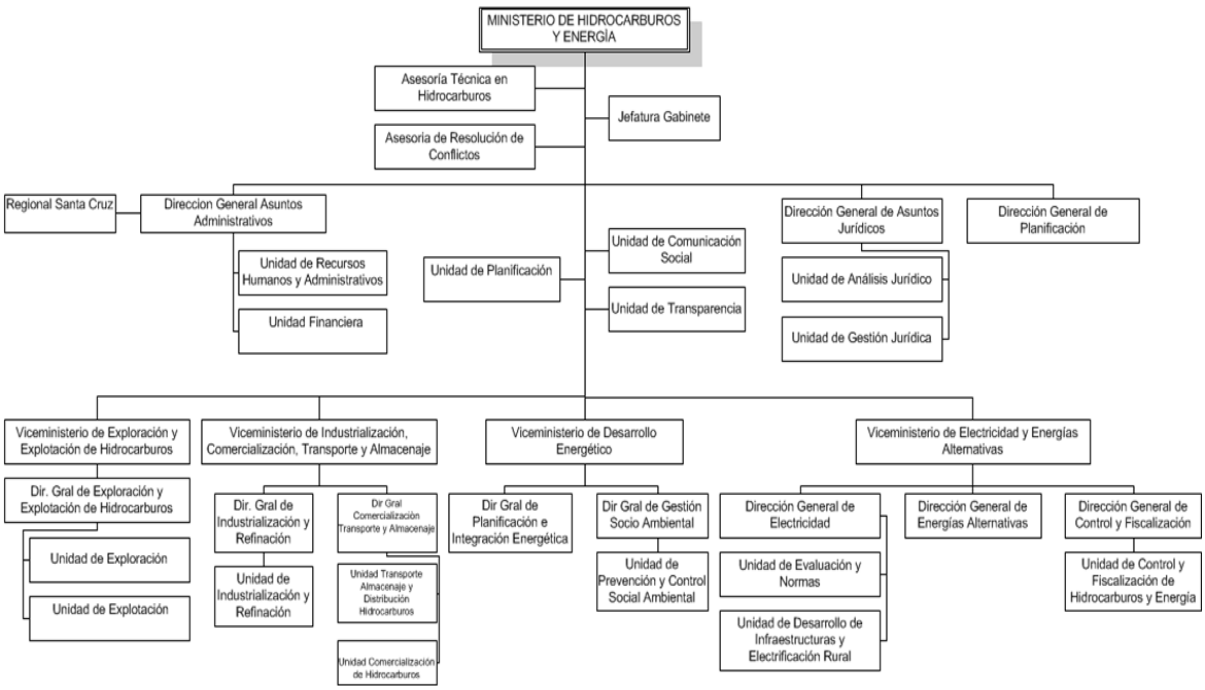
Table 1-6 Power Tariff for General Consumers (CRE)

Category of Consumption (kWh/Mon)	Unit Charge (Bs/kWh)
0-15 kWh	0.529
16-120 kWh	0.529
121-300 kWh	0.706
300 kWh and over	0.753

Source: JICA Study Team

4）Organization

Figure 1-6 shows the organizational structure of MHE.



Source: MHE

Figure 1-6 Organizational Structure of the MHE

(3) Natural Circumstances

1) La Paz City

One of the project sites is located inside the Cota Cota Campus of the Faculty of Engineering at the Higher University of San Andrés (*Universidad Mayor de San Andrés*: UMSA) in La Paz City. La Paz City is, in effect, the capital of Bolivia and the area where most national administrative and legislative institutions are situated. (Although the constitutional national capital is Sucre, the only national institution located there is the Supreme Court.)

La Paz is located in the valleys of the Andes, which is over about 3,500 m above sea level. It is closer to the eastern split of the Altiplano (plateau region sandwiched between the Andes Mountains). Therefore, it is closer to the famous mountains such as the Illimani (guardian of La Paz), Huayna Potosi, Mururata, and Illampu.

The city is built in a canyon created by the Choqueyapu River (now mostly built over), which runs northwest to southeast. The city's main thoroughfare, which roughly follows the river, changes names over its length but the central tree-lined section running through the downtown core is called the Prado.

La Paz has a subtropical highland climate. Owing to the altitude of the city, temperature is consistently cool throughout the year (average annual temperature is 8.5 °C), although the diurnal temperature variation is typically large. The city has a relatively dry climate, with rainfall occurring mainly in the slightly warmer months of November to March (average annual precipitation is 817 mm). The sun passes directly overhead in late October and mid-February, and irradiation is 1.3 times higher compared with Santa Cruz.

The project area is located in the Cota Cota Campus, and the area is facing the river with sloping terrain. It is assumed that negative impacts would not affect the project's surrounding area since the project scale is not large enough and developed.

2) Santa Cruz Department (Prefecture) and Santa Cruz City

The another project site is located in the Viru Viru International Airport which spans two cities in Santa Cruz Department, i.e., Santa Cruz City and Warnes City.

The Santa Cruz Department occupies most of the eastern and southeastern parts of Bolivia, and has a larger area than any other department.

Its main industries are agriculture, livestock production, forestry, mining (iron ore, manganese, etc.), oil, and natural gas. In recent years, it has been recording the highest rates of economic growth of all Bolivian departments.

The department capital is Santa Cruz (officially known as Santa Cruz de la Sierra). Most of the Santa Cruz Department has a climate that is either tropical or subtropical. However, it encompasses a diversity of geographical and climatic features, including desert, savannah, part of the Amazon River basin, tropical rain forests, and temperate areas in the foothills of the Andes in the western part. It has an abundance of forest resources (mainly tropical rain forests).

In addition to their value as biological resources, forests act to foster water resources and alleviate water disasters. Over the ten-year period from 2000 to 2010, Bolivia as a whole, lost 1.82 million ha of forest, and 76 % of this loss was in the Santa Cruz Department. The destruction of forests is caused mostly by slash-and-burn farming, forest fires, expansion of farmland (both legal and illegal), and expansion of pasture accompanying overgrazing.

The city of Santa Cruz lies at an elevation of about 400 m and has an annual average temperature of 28 ℃. The climate is mild throughout the year, but winter sometimes brings "*surazos*", i.e., cold winds from the south which cause temperatures to plunge overnight to very low levels that can continue for a few days. The months of January and February see the highest

levels of precipitation, which averages 1,403 mm for the year.

The project area is located in the Viru Viru International Airport, and the area is facing National Road No. 4 and almost flat. It is assumed that negative impacts would not affect the project's surrounding area since the project scale is not large enough and developed.

(4) Environmental and Social Considerations

1) Environmental Impact Assessment (EIA)

a) Organization of MMAyA, and EIA

The MMAyA is the governing agency in charge of environmental problems and EIA in Bolivia. The organizational chart of MMAyA is shown in Figure 1-2. The responsible authority for EIA is VMA.

b) Legal EIA System in Bolivia

The EIA system in the Plurinational State of Bolivia was enacted on 27 April 1992 with an aim to protect and preserve the environment and natural resources in order to promote sustainable development while improving people's quality of life and controlling human activities that affect nature. Its fundamental principle is set down by the Environmental Law and regulations relevant to the environment (*Ley Del Medio Ambiente Nº1333*). The concrete EIA system was established by detailed regulations of Environment Law No. 1333 (*Reglamentacion De La Ley Nº1333 Del Medio Ambiente*), which was approved by the National Development Committee and effectuated by the Republic of Bolivia Supreme Decree No. 2416 in 1995. Also, the implementation rules were formulated. The concrete EIA implementation procedures are set forth in the Environmental Control and Protection Guidelines of Environment Law No. 1333.

c) Target Projects of Environmental Permit

The Environmental Control and Protection Guidelines state that an environmental permit is necessary for all public and private undertakings, projects, activities, and additional constructions.

d) Submission of Environmental Factsheet (*Ficha Ambiental*: FA)

The project proponent submits an environment factsheet (FA) to the governmental authority in charge of the environmental permit.

It should be stated in the FA the descriptions of the plan, the project site, and other details.

The signatures of two persons are necessary on the FA, i.e., one is an environmental consultant registered with the national organization of environmental consultants, and the other one is a legal representative of the project proponent.

e) Process of Environmental Permit（Obtaining Environmental License）

(i) Authority

Generally, the governmental authority which accepts the FA is the environmental bureau in the local department (prefecture) where the project is located. However, in case the project is located in more than one department, the authority for reception is VMA.

On the other hand, there is another process of application for each sector, such as for the power sector. For power sector projects, except for short power line extension project, MHE accepts the FA from the project proponent and submits it to the environmental authority.

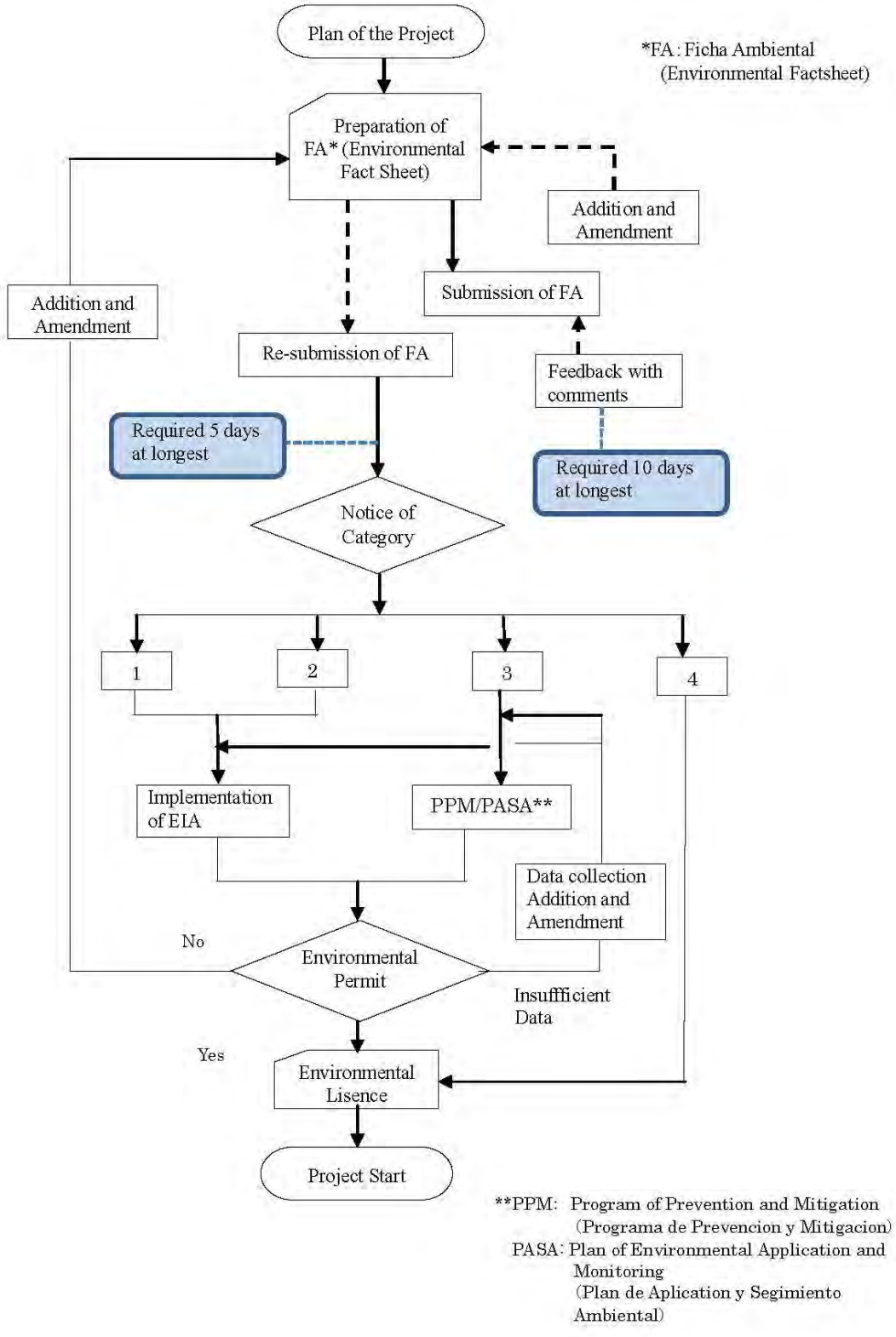
According to this process, each FA of the two solar power projects was submitted to the MMAyA through MHE.

(ii) Flow of Environmental Permit

Figure 1-7 shows the basic flow of environmental permit after an FA is prepared by the project proponent.

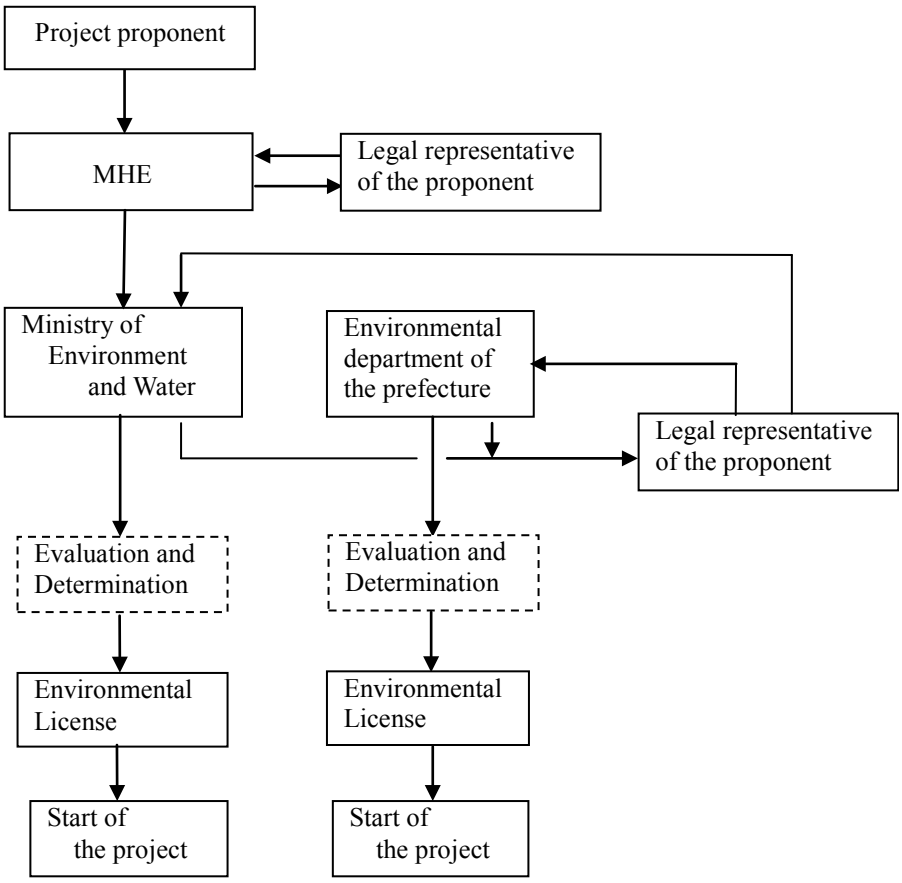
At most ten days is necessary from acceptance of the FA until feedback of the FA is received with comments from the authority that evaluated the FA. Furthermore, five days is required from acceptance of an FA that was modified by the applicant according to the comments provided by the authority until notice of category will be received.

Figure 1-8 shows the outline flow of environmental permit for projects of the power sector



Source: MMAyA

Figure 1-7 Basic Flow of Obtaining Environmental Permit



Source: MHE

Figure 1-8 Outline Flow of Obtaining Environmental Permit for Power Sector Projects

f) Evaluation and Category Classification

The environmental authority evaluates an FA and classifies the category for submitted project with information on the possible impacts of the project to the environment.

There are four categories according to impact level as shown below.

- Category 1: Full EIA is needed (Detailed analysis for impact to ecological system)
- Category 2: Partial EIA is needed (Partial analysis for impact to ecological system)
- Category 3: Although EIA is not needed, mitigation measures and a monitoring plan are required
- Category 4: EIA is completely exempted (unnecessary of environmental examinations after acquisition of environmental license)

For the project, UMSA and Administration of Airports and Auxiliary Services Air Navigation (*Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea:* AASANA) applied for their official environmental licenses, which have already been issued on 26 April 2013 for UMSA and on 6 June 2013 for AASANA.

Each site of the project is categorized under Category 4 by VMA; therefore, it is not necessary to conduct EIA for this project.

2) Environmental and Social Considerations for this Project

a) Survey for Possible Environmental and Social Impacts

The JICA Study Team prepared the entire environmental and social items that are subject for survey work (Table 1-7) based on the JICA Guidelines for Environmental and Social Considerations.

Table 1-7 Environmental Items for Screening of Possible Environmental and Social Impacts

(1) Social Environment		
	Environmental Items*	**Phase****
1	Land acquisition and involuntary resettlement	P
2	Local economies, such as employment, livelihood, etc.	P, C
3	Land use and utilization of local resources	P
4	Water usage	C
5	Social institutions such as decision-making institutions	P
6	Existing social infrastructures and services	P
7	Vulnerable social groups such as poor, indigenous, or ethnic people	P
8	Misdistribution of benefit and damage	O
9	Local conflict of interests	P
10	Cultural heritage	P,C
11	Sanitation	C
12	Infectious diseases such as HIV/AIDS	C
13	Working conditions	C
14	Accidents	C

(2) Environmental Pollution		
	Environmental Items*	**Phase****
15	Air pollution	C
16	Water pollution	C
17	Soil contamination	C
18	Bottom sediment	C
19	Waste	C
20	Noise and vibration	C
21	Ground subsidence	C
22	Odor	C

(3) Natural environment		
	Environmental Items*	**Phase****
23	Topography and geographical features	C
24	Soil erosion	C
25	Ground water	C
26	Hydrological conditions	C
27	Biota and ecosystems	C
28	Protected areas	P
29	Meteorology	P
30	Landscape	O
31	Global warming	O

note 1) * Environmental items are selected basically according to "JICA Guideline for Environmental and social considerations, April 2010 " considering contents, situation and area of the project.
note2) ** Progressing Phase of the project:
P - Stage of Planning C - Stage of Construction
O - Stage of Operation

Source: JICA Study Team

Utilizing the information obtained from the preliminary survey, which mainly are existing data for analysis, the presence or absence of environmental and social impacts for each item were checked by the method of "screening" in EIA.

As a result, eight items, as listed below, were evaluated to have possible impacts only in the construction phase. These items are shown below. (The items are shown in Table 1-8.)

11 public health 13 working environment 14 accidents 15 air pollution
16 water pollution 19 waste 20 noise and vibration 27 biota and ecosystems

Other items were evaluated as "not applicable" or "impact is very minor or does not occur".

For the project site, involuntary resettlement and land acquisition would not occur in the new area.

Processing of waste battery could possibly cause huge environment impacts. The PV system of this project does not use batteries.

b) Examination for Screened Environmental Items

For items with possibility of environmental or social impact, the JICA Study Team examined in detail the environmental and/or social impacts expected. Table 1-8 shows the results from the examination.

Table 1-8 Contents of Environmental and Social Impacts and Mitigation

Environmental Item		Rating*	Basis for Rating	Mitigation
Social Environment	Sanitation	C	There is slight possibility of impact to sanitation by activities of work and life of construction workers. However, contents of the construction and environment around is not a special. Any environmental impact do not occur by taking appropriate sanitation management measures.	The contractor must comply with regulations and administrative guidance of sanitation. The contractor must fulfill the responsibilities to control sanitation during construction work, by using proper measures such as temporary toilet, effective waste bin and safe water supply measures.
	Working conditions	C	Contents of the construction and working environment is not a special. By performing the work with taking safety management measures according to the standards and regulations for the work safety, any impact does not occurs.	1) Work around high-voltage power line and charging unit should be done under monitoring by safety management supervisor. 2) Around the charging unit and portion of the opening set partition with a rope to prevent danger. 3) Make a health and safety plan and execute education and training for safety (including traffic safety, accident prevention, and public sanitation, etc.).
	Accidents	C	There is a slight possibility of accident occurrence during the transportation and the construction. However, the possibility can be reduced to nearly zero by proper selection of the access road and thorough safety management by the proponent and the contractor.	Refer "c) Matters to be considered in terms of Environmental and Social Impact" about specific mitigation measures and about fire protection of grassland (Viru Viru Airport site).
Environmental Pollution	Air pollution	C	There is possibility of air pollutant exhausted from construction vehicles and machinery. However, emission amount is quite limited because the magnitude of construction works is very small.	
	Water pollution	C	There is slight possibility of impact by soil effluent from the temporal waste soil collection and disposal compartment in rainy season. However, the impact is vanishingly small.	If necessary install equipment to prevent soil effluent from temporal waste soil collection and disposal compartment.
	Waste	C	Wastes are generated during construction phase (soil, iron pipes and other construction waste) that don't include hazardous materials. As the wastes can be treated and disposed without any difficulty complying with the regulations of Bolivia, the possibility of environmental impact is expected to be negligible small.	About specific mitigation measures, refer "c) Matters to be considered in terms of Environmental and Social Impact" .
	Noise and vibration	C	There is a possibility of noise and vibration generated by construction vehicles and machinery. However, noise and vibration level is low and limited within a narrow area. ・UMSA Cota Cota Campus site: Operation scale of vehicles and machinery for construction is small. ・Viru Viru Airport site: The residents living area is far from the Project site.	
Natural Environment	Biota and ecosystems	C	Precious animals or plants do not exist in and around the project site. By the environmental management according to the vegetation around, it is possible to prevent even slight environmental impact.	About specific mitigation measures, refer "c) Matters to be considered in terms of Environmental and Social Impact" .

Note) * Category of rating for evaluation of Environmental and Social Impact
Adverse impact is evaluated here along the provisional with "JICA Guideline for Environmental and social considerations, April 2010 ".
A: Serious impact is expected.
B: Some impact is expected.
C: No impact is expected or impact expected to be negligible small.

Source: JICA Study Team

Since the construction scale of this project is not too large, and emission of pollutants to the environment is also very limited, environmental and social impacts for each item is evaluated to be minimal.

Each item is classified as "C rating" of impact that is expected to have a "very slight impact, or no impact".

The mitigation measures shown in Table 1-8 are intended to avoid or minimize any impact or slight impact even further. Most of these mitigation measures are mentioned in related instructions or agreements with the contractor. In addition, related strict compliance is an

essential prerequisite for the implementation of construction works, which are described in the meaning of confirmation.

c) Matters to be Considered in Terms of Environmental and Social Impacts

(i) Conservation of Trees and Green Space on the Slope around the Cota Cota Campus of UMSA

Trees and green spaces with a rather high natural condition exist around the site. Trees planted on the north slope of the site are *Eucalyptus* species. These trees, including other large trees, function as slope protection. *Eucalyptus* is a diverse genus of flowering trees from Australia. However, *Eucalyptus* trees have been planted extensively for a long period of time in La Paz; therefore, a forest of such trees has become the typical forest landscape there. Due to the importance of *Eucalyptus* trees as mentioned above, these trees around the site should be conserved as much as possible.

Thus, the arrangement of PV systems is designed with the assumption that the *Eucalyptus* trees would not be cut down.

Pine (Pinus) trees on the slope at the east side of the site

Eucalyptus trees on the slope at the northeast side of the site

(ii) Appropriate Management for Fire Protection of Grassland (Viru Viru International Airport Site)

The site is comprised of grassland that is part of the unused land around the airport. Therefore, management activities, such as mowing, are done in moderation.

Plants in the site mainly belong to the Gramineae family, but other types of grasses also exist. Such land is referred to as “weed land”, and is also seen in Japan. Important creatures for protection do not exist in the site.

From the viewpoint of environmental effects, safety management of grassland with focus on fire prevention is very important.

Withered grass is very easy to ignite. There is also a problem on security that when grasses grow wildly and tall, it becomes difficult to monitor people who enter the site from outside.

Therefore, the following precautionary actions are necessary:

- Lay a firebreak by gravel around the installation area of the PV system.
- Perform appropriate activities for management of grassland around the site, such as mowing of grass and sufficient monitoring.

(iii) Accident Prevention Measures

- The proponent and the contractor should understand well the detailed description of works and safety management measures in order to eliminate the risk of accidents during construction and transportation by thorough safety management.
- In order to ensure safety of people working, acting, or moving in and around the project area, it is important to set danger plate signs and clear division by using a rope fence bounding the construction work area.
- Select the best access road route that can minimize the risk of accidents.
- Take effective road safety measures thoroughly for both road users and construction vehicles.
- Transporting or moving of materials, equipment, and facilities in and out the site should be monitored by a safety management supervisor.

d) Construction Waste

- Comply strictly with regulations in conducting proper collection, treatment, and disposal of waste. In Bolivia, Ley Del Medio Ambiente Nº1333 prescribed proper waste management and disposal.
- Reduce the quantity of construction waste as much as possible by effective recycling, reuse, etc. Provide effective education and enlightenment for construction workers based on the 'principle of 3Rs' (reduce, reuse and recycle).
- Select and effectively utilize waste containers, such as separation of trash bins; and conduct proper waste disposal by classifying the difference of metallic, non-metallic, and other waste.
- Soil waste generated by foundation works should be backfilled as much as possible, and surplus soil should be collected and disposed properly according to the rules and regulations of relevant government authorities.

3) National Activities Related to Climate Change and GHG

a) Development of Major Environmental Policies Related to Climate Change in Bolivia

- Ratification of the Kyoto Protocol (1999)
  Clean Development Mechanism (CDM) projects are under the jurisdiction of the CDM Secretariat of the MPD.
- Strategy for national promotion of the UNFCCC (2002)
  (i) Incorporation of technology to reduce GHG emissions into various industries.
  (ii) Management of forests, tropical and wetland areas, and other ecosystems in contributing to the reduction of carbon dioxide (CO_2) emissions.
  (iii) Increase the efficiency of energy supply to resolve risks of GHG emission.
  (iv) Examination and understanding of environmental changes in the interest of prompt response.
- Five-year action plan (2004) under the PNCC (1995)

- Ten-year National Development Plan (NDP) (2006)
  The NDP emphasized the importance of problems caused by changes on a global scale in Bolivia, and initiated approaches in mitigating the country's vulnerability to climate change and reduction of GHG emission.
  In its section on environmental resources, the NDP put out distinct initiatives to reduce GHG emission and adapt to climate change.
- National Mechanism for Adaptation to Climate Change (*Mecanismo Nacional de Adaptacion al Cambino Climatico*: MNACC) (2007)
  This national mechanism reflects the general prescriptions of the NDP in an action plan in response to climate change. It consists of five sector-specific programs (water resources, food and health, settled residence and risk reduction, and ecosystems), and three multisectoral programs (scientific study and research, education, and tradition and other social features).

(Strategic aims of the MNACC)
- Reduce vulnerability to climate change
- Reduce risk to the impacts of climate change on different sectors identified as vulnerable.
- Promote planned adaptation in the context of various sectoral programs.

(Management objectives of the MNACC)
- Respond to the policies of the NDP with actions for adaptation to climate change in a comprehensive and multisectoral manner that allows a high degree of sustainability.
- Strengthen mechanisms for participation of different social actors and institutions.
- Coordinate among sectors the actions for adaptation to climate change.
- Support the efforts of the PNCC within the state structure to encourage actions for adaptation to climate change.
- Support the achievement of financial mechanisms for national development to integrate the adaptation actions (e.g., investment funds, supports programmatic, sectoral, etc.).
- Integrate adaptation actions with other operational measures that are relevant, either in development programs (watershed management programs and irrigation projects, health programs, etc.) or specific projects, and devise the need to include actions aimed at reducing national vulnerability to climate change.
- Promote the integration of adaptation actions within the community, municipality, and department.
- Support in consideration of issues of the country's response to climate change through discussions and strategic planning at the local, municipal, departmental, and national levels, including such as dialogue processes in national municipal forums, network research, reflection, etc.

b) CO_2-equivalent Emission Amount (Total National Emission)

Table 1-9 shows Bolivia's total GHG emissions in 2002 and 2004 in terms of CO_2-equivalent.

The Second National Communication Executive Summary is described as follows.

As shown in Table 1-9, CO_2 contributed 61% in 2002, and 54% in 2004 as compared to total emission. Also, methane (CH_4), contributed 23% in 2002 and 21% in 2004, ranking third in this year. The joint contributions of hydrofluorocarbons (HFCs) reached third place in 2002 with 14%, and second place with 24% in 2004.Nitrous oxide (N_2O) has contributed 1.1% in 2002, and 1.3% in 2004, ranking fourth. Finally, sulfur hexafluoride (SF6) is the gas that has contributed to a lesser extent in both years to the total emission equivalent of 0.03% in 2002, and 0.02% in 2004.

Table 1-9 Bolivia's Total GHG Emissions for 2002 and 2004 in CO_2-equivalent

(Unit: CO_2-eq.g)

Sector	Greenhouse Gas (GHG)	Global Warming Potential (GWP)	2002	2004
Energy	CO_2	1	8,603	9,147
	CH_4	23	1,073	983
	N_2O	296	69	73
Industrial Processes	CO_2	1	607	769
	SF6	22,200	19	19
	HFC-125	3,400	1	3,611
	HFC-134[a]	1,300	9,521	11,335
	HFC-143[a]	4,300	0	5,574
Agriculture	CH_4	23	12,569	13,517
	N_2O	296	465	546
Land Use, Land Use Change and Forestry	CO_2	1	31,950	36,203
	CH_4	23	277	1,264
	N_2O	296	76	345
Waste	CH_4	29	1,630	1,803
	N_2O	296	138	144
Total			66,998	85,331

Source: Plurinational State of Bolivia Second National Communication Executive Summary (UNFCCC)

c) Project Development for CDM

In Bolivia, several CDM projects registered to the United Nations CDM Executive Board have been developed. Table 1-10 shows these CDM projects.

Table 1-10 CDM Projects in Bolivia Registered to the UN CDM Executive Board

No.	Project Title	Sectoral Scope	Activity Scale	Amount of Reduction (t-CO_2-eq. /year)	Crediting Period	Date of Registration
1	Rio Taquesi Hydroelectric Power Project	Energy industries	Large	188,632	7/1/2002 -6/30/2009	7/16/2007
2	Rio Taquesi Hydroelectric Power Project (Registration Renewal)	Energy industries	Large	141,691	7/1/2009- 6/302016	11/2/2009
3	Santa Cruz Landfill Gas Combustion Project	Waste handling and disposal	Large	82,680	7/1/2005 -6/30/2012	6/3/2005
4	Carbon Sequestration through Reforestation in the Bolivian Tropics by Smallholders of FECAR	Afforestation and reforestation	Small	4,391	2/12/2008 -2/11/2029	6/11/2009
5	Conversion of Existing Open Cycle Gas Turbine to Combined Cycle at Guaracachi Power Station, Santa Cruz	Energy industries	Large	335,279	4/13/2010- 4/12/2017	4/13/2010

Source: Homepage of UNFCCC (http://cdm.unfccc.int/index.html)

4）Environmental Education

a) National Strategy for Education

Since 2007, in parallel to the development of the Second National Communication of UNFCCC, led by the Ministry of Education, participatory national level process was built in cooperation with the sectors, provinces, and regions. The process was built to meet the need to establish an active line and cooperative strategies in introducing the climate change theme into the education system of the country.

< Action policy for activities of education and communication >

(i) Formation of a process for learning about the influence of climate change to the Bolivian people in order to empower activities for adaptation to and mitigation of climate change.
- Examination and assessment of the contents and level of knowledge about climate change problems.
- Activities for the spread of knowledge and enlightenment regarding the country's vulnerability to climate change and other issues, negative impacts of climate change, and measures for adaptation and mitigation.

(ii) Development of educational programs effective for problem awareness and learning, and methodology for the incorporation of an effective capacity building process at various stages into the domestic educational system.
- Consciousness raising and capacity building related to climate change problems among teachers and educational institutions.
- Development of educational and communication tools for instruction about climate change issues.
- Inclusion of climate change topics into educational programs in Bolivia.

b) Environmental Education by Non-Government Organization (NGO)

The first activity of environmental education in Bolivia was conducted by a private sector institution in the 1980s for the purpose of national advancement. In more recent years, there have been rising concerns regarding environmental problems in the international community. In Bolivia too, public sector institutions such as universities and international organizations have been engaged in activities of environmental education, and the number and importance of these activities are rising (as reported in an article in a Japanese magazine, i.e. Global Environmental Research, Vol. 6, 2004).

According to the NGO-JICA Japan Desk, many NGOs are active in Bolivia in the field of environmental education and recycling. The major ones are the Bolivian Association for Conservation (*Asociacion Boliviana para la Conservacion*: TROPICO), Energy for Development (*Energia para el Desarrollo*: ENERGETICA), Save the Children (SC), and the Foundation for Recycling (*Fundacion para el Reciclaje*: FUNDARE). These organizations are active in the field of environmental education in Bolivia.

1.1.2 Development Plan

(1) National Development Plan

In the national development plan of Bolivia (2006-2010), the objective in the power supply plan is to increase the electrification rate and export of electricity while contributing to national economic development. In 2010, the population of Bolivia exceeded 10 million. And around 850,000 households, equal to approximately 47% received power supply by grid connected

system, and for isolated power supply system by renewable energy was around approximately 3%. The electrification rate of the urban area in 2010 (except in Pando, Beni, and Tarija) was higher than 80%.

In the 29,635th highest cabinet ordinance (Supreme Decree) entitled "Program Electricity to Live with Dignity (*Programa Electricidad para Vivir con Dignidad:* PEVD)", applied in July 2008, the target values of electrification rates in urban areas are 97% in 2015, and 100% in 2020, from 90% in 2010. In rural areas, the target electrification rates are 70% in 2015, and 87% in 2020, from 50% in 2010. Table 1-11 shows the target electrification rates of the PEVD.

Table 1-11 Target Electrification Rate

Stage	Year		Rural		Urban	
	From	To	From	To	From	To
Prime	2006	2010	33%	53%	87%	97%
Second	2010	2015	53%	70%	Universalization of electric service	
Third	2015	2020	70%	87%		
Fourth	2020	2025	Universalization of electric service			

Source: PEVD

(2) Climate Change National Adaptation Plan

On the basis of the action plan on climate change (2004-2009), the Climate Change National Adaptation Plan was developed by the MPD, Vice-Ministry of Territorial Planning and Environment, and Clean Development Office. The main subjects are as follows:

i) Organizational development for GHG emission reduction with introduction of CDM scheme and other related activities in Bolivia;

ii) Climate change mitigation program on GHG emission reduction, which is consistent with the national development plan; and

iii) Improvement of accessibility to information on CDM and other environmental issues.

1.1.3 Social and Economic Status

The Plurinational State of Bolivia (Bolivia) in South America is an inland state surrounded by five other nations, namely, Brazil (to its north and east), Argentina (south), Paraguay (south), Chile (west), and Peru (west). The country covers about 1.1 million km^2 and is the sixth largest country in Latin America. Bolivia is divided into nine departments, namely, Chuquisaca, La Paz, Cochabamba, Oruro, Potosí, Tarija, Santa Cruz, Beni, and Pando. Sucre City is an administrative capital, but most of the main facilities including the central government are located in La Paz.

Bolivia is a nation with no access to the sea, and the country consists of the Andes highlands, called ‘Altiplano’, and tropical Amazonian forests. In Altiplano, since ancient times high standard of civilizations flourished and this area is bountifully endowed with mineral resources, therefore, about 44% of the population of Bolivia have intensively crowded this area.

The total population is 10.46 million (as of July 2013) and the population growth rate is 1.664%. The ethnic composition of the population is estimated to be 55% indigenous such as Aymara, Quechua, and others, 30% are mixed or mestizo (self-identified), and 13% are white (especially Hispanic). Also, the composition has a high proportion of indigenous people as compared with other Latin American countries.

In the early 1980s, during the economic crises, Bolivia's economic structure was reformed. In the said reform, private investments were accelerated to stimulate economic growth, thus reducing the number of poor people in the 1990s. In 2003-2005, there occurred political instability and racial strain. There were violent protest movements against the plan (this plan was cancelled later) to export newly discovered natural gas to the Northern Hemisphere market. At present, as soaring prices of prime commodities, such as hydrocarbon resources and mineral products, become principal factors, economic indicators of Bolivia show good value.

According to the World Bank (WB), the gross national product (GNP) per capita was US$1,490 in 2008, and increased to US$2,020 in 2011. There was surplus revenue in 2008 due to increase in mining and hydrocarbon exports prices. In 2009, the global recession slowed the economic growth. During this period, Bolivia showed the highest economic growth rate in South America. From 2010 to 2012, when product market prices were high, Bolivia's economy maintained high growth.

1.2 Background and Outline of Program Grant Aid for Environment and Climate Change

The Program Grant Aid for Environment and Climate Change of the Government of Japan (GoJ) is introduced as assistance to developing countries aimed at achieving both economic growth and reduction of GHG emissions, and at contributing to achieving climate stability. As one measure, Japan established a new financial mechanism. Through this mechanism, Japan decided to cooperate actively with developing countries' efforts to reduce emissions and promote clean energy. At the same time, Japan extended assistance to developing countries suffering severely from adverse impacts caused by climate change. According to the initiative of this mechanism, the JICA, in consultation with the GoJ, decided to conduct a Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia in 2009 and 2010. As a result of this study, the grid connected PV system with capacity of 155 kW was planned to be installed inside the Miraflores Hospital Complex in La Paz City.

In February 2013, the selection of new candidate sites was carried out by the Bolivian government because implementation of the project became difficult. Then, this site survey was carried out at two candidate sites, i.e., UMSA in La Paz City, and Viru Viru International Airport (VVI) in Santa Cruz City. Three choices for the project site were considered as project candidate sites: (1) only at UMSA, (2) both at UMSA and VVI, and (3) only at VVI. For the selection of project site, many discussions were carried out among concerned institutions. As a result, a plan to introduce solar PV in both UMSA and VVI was agreed upon.

In the project, a grid-connected solar PV system was planned. Battery storage is not included in the design to avoid economic burden in replacing the batteries in the future. Therefore, it is necessary to assist in capacity building for operations and maintenance (O&M) personnel by the use of soft component (technical assistance).

1.3 Assistance by the GoJ

There is no official development assistance project such as a grid-interconnected PV system by the GoJ.

1.4 Assistance by Donor Country and International Organization

Many rural electrification projects using solar PV have been carried out by other organizations. In most projects, a solar home system (SHS) was introduced. In Bolivia, there are no experiences in implementing a grid-connected solar PV system. Table 1-12 shows the assistance given by donor countries and international organizations.

Table 1-12 Assistance by Donor Countries and International Organizations (Climate Change/Solar PV)

Year	Donor	Project	Budget	Description
2001-2008	UNDP/GEF	A Program for Rural Electrification with Renewable Energy Using the Popular Participation Law (Only for solar)	US$4.06 million (US$0.571million)	Grant funds for SHS. 22 municipalities based project (15 for SHS projects)
2007-2011	EU	Programa Euro-Solar (Only for solar)	US$4,429,969 (N/A)	59 kits of Solar-Wind Hybrid generation system.
2007−2013	WB/GPOBA	Prestación de Servicios de Electricidad con sistemas fotovoltaicos	US$5,175,000 (SHS: US$3.3 million)	SHS:6.766
2005−2011	WB/GOB	Decentralized Infrastructure for Rural Transformation	US$23.4 million (N/A)	SHS: 10.174

Source: MHE

Chapter 2
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CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Basic Concept of the Project

(1) Upstream Plan and Objectives of the Project

The National Development Plan 2006-2010 of Bolivia specifies the promotion of research work and the introduction of renewable energies in order to enhance national energy independence. The strategies are written in "Policy 3 Sovereignty and Energy Independence" under Item 5.3.3 "Power" of Chapter 5 "Industry of Bolivia" in the National Development Plan of Bolivia. The national development plan has not been revised since 2006.

Renewable energies mentioned as part of the strategy are: Solar photovoltaic (PV) energy, hydroelectric energy, geothermal energy, biomass energy, wind energy, etc. In the policy, the importance of the improvement of legal regulations governing the installation of renewable energy is described. Moreover, the importance of the development of renewable energies in order to provide a medium-term increase in the energy supply is mentioned in the national alternative energy policy.

(2) Project Goal

Under the grid-connected solar PV system, it is possible to contribute to the increase of generated power supply from renewable energy and a reduction of greenhouse gas (GHG) emissions from power generation. Therefore, this project will contribute to the mitigation of climate change by Bolivia as a cool earth partnership recipient country.

The promotion of renewable energy projects falls under the medium- and long-term policies of Bolivia. In this project, the 50 kW-capacity system will be introduced at Cota Cota Campus of University Mayor of San Andrés (*Universidad Mayor de San Andrés, UMSA*) Engineering Faculty in La Paz City and the 315 kW-capacity system will be introduced to Viru Viru International Airport (VVI) in Santa Cruz City as the first grid-connected solar PV project in Bolivia. In addition, the project will include technical training for solar PV system and activities for raising awareness on environmental aspects.

(3) Summary Description of the Project

In the agreement requested by the Government of Bolivia, necessary equipment for grid-connected solar PV system will be introduced in the project. The Ministry of Hydrocarbons and Energy (*Ministerio de Hidrocarburos y Energía*: MHE) is the agency responsible for the project, and the Administration of Airports and Auxiliary Services of Air Navigation (*Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea*:

AASANA) and the Engineering Faculty of the UMSA are the implementing agencies. The equipment should be procured according to necessity, adequacy and sustainability for climate change mitigation. The schedule of equipment and technical support are as shown below:

Equipment: Grid-connected Solar PV system

Application: The solar PV system will be connected to the existing distribution network.

Necessity: Under the energy policy of the Government of Bolivia, it is possible to contribute to GHG emission reduction and reduce consumption of fossil fuel for power generation by operating the grid-connected solar PV system.

Soft Component (Technical Assistance): Solar PV Technology

Contents:
- Basic knowledge on solar PV
- Management skills for solar PV plant
- Technology of grid-connected PV system
- Operation and maintenance (O&M)

Necessity:
- Limited number of solar PV engineers
- First project of grid-connected solar PV system

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

(1) Basic Policy

This introduction of grid-connected solar PV system is the first case in Bolivia. Therefore, it is necessary to consider maximizing the project effects within short- and long-term periods for the establishment of the basic plan. In general, silicon crystalline-type and amorphous-type of PV modules are mainly used in the market. For the basic design of the project, the selection of module type should consider the conditions for achieving maximum effective benefit. Not only power output from solar PV but also reduction of GHG emissions will be the important results of this project. For project sustainability, human resource development for O&M technicians and introduction of awareness-raising schemes for environmental aspect are important components.

(2) Policy for Natural Conditions

A. La Paz (UMSA, Engineering Faculty, Cota Cota Campus)

Solar PV system will be installed at about 3,000 m above sea level. The temperature is low and stable throughout the year. Annual precipitation is low at around 516 mm. The relative humidity is also low and dry throughout the year. Wind speed is also low because the project site is located inland and at the bottom of a basin. Due to the high altitude, it is necessary to make special arrangements regarding the specifications of the power conditioner. Because the air is thin, the forced air cooling system shall be used as a countermeasure.

The following meteorological conditions will be considered in the plan:

i) Ambient Air Temperature

Maximum Ambient Temperature:	28.3 °C (December 2008)
Minimum Ambient Temperature:	-3 °C (July and August, 2004)
Annual Average Ambient Temperature:	13.8 °C (1991–2012)

ii) Latitude and Longitude

Latitude:	16° 32’ south
Longitude:	68° 03’ west

iii) Altitude

Altitude: from 3,451 m to 3,454 m above sea level (by GPS Topographic Survey)

iv) Relative Humidity

Relative Humidity: 45% to 70% (no seasonal variation)

v) Rainfall

Annual Mean Rainfall: 516 mm (1991–2012)

vi) Wind Velocity

Maximum Wind Velocity: 30 m/sec

vi) Solar Irradiation

Annual Horizontal Irradiation for Design: 5.4 kWh/m^2/day

vii) Earthquake Factor

Earthquake Factor: 0.1 G

viii) Salt Erosion Not applicable

B. Santa Cruz (Viru Viru International Airport)

Solar PV system will be installed at about 373 m above sea level. The temperature is mild and stable throughout the year. Annual precipitation is low at around 1403 mm. The relative humidity is high at around 70% throughout the year. Wind speed is also high because the project site is located in flat terrain at low altitude.

The following meteorological conditions will be considered in the plan:

i) Ambient Air Temperature

Maximum Ambient Temperature: 40.0 °C (September 2007)

Minimum Ambient Temperature: -1.9 °C (July 2010)

Annual Average Ambient Temperature: 24.0 °C (1991–2012)

ii) Latitude and Longitude

Latitude: 17° 39’ south

Longitude: 63° 09’ west

iii) Altitude

Altitude: 373 m above sea level

iv) Relative Humidity

Relative Humidity:	76.9% (1984-2008)

v) Rainfall

Annual Mean Rainfall:	1403 mm (1981–2012)

vi) Wind Velocity

Maximum Wind Velocity:	35 m/sec

vii) Solar Irradiation

Annual Horizontal Irradiation for Design:	4.4 kWh/m^2/day

viii) Earthquake Factor

Earthquake Factor:	0.1 G

ix) Salt Erosion	Not applicable

(3) Policy for Environmental Impact Assessment (EIA)

All public and private undertakings or projects must submit an Environmental Fact Sheet (*Ficha Ambiental:* FA) to competent administrative authorities, to receive the determination on whether the implementation of an EIA is necessary or not, and to get an Environmental License.

In accordance with detailed regulations of the Environment Law on this procedure, as the project belongs to the power sector, AASANA and UMSA submitted the FA for the official Environmental License to the Ministry of Environment and Water (MMAyA) through MHE.

Environmental License has already been issued on April 26, 2013 for UMSA and on June 6, 2013 for AASANA.

As each site of the project is classified under Category 4 by the VMA, it is not necessary to conduct an EIA for this project.

(4) Policy for Social and Economic Status

Bolivia is an inland country in South America surrounded by five nations, namely: Brazil (north and east), Argentina (south), Paraguay (south), Chile (west) and Peru (west). The country is the sixth largest in Latin America in terms of land area. There are nine departments and Sucre is the administrative capital. However, almost all important institutions, including Congress, are located in La Paz City.

Recently, economic indicators are increasing in Bolivia due to the trend of continuous increase in the international price market of primary products such as fossil fuel and mineral

products. According to the World Bank, the gross national income (GNI) per capita of Bolivia was US$1,490 in 2008 and it increased up to US$2,020 in 2011. In 2008, the national fiscal balance showed a surplus because the price of fossil fuel and mineral resources were high. In 2009, economic growth slowed because of global economic recession. However, Bolivia showed the highest economic growth rate in South America and kept the high growth rate from 2010 to 2012 when product market price was still high.

(5) Solar PV Policy for Construction Situation/Acquisition Situation/Commercial Custom in Bolivia

This is the first project to introduce grid-connected solar PV system in Bolivia. Most of the electric companies in Bolivia transmit electricity using medium voltage distribution lines. Even if the country has no related experience on any medium voltage solar PV system having 50 kW and 315 kW capacities. It is still possible to construct and install a solar PV system. There are no problems in hiring workers on site. Also, construction materials such as reinforcing bars and cement are available and can be procured locally in Bolivia.

Installation of solar PV system is included in the scope of works of the Japanese contractor. The contractor will send supervisors for installation work and the workers will be hired on site.

(6) Capability of Implementing Organization

Under the Engineering Faculty of UMSA in La Paz, there are departments of Civil Engineering, Electrical Engineering, and others. Professors and maintenance staff of the departments will be in charge of the O&M. Technical transfer of O&M will be directed to the person in charge of the soft component. There are no O&M experiences on medium voltage grid connections in UMSA. The project site is surrounded with a fence, and there are security guards in the area.

In the other site in Santa Cruz, AASANA consigns the O&M works of airport facilities to Bolivia Airport Services S.A. (*Servicios de Aeropuertos de Bolivia S.A.*: SABSA). There are three engineers and eight technicians for O&M. These workers are working 24 hours by shift. At Viru Viru International Airport, electricity is being supplied at 10.5 kV which is a step down from the 69 kV coming from the national grid of 69 kV. SABSA has previous work experience on substation facility O&M. However, there are no O&M experiences on the equipment for medium voltage grid connections to 24.9 kV distribution line. The airport is surrounded with a fence, and there are security guards for 24 hours services in the area.

Based on the above data, Table 2-1 shows the roles of O&M staff in charge of solar PV facilities. O&M plan will be prepared based on the assigned roles.

Staff from UMSA and AASANA/SABSA are in charge of daily and periodic inspections. MHE will assist in the collection of operational and meteorological data. Currently, medium voltage lines are operated and maintained by Delapaz (a power company in La Paz) and CRE (a power company in Santa Cruz) at each project site. Both companies have agreed to assume the O&M works for medium voltage equipment through a consignment agreement after the implementation of the PV system.

Table 2-1 Role of O&M Organization

Organization	Role
MHE	Technical assistance for collection of operational and meteorological data
UMSA	Daily O&M/Periodic inspection/Monitoring and O&M of the medium-voltage side by means of outsourcing agreement
AASANA/SABSA	Daily O&M/Periodic inspection/Monitoring and O&M of the medium-voltage side by means of outsourcing agreement
Delapaz	O&M of section switches and distribution lines
CRE	O&M of section switches and distribution lines

Source: JICA Study Team

Table 2-2 below shows the items for daily inspection. Basically, it is not important to conduct complicated daily O&M on PV system since it operates automatically. However, daily inspection is important to find faulty parts promptly. Also, it is important to obtain higher power output as much as possible. In addition, damage caused by stolen system components and intended malicious actions can be prevented by frequent inspection. Daily O&M will be conducted by the staff of UMSA and AASANA/SABSA.

Table 2-2 Daily Inspection

	Visual Inspection
PV Array	Dirty and broken module surface
	Corrosion and rust on mounting structure
	Damage to outside cable
Connection Box	Corrosion and rust on box
	Damage to outside cable
Power Conditioner	Corrosion and rust on outside surface
	Damage to outside cable
	Abnormal noise and sound during operation
	Clogging of filter at ventilator exit
	Surrounding circumstance (humidity, temperature)
Grounding	Damage to outside cable
Power Generation	Check operational conditions through display meters and indicators
Surrounding Condition	Damage of fence, growth of vegetation, bird's nest, etc.

Source: JICA Study Team

Table 2-3 below shows the list of periodic inspection items which will be conducted every two months. The detailed items for each inspection period will be instructed by the manufacturers of the installed equipment. O&M staff of UMSA and AASANA/SABSA will be in charge of periodic inspections.

Table 2-3 Regular Service

Equipment	**Visual Inspection**	**Measurement**
PV Array	Dirty and broken module surface	Insulating resistance ( ) MΩ
	Corrosion and rust on mounting structure	
	Damage to outside cable	Open circuit voltage ( ) MΩ
	Damage to grounding cable, tightness of grounding connection	
Connection Box	Corrosion and rust on box	Insulating resistance ( ) MΩ
	Damage to outside cable	
	Damage to grounding cable, tightness of grounding connection	
Power Conditioner	Corrosion and rust on outside surface	Check function
	Damage to outside cable	
	Abnormal noise and sound during operation	Insulating resistance ( ) MΩ
	Clogging of filter at ventilator exit	
	Surrounding circumstance(humidity, temperature)	
	Damage to grounding cable, tightness of grounding connection	
Grounding	Damage to outside cable	Grounding resistance ( ) MΩ

Source: JICA Study Team

It is necessary to confirm the contents of the monitored data on the PV system. Also, it is necessary to store the data properly. When it is difficult to settle problems locally, such as the repair of malfunctioning parts, UMSA and AASANA/SABSA need to be supported by the manufacturers. Except for management procedures, the monitoring of power generating condition and calculation of amount of CO_2 emission reduction will be transferred. Table 2-4 below shows the operation and data management structure.

Table 2-4 Management of Operation and Data

	Activity
Operational Management	Managing operational condition
	Managing educational structure of O&M technician
	Coordinating with manufacturers when necessary
Data Management	Monitoring of power generating condition
	Compiling data on CO_2 emission reduction

Source: JICA Study Team

The PV system will be installed at UMSA in La Paz City and Viru Viru International Airport in Santa Cruz City. Thus, many visitors are expected at the PV system site. Therefore, it is important to have some persons who can guide visitors on the PV system and environmental issues. This guidance can further showcase the effect of the project. In the project methodology, the role of providing guidance on the facility will be transferred to the UMSA and AASANA staff.

Table 2-5 Awareness-Rising Activities

	Activity
Awareness Raising	Explain PV power generation system
	Hold a seminar
	Prepare brochure on the PV system

Source: JICA Study Team

(7) Policy for Procurement Process and Schedule

Main equipment for PV system such as PV module and power conditioner is purchased from Japan. The construction work plan including the procurement of PV system equipment takes around 11.5 months. Transportation of cargo from Japan to La Paz is carried out through shipment to Alica Port of Chile, then via land transportation for around 500 km to La Paz and 800 km to Santa Cruz. There is no problem on the inland transportation. During the transportation of materials and equipment to the site, it is important to consider the transportation route conditions.

(8) Policy for Plan of Grid Connection

There is no guideline for grid-connected PV system in Bolivia. The JICA Study Team introduced the "Technical Guideline on Grid Connection for Secure Quality of Electricity" (prepared by Agency of Natural Resources and Energy of Japan, October 1, 2004) and recommended to adopt the requirements for grid connection indicated in this guideline. Basic design of PV system should comply with requirements of the "Grid Interconnection Code" (JEAC-9701-2006) as well as the above guideline.

1) Connection plan to medium voltage distribution line

The PV system has a large capacity. The generated electricity will be fed to the existing distribution grid line of the power company under a reverse current flow condition. Therefore, it can be said that this is "a project with reverse current flow". The generated power will be purchased by the distribution company and the shortage of electricity during midnight will be supplied by the central grid of the power company.

Medium voltage connection has an economic advantage compared to low voltage connection because it is possible to reduce power loss caused by distribution under the simple PV system.

2) Requirement for grid connection

The condition of grid connection for solar PV system is shown below:

a) Power connection

Power conditioner has to supply power using three-phase three wires because the distribution line also has three-phase three wires.

b) Power factor

Power factor at the connection point will be more than 85% under a reverse current flow condition, and it should not be the leading power factor from the viewpoint of the grid line.

c) High harmonic distortion

Total current distortion rate is 5% or less, and each current distortion rate is 3% or less.

d) Coordination of system protection

The following protection devices will be required:

- Protective relay
- Over voltage relay (OVR)
- Under voltage relay (UVR)

- Over frequency relay (OFR)
- Under frequency relay (UFR)
- Island operation prevention relay

Protection relay of medium voltage equipment for grid connection

-Over current relay (OCR)
-Over current grounding relay (OCGR)
-Over voltage grounding relay (OVGR)

In addition to the above requirements, the following functions and equipment will be implemented in order to maintain quality of electricity and prevent electric shock:

e) Installation of insulation transformer to prevent DC current flow to connected grid. This insulation transformer is installed in the power conditioner.

f) Circuit breaker in the power conditioner cannot be closed to prevent supply of electricity during grid power failure. After recovery from power failure, the circuit breaker cannot be closed for a certain period.

3) Influence of PV System to Grid Line

There are influences of the PV system to the quality of electricity in the grid line such as voltage fluctuation, frequency fluctuation, and harmonic distortion.

a) Voltage Fluctuation

In the "Grid Interconnection Code", the range of allowable voltage fluctuation is limited to within ±10% for medium voltage grid connection. The standard range of voltage fluctuation is 6.9 kV ±7.5% as stated by Delapaz in La Paz City and 24.9 kV ±5.0% as stated by CRE in Santa Cruz City. The generated energy will be supplied to electrical equipment such as household lighting, air-conditioner, and other industrial appliances through the power grid. This range of fluctuation is within the permissible voltage range for electrical equipment at ±10%. Therefore, it is expected that the fluctuation will not affect both PV system and customers.

b) Frequency Fluctuation

There is no indication of frequency fluctuation range in "Grid Interconnection Code". Frequency fluctuation range applied to Japanese electric companies is 50 Hz ±0.2 to 0.3 Hz.

However, according to Delapaz in La Paz City, the frequency fluctuation range is 50 Hz ±0.25 Hz. In addition, the frequency variation does not affect the PV system because the range is smaller than ±1%. Therefore, it is considered that the frequency fluctuation will not affect both PV system and customers.

According to CRE in Santa Cruz City, the frequency fluctuation range is from 50 Hz ±0.8 Hz to 50 Hz ±1.4 Hz. This frequency fluctuation range is large in general. On the other hand, the National Load Dispatching Committee (*Comité Nacional de Despacho de Carga*: CNDC) is the implementing agency for power quality control in the high voltage system of the National Interconnection System (*Sistema Interconectado Nacional*: SIN). Therefore, the 24.9 kV system of CRE as well as the 69 kV high voltage system shall be monitored for power quality control, and UMSA and AASANA shall require CRE and CNDC to maintain power quality so as not to affect both PV system and its customers. Therefore, it is necessary to include the above conditions of fluctuation range in the tender requirements so that the electrical equipment of power conditioners will not be adversely affected by the frequency fluctuation.

c) Harmonic Distortion

In the "Grid Interconnection Code", harmonic distortion rate is given as 5% or less in the total current, and 3% or less in each current. According to the distribution company, the actual harmonic distortion rate is the same or smaller than that specified in the "Grid Interconnection Code". Therefore, it is considered that the harmonic distortion will not affect both PV system and customers because the harmonic distortion rate is within the appropriate range.

(9) Policy for the Relationship of Laws and Regulations, and Standards

1) Laws and Regulations

In relation to electricity regulations still to be published, the MHE sent an official letter stating that current and future regulations will not affect the implementation of the grid-connected PV system project. New electrical regulation is being prepared.

Requirements for grid-connected PV system are not mentioned in the laws and regulations, such as electrical systems, voltage fluctuation, power factor and preventing run-off operation. Law related to the electric power industry was enacted on December 21, 1994. On the basis of the electricity laws and regulations, the Electricity Supervision and Social Control Authority (*Autoridad de Fiscalización y Control Social de Electricidad*: AE) has been established as the regulatory entity responsible for auditing, controlling, supervising, and regulating the provision of services and activities by entities and operators in the electricity industry. Specific roles are as follows:

a) Protection of customers;
b) Revision and issuance of business license;
c) Approval of international interconnection of transmission line project;

d) Supervision of CNDC; and
e) Certification and setting of electricity tariff.

Thus, the JICA Study Team will adopt the conditions for grid connection under the "Grid Interconnection Code" including the "Technical Guideline on Grid Connection for Secure Quality of Electricity" as there are no regulations for grid-connected generating system.

2) Applicable Standards

The following standards will be applied for the design, manufacturing, inspection,and testing of equipment to be procured from Japan.

a) Electrical equipment and materials

In principle, Japanese standards such as Japanese Industrial Standards (JIS), Japanese Electrical Committee (JEC), Japan Electric Machine Industry Association (JEM) and Japanese Cable Makers' Association Standard (JCS) will be applied for the electrical equipment and materials supposed to be procured from Japan.

b) Equipment for medium voltage grid connection

It is recommended to apply the regulation and standards of electric companies in Bolivia on equipment for medium voltage connection because of maintenance and availability of spare parts. Japanese standards such as JIS, JEC, and JEM as well as international standards such as the International Electro-technical Commission (IEC), the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE) and electric company standards will be applied to medium voltage equipment for grid connection.

3) Construction codes and rules for electric works

The installation works, cabling works, and site tests for the PV system will adopt Japanese standards for straightforward prefabricated installation. However, international standards such as IEC and NEC will also be applied.

4) Approval procedure for power producer

For interconnection to the grid using solar PV generation system, it is necessary to register as a power producer in Bolivia. Power producers having 2 MW or more installed capacity shall be necessary to get the approval from authority. However, power producers having less than 2 MW have to register.

Currently, generating capacity of UMSA Cota Cota Campus is 50 kW, and Viru Viru International Airport is 315 kW; therefore, it is necessary to register these PV systems as

generating facilities. Therefore, UMSA and AASANA as implementation entities and power producers need to get approval of registration from AE.

After registration and before the PV system is connected to the grid line, AASANA and UMSA shall make agreements with power distribution companies CRE and Delapaz, respectively, for application of grid-connection, tariff of electricity and maintenance of switchgear medium voltage on consignment contract. Furthermore, regarding the stability of the power system (voltage, frequency variation, etc.), they will need to consult with CNDC, which is managing the power system over 69 kV in Bolivia, before operation of the PV system.

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

2-2-2-1 Facilities Plan

(1) Site Plan

A. UMSA Cota Cota Campus

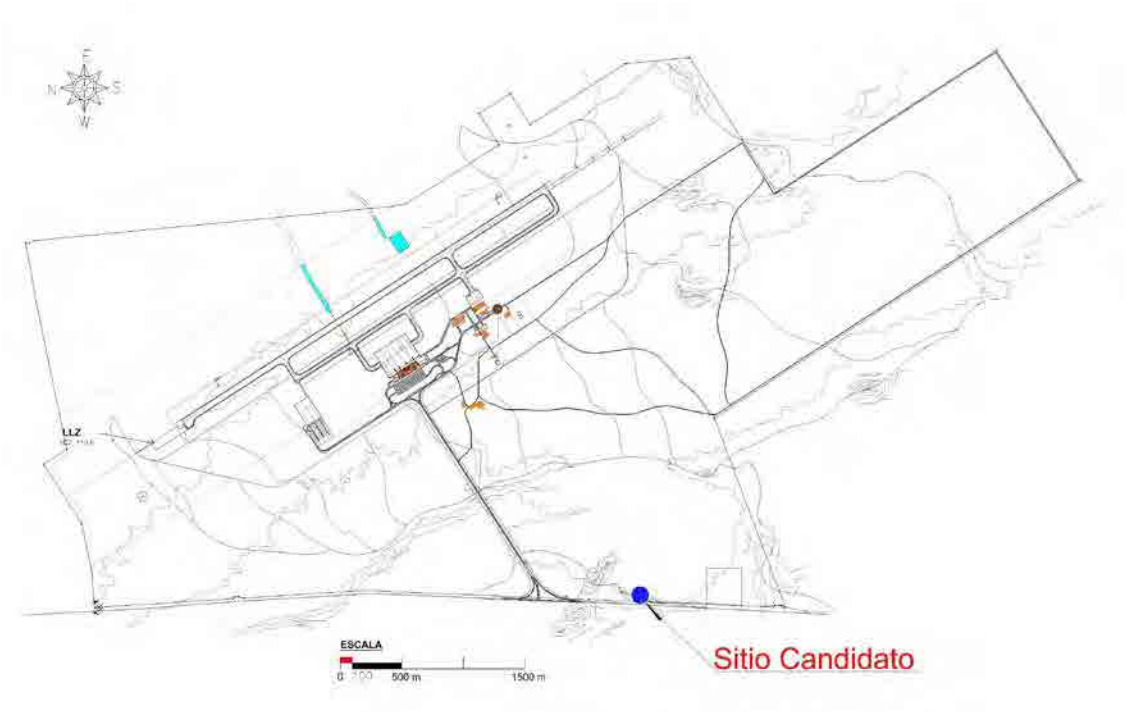
It is clarified that the dimensional area of the candidate site for the installation of solar PV system may be smaller than expected because of the influence of the shadow from adjacent trees. Therefore, discussion for site selection was carried out with Bolivian counterparts. In the discussion, installation of the system on the roof top of an existing building was suggested although it is difficult to confirm the structure of the building. During the discussion, it was agreed to find a suitable site for on-ground installation. The available space in UMSA Cota Cota Campus is limited. In the site survey, three candidate sites in the campus have been studied. After careful consideration, both sides agreed on the installation at the site shown in Figure 2-1.

Source: Prepared by the JICA Study Team

Figure 2-1 Site Layout (UMSA)

B. Viru Viru International Airport

In the first field survey, candidate site for the project at Viru Viru International Airport was studied. The proposed site was flat, and it was confirmed to have enough area for installation of solar PV system on the ground. As a result of the study on candidate sites of solar PV, the location shown in Figure 2-2 was selected.



Source: Prepared by the JICA Study Team

Figure 2-2 Site Layout (VVI)

The following points are considered in the project formulation policy:

1) Showcase Effect

A. UMSA

The site proposed for construction of solar PV facilities is located in La Paz City, a metropolis with a population of 840,000. The candidate site is located at the back of the UMSA Engineering Faculty Building in Cota Cota Campus and is next to the Jillusaya River flowing through the campus area. The number of enrolled students at the UMSA Engineering Faculty is approximately 6,320. It is possible to enhance a showcase effect by utilizing solar PV facilities in lectures and other educational opportunities. The installation of a display panel is planned near the solar PV facilities which will be installed through Japanese grant aid program.

B. Viru Viru International Airport

The site proposed for construction of PV system is located in Santa Cruz City with a population of 1,620,000 and Warnes City with a population of 26,000. The candidate site is located in the area owned by AASANA, and faces National Route 4. The ownership of this land was transferred from the Air Force to the Ministry of Transport, Telecommunication and

Air Navigation by the Supreme Decree. No. 13705, (dated June 25, 1975), General Hugo Banzer Suarez: President of the Republic. The number of visitors passing through Viru Viru International Airport is approximately 1,500,000 a year. Furthermore, a soccer stadium is under construction on the opposite land across National Route 4, and it is expected that the showcase effect will rise more in the future.

In addition, a display panel which shows power generation condition will be installed at the entrance of the airport terminal building in consideration of a showcase effect. The airport terminal building is approximately 4 km away from the PV system. In this regard, it is necessary to install a communication network. Considering the airport expansion plan, a radio local area network (LAN) is planned. License for use of radio LAN frequency is not necessary in Bolivia.

2) Introduction of Advanced Technology and Know-how from Japan

There have been experiences on small-scale independent solar PV systems and small-scale low voltage grid-connected systems in Bolivia. However, there has been no experience on the installation of large-scale grid-connected power generation systems. On the other hand, grid-connected solar PV systems are widespread in Japan. In this project, Japanese advanced technology such as solar PV systems and grid-connected technology can be applied.

3) Establishment of Sustainable O&M Structure

In this project, O&M personnel will be trained under the soft component program because there has been no O&M experience on grid-connected solar PV system. The technical transfer will be conducted with MHE, UMSA, and AASANA/SABSA as counterpart and implementing organizations, respectively.

(2) Adequacy of the Installed Capacity

According to the requirements and result of the calculation at the candidate sites, power generated output of 50 kW in UMSA and 315 kW in Viru Viru International Airport by PV system are appropriate.

(i) PV module

There are many kinds of PV modules with different specifications such as type, capacity and dimensional sizes from different manufacturers. The silicon crystalline-type module with capacity of 180 to 300 W has a conversion efficiency of around 14% to 19%. Amorphous-type module with capacity of 80 to 130 W has a conversion efficiency of around 6% to 9%. From the above conditions, the required area of the amorphous-type is 1.6 times larger than that of the silicon crystalline-type with same rated capacity. Moreover, duration of

installation work have to be extended with the increase in the required area. Therefore, installation cost using amorphous is around 20% larger than that of silicon crystalline. In this project, the available area is limited in UMSA. Therefore, it is necessary to select silicon crystalline module because of the higher efficiency. In this study, based on typical performance of 200 W capacity PV module, required area and power output are estimated. The dimension of the sample module is 1 m x 1.5 m, and the optimum operational voltage is 30 V.

(ii) Location

A.UMSA

The location for solar PV installation is decided from discussions with the Bolivian counterparts. The project site is selected in UMSA Engineering Faculty Cota Cota Campus. In the campus, there are many buildings such as educational facilities and research buildings as well as buildings for experiments and trees. It is important to select an appropriate site for the solar PV because the power output depends on the solar potential and array capacity. The PV array capacity is determined based on the available area for installation, azimuthal angle, tilting angle, and the available area with no shadow for a certain period.

There is no large difference on the power output if there is no shadow on the surface of the PV array between 9 a.m. and 4 p.m. during a midwinter day when shadows become longest. Therefore, the direction and length of shadows at 9 a.m. and 4 p.m. on the 22nd of June were estimated. At the location agreed with the Bolivian side, installed capacity was calculated to minimize the effect of shadows. As a result, installed capacity is selected for a total of 50 kW of solar PV system.

B. Viru Viru International Airport

As a result of discussions with the Bolivian side, installation site of the solar PV was decided in the area of Viru Viru International Airport. There is a future expansion program for Viru Viru International Airport, and it is necessary to select the project location that is not affected by this program. The site at the Viru Viru International Airport is flat with enough land area for the installation of a solar PV system. In consideration of the project budget, the capacity of solar PV was estimated at around 315 kW. In addition, the estimated capacity will be reviewed as necessary depending on the project budget.

(3) Plan for Power Generation and Grid Connection

1) Power Grid in Project Area

At the project sites, solar PV will be connected to the following power distribution routes with high reliability.

A. UMSA Cota Cota Campus

There are buildings for six faculties in UMSA Cota Cota Campus. Power is being supplied at 6.9 kV by Delapaz in the Cota Cota Region via a 6.9 kV overhead distribution line (AAC 160 mm^2) through the transformers (LT-101, 115 kV/6.9 kV, 20 MVA) in Cota Cota Substation. The distance to the candidate site from the solar PV system is around 1 km. The electricity supplied to UMSA Cota Cota Campus is being monitored by a power meter at the termination point of the 6.9 kV line in Cota Cota Substation.

B. Viru Viru International Airport

Viru Viru International Airport is located 15 km away from the center of Santa Cruz in the north. Generated power by the solar PV system will be connected to the 24.9 kV distribution line (AAC 107 mm^2) located along National Route No.4 in the west side of the airport. Power is being supplied from the transformer (T-1, 69 kV/24.9 kV, 37 MVA) in Nueva Jerusalen Substation located 8 km away from the site in the south. Backup power source is being supplied from the transformer (T-2, 69 kV/24.9 kV, 12.5 MVA) in Warnes Substation located 16 km away in the north. The electricity supplied from Nueva Jerusalen Substation is monitored by a power meter at the termination point of the 24.9 kV line.

2) Grid Connection and Reverse Flow

The PV system is planned to be connected directly to the power distribution line of the power company. The power converted from DC to AC will be connected to the medium voltage grid line through a step up power transformer and medium voltage switchgears. Generated power from the PV system is supplied to the distribution line as reverse flow. Therefore, it should be verified at each site that the reverse power flow from the PV system will not affect the voltage and protection coordination on the transformer bank in the substation.

A. UMSA Cota Cota Campus

Voltage fluctuation of the PV system output is caused by an impedance of transformer, distribution line, capacitor and load current (demand power) on the grid side. When estimating the voltage drop caused by the reverse power flow of PV system in the existing distribution network, it is expected that voltage drop of about 1.0% will occur at the

connection point for a 2.8 MW maximum power consumption on the existing grid line. It is considered that the voltage influence to the grid will be small because the voltage drop is less than 10%. The power output from solar PV system is estimated at about 0.25% of the grid capacity (capacity of main transformer is 20 MVA), therefore, it is considered that the effect by the reverse flow to the grid is limited.

Through this grid connection, the power company's grid line will be supplied by the reverse power flow from the PV system. Dealing power meters with both incoming and outgoing flow will be supplied by the Project. These dealing meters shall be non-reverse type based on "Grid Interconnection Code".

In case the power distribution company will accept the power supplied by the power generation entity, the grid connection shall be performed based on the requirements of the power distribution company. As for the tariff, it is necessary for UMSA to agree with the power supply company (Delapaz) because this is the introduction of PV system in Bolivia.

B. Viru Viru International Airport

Voltage fluctuation of the PV system output is caused by an impedance of transformer, distribution line, capacitor and load current (demand power) on the grid side. When estimating the voltage drop caused by the reverse power flow of PV system in the existing distribution network, it is expected that a voltage drop of about 8.6% at the connection point for a 32 MW maximum power consumption on the existing grid. It is considered that the voltage influence to the grid will be small because the voltage drop is less than 10%.

The power output from solar PV system is estimated at about 1.0% of grid capacity (capacity of main transformer is 32 MVA), therefore, it is considered that the effect by the reverse flow to the grid is limited.

Through this grid connection, the power company's grid line will be supplied by the reverse power flow from the PV system. Dealing power meters with both incoming and outgoing flow will be supplied by the Project. These dealing meters shall be non-reverse type based on "Grid Interconnection Code".

In case the power distribution company will accept the power supplied by the power generation entity, the grid connection shall be performed based on the requirements of the power distribution company. As for the tariff, it is necessary for AASANA to agree with the power supply company (CRE) because this is the introduction of PV system in Bolivia.

3) Estimated Power Output

A. UMSA Cota Cota Campus

In the project, the appropriate tilting angle of the solar module is estimated at 20° for optimal power output based on the location (latitude: -16.32, longitude: -68.03) and ease of O&M. It was decided to orient the module in the direction facing north since the area is located in the southern hemisphere. Table 2-6 below shows the monthly power output estimated by the JICA Study Team. The irradiation data for the estimation is provided by UMSA which has been doing the monitoring in the campus. And the ambient temperature at Achumani Region, where the nearest meteorological station to UMSA Cota Cota Campus is located, was obtained from the National Weather Service and Hydrology (Servicio Nacional de Meteorologia e Hidrologia: SENAMHI), a meteorological agency in Bolivia.

Table 2-6 Power Output of Solar PV System (UMSA)

Month	Days	Irradiation angle 20 (kWh/m^2-day)	Ambient Temp (℃)	50 kW	
				Power Output (kWh/day)	Monthly Output (kWh/mo)
Jan	31	5.4	14.5	205	6,354
Feb	28	4.3	14.3	163	4,570
Mar	31	4.9	14.7	186	5,787
Apr	30	6.0	14.4	226	6,792
May	31	6.4	13.1	242	7,524
Jun	30	6.0	11.9	229	6,890
Jul	31	6.0	11.5	230	7,137
Aug	31	6.0	12.6	230	7,137
Sep	30	6.0	13.3	227	6,835
Oct	31	5.8	14.7	220	6,828
Nov	30	6.7	15.4	251	7,554
Dec	31	5.6	14.9	211	6,552
Average	365	5.7	13.8	218	6,663

Source: JICA Study Team

Annual Output Energy (50 kW): 79,960 kWh

B. Viru Viru International Airport

In the project, the appropriate tilting angle of the solar module is estimated at 20° for optimal power output based on the location (latitude: −17.39, longitude: −63.09) and ease of O&M. It was decided to orient the module in the direction facing north since the area is located in the southern hemisphere. Table 2-7 below shows the monthly power output estimated by the JICA Study Team. The irradiation data for the estimation is obtained from NASA's database. Ambient temperature at Viru Viru International Airport was obtained from SENAMHI.

Table 2-7 Power Output of Solar PV System (VVI)

Month	Days	Irradiation Angle 20 (kWh/m^2-day)	Ambient Temp (℃)	315 kW	
				Power Output (kWh/day)	Monthly Output (kWh/mo)
Jan	31	4.8	26.3	1,084	33,611
Feb	28	4.6	25.9	1,035	28,985
Mar	31	4.5	25.8	1,020	31,609
Apr	30	4.3	24.2	979	29,375
May	31	3.9	21.7	894	27,724
Jun	30	3.8	20.6	870	26,115
Jul	31	4.2	20.0	967	29,964
Aug	31	4.7	22.1	1,070	33,183
Sep	30	4.8	23.7	1,093	32,791
Oct	31	4.8	25.6	1,087	33,703
Nov	30	4.9	26.1	1,112	33,370
Dec	31	4.8	26.1	1,094	33,906
Average	365	4.5	24.0	1,025	31,195

Source: JICA Study Team

Annual Output Energy (315kW): 374,336 kWh/year

4) Estimated CO_2 Emission Reduction

i) CO_2 Emission Reduction Unit

The amount of the CO_2 emission reduction is calculated based on the estimated power output. In Bolivia, the emission reduction unit applied in the Clean Development Mechanism (CDM) project of UNFCCC will be used. The unit was applied to a hydropower CDM project in June 2007 by UNFCCC at Sud-Yungas City in La Paz. Project title is "Rio Taquesi Hydroelectric Power Project".

CO_2 Emission Reduction Unit＝0.61 kg-CO_2/kWh

ii) CO_2 Emission Reduction by the Project

a) UMSA Cota Cota Campus

Annual CO_2 emission reduction = emission reduction unit × annual power output

= 0.61 (kg-CO_2/kWh) × 79,961 (kWh/year)

= 480,800 (kg-CO_2/year) = approx. 49 (ton-CO_2/year)

b) Viru Viru International Airport

Annual CO_2 emission reduction = emission reduction unit × annual power output

= 0.61 (kg・CO_2/kWh)×374,336 (kWh/year)

= 228,345 (kg・CO_2/year) ≒ 228 (ton・CO_2/year)

c) Total

Annual CO_2 emission reduction = 277 (ton-CO_2/year)

5) Power Demand of Planned Facility

Power demand in the project area are as follows:

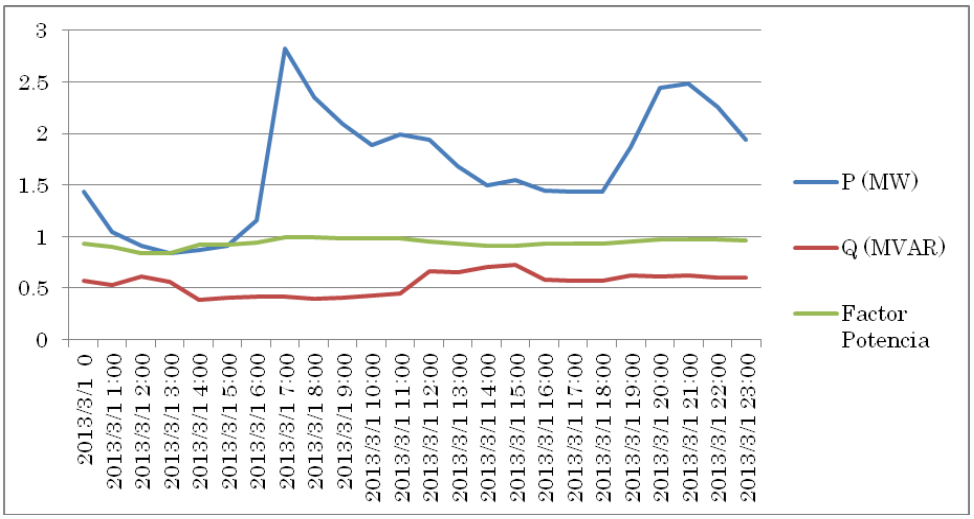
A) UMSA Cota Cota Campus

i) Power Demand of the Entire Grid System

The power demand of the entire grid system is recorded at a power meter on the 6.9 kV feeder in Cota Cota Substation which distributes electricity to UMSA Cota Cota Campus by Delapaz.

Power demand on the entire grid system of UMSA Cota Cota Campus is 2.83 MW maximum, 1.67 MW on average and with a 60% load factor, referring to Figure 2-3.

The power generating capacity by the PV system (50 kW) is small compared with the substation bank transformer capacity (20 MVA). Therefore, it is considered that the reverse-current influence of the PV system is small.



Source: Delapaz

Figure 2-3. 6.9 kV Load Curve on March 1, 2013

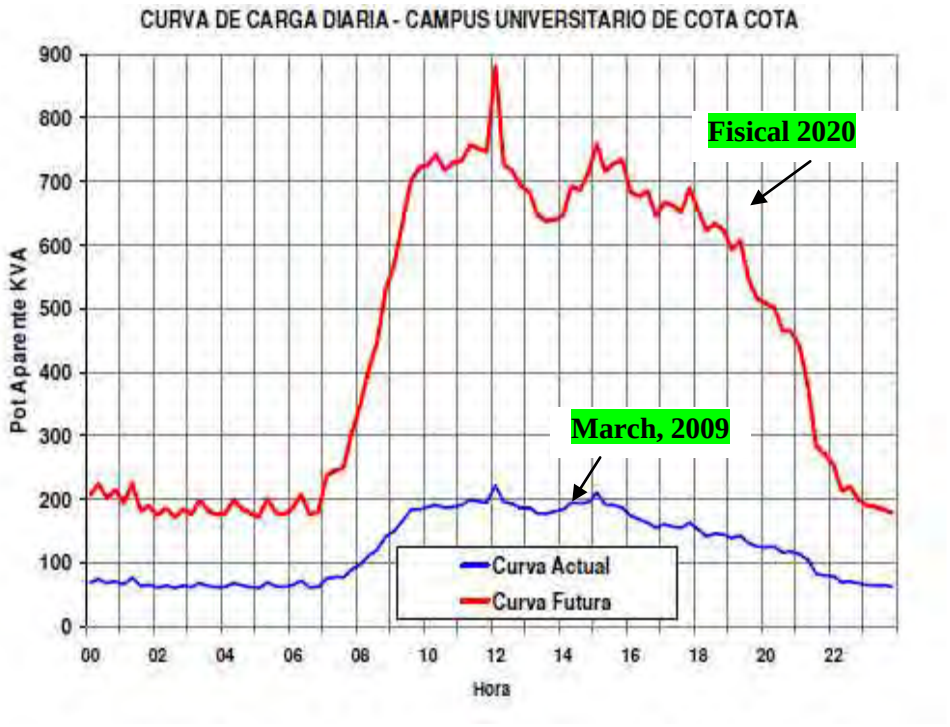
ii) Power Demand in UMSA Cota Cota Campus Premises

The entire power demand is recorded at each power meter in each building in UMSA Cota Cota Campus premises. The overall power demand in the campus is the sum of each power meter.

Power demand of six faculty buildings in UMSA Cota Cota Campus are 210 kW at the

maximum, 130 kW on the average and with a 62% load factor, referring to Figure 2-4. Power consumption in the UMSA Cota Cota Campus premises is about 8% of the entire 6.9 kV power supply system. Peak power demand of UMSA Cota Cota Campus occurs in the daytime when students are having lecture classes. UMSA expects an increase in power consumption to about three times in the power demand forecast for 2020.

Generated power by PV system is equivalent to about 6% of the amount of power consumed in the UMSA Cota Cota Campus.



Source: UMSA

Figure 2-4 Daily Load Curve in UMSA Cota Cota Campus (March 2009)

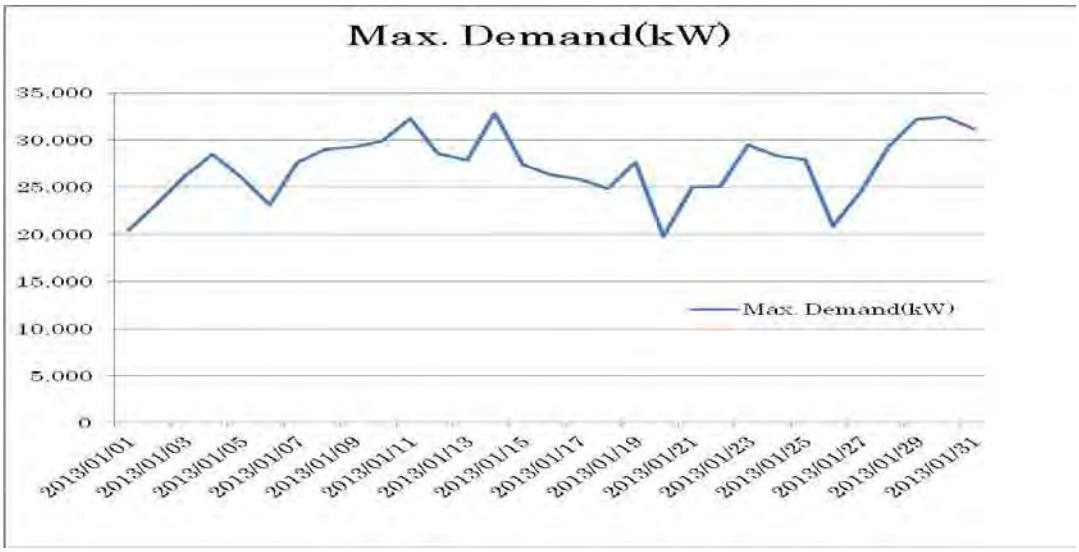
B) Viru Viru International Airport

i) Power Demand of the Entire Grid System

The power demand of the entire grid system is recorded by CRE at a power meter on the 24.9 kV feeder in Nueva Jerusalen Substation.

Power demand on the entire grid system of Viru Viru International Airport is 32.3 MW at the maximum, 27.0 MW on the average and with an 83% load factor referring to Figure 2-5.

The power generating capacity by the PV system (315 kW) is small compared with substation bank transformer capacity (37 MVA). Therefore, it is considered that the reverse-current influence of the PV system is small.



Source: CRE

Figure 2-5 24.9 kV Load Curve in January 2013

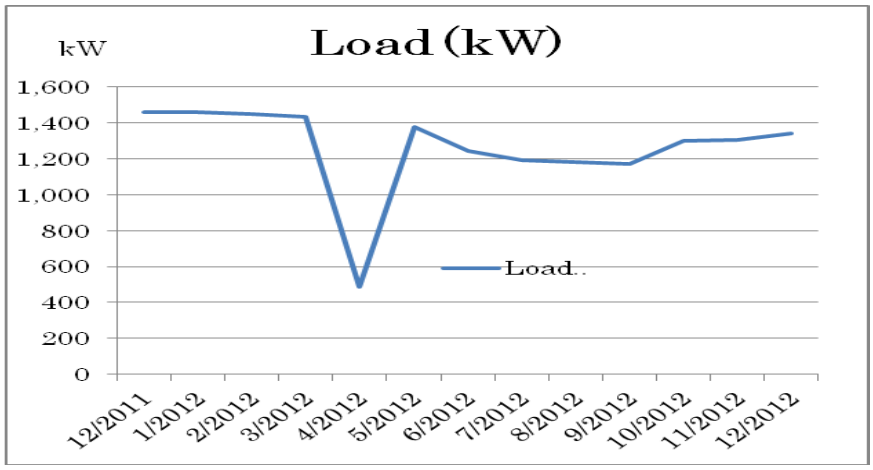
ii) Power Demand in Viru Viru International Airport Premises

The entire power demand is recorded at the power meter of the main substation (69 kV/10.5 kV) in Viru Viru International Airport.

Power demand of 10.5 kV feeder is 1,460 kW at the maximum, 1,260 kW on the average and with an 86% load factor, referring to Figure 2-6.

The minimum power demand of 500 kW (April, 2012) in the international airport building is considered that power consumption may be decreased by the periodic inspections in the airport.

Generated power by PV system is equivalent to about 4.6% of the amount of power consumed in Viru Viru International Airport.



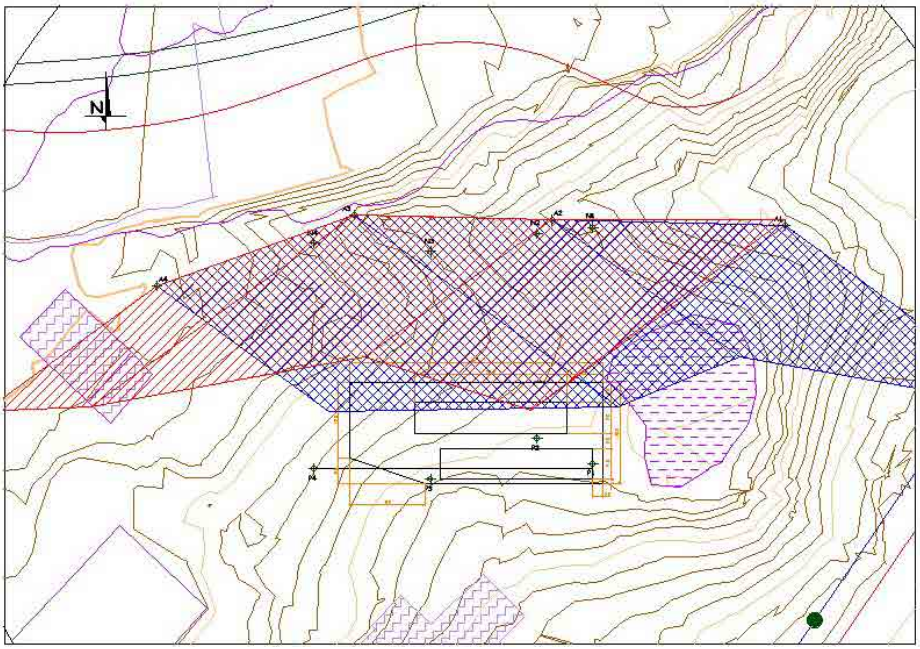
Source: SABSA

Figure 2-6 Load Curve of Viru Viru International Airport in 2012

6) Layout and Arrangement of Equipment

A. UMSA Cota Cota Campus

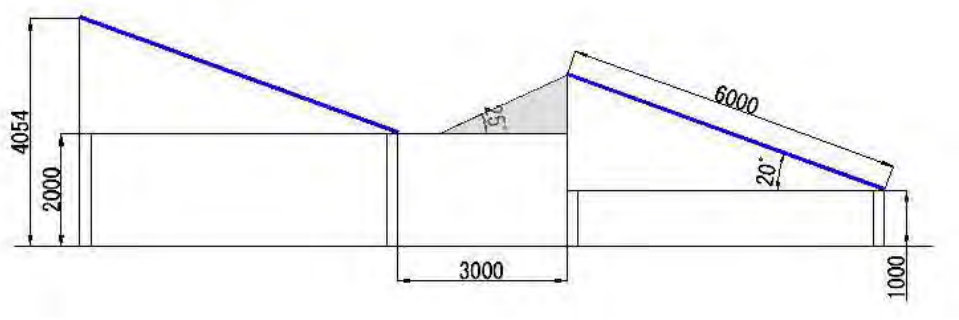
The required dimensions for the PV system installation are calculated assuming a PV array with cascade connection of four modules. The PV modules are oriented to the north with tilting angle of 20° to generate power output effectively and avoid accumulating dust on the surface. Under the above condition, the required area for the necessary power output was calculated. There will be no large differences in the power output from PV system if it is to avoid shadows falling on the surface of the module from 9 a.m. to 4 p.m. during midwinter days. Therefore, the shadow condition from 9 a.m. to 4 p.m. was estimated on the midwinter day of 22nd June. Since there are many trees in the north direction of UMSA, the installation sites were selected so as to avoid shadows of the trees during the term. The space for a solar PV power generation system is around 970 m^2. And the space for cubicle unit and transformer is around 36 m^2. Figure 2-7 below shows the shadow coverage of the project site.



Source: JICA Study Team

Figure 2-7 Shadow of the Trees at the Project Site (22 June at 9 a.m. and 4 p.m.)

In addition, it is necessary to minimize the distance between arrays in order to carry out installation in a limited area. Distance between two arrays can be shortened by raising the height of the back row from the front row. During winter solstice, angle of the sun becomes 25° at 9:00 a.m. It is necessary to prevent the shadow of the front array from falling in the back row. Therefore array distance of approximately 3 m is necessary with a 1 m height difference between the front and back rows as shown in Figure 2-8 below.



Source: JICA Study Team

Figure 2-8 Shadow Between Arrays

B. Viru Viru International Airport

The required dimensions for the PV system installation are calculated assuming a PV array with cascade connection of four modules. The PV modules are oriented to the north with tilting angle of 20° to generate power output effectively and avoid accumulating dust on the surface. Under the above condition, the required area for the necessary power output was calculated. The planned site at Viru Viru International Airport is flat and has enough area for PV installation. Therefore, the installation of seven lines of PV array with around 40 kW and one line of PV array with 35 kW facing the north were examined. The available space for a solar PV power generation system is around 10,000 m^2.

During vernal equinox, summer solstice, autumnal equinox, and winter solstice, it was examined whether the light reflected by the surface array of the solar power equipment is affecting the landing aircraft at 3° angle of approach. As a result of studying the reflected light during each day, it was determined that it does not affect the aircraft landing and taxiing on the runway and entry pathway.

7) Geological Condition of the Candidate Sites

A. UMSA Cota Cota Campus

i) Geological survey results (Report dated September 2008)

UMSA Cota Cota Campus is located and constructed over an alluvial fan formation, having soft ground underneath and high water level.

The soil structure is considered due to the survey result showing that cohesive gravel or silty gravel (GM-GC) is up to 2.0 m below ground level, and low compressibility clay (CL) is distributed up to 3.5 m below ground level. Plasticity indexes of each soil layer (IP) are 5% in the GM-GC layer, and 23% for CL layer. In addition, underground water flow has been confirmed at GM-GC layer.

ii) Considerations in the design and construction for foundation

a) It is expected that spread foundation is the foundation generally used by structures on this soft ground from the aspect of bearing capacity. However, the superstructure load of the solar panels is rather small compared with the general structure. Therefore, it is necessary to carefully study the selection of foundation type, in consideration of the physical characteristics and dynamic properties of the soil. It should be noted that there are different types of foundations, such as isolated footing, continuous footing foundation, mat foundation, mat foundation with soil improvement, such as pile foundations and the like.

b) In consideration of the impact of erosion due subsoil (underflow) water, the depth penetration of the foundation shall be deeper than 2.5 m.

c) Bearing capacity of the foundation base (CL layer) is assumed to be 35 kN/m^2.

d) It is necessary to perform measures to prevent erosion by subsoil (underflow) water at surrounding ground of foundation. In addition, it is necessary to consider that the mounting structures for PV module must be set higher than the ground surface to protect against corrosion.

e) There is a possibility of foundation settlement due to the increased stress after installation at the foundation base (CL layer). Therefore, in the design, it is necessary to examine the foundation settlement considering the consolidation properties of the CL layer.

f) Topography of the foundation will be assumed as flat but development gradient of the entire site is assumed to be at least I = 0.4% taking into account the rainwater drainage on site.

g) Before starting the construction, it is necessary to make sure that the Contractor shall investigate in advance the bearing capacity of the soil at the foundation depth to confirm that the soil bearing capacity is greater than the design subgrade reaction. If the subgrade reaction is higher than the bearing capacity of the soil, the Contractor shall consider an auxiliary method of soil improvement, and if necessary, change of the shape of the foundation.

B. Viru Viru International Airport

i) Geological survey results (Report dated September 2006)

Viru Viru International Airport is located and constructed over an alluvial sedimentary soil, characterized by loose sandy soil. The soil structure is considered due to the survey result showing that silty sand (SM) is distributed up to 6.0 m below ground level.

In addition, from the boring results in two places, groundwater level was found to be at a depth of 1.8 m.

ii) Considerations in the design and construction for foundation

a) The soil is loose sandy soil layer, and groundwater is relatively high. Therefore, it is considered to design the depth of penetration of foundation to be shallower than the groundwater level. It should be noted that the appropriate foundation for this type of soil is either continuous footing foundation or mat foundation.

b) Bearing capacity at the foundation level shall be investigated separately by the Contractor. (For a loose sandy soil layer, expected bearing capacity is assumed to be 30-50 kN/m^2)

c) Foundation level shall be compacted for the purpose of increasing the ground density and land leveling after excavation.

d) Topography of the foundation will be assumed as a flat but development gradient of the entire site is assumed to be at least I = 0.4% taking into account the rainwater drainage on site.

e) Before starting the construction, it is necessary to make sure that the Contractor shall investigate in advance the bearing capacity of the soil at the foundation depth to confirm that soil bearing capacity is greater than the design subgrade reaction. If the subgrade reaction is higher than the bearing capacity of the soil, the Contractor shall consider an auxiliary method of soil improvement, and if necessary, change the shape of the foundation.

2-2-2-2 Equipment Plan

(1) Design Standard

In Bolivia, the international standard of IEC is applied for electrical equipment. However, in the case of international cooperative programs with industrialized countries, other standards can be generally accepted. In the case of procurement under Japanese grant aid project, there is no problem in using JIS, JEC, JEM and JCS standards. In addition, the standards for medium voltage equipment must refer to that of Delapaz because altitude of the La Paz area is over 3,600 m.

(2) Equipment for PV System

Tables 2-8A to 2-8B show a list of necessary equipment with their specifications and quantities for the PV system.

A.UMSA Cota Cota Campus

Table 2-8A List of Necessary Equipment

Name	Item	Specifications	Q'ty	unit
PV system	1) PV module	(a) Type: Silicon crystal (b) Module capacity: Not less than 200 W (c) Maximum power: *200 W (d) Maximum power voltage: *23.6 V (e) Maximum power current: *8.4 A (f) Open circuit voltage: *29.5 V (g) Short circuit current: *9.3 A (h) Total array capacity: Not less than 50 kW	1	lot
	2) Mounting structure for PV module	(a) Type: Mounting structure for PV module (b) Material: SS400 and hot dip galvanized (c) Configuration: Base channel, truss (d) Height above ground level: Not less than 1 m and 2 m	1	lot
	3) Junction box and connection box	(a) Configuration: Outdoor type (b) Material: SPC steel sheet (c) PV input voltage: *DC800V (d) PV input current: *12A/circuit (e) Input circuit: *Max. 4 circuits (f) Output circuit: 1 circuit (g) Accommodated equipment: Cable disconnector, circuit breaker, surge protection device	1	lot
	4) Power conditioner (including one spare set)	(a) Configuration: Indoor, self-standing type (b) Main circuit type: Self-exciting voltage type (c) Switching type: High frequency PWM (d) Insulation type: Insulation transformer (e) Cooling: Forced air cooling (f) Rated power output : Not less than 50 kW (g) Rated input voltage: *DC 600 V (h) Maximum input voltage: *DC 900 V (i) Input voltage operating range: *DC 420V-850V (j) Maximum power point tracking range: *DC 500 V-700 V (k) Type of output power: *3 phases, 3 lines, or 3 phases, 4 lines (l) Rated output voltage: *AC 400 V or 230 V (m) AC output current distortion factor: Total harmonic distortion: 5.0% and below Each harmonic distortion: 3.0% and below (n) Power control type: Maximum power point tracking (o) Efficiency: *90% and above (p) Function: Automatic voltage adjustment,in-out current regulation, output regulation, soft start	*2	set

		(q) Grid-connection protection function: UVR, OVR, UFR, OFR, islanding operation prevention (passive, active detection), prevent power supply after recovery (r) Communication: Condition, accident, monitoring signal (RS485 and/or Ethernet port)		
	5) Power transformer for step up voltage	(a) Rated power output: 100 kVA (b) Primary/secondary voltage: 6.9 kV/400 V/230 V, 3 phases 4 lines, 50 Hz (c) Particular specification: Outdoor, elephant nose type cable terminal connection box, oil self-cooling type, Wiring: Δ-Y, neutral ground, Total load capacity tap: ±2.5%, ±5%	1	set
	6) 6.9 kV switchgear for grid connection	(a) Outdoor-type metal-enclosed cubicle type switchgear (b) CB rating: 15 kV, 400 A, 12.5 kA (c) Standard: IEC, JIS (d) Enclosed equipment: a) Voltage Current Transformer(VCT) b) Disconnecting Switch (DS) c) Lightning Arrester (LA) d) Measuring Transformer (VT, CVT) e) Zero-phase Current Transformer (ZCT) f) Vacuum Circuit Breaker (VCB) g) Current Transformer (CT) h) Protective Relay: OCGR, OVGR, OCR i) Meter: V, A, W, PF, WH	1	set
	7) Low voltage distribution board	(a) Configuration: Indoor, hanging or self-standing (b) Material: SPHC steel sheet (c) Circuit number: Input: 2 circuits (MCCB 200A x 2), Output: *10 circuits (d) Accommodated equipment: Molded case circuit breakers (MCCB), Surge protection devices Instrument: V, A, WH	1	set
	8) Monitoring display panel	(a) Configuration: Outdoor, hanging or self - standing (b) Material: SPHC steel sheet (c) Display data: Power output/day (kWh), instantaneous power potential (kW), irradiation (kWh/m^2), CO_2 emission reduction (kg-C), ambient temperature (°C) (d) Size: *W: 1000 mm x L: 800 mm x H: 200 mm	1	set
	9) Data logging and monitoring system	(a) Pyranometer: ISO 9060, Second Class 6 - 8 mV/(kW/m^2) (b) Thermometer: Resistance temperature sensor Pt 100 Ω, 4 lines type, from –50 °C to +100 °C (c) Meteorological transducer for data logging system a) Configuration: Outdoor hanging type b) Material: SPHC steel sheet c) Input signal: Irradiation (0-10 mV)	1	set

		Thermometer (Pt 100 Ω) d) Output signal: 4-20 mA e) Power source: AC 230 V f) Accommodated equipment: Pyranometer converter (T/D, thermometer T/D, power T/D, potential T/D (selling, buying electricity) (d) Monitoring equipment (indoor) a) Data monitoring : Monitoring cycle: 6 seconds, Collected data: irradiation, temperature, power output b) Equipment: Personal computer, signal converter, UPS c) Software: Display of instantaneous value, figures, forms, tables, condition of PC, accidents, and other necessary data d) External communication: Operation status, failure signal, measurement information signals for display panel and others e) Serial port: RS 232C, RS 485 and Ethernet port		
	10) Control house	(a) Type: Pre-fabricated house (b) Size: *W: 8,000 x L: 4,000 x H: 2,500 (c) Accessory: Door, light, air conditioner, dial thermometer (with contact point for alarm) (d) Accommodated equipment: Power conditioner, low voltage distribution board, data logging system and monitoring system	1	set
Construction materials	1) Cable 2) Grounding, etc.	(a) Cable: 15 kV, CV 60 mm^2-3 core, or CVT 60 mm^2 600 V, CV 250, 5.5, 2 mm^2 600 V CVV-S 2.0 mm^2 (b) Grounding wire and terminal, FEP piping materials, steel conduit piping, IV cable etc.	1	lot

*: Reference value, adopted from manufacturer's standards

Source: JICA Study Team

B. Viru Viru International Airport

Table 2-8B List of Necessary Equipment

Name	Item	Specifications	Q'ty	Unit
PV system	1) PV module	(a) Type: Silicon crystal (b) Module capacity: Not less than 200 W (c) Maximum power: *200 W (d) Maximum power voltage: *23.6 V (e) Maximum power current: *8.4 A (f) Open circuit voltage: *29.5 V (g) Short circuit current: *9.3 A (h) Total array capacity: Not less than 315 kW	1	lot
	2) Mounting structure for PV module	(a) Type: Mounting structure for PV module (b) Material: SS400 and hot dip galvanized (c) Configuration: Base channel, truss (d) Height above ground level: Not less than 0.6 m	1	lot
	3) Junction box and Connection box	(a) Configuration: Outdoor type (b) Material: SPC steel sheet	1	lot

		(c) PV input voltage: *DC800V (d) PV input current: *12A/circuit (e) Input circuit: *Max. 4 circuits (f) Output circuit: 1 circuit (g) Accommodated equipment: Cable disconnector, circuit breaker, surge protection device		
	4) Power conditioner (including one spare set)	(a) Configuration: Indoor, self-standing type (b) Main circuit type: Self-exciting voltage type (c) Switching type: High frequency PWM (d) Insulation type: Insulation transformer (e) Cooling: Forced air cooling (f) Rated power output : Not less than 315 kW (g) Rated input voltage: *DC 600 V (h) Maximum input voltage: *DC 900 V (i) Input voltage operating range: *DC 420V-850V (j) Maximum power point tracking range: *DC 500 V-700 V (k) Type of output power: *3 phases, 3 lines, or 3 phases, 4 lines (l) Rated output voltage: *AC 400 V or 230 V (m) AC output current distortion factor: Total harmonic distortion: 5.0% and below, Each harmonic distortion: 3.0% and below (n) Power control type: Maximum power point tracking (o) Efficiency: *90% and above (p) Function: Automatic voltage adjustment, in-out current regulation, output regulation, soft start (q) Grid-connection protection function: UVR, OVR, UFR, OFR, islanding operation prevention (passive, active detection), prevent power supply after recovery (r) Communication: Condition, accident, monitoring signal (RS485 and/or Ethernet port)	*5	set
	5) Power transformer for step up voltage	(a) Rated power output: 400 kVA and above (b) Primary/secondary voltage: 24.9 kV/400 V/230 V, 3 phases 4 lines, 50 Hz (c) Particular specification: Outdoor, elephant nose type cable terminal connection box, oil self-cooling type, Wiring: Δ-Y, neutral ground, Total load capacity tap: ±2.5%, ±5%	1	set
	6) 24.9 kV switchgear for grid connection	(a) Outdoor-type metal-enclosed cubicle type switchgear (b) CB Rating: 24.9 kV, 400 A, 12.5 kA (c) Standard: IEC, JIS (d) Enclosed Equipment: a) Voltage Current Transformer (VCT) b) Disconnecting Switch (DS) c) Lightning Arrester (LA) d) Measuring Transformer (VT, CVT) e) Zero-phase Current Transformer (ZCT) f) Vacuum Circuit Breaker (VCB) g) Current Transformer (CT) h) Protective Relay: OCGR, OVGR, OCR	1	set

		i) Meter: V, A, W, PF, WH		
	7) Low voltage distribution board	(a) Configuration: Indoor, hanging or self-standing (b) Material: SPHC steel sheet (c) Circuit number: Input: 5 circuits (MCCB 1,000A x 1, 200 A x 4), Output: *10 circuits (d) Accommodated equipment: Molded case circuit breakers (MCCB), Surge protection devices, Instrument: V, A, WH	1	set
	8) Monitoring display panel	(a) Configuration: Outdoor, hanging or self - standing (b) Material: SPHC steel sheet (c) Display data: Power output/day (kWh), instantaneous power potential (kW), irradiation (kWh/m^2), CO_2 emission reduction (kg-C), ambient temperature (°C) (d) Size: *W: 1000 mm x L: 800 mm x H: 200 mm (e) Communication equipment: Peer to peer communication between PC of PV system site and remote display panel at the airport terminal building a) Wireless LAN: Ethernet and serial data over 802.11 b/g/n 2.4 GHz band wireless network, frequency 2,400 to 2,483.5 MHz b) Peer to peer with high gain antenna: 802.11 b/g–6 miles/10 km of line of site range (4 km with 10 m high) c) Antenna pole: More than 17 m in height at PV system site and at the roof of the terminal building +5 m	1	set
	9) Data logging and monitoring system	(a) Pyranometer: ISO 9060, Second Class 6 - 8 mV/(kW/m^2) (b) Thermometer: Resistance temperature sensor Pt 100 Ω, 4 lines type, from – 50 °C to +100 °C (c) Meteorological transducer for data logging system a) Configuration: Outdoor hanging type b) Material: SPHC steel sheet c) Input signal: Irradiation (0-10 mV), Thermometer (Pt 100 Ω) d) Output signal: 4-20 mA e) Power source: AC 230 V f) Accommodated equipment: Pyranometer converter (T/D), thermometer T/D, power T/D, potential T/D (selling, buying electricity) (d) Monitoring equipment (indoor) a) Data monitoring : Monitoring cycle: 6 seconds, Collected data: irradiation, temperature, power output b) Equipment: Personal computer, signal converter, UPS c) Software: Display of instantaneous value, figures, forms, tables, condition of PC,	1	set

		accidents, other necessary data d) External communication: Operation status, failure signal, measurement information signals for display panel and others e) Serial port: RS 232C, RS 485 and Ethernet port		
	10) Control house	(a) Type: Pre-fabricated house (b) Size: *W: 10,000 x L: 4,000 x H: 2,500 (c) Accessory: Door, light, air conditioner, dial thermometer (with contact point for alarm) (d) Accommodated equipment: Power conditioner, low voltage distribution board, data logging system and monitoring system	1	set
Construction materials	1) Cable 2) Grounding, etc.	(a) Cable: 24.9 kV, CV 60 mm^2-3 core, or CVT 60 mm^2 600 V, CV 250, 5.5, 2 mm^2 600 V CVV-S 2.0 mm^2 (b) Grounding wire and terminal, FEP piping materials, steel conduit piping, IV cable etc.	1	lot

*: Reference value, adopted from manufacturer's standards

Source: JICA Study Team

(3) Basic Design of PV System Component

The basic design of PV system component preparation is shown below.

A. UMSA Cota Cota Campus

1) PV Module (Array)

A PV array is a linked collection of PV modules. The total capacity of PV system should not be less than 50 kW. The PV module shall be "silicon crystal PV module" specified under JIS C 8918 or modules with same performance level.

2) Mounting Structure for PV Module/Junction Box and Connection Box

i) The construction cost of the mounting structure for the PV module, junction box and connection box with wiring work makes up almost 20% of the total cost.

ii) The supporting structure for the PV module is designed based on "Standard Design of Support Structure for PV Array: JIS C 8955". It should be able to withstand wind speeds of 30 m/s. Wind pressure load is calculated based on a wind density of 3,600 m.

iii) There are many high trees north of the PV system in UMSA Cota Cota Campus. Therefore, it is necessary to select the location to avoid the shadow cast by the trees on the surface of the modules. On the basis of the shadow cast during midwinter days, the layout and height of the supporting structure have to be determined. The direction of PV is north. In the plan, tilting angle is set at 20° to receive solar irradiation effectively and avoid the accumulation of dust on the surface. It is necessary to raise the height of back row array 1 m higher than the front row to avoid shadows.

iv) The base of the supporting structure depends on the combination of PV modules. For 200 W modules, vertical load is around 160 kg. Therefore, concrete foundation is necessary to support the PV array.

v) Junction box and connection box are used for interconnecting PV arrays and disconnecting DC circuit during maintenance and repair works. The junction box and connection box houses the circuit breakers for the distribution line, input circuit switch, output circuit switch, reverse-flow prevention diode, and surge protection devices (class 2). It is necessary to install reverse flow diode and surge protection device at each DC circuit.

3) Power Conditioner (including protection devices of grid-connected operation)

(a) Power conditioners convert DC from PV array to AC, and consist of inverter and protection devices for grid-connected operation.

(b) Power conditioners are selected according to "Power Conditioner for Small Photovoltaic Power Generation System (JIS C 8980)" and "Grid Interconnection Code".

(c) Functions of power conditioner include regulation and protection of PV system, power converter and grid connection. The main functions are as shown below. In

grid-connected PV system, reverse current flow to the grid is possible but islanding operation is not applied. Self-sustained operation is not done for safety reasons. This function will be locked in during operation, but recovery function will be used only after recovery of grid line.

(i)	Accuracy of output voltage	: AC 400 V or 230 V ± 10%
(ii)	Accuracy of output frequency	: ±0.2 Hz
	Accuracy of output frequency (grid-connected operation)	: ±1 Hz (within adjustable range)
(iii)	Distortion factor of AC voltage	: Total 5% and below (Line rated load connection)
	Distortion factor of AC current	: Total current 5% and below (Rated output)
		: Each harmonic 3% and below (Rated output)
(iv)	Power factor	: 0.85 and above
	(grid-connected operation)	: (Except in emergency cases such as preventing voltage rises)
(v)	Total efficiency	: Not less than 90%
(vi)	Output voltage unbalanced ratio	: Not more than 10%

(vii) Grid-connected operation and protection
: Voltage/frequency monitoring
: Maximum power point tracking function
: Islanding operation prevention function
: Automatic voltage regulating function
: DC output protection function (insulating transformer)
: DC ground fault detector
: UVR, OVR, UFR, OFR, islanding operation prevention (passive, active detection), power supply isolation after recovery

(d) Power transformer and medium voltage grid connection system

Outdoor-type power transformer converts AC power output voltage from power conditioner to 6.9 kV for grid connection. "IEC 60076 Standard" is applied for the power transformer. The power transformer shall be equipped with elephant nose-type cable terminal connection box for safety purposes. Main specifications are shown below:

<u>Power Transformer</u>

- Type: Outdoor ONAN transformer (ONAN)
- Rated power output: 100 kVA

- Primary voltage/secondary voltage: 6.9 kV/400 V/230 V, 3 phases 4 wires, 50 Hz
- Withstand voltage: Impulse withstand voltage: 1.2 x 50 μs, 95 kV
- Commercial withstand voltage: 38 kV, 1 min.
- Particular specification: Outdoor, oil self cooling type, Wiring: Δ-Y, neutral grounding, Total load capacity tap changer: ±2.5%, ±5%

Medium voltage grid connection system

- Surge Arrester (SA):	15 kV, 10 kA
- Vacuum Circuit Breaker (CB):	15 kV, 12.5 kA
- Disconnecting Switch (DS):	15 kV, 1,250 A
- Protection relay:	OCR, OCGR, OVGR
- Measuring device:	VCT, CT, ZCT, CVT
- Instrument meter:	V, A, W, Pf, WH

(e) Low voltage distribution board

Low voltage distribution board receives electricity from the grid for PV system operation. Power is consumed for operations such as for air conditioning, lighting, data logger, monitoring display, and so on. The total capacity is around 5 to 10 kW. Low voltage distribution board is made from steel sheets with indicator lights for power. Circuit breakers (MCCB) shall be equipped for each load. Instrument meters such as V, A, WH are also equipped at the front face/panel of the low voltage distribution board.

(f) Monitoring display panel

A monitoring display panel will be installed near the control house in the PV system site. The monitoring display panel has an important role in increasing the showcase effect.

In the display panel, the information below will be shown. Other information will be suggested by the contractor.

- Power output /day (kWh/day)
- Instantaneous power potential (kW)
- Solar irradiation (kWh/m^2)
- Temperature (°C)
- CO_2 emission reduction (kg-C)

(g) Data management and monitoring system

Operational data management and monitoring system will be installed in the control house to clarify the following performances of the PV system:

(i) Solar irradiation and outdoor ambient temperature

- Pyranometer: ISO 9060/2nd Class, Input signal: irradiation (0-10 mV)
- Ambient thermometer: Pt 100 Ω, JIS standard or equivalent

(ii) Monitoring data

The following data and suggested data from manufacturers will be logged:

- PV output voltage (V)
- PV output current (A)
- Inverter output voltage (V)
- Inverter output current (A)
- Inverter output potential (kW)
- Inverter power output (kWh)
- Inverter operation condition
- Grid connection condition

(iii) Failure information

- Grid connection failure (grid connection protection function)
- Inverter failure
- Protection function in inverter
- Circuit breaker for wiring of low voltage distribution board

(iv) Data logging system

Generated power, consumed power from distribution line, and CO_2 emission reduction and other data will be calculated and recorded in the computer with time, day, month, and year.

(h) Control House

Pre-fabricated house will be used for the control house. Power conditioner, low voltage distribution board, data management and monitoring system will be installed inside the control house. Also, entrance door, air conditioner, thermometer with alarm contacts, illumination inside and outside the entrance and spare power conditioner shall be installed in the manufacturer's factory.

B. Viru Viru International Airport

1) PV Module (Array)

A PV array is a linked collection of PV modules. The total capacity of the PV system should not be less than 315 kW. The PV module shall be “silicon crystal PV module” specified under JIS C 8918 or modules with the same performance level.

2) Mounting Structure for PV Module/Junction Box and Connection Box

i) The construction cost of the mounting structure for the PV module and connection box with wiring work makes up almost 20% of the total cost.

ii) The supporting structure for the PV module is designed based on "Standard Design of Support Structure for PV Array: JIS C 8955". It should be able to withstand wind speeds of 35 m/s in Viru Viru International Airport.

iii) The base of the supporting structure depends on the combination of PV modules. For 200 W modules, vertical load is around 160 kg. Therefore, concrete foundation is necessary to support the PV array.

iv) Junction box and connection box are used for interconnecting PV arrays and disconnecting DC circuit during maintenance and repair work. The junction box and connection box houses the circuit breakers for the distribution line, input circuit switch, output circuit switch, reverse-flow prevention diode, and surge protection devices (Class 2). It is necessary to install reverse flow diode and surge protection device at each DC circuit.

3) Power Conditioner (including protection devices of grid-connected operation)

(a) Power conditioners convert DC from PV array to AC, and consist of inverter and protection devices for grid-connected operation.

(b) Power conditioners are selected according to "Power Conditioner for Small Photovoltaic Power Generation System (JIS C 8980)" and "Grid Interconnection Code".

(c) Functions of power conditioner include regulation and protection of PV system, power converter, and grid connection. The main functions are shown below. In grid-connected PV system, reverse current flow to the grid is possible but islanding operation is not applied. Self-sustained operation is not done for safety reasons. This function will be locked in during operation, but recovery function will only be used after recovery of grid line.

(i)	Accuracy of output voltage	: AC 400 V or 230 V ±10%
(ii)	Accuracy of output frequency	: ±0.2 Hz
	Accuracy of output frequency (grid-connected operation)	: ±1 Hz (within adjustable range)
(iii)	Distortion factor of AC voltage	: Total 5% and below (Liner rated load connection)
	Distortion factor of AC current	: Total current 5% and below (Rated output)
		: Each harmonic 3% and below (Rated output)
(iv)	Power factor	: 0.85 and above
	(grid-connected operation)	: (Except in emergency cases such as preventing voltage rises)

(v) Total efficiency : Not less than 90%

(vi) Output voltage unbalanced ratio : Not more than 10%

(vii) Grid-connected operation and protection

: Voltage/frequency monitoring

: Maximum power point tracking function

: Islanding operation prevention function

: Automatic voltage regulating function

: DC output protection function (insulating transformer)

: DC earth detector

: UVR, OVR, UFR, OFR, islanding operation prevention (passive, active detection), power supply isolation after recovery

(d) Power transformer and medium voltage grid connection system

Outdoor-type power transformer converts AC power output voltage from power conditioner to 24.9 kV for grid connection. "IEC 60076 Standard" is applied for the power transformer. The power transformer shall be equipped with elephant nose-type cable terminal connection box for safety purposes. Main specifications are shown below:

Power Transformer

- Type: Outdoor ONAN transformer (ONAN)
- Rated power output: 400 kVA
- Primary voltage/secondary voltage: 24.9 kV/400 V/230 V, 3 phases 4 wires, 50 Hz
- Withstand voltage (impulse withstand voltage): 1.2 x 50 μs, 95 kV
- Commercial withstand voltage: 50 kV, 1 min.
- Particular specification: Outdoor, oil self cooling type, Wiring: Δ-Y, neutral grounding, Total load capacity tap change: ±2.5%, ±5%

Medium voltage grid connection system

- Surge Arrester (SA):	33 kV, 10 kA
- Circuit Breaker (CB):	33 kV, 12.5 kA
- Disconnecting Switch (DS):	33 kV, 1,250 A
- Protection relay:	OCR, OCGR, OVGR
- Measuring device:	VCT, CT, ZCT, CVT
- Instrument meter:	V, A, W Pf, WH

(e) Low voltage distribution board

Low voltage distribution board receives electricity from the grid for PV system operation. Power is consumed for operation such as for air conditioning, lighting, data logger, monitoring display and so on. The total capacity is around 5 kW to 10 kW. Low voltage distribution board is made from steel sheets with indicator lights for power. A circuit breaker (MCCB) shall be equipped for each load. Instrument meters such as V, A, and WH are also equipped at the front face/panel of the low voltage distribution board.

(f) Monitoring display panel

A monitoring display panel will be installed at the terminal building entrance in Viru Viru International Airport. The monitoring display has an important role in increasing the showcase effect at the Viru Viru International Airport.

In the display panel, the information below will be shown:

- Power output /day (kWh/day)
- Instantaneous power potential (kW)
- Solar irradiation (kWh/m^2)
- CO_2 emission reduction (kg-C)
- Temperature (°C)

There is a distance of approximately 4 km from PV system site to terminal building. Therefore, it is necessary to install a communication network using optical fiber cable or radio communication. On the other hand, the airport has a future expansion plan, as a result of which, the communication network will be established by the wireless LAN only. Specification of wireless LAN communication will be as follows:

Wireless LAN (one pair of industrial wireless network devices)

- Frequency range: 2.4 GHz band (from 2400 MHz to 2483.5 MHz)
- Channels: From 1 to 13 (using Channel 14 of the 802.11 is prohibited due to Bolivian regulations)
- Wireless data rate shall be not less than 1 Mbps
- Peer to Peer with high gain antenna: 802.11 b/g–6 miles/10 km (10 km direct line of site range, 4 km with 10 m high small hill), more than 30 km at 6 Mbps
- Antenna height: Not less than 17 m with lightning arrester and rod at the PV system, and +5 m at the terminal building roof with lightning arrester and rod

(g) Data management and monitoring system

Operational data management and monitoring system will be installed in the control house to clarify the following performances of the PV system:

(i) Solar irradiation and outdoor ambient temperature

- Pyranometer: ISO 9060 / 2nd Class, input signal: irradiation (0-10 mV)
- Ambient thermometer: Pt 100 Ω, JIS standard or equivalent

(ii) Monitoring data

The following data and the suggested data from manufacturers will be logged.

- PV output voltage (V)
- PV output current (A)
- Inverter output voltage (V)
- Inverter output current (A)
- Inverter output potential (kW)
- Inverter power output (kWh)
- Inverter operation condition
- Grid connection condition

(iii) Failure information

- Grid connection failure (Grid connection protection function)
- Inverter failure
- Protection function in inverter
- Circuit breaker for wiring of low voltage distribution board

(iv) Data logging system

Generated power, consumed power from distribution line, and CO_2 emission reduction and other data will be calculated and recorded in the computer with time, day, month, and year.

(h) Control house

Pre-fabricated house will be used for the control house. Power conditioner, low voltage distribution board, data management and monitoring system will be installed inside the control house. Also, entrance door, air conditioner, thermometer with alarm contacts, illumination inside and outside the entrance and spare power conditioner shall be installed in the manufacturer's factory.

2-2-3 Outline Design Drawings

Basic design drawings of the project are shown below:

Table2-9 List of Basic Design Drawings

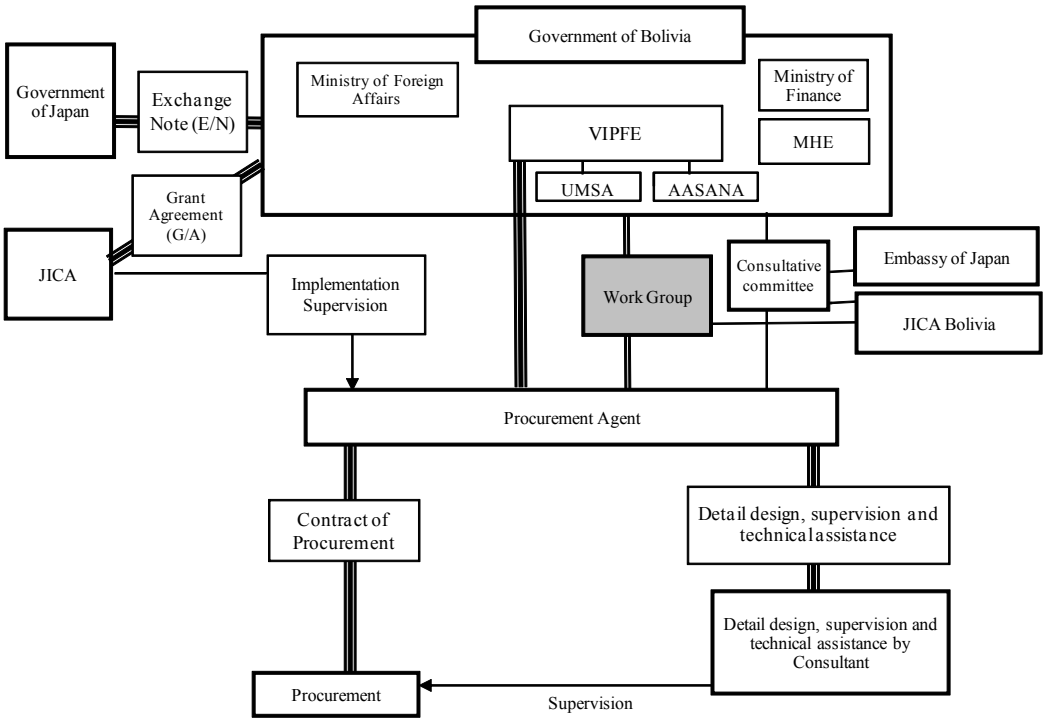
No	DWG No	Title
1	BO-E-101	Universidad Mayor de San Andrés Layout Drawing of PV System (50 kW)
2	BO-E-102	Universidad Mayor de San Andrés Single Line Diagram
3	BO-E-103	Universidad Mayor de San Andrés Civil Works and PV System Foundation
4	BO-E-201	Aeropuerto International Viru Viru Layout Drawing of PV System (315 kW)
5	BO-E-202	Aeropuerto International Viru Viru Single Line Diagram
6	BO-E-203	Aeropuerto International Viru Viru Civil Works and PV System Foundation

Source: JICA Study Team

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

The project is carried out based on the framework of the Environmental Program Grant Aid by the Government of Japan. The acknowledgement of the business operation is made by the Government of Japan, after the E/N by the two countries was signed last March 19, 2010. In addition, the Bolivian government will contract out the implementation of the project to the procurement agency. Figure 2-9 shows implementation system for this program.



Source: JICA/MD Annex

Figure 2-9 Implementation System

For the implementation of this project, the basic issues and items to be considered are shown below.

Work items of this plan are as follows:

(i) Land filling and leveling, civil works such as foundations, etc.;

(ii) Procurement, supply, installation, testing and taking over of PV system; and

(iii) Procurement, supply, installation, testing and taking over of the medium voltage grid connection equipment.

As mentioned in Clause 2-2-4-2 (1), all work items need to be executed with good coordination. Fundamental subjects and items that need special attention are discussed below.

(4) Executing Agency of Bolivian Side

In this project, the responsible organization and executing organization are as follows:

- Responsible organization: Ministry of Hydrocarbon and Energy (MHE)

- Executing organization: Universidad Mayor de San Andrés (UMSA), and

  Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea (AASANA)

MHE is the organization from the Bolivian side responsible for the completion of the project. The Vice-ministry of Electricity and Alternative Energy (Viceministerio de Electricidad y Energias Alternativas: VMEEA) is the responsible organization inside MHE. There are engineers in MHE with electric power-related experience who can assume leading and coordinating positions. VMEEA will provide support staff responsible for the application of laws and regulations, coordination with other related entities, and technical assistance for data collection from PV system.

The UMSA and AASANA are the implementation organizations. As for O&M after the project completion, the O&M group of the UMSA Department of Engineering Faculty and SABSA, which takes charge of the O&M of the airport service from AASANA, will carry out daily and periodic inspections. Because there is no experience for the O&M of grid connected medium voltage equipment for UMSA and SABSA, Delapaz and CRE will be in charge of O&M of the medium voltage equipment instead.

1) Arrangement of Budget and Staff Necessary for Executing Responsibilities of Bolivian Side

Some portions of works in this project have to be executed by the Bolivian side. For the shared activities, it is necessary to coordinate these with the implementation schedule of the associated works and be carried out in a timely manner. It is necessary to secure budget and staff for this purpose. Specific demarcation of construction works to be undertaken by the Bolivian side is mentioned in 2-2-4-3.

2) Transfer of Technology

In this project, O&M staff of the Bolivian side will participate as observers in the installation work of the PV system. In the series of works, basic principles of the PV system equipment and knowledge of assembling PV system will be transferred to the Bolivian side. It is necessary for the Bolivian side to understand that participation of engineers and technicians is required not only for the execution of duties but also for the mastery of O&M works for future operations.

(5) Implementing Contractors

Based on the framework of grant aid program of the Government of Japan, procurement and installation of equipment will be done by the Contractor selected through bidding conducted by the procurement agency. Civil works, installation of PV system, and grid connection will be conducted in the project site. Each works relate closely to the operational aspects and schedules. Therefore, the Japanese contractor will implement all the works related to quality guarantee, guarantee of characteristics, defects liability, and schedule management.

In accordance with the specifications prepared by the Consultant, the Contractor will carry out the civil works, design, manufacture, factory inspection, packing for export, transport to site, erection, site tests, and hand over of the PV system. Throughout the site construction, equipment erection works and testing, the contractor will undertake technology transfer to Bolivian staff.

2-2-4-2 Implementation and Procurement Conditions

(1) Implementation Matters

For various kinds of site work at UMSA, such as erection of heavy equipment, PV module installation works, control house, works approaching the medium voltage line and other works, these will be executed simultaneously in the same premises of the UMSA. Therefore, utmost care must be taken to ensure safety during works, especially during the transportation of equipment to the UMSA Cota Cota Campus area, and utmost care must be also taken to secure them against students and university personnel.

For various kinds of site work at Viru Viru International Airport, such as erection of heavy equipment, PV module installation works, control house, works approaching the medium voltage line and other works, these will be executed simultaneously in the same premises of the project site of VVI. Therefore, utmost care must be taken to ensure safety during works, especially during the transportation of equipment to the VVI project site, and utmost care must also be taken to secure them against people coming to the airport.

Before initiating site works, detailed work plans shall be prepared through detailed discussions among the different working groups. It is necessary to identify the locations of the existing power line, gas pipe or waterlines under the ground. It is necessary to confirm safe and effective working environment especially near the existing grid. In addition, it is necessary to indicate electrically-charged area by installing safety fence and danger sign board.

In the project site, various kinds of works such as civil works, steel structure assembly works, erection of PV system facilities and electrical facilities, installation of underground cables and other works must be executed with excellent coordination. The civil works for foundation of PV system must be completed before the commencement of PV system installation.

The PV system will be installed at two different locations in La Paz and Santa Cruz. Various kinds of work in the site premises must be executed in parallel to complete the project on schedule. It is necessary to prepare effective implementation plan and work schedule because the work in each site is related to the schedule.

Therefore, the Consultant and Contractor must take utmost care in coordinating each work component, their responsibility toward each work component, safety of university and airport

staff, workers and facilities, quality control, etc. at the two project sites. The joint implementation plan must be prepared to guarantee efficient and smooth execution of site works at the two sites.

(2) Concerns during Procurement Works

Main equipment for PV system such as PV modules, power conditioner and transformer are supposed to be procured from Japan. During the procurement stage, the Consultant shall confirm that the main part of the PV system is made from an eligible country before the approval of drawings. It is important to efficiently manage procurement and transportation to implement the construction according to schedule. It is necessary for implementing contractors to conduct procurement, manufacturing, transportation, and delivery consistently.

A. UMSA Cota Cota Campus

For the design of the PV system, it is necessary to avoid shadows cast by surrounding trees. Also, road conditions have to be researched for the transportation of equipment. In addition to the above, since the system will be installed at a high altitude of over 3,000 m above sea level, the cooling effect of the power conditioner is reduced. However, there is a countermeasure of upgrading the specification for the decrease in temperature and atmospheric pressure by using a forced air cooling system and increasing the capacity of capacitor and so on. It is important for the Consultant to confirm this during the procurement stage.

There is a plan to upgrade the distribution line voltage from 6.9 kV to 12 kV by Delapaz in the future. However, the plan is not yet decided and clearly presented at this time. Therefore, the project is planned on the basis of the current condition. In case the distribution voltage will be upgraded to 12 kV, UMSA discussed this with Delapaz and agreed to accommodate this upgraded voltage.

In addition, it is necessary to confirm the set value for protection relay and the position of dealing power meter for trading between distribution network and a medium voltage switch board for grid connection of Delapaz before the PV system is connected.

B. Viru Viru International Airport

At Viru Viru International Airport, PV system will be installed in a flat land along the national road. Therefore, it is necessary to put enough distance to avoid damage from stones or other debris from the road. In addition, the project location is surrounded by numerous low small trees and weeds; therefore, it is necessary to surround the perimeter fence with a gravel path with enough space to avoid any effect from accidental grass or bush fire through spontaneous

combustion. It is necessary to design the facilities based on local site conditions including the access road.

In addition, it is necessary to confirm the set value for protection relay and the position of dealing power meter for trading between distribution network and a medium voltage switchboard for grid connection of CRE before a system is connected.

2-2-4-3 Demarcation of Construction Works

(1) Demarcation of Construction Works

Table 2-10 shows the demarcation of construction works between Japanese and Bolivian implementation entities. All works related to the construction of PV system facilities will be carried out by Japanese contractors.

Table 2-10 Demarcation of Construction Works

No.	Item	Japanese side	Bolivian side
1)	Acquisition of necessary land for construction work		X UMSA, AASANA
2)	Land clearance and removal of embedded materials such as drain pipes and cables, walls and houses affecting the PV system, preparation of access road, land leveling and compaction, installation of temporary fence and water drains		X UMSA, AASANA
3)	Foundation work and structure assembly, perimeter fence and gates	X	
4)	Construction of PV module and control house	X	
5)	Construction, testing, and commissioning of PV system	X	
6)	Construction, testing, and commissioning of medium voltage switchgear (transformer, medium voltage receiving panel, lead-in cable)	X	
7)	Installation of section switches, extension of existing distribution lines approximately 30 m		X Delapaz, CRE
8)	Installation of dealing watt-hour meters for income and outgoing	X	
9)	Connection work for power cable	X	
10)	Installation of wireless LAN for display panel (at VVI)	X	

Source: JICA Study Team

2-2-4-4 Construction and Procurement Supervision Plans

The E/N was concluded between the two countries on 19 March 2010. After that, it was accepted as an environmental program grant aid by GOJ. JICA will recommend a procurement agency to GOB to manage the project, and JICA will supervise this project. Then, the procurement agency will procure a Consultant and a Contractor. As for the supervision of the project, the following should be taken into consideration:

(i) Understand the background of project implementation.
(ii) Confirm the content of the preparatory survey.
(iii) Understand the framework of grant aid assistance of Japan.
(iv) Confirm the contents of the E/N agreed between the two governments.
(v) Site working conditions are to be fully taken into account.
(vi) Confirm stakeholders in this project and future plans.
(vii) Understand the necessity of the soft component and its implementation.

Taking into account the above, the contents of consulting services, consultant members and the necessary organization for execution are discussed below.

(1) Basic Policies of Construction Supervision

The Consultant shall manage and supervise the whole phases of works executed by the contractors so that the project works are on schedule, using the following three basic principles:

1) Schedule Management

(i) For each facility, the progress of manufacturing, transport and erection of equipment and materials must be reviewed frequently. The progress of the Bolivian side's works shall also be confirmed.
(ii) Process of works by both Japanese contractors and Bolivian authorities shall be confirmed and coordinated.
(iii) Scheduled meetings shall be held at appropriate times for overall schedule management and adjusted if necessary. The scheduled meetings will be held weekly during site erection period and daily during site testing period.

2) Safety Management

(i) For the persons in charge of UMSA and AASANA, site work and safety measures shall be explained and confirmed.
(ii) Safety arrangement of site works shall be confirmed before starting the works.
(iii) In case many different works are to be executed at the same place, necessary safety measures shall be taken to avoid accidents by confirming the working methods and schedules of concerned parties.
(iv) Transport of equipment in and out of the UMSA Cota Cota Campus and Viru Viru International Airport shall be executed under the supervision of a safety manager.
(v) Before transporting, stockyard of facilities shall be explained and confirmed by Bolivian authorities, UMSA and AASANA.
(vi) Site works near live electrical facilities shall be executed under the supervision of a safety manager.
(vii) The areas shall be sectionalized with safety ropes around openings and electrically-charged areas to avoid personnel accidents.

3) Quality Control

(i) The implementing contractor shall submit drawings, specifications, calculation data, etc. for approval to the Consultant, who will review the submitted documents to confirm conformity to applied standards, contract specifications, etc.

(ii) The Consultant will attend the factory tests before shipment of major equipment to confirm whether facilities have been manufactured according to the applied standards and contract specifications.

(iii) The completed works will be tested on site before taking over.

(2) Procurement Management Plan

(i) When items are to be imported, UMSA and AASANA shall carry out the necessary procedures for tax exemption. When imports enter Bolivia overland from Chile, they will manage things so that exemption from import duties goes smoothly and satisfactorily on the Bolivian side.

(ii) With respect to value-added tax on locally-procured items, UMSA and AASANA shall refund tax paid by the Contractor. UMSA and AASANA will ensure that the refunding of value-added tax is carried out smoothly.

(3) Consulting Services

1) Implementation Plan and Review of Tender Documents

Based on the results of the preparatory survey, the design outline, implementation costs and work schedule of the Project are to be reviewed in discussion with Bolivian authorities.

The tender documents shall be prepared based on the results of the review of detailed design. After review of the technical parts of the tender documents, it shall be completed in conjunction with the commercial parts prepared by the procurement agency.

2) Construction Supervision

a) Tendering Process

The tender process includes the request for tender, questions and answers, attendance during tender submission and opening, evaluation of tender results, assistance during tender negotiation and conclusion of implementation contracts.

b) Site Supervision Process

This process comprises meetings among concerned parties before commencing site works, approval procedure for design drawings, factory inspection before shipment, supervision of site erection works, preparation of progress reports during site construction, issuance of interim payment certificates, and attendance to site tests before taking over.

c) Process after Completion of Construction and Erection

This process comprises the issuance of completion certificate, processing for taking over,

preparation of completion report and defects liability test, which shall be carried out one year after the issuance of taking over certificate.

(4) Members of the Consultant

To smoothly execute the necessary services itemized in Item (3) above, it is required that a senior engineer with ample experience on similar kinds of services and enough understanding of the contents of the project be nominated as the Project Manager. Also, an effective organization with experienced staff for detailed design, tendering procedures, review and approval of design, factory inspection, and site supervision needs to be established.

1) Project Manager

Based on full understanding of the background and purpose of the project, the Project Manager will manage the overall execution of the project. He will review and understand the progress of the project and current problems, control the progress of the works, and instruct and provide advice to members.

2) Engineers for Detailed Design Review

Based on the established basic criteria, the engineers will review specifications of equipment and materials for the project, layout design, detailed design, and construction plan taking into account supply interruption planning, and estimation of project cost.

3) Engineers for Tendering Process

The Consultant shall at first prepare the tender documents and assist the call for tender, questions and answers, tender acceptance, evaluation of submitted tenders, and negotiation and conclusion of contract.

4) Engineers for Design Review and Factory Inspection

In the home office, the Consultant shall review drawings, specifications, instruction manuals, etc. to be submitted for approval by the implementing contractor, approve or disapprove such submissions and inform the Contractor, and carry out factory inspection prior to shipment.

5) Engineers for Site Supervision

The resident supervising engineer will supervise the entire site works from commencement of construction up to completion of the project. In addition, the electrical engineer in charge of the electrical facilities will be dispatched to the site to perform necessary supervision works.

2-2-4-5 Quality Control Plan

(1) Quality Control of Equipment and Materials to be Procured

Quality of equipment and materials to be procured under the project will be controlled in accordance with the following steps:

1) Review of Design Drawings and Specifications and Their Approval

The Consultant will review drawings, specifications, calculations, etc. to be submitted for approval by the Contractor after conclusion of the contract. Specifically, the Consultant will review their conformity to applied standards, contract specifications, etc. and will approve them if there are no problems or give necessary comments. The Consultant will perform these services in Japan. Equipment and materials will be manufactured after such approval is obtained.

2) Factory Inspection

After equipment is manufactured, it shall be subject to factory inspection before delivery to the site. The purpose of this inspection is to confirm that the equipment is manufactured in accordance with the applied standards and contract specifications. Generally, visual inspection and characteristics tests are carried out. The tests of major equipment will be attended by the Consultant.

3) Site Supervision and Tests upon Completion

The Consultant will carry out construction supervision in cooperation with UMSA and AASANA/SABSA engineers so that the site construction and erection works are performed in accordance with the specifications. The completion tests are performed before taking over to confirm whether the works are completed in accordance with the specifications or not.

(2) Quality Control of Civil Works

1) Review of Construction Drawings and Their Approval

The structural design and construction drawings are to be prepared by the Contractor and be subject to review and approval by the Consultant. These review and approval services of the Consultant will be performed in Tokyo and on site.

2) Inspection of Materials to be Used

The Consultant will inspect all the materials to be used for the works before their use. These tests will be performed at the origin of the supply or on site as required.

3) Construction Supervision at Site

The Consultant will carry out construction supervision with the cooperation of UMSA and AASANA/SABSA engineers for soil filling, concreting (concrete quality and arrangement of steel bars), steel frames of foundation works, etc. including attendance on some work items.

2-2-4-6 Procurement Plan

(1) Purchasing Sources

Major equipment of PV system, power conditioner and transformers will be purchased from Japan.

(2) Scope of Spare Parts

It is necessary to prepare the plan for procurement of spare parts for continuous operation. For this project, spare parts are not available locally. Therefore, it is necessary to procure them from Japan. As for PV modules, 3% of total quantities have to be procured as spare parts due to shortened shutdown periods during lightning or equipment breakdown. Power conditioner is most important in the PV system. In this project, one complete set of power conditioner with a unit capacity, which is mentioned in the single line diagram, will be supplied as a spare part. Additional surge protection devices, fans and filters will be procured as spare parts. As for medium voltage equipment, each type of arrester (3 phases), protection relay and meters will be procured.

(3) Particulars of Defects Liability

Defects liability period of one year after the taking over will be requested for all the facilities included in the project. In case defects are found on facilities that are not included in the project due to reasons attributable to the project works, such defects will be included in the defect liabilities of the project.

2-2-4-7 Initial Training and Operation Management

The explanation of initial instruction and operative management mainly on newly-introduced instrumentation will be conducted by the manufactures. On the other hand, with the soft component, the technology about basic knowledge on solar PV, O&M procedures, suitable recording for management and analysis method of acquired data will be transferred. Manuals on daily and periodic inspection of solar PV will be prepared for the soft component based on the contents of manufacturer's instructions. As for the operation and O&M of solar PV facilities, staff of UMSA and SABSA will carry out daily and periodic inspections. Because UMSA and

AASANA does not have experience in the O&M of medium voltage equipment , technical support from Delapaz and CRE is necessary for the project. In addition, it is necessary to have support on technical, legal and regulatory aspects from MHE.

It is recommended that the engineer in charge of O&M and management should participate during the technical training in the initial stage. Also, it is necessary for the electrical engineers of Delapaz and CRE who are in charge of O&M of medium voltage system to attend the training. Since UMSA has no electrical engineers for medium voltage distribution lines, it is important to prepare the layout of the supporting framework and maintenance of medium voltage switchgear on consignment contracts in case of accidents on the distribution line.

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

(1) Background of the Soft Component Plan

"The Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia" aims to introduce solar PV system of 50 kW capacity in the UMSA Cota Cota Campus in La Paz City, and 315 kW in the Viru Viru International Airport in Santa Cruz City. The generated power will be supplied to the existing power grid. This Project is the first attempt to install a grid-connected solar PV system in Bolivia. Therefore, it is necessary to assist in capacity improvement and basic technical training for engineers in the aspect of technical transfer.

This is the first attempt to introduce a grid-connected solar PV system in Bolivia. To secure smooth operation, it is necessary to introduce further technical information, documents and human resources on PV systems as shown below:

i. Lack of technical engineers who work on O&M and repair.
ii. Lack of training manuals for O&M engineers.
iii. Lack of human resources to act as guides to visitors of PV system and enable them to explain its effects.

Thus, the following activities have to be conducted for (i) smooth operation in the initial stage and (ii) secure the sustainability of project outcomes as soft component program:

i. Training for O&M engineers;
ii. Prepare and organize necessary manuals for O&M; and
iii. Training for the person in charge in guiding visitors to the facility and explaining its effectiveness.

The details of activities to be implemented are explained below.

A. Operational Management / Monitoring

An appropriate management structure on solar PV system is necessary to secure sustainability of the project outcome. Therefore, the Ministry of Hydrocarbon and Energy (MHE) have to confirm the activities by referring to O&M reports submitted by daily and periodic maintenance staff members of UMSA and AASANA. In addition, it is necessary to collect data on power generation and the amount of carbon dioxide ($CO_{2)}$ emission reduction for analysis.

B. Basic Technology/O&M/Troubleshooting

It is necessary to transfer appropriate O&M skills for sustainable use of solar PV system. It is desirable to conduct repair or replacement of faulty parts of the PV system locally. Therefore, in addition to O&M techniques, troubleshooting techniques have to be transferred. A troubleshooting table has to be included in the project. Moreover, it is necessary to maintain the manuals on O&M and troubleshooting, which will be utilized as materials for training technicians locally.

C. Education/Awareness-Raising

For the PV system which was introduced in this project, a showcase effect of Japanese technical cooperation is expected. It is necessary to train the persons in charge in guiding visitors to the installed facility and explain its effects. Brochures have to be prepared as guide to those visiting the installed facility.

(2) Objectives of Soft Component

The following objectives have to be accomplished within one and half months during and after installation of the PV system at each site:

- Management of operation and monitoring of data can be conducted by UMSA and AASANA staff.
- Daily inspection can be conducted by UMSA and SABSA personnel.
- Periodic inspection can be conducted by UMSA and SABSA staff.
- Finding out malfunctioning parts and determining corresponding countermeasures can be conducted by maintenance staff of UMSA and SABSA.
- Visitors can be guided by UMSA and AASANA personnel to see the PV system.

(3) Output of Soft Component

A. Operational Management/Monitoring

Management of operation and monitoring data at the PV facility are conducted by MHE, UMSA, and AASANA/SABSA. It is necessary to transfer the technology to UMSA and AASANA on confirming operational data such as power output, solar irradiation, and the amount of reduction

of CO_2 emissions. In addition, inspection reports written by O&M staff have to be confirmed and adequate countermeasures have to be carried out, as follows:

- Understanding of PV system, power conditioner, and grid connection technology;
- Understanding of preparation of inspection report and countermeasures in response to troubles;
- Analysis of monitored data (power output, irradiation, CO_2 emission reduction); and
- Training system of O&M technicians or engineers.

B. Basic Technology/O&M/Troubleshooting

The technical staff of UMSA and AASANA/SABSA will need to understand the basic technology on solar PV to carry out O&M appropriately. In accordance with the prepared manual, periodic inspection has to be conducted by UMSA and AASANA/SABSA. The process of installation and O&M training will be filmed to be used as technical training documents for dissemination and accession of transferred technologies. In addition, a troubleshooting table will be prepared to find malfunctioning parts and the corresponding countermeasures. The expected outputs from the above training are shown below:

- Understanding of the PV system, power conditioning, and PV system technology;
- Understanding of daily maintenance and confirmation of generating condition;
- Acquisition of knowledge on maintenance checkpoints such as operating panel, indicator panels, and protection instruments and detailed operational instruction for each facility and equipment;
- Acquisition of knowledge on measurement device for maintenance, equipment adjustment device, special tools, machine proofing, adjustment, etc.;
- Acquisition of reporting skills for operational records, accidents, repairs and inspections;
- Acquisition of knowledge on management of spare parts and tools;
- Acquisition of knowledge on locating faulty parts and their corresponding replacement;
- Acquisition of knowledge on forecasting the exchange period for parts, identification of faulty parts and the necessary countermeasures.

C. Education/Awareness-Raising

Using the installed solar PV system in UMSA and Viru Viru International Airport, explanation of the installed system and its effectiveness will be conducted to visitors and other concerned persons. Brochures which introduce the installed facility will be prepared. Furthermore, a simulated seminar to raise awareness will be held using the developed brochure. The expected outputs from the above training are shown below:

- Development of the skills and expertise of person in charge in guiding visitors to the installed system;

- Development of human resources that are capable of explaining the effectiveness of the installed system; and
- Brochures for the activities mentioned above are developed.

(4) Contents and Activity of Soft Component

Two persons from each organization will participate for the soft component. Depending on the role of the organization, the required technologies to be transferred are different as needed.

Table 2-11 shows the contents of the activities and the number of attendees and organizations for the soft component. During the training at the site, practical training will mainly be conducted for UMSA and SABSA staff. Delapaz and CRE will be in charge of O&M of medium voltage equipment so both companies can be one of the candidates who will participate during the implementation of the soft component.

As an implementation organization, the MHE and AASANA persons in charge of the project must have knowledge on O&M for its proper management. Technical transfer will be conducted using prepared manuals and troubleshooting table.

Table 2-11 Number of Participants According to Technical Transfer

Technical transfer		No. of participants	Organization (No.)
A.	Operational Management/Monitoring	8	La Paz: MHE (2), UMSA (2) Santa Cruz: AASANA (2), SABSA (2)
B.	Basic Technology of PV System/O&M/Trouble shooting	12	La Paz: MHE (2), UMSA (2), Delapaz (2) Santa Cruz: AASANA (2), SABSA (2), CRE (2)
C.	Education/Awareness-Raising	4	La Paz: UMSA (2) Santa Cruz: AASANA (2)

Source: JICA Study Team

Details of the work items on technology transfer items are presented and discussed below.

A. Operational Management/Monitoring

Technical skills on operational management and monitoring will be transferred. After training, it is possible to confirm contents of the O&M report and monitoring data such as power output. The table below shows the details of training.

Table 2-12 Operational Management/Monitoring

	Item	Contents and Activities
1.	Basics of Solar PV	Basic knowledge on solar PV
2.	O&M	Contents of O&M reports based on daily and periodic maintenance; Understand necessary procedure for carrying out countermeasures against malfunctions.
3.	Data Analysis/Operational Management	Confirm procedure for data collection and analysis in the PV system.

Source: JICA Study Team

B. Basic technology of PV system/O&M/Trouble shooting

The basic technology of a PV system is taught. At first, a comprehension test on basic knowledge of the PV system is conducted to grasp current knowledge level of the trainee. Training items and contents are shown in Table 2-13 below.

Table 2-13 Basic Technology of PV System

	Item	Contents and Activities
1.	Comprehension Test	Confirmation of the basic technical knowledge of trainee
2.	Basics of PV System	Actual system; international trend
3.	PV System, Power Conditioner	Specifications and details of the PV system and power conditioner
4.	Grid Connection	The principle of a grid-connected system, its specifications and details

Source: JICA Study Team

Before and after completion of the trial operation, O&M training will be conducted with emphasis on the purpose of improvement of O&M and troubleshooting skills. Training items and contents are as shown in Table 2-14.

Table 2-14 O&M/Troubleshooting

	Item	Contents and Activities
1.	Daily Maintenance	Confirmation of generation facilities, operational and surrounding conditions
2.	Periodic Inspection, Maintenance	Periodic inspection, maintenance
3.	Handling of Measuring Equipment and Special Tools	Handling of electrical and adjustment equipment
4.	Reporting	Report writing related to O&M
5.	Operating Inspection (participation to completion test)	Operating inspection and testing Testing and confirmation of safety operation
6.	Troubleshooting	Diagnostic flowchart repair and fault
7.	Trouble and Repair	Diagnostic flowchart repair and fault
8.	Confirmation of O&M	Confirmation of the results of soft component

Source: JICA Study Team

C. Education/Awareness Raising

Brochures for the introduction of the PV system and manuals on raising awareness will be developed. Consequently, each staff officer can give a guided tour in the PV facility and explain its effectiveness. The training items and contents are shown in Table 2-15 below.

Table 2-15 Awareness-Raising Activities

	Item	Contents and Activities
1.	Comprehension Test	Confirmation of basic knowledge
2.	Preparation of Brochure for Awareness-Raising Activity	Preparation of brochure on solar PV and the Project for dissemination to visitors.
3.	Holding of Awareness-Raising Simulation Seminar	A simulation seminar for UMSA and AASANA staff is conducted using the prepared manuals and brochure.

Source: JICA Study Team

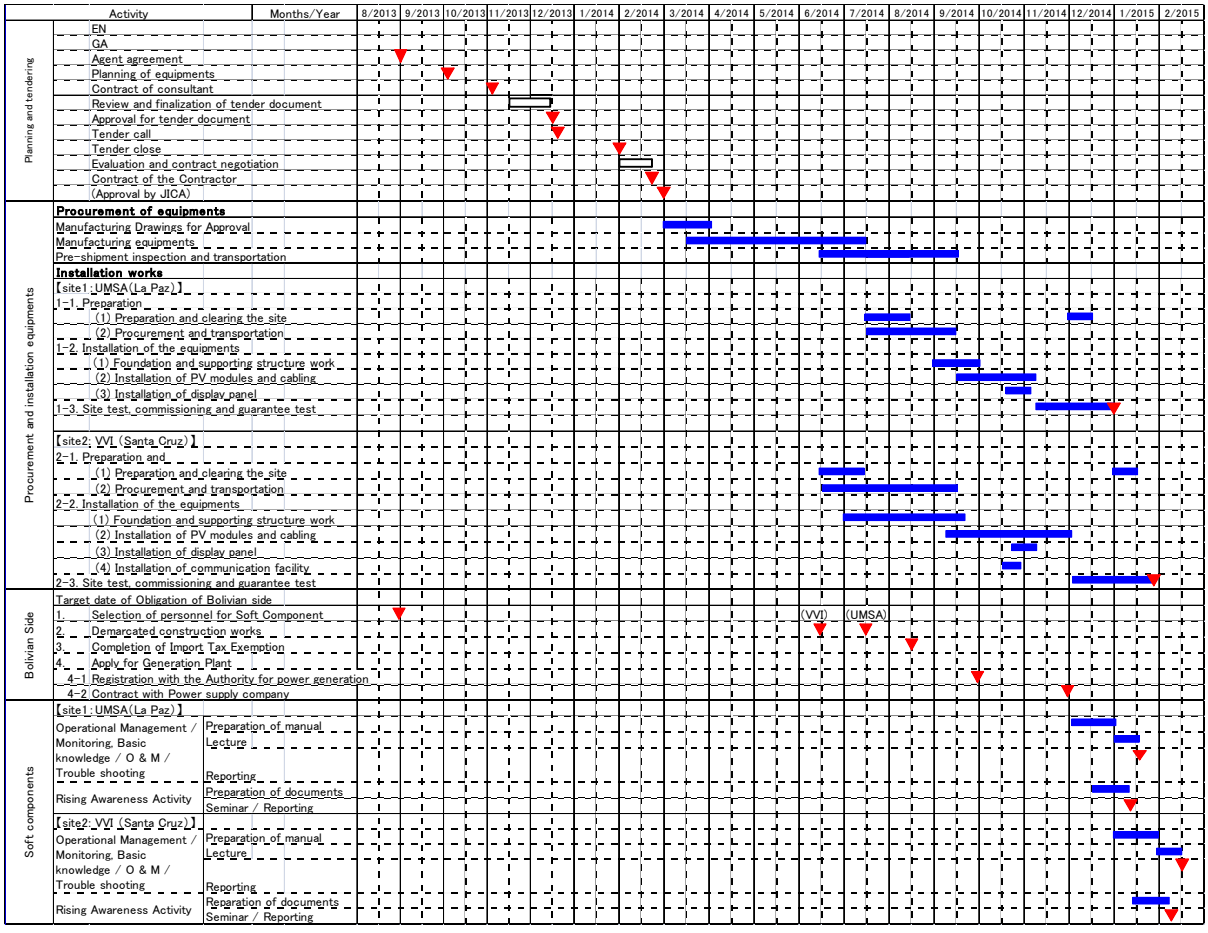
(5) Problems in Implementation

In Bolivia, it is necessary to communicate using Spanish language. Therefore, it is necessary to work with an assistant who can serve as interpreter during seminars and for the translation of manuals.

2-2-4-9 Implementation Schedule

The estimated implementation schedule is shown in Table 2-16.

Table 2-16 Estimated Implementation Schedule



Source: JICA Study Team

The planned total duration from initial stage of design, preparation of drawings for inspection,

execution of works until the project handover is 11.5 months. It is necessary to prepare an implementation plan which considers the detailed plan and countermeasures since solar PV system will be installed at La Paz and Santa Cruz.

2-3 Obligation of Recipient Country

Items to be executed by the Bolivian authorities in case a grant aid project from Japan is implemented are as follows:

(i) Banking Arrangement (B/A): Vice-Ministry of Public Investment and External Financing (Viceministro de Inversión Pública y Financiamiento Externo: VIPFE) (completed);

(ii) Issue of Blanket Disbursement Authorization Comprehensive Authority to Pay (BDA): UMSA, AASANA;

(iii) Obtaining license for importation of PV system facilities to Bolivia and payment of necessary fees: UMSA, AASANA;

(iv) Procedures for the temporary importation of equipment to be used in the implementation of the Project: UMSA, AASANA ;

(v) Right to enter in the project area: UMSA, AASANA;

(vi) Obtaining permissions from related authorities in relation to project works: UMSA, AASANA;

(vii) Acquisition of land necessary for the PV system, removal of sewerage pipes and cables under the ground for site clearance, temporary fence, access road and site leveling: UMSA, AASANA;

(viii) Settlement of conflicts with inhabitants in the surrounding area: UMSA, AASANA;

(ix) Other items that cannot be provided under the grant aid: UMSA, AASANA.

Necessary matters for the smooth implementation of this project are explained below.

(1) Acquisition of Land for PV System

The land that will be used for the PV system was selected by the Bolivian side. They have acquired the land in UMSA and VVI. The acquired lands are shown in Table 2-17 below. The required area for PV system which will be installed at UMSA Cota Cota Campus is 1,060 m^2. The required area for PV system which will be installed at Viru Viru International Airport is 10,000 m^2.

Table 2-17 Acquired Land for Project

Site	Required Land (m^2)	PV Output (kW)
UMSA Cota Cota Campus	1,060	50
Viru Viru International Airport	10,000	315

Source: JICA Study Team

(2) Participation during Installation and Commissioning Tests

As part of human resource development for the O&M of PV system, it is necessary for the candidate O&M staff to participate during the installation process. It is important not only to participate in the installation but also to understand how to assemble PV system by cooperating with Japanese engineers of the Contractor.

2-4 Project Management, O&M Plan

The following countermeasures are necessary to carry out management and O&M without any problems in the future.

(1) Establishment of O&M System

A. MHE

The Ministry of Hydrocarbon and Energy will take responsibility for the formulation of necessary rules and regulations for O&M.

MHE engineers will assist in the analysis of the O&M data accumulated. It is necessary to compile the accumulated data necessary for the future introduction of renewable energy in line with the national plan.

B. UMSA

The UMSA engineering faculty, which is an implementing organization, has a department of electrical engineering, and there are students and professors with technical engineering knowledge. However, they do not have staff with O&M experience on solar PV system. It is possible for Delapaz, which is the electric company in La Paz City, to handle the O&M for the medium voltage system.. It is therefore necessary to have a preliminary agreement with Delapaz to handle the O&M of medium voltage power distribution equipment in the future. In addition, it is necessary to systematically prepare the documentary forms that will be used such as operations manuals, maintenance reports and records of equipment malfunctions and breakdown through technology transfer of soft components.

C. Viru Viru International Airport

The AASANA will need to have a contract with SABSA for the O&M of solar PV facility. After the nationalization of SABSA, SABSA was entrusted with AASANA for O&M airport services for Viru Viru International Airport. In addition, it is necessary to have a contract for O&M of medium voltage facilities in solar PV system and for selling its generated power.

(2) General Training of Technology during Construction

Given that there is no experience on PV system construction in Bolivia, it will be more effective to be instructed by manufacturer's supervisor and the Consultant on site during the construction period. Therefore, it is requested that all O&M candidate staff should participate and be trained in the construction works during the construction period.

(3) Assistance by MHE, Delapaz and CRE

After installation of PV system, it is necessary to receive consigning contract for assistance from Delapaz and CRE on the medium voltage line. Also, assistance from MHE will be required for sustainable training on O&M.

(4) Contract with the Electric Power Company

It is necessary to have a contract agreement with Delapaz and CRE for the O&M of the medium voltage side because Delapaz and CRE have been conducting the O&M on medium voltage line.

2-5 Project Cost Estimation

2-5-1 Project Cost Estimation

(1) Demarcated Cost of Bolivian Side

The costs to be shouldered by the implementing organizations on the Bolivian side in the implementation of the grant aid project are shown in Table 5-1. It is necessary to complete the demarcated work before the arrival of equipment on the project site.

Table 2-18 Demarcated Cost of Bolivia

(US$1 = ¥93.46)

Site	Contents	Cost
UMSA	1) Removal of embedded materials such as drain pipes and cables, walls and houses affecting the PV system, if necessary,	
	2) Preparation of temporary access road,	US$4,500 (¥421,000)
	3) Land leveling and compaction,	US$26,700 (¥2,496,000)
	4) Installation of temporary fence and,	US$2,500 (¥234,000)
	5) Water drain outside the site,	US$1,500 (¥141,000)
Subtotal		US$35,200 (¥ 3,292,000)
Viru Viru International Airport (Operational cost only)	1) Removal of embedded materials such as drain pipes and cables, advertising walls and houses affecting the PV system, if necessary,	
	2) Preparation of temporary access road,	US$1,500 (¥141,000)
	3) Land leveling and compaction,	US$1,500 (¥141,000)
	4) Installation of temporary fence and,	US$2,500 (¥234,000)
	5) Water drain outside the site.	US$1,500 (¥141,000)
Amount		US$7,000 (¥657,000)
Total Amount		US$42,200(¥3,949,000)

Source: JICA Study Team

In addition to the above costs, the banking arrangement (B/A) formalities will be carried out by VIPEE, and the cost of issuing the Blanket Disbursement Authorization Comprehensive Authority to Pay (BDA) will be paid by UMSA and AASANA. There will also be the acquisition of import permits and the cost of the same, and the cost of refunding the value-added tax. For the smooth execution of such duties, UMSA and AASANA will need to secure the necessary budget beforehand.

2-5-2 O&M Cost

(1) Detailed Contents of O&M Works

Basically, PV system is automatically operated and maintenance-free. Therefore, maintenance work is supposed to involve the following items only:

(i) Daily check for O&M (Visual check once a day)

- Visual check of operating conditions, alarm and corrosion (PV module, power conditioner, connection box, medium voltage, transformer, etc.)

- Cleaning of PV module and mowing of surrounding grass

(ii) Regular service maintenance (Every two months)

(iii) Repair and replacement of parts (Depending on necessity)

O&M staff will be managed by organizing a permanent maintenance staff. New staff is not required to be employed for O&M. On the other hand, UMSA and AASANA will be requested to secure the budget for 2014 during the budget planning in September 2013.

(2) Assignment Schedule of O&M

Table 2-19 presents the assignment plan for the O&M staff, as follows:

Table 2-19 Assignment Plan

Position	UMSA		VVI	
	Organization	No.	Organization	No.
Advisory Staff Electrical Engineer	MHE	2	AASANA	2
O&M Staff Electrical Engineer, Technician	UMSA	2	SABSA	2
Medium Voltage Maintenance Contract Engineer	DELAPAZ	2	CRE	2
O&M Staff	UMSA	2	SABSA	2
Total		8		8

Source: JICA Study Team

1) Assignment plan for operation and daily inspection staff

Two engineers/technicians from UMSA will be responsible for the operation of PV system in UMSA Cota Cota Campus, and two engineers/technicians from SABSA will be responsible for the operation of the PV system in Viru Viru International Airport.

2) Assignment plan for periodic service and maintenance staff

Maintenance staff will conduct daily and periodic inspection to maintain good condition of the facilities and equipment. Two engineers/technicians from UMSA and two engineers/technicians from SABSA will be assigned for maintenance. Since there is no

O&M experience for medium voltage equipment, Delapaz and CRE will be in charge of O&M of medium voltage equipment. Two engineers from MHE will be expected to assist in the technical side as MHE have qualified electrical engineers in their organization.

(3) O&M Cost

1) Equipment maintenance cost

Basically, PV system is maintenance-free. Operational cost involves costs of spare parts and consumable parts, measuring device, and erection materials. Annual allocated equipment maintenance cost is US$3,850 comprising 0.1% of all the equipment cost.

2) Employment cost

It is being considered to engage two engineers and train them as O&M staff through technical training.

In addition, maintenance works for medium voltage system will be executed in cooperation with Delapaz and CRE.

According to the above assignment, six staff will be required for the management and O&M of PV system. Therefore, employment cost may not be required.

3) Management and other cost

In general, the annual maintenance and other costs are estimated at 1% of the generated power (kWh) cost. Costs of management and others for the newly installed PV system are calculated with the same ratio. This cost comes to around US$1,100 annually, computed by multiplying 1% of the annual power output by the unit power tariff (US$0.2/kWh).

In total, the annual O&M costs are as shown in Table 2-20.

Table 2-20 Annual O&M Cost

Site	Cost	US$/year	Bolivianos (BOB)/year
UMSA	Equipment Maintenance Cost	500	4,845
	Employment Cost	0	0
	Management Cost and Others	200	1,392
	Amount	700	6,237
Viru Viru International Airport	Equipment Maintenance Cost	3,350	22,968
	Employment Cost	0	0
	Management Cost and Others	900	6,264
	Amount	4,250	29,232
	Total Amount	4,950	35,469

Exchange rate: US$1 = BOB 6.96
Source: JICA Study Team

Chapter 3
PROJECT EVALUATION

CHAPTER 3 PROJECT EVALUATION

3-1 Preconditions

(1) Land Use for Installation of Photovoltaic (PV) System

The land that will be used for installation of PV system are owned by the Higher University of San Andres (*Universidad Mayor de San Andres*: UMSA) and the Administration of Airports and Auxiliary Services of Air Navigation (*Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea:* AASANA). Therefore, land expropriation is not necessary for the Project. Listed below are the items to be prepared by Bolivian side:

1) Leveling of ground at the construction site

2) Installation of temporary fence

3) Construction of temporary road

4) Construction of drainage outside of the site

5) Preparation of water supply to the construction site

6) Preparation of temporary power supply

7) Removal of obstacles under the ground

8) Removal of possible hindrances

(2) Power Output from the PV System

It is necessary for the Bolivian side to carry out the registration required for the grid-connected solar PV to related authorities before acceptance test for delivery is carried out. After the registration, it is necessary to exchange the contract on the operation and maintenance (O&M) system of medium-voltage equipment and sales contract between UMSA and Delapaz, AASANA and CRE.

(3) Official License Related to Environmental Impact Assessment (EIA)

Before submission of the final report, it is necessary to satisfy the requirement for environmental and social considerations. According to the process specified by the Ministry of Environment and Water (*Ministerio de Medio Ambiente y Agua*: MMAyA), UMSA and AASANA submitted an environmental factsheet to MMAyA before submission of the final report. The Project is classified under Category 4, and the official environmental license was already issued by MMAyA. It confirmed that the implementation of EIA is unnecessary. Accordingly, the Project has met the requirements for environmental and social considerations.

(4) Application of Law and Related Standards

It is necessary to design the structure of the PV system depending on the building standards of Japan and Bolivia. The electric design of the grid-connected PV system must be designed based on Japan Industry Standard (JIS)/ International Electro-technical Commission (IEC) standards.

(5) Customs and Tax Exemption

It is necessary for UMSA and AASANA to prepare the budget for tax exemption with regard to import tax of equipment and value added tax (VAT). It is necessary to conduct tax exemption before the sets of equipment will arrive in August 2014, which is six months later from the date of the procurement contract in February 2014.

(6) Selection of Counterpart

1) Overall Management of the Project

It is necessary to have overall coordinators for project management from each organization. The coordinators have been chosen as follows:

MHE: Director General of Electricity and Alternative Energies
UMSA: Director of Electric Engineering Carrier
AASANA: Chief of National Communication, Navigation and Surveillance Unit

2) Soft Component

It is necessary to select personnel for the soft component plan.

- MHE: two persons
- UMSA: two persons
- Delapaz: more than one person
- AASANA: two persons
- SABSA: two persons
- CRE: more than one person

(7) Ownership, Management and Operation

The UMSA and AASANA have the proprietary rights of the installed PV system and are in charge of its O&M. The UMSA and AASANA should secure the budget required for O&M for grid-connected PV system. The minimum annual budget is approximately US$4,950 (AASANA: US$4,250, and UMSA: US$700). The person in charge of O&M will be appointed from the staff of UMSA and AASANA.

(8) O&M of Medium-Voltage Grid

The Bolivian side agrees that by the completion of installation, UMSA and AASANA will have an agreement with Delapaz and CRE on O&M of medium voltage grid of Delapaz (6.9 kV) and CRE (24.9 kV), and O&M of equipment for grid connection with the PV system. In this agreement, the management structure of solar PV system will be prepared in consideration of the correspondence at the time of the accident of electric system and generation facilities.

3-2 Necessary Inputs by Recipient Country

(1) Placement of Required O&M Personnel

Daily and periodical inspection will be conducted by the O&M group of UMSA and the O&M staff of AASANA and Bolivia Airport Sevices S.A. (*Servicios de Aeropuertos Bolivianos*: SABSA) after installation of PV system. At each project site, around two O&M staff and two O&M workers are necessary. In addition, it is necessary to conduct training on O&M technologies in each group continuously.

(2) New Construction and Renovation Plan Around the Project Site

It is necessary to consider the construction and renovation plan of buildings around the project site because shadow on the surface of the PV modules reduces efficiency of power generation.

(3) Plan of Increase Grid Voltage of Delapaz

Delapaz has a plan to increase grid voltage from 6.9 kV to 12 kV in the future. It is necessary to exchange electrical equipment such as transformers if grid voltage is increased to 12 kV. Solar PV facilities have to be managed continuously so that UMSA needs to coordinate with Delapaz to find solutions. Also, it is necessary for the Ministry of Hydrocarbon and Energy (*Ministerio de Hidrocarburos y Energia:* MHE) to support UMSA and Delapaz to find the solution without delay.

(4) Enhancement of the Project by Other Schemes

The UMSA is considering to use grid-connected solar PV system for educational objectives. However, technical assistance for educational objectives is not included in the Project. It is possible to enhance the educational activities through the input of a JICA senior volunteer or expert. In addition, the O&M group can be trained well.

3-3 Important Assumptions

(1) Laws and Regulations

It is necessary to maintain laws and regulations for the grid-connected solar PV system. In addition, it is necessary to consider policy which gives incentive for users such as feed-in tariff (FIT).

(2) National Development Plan

In the National Development Plan 2006–2010, introduction and research and development (R&D) of renewable energy is one of the main policies to establish independency of national energy. However, the national policy is not currently clear because the national development plan has not been updated since 2010. It is necessary to indicate the importance of renewable energy in the new national development plan.

3-4 Project Evaluation

3-4-1 Relevance

The key issues for adequacy of this project implementation are as follows:

1) Conformity with the National Strategy in the Energy Sector
In the medium- and long-term energy policies of Bolivia, encouragement of research work and introduction of renewable energy are indicated to enhance the independence of national energy. Furthermore, the importance of renewable energy development to increase power supply is cited in the long-term policy (2011 to 2015). Thus, this Project is in conformity with the national energy policy.

2) Showcase Effect
The installed capacity of the solar PV system in the Cota Cota Campus is small at 50 kW because the project site is surrounded by buildings and trees. However, showcase effect is expected to continue in the long term because the system will be used for educational purposes. For Viru Viru International Airport (VVI), the number of customers of the facility is around 1.5 million people per year. The installed capacity of the airport is high at 315 kW. Showcase effect can be increased by putting a display monitor which shows the operational conditions of the generation system in the airport facility.

3) Introduction of Advanced Technology and Know-how of Japan
Bolivia's experiences are mainly on independent small-scale solar systems in rural areas but none on the installation of a grid-connected power generation system. Moreover, grid-connected solar PV systems are commonly disseminated in Japan. In this Project, advanced technologies of Japan such as solar PV systems and grid-connected technologies can be applied.

4) Establishment of Sustainable O&M Structure
In the Project, the person in-charge of O&M will be trained by the manufacturer's engineer under the soft component program because there is limited experience on O&M of grid-interconnected solar PV system in the country. The establishment of a sustainable O&M structure will be expected to promote renewable energy projects.

5) Influence on the Environment
Construction works are carried out at UMSA and VVI. Therefore, it is important to consider measures for noise and safety protection in and around the project sites. There will be no influence to the surrounding conditions if the site is enclosed with fences, and danger plate signs are properly placed around the construction site. In addition, human resources development for environmental education with regard to PV systems will be carried out in the soft component.

As mentioned in the above key issues, the adequacy of the implementation in an environmental program grant aid by the Government of Japan (GoJ) is of great significance to this Project.

3-4-2 Effectiveness

(1) Quantitative Benefits

The supply of power output and reduction of carbon dioxide (CO_2) emission are considered as quantitative benefits of the project implementation. The details of such benefits are shown in Table 3-1.

Table 3-1 Effective Index and Target Value

Index	Standard Value (2013)	Target Value (2016) {3 years after project completion}
Annual Estimated Power Output (MWh/year)	0	454 MWh/year
CO_2 Emission (t/year)	0	277 t/year

Source: JICA Study Team

(2) Qualitative Benefits

1) Introduction of Renewable Energy
The introduction of a grid-interconnected PV system is the first of its kind in Bolivia. After this Project, other renewable energy projects will be expected to be promoted and such will increase generated electricity through clean energy. The soft component, including O&M and troubleshooting technology on the PV system, will contribute to the training of O&M staff, and not only PV engineers but also grid interconnection engineers.

2) Demonstration Effect
Monitoring display panels indicating power output and solar irradiation will be installed at UMSA and VVI. This demonstration plan using display monitors will have affect the interest of university staff, students and visitors at VVI on the reduction of environmental burden and CO_2 emission.

3) Raising of Awareness
Through awareness-raising activities regarding PV systems which will be carried out in the soft component, it is possible to deepen the understanding the effect and role of solar PV systems to visitors at VVI, and students and staff at UMSA. In addition, through this Project, improvement on the consciousness for effective use of energy and countermeasures against global warming are expected.

As mentioned above, the relevance and effectiveness of the project implementation are confirmed.

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**
6. **Drawings**
7. **References**

Appendix-1
Member List of the Study Team

MEMBER LIST (FIRST SURVEY)

No.	Name	Job title	Occupation	Period (Dep. -- Arr.)
1	鈴木　薫 Kaoru SUZUKI	総括/計画監理 Team Leader/Planning Management	JICA 産業開発・公共政策部　参事役 Special Advisor to the Director General, Industrial Development and Public Policy Department, JICA	2013.2.19 – 2012.3.4 (2013.2.20-3.2)
2	石岡　秀敏 Kaoru SUZUKI	資金協力計画 Grant Aid Project Planning	JICA 資金協力支援部　企画役 Advisor t Grant Aid Project Management Division 1, Financing Facilitation and Procurement Supervision Department, JICA	2013.2.19 – 2012.3.4 (2013.2.20-3.2)
3	小林　要昭 Toshiaki KOBAYASHI	業務主任/太陽光発電システム Chief Consultant /PV system	日本工営株式会社プラント事業部 Senior Electrical Engineer Plant Engineering Dept. NIPPON KOEI CO., LTD	2013.2.12 – 2013.3.7 (2013.2.13 – 2013.3.5)
4	出井　努 Tsutomu DEI	系統連系太陽光発電システム Grid-connected PV system	日本工営株式会社水環境エネルギー部 Senior Mechanical Engineer Water and Energy Dept. NIPPON KOEI CO., LTD	2013.2.12 – 2013.3.1 (2013.2.13 – 2013.2.27)
5	藤田　和夫 Kazuo FUJITA	機材・設備計画 Equipment and Facility Planner	日本工営株式会社　-(㈱岩崎) NIPPON KOEI CO., LTD	2013.2.12 – 2013.3.1 (2013.2.13 – 2013.2.27)
6	江川　等 Hitoshi EGAWA	調達計画/積算 1 Procurement Planner/Cost Estimator 1	日本工営株式会社プラント事業部 Manager Plant Engineering Dept. NIPPON KOEI CO., LTD	2013.2.18 – 2013.3.7 (2013.2.19 – 2013.3.5)
7	田中　哲治郎 Tetsujiro TANAKA	環境社会配慮 Environment & Social Specialist	日本工営株式会社　-(㈱ｴｰ･ｴｽ･ｴﾝｼﾞﾆｱﾘﾝｸﾞ) NIPPON KOEI CO., LTD	2013.2.18 – 2013.3.7 (2013.2.19 – 2013.3.5)
8	末澤　洋介 Yousuke SUEZAWA	系統運用／制度・基準 Grid Operation/Institution & Standards	日本工営株式会社　-(㈲末沢システムズ) NIPPON KOEI CO., LTD	2013.2.12 – 2013.3.1 (2013.2.13 – 2013.2.27)

MEMBER LIST (SECOND SURVEY)

No.	Name	Job title	Occupation	Period (Arr. -- Dep.)
1	小林　要昭 Toshiaki KOBAYASHI	業務主任/太陽光発電システム Chief Consultant /PV system	日本工営株式会社プラント事業部 Senior Electrical Engineer Plant Engineering Dept. NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)
2	出井　努 Tsutomu DEI	系統連系太陽光発電システム Grid-connected PV system	日本工営株式会社水環境エネルギー部 Senior Mechanical Engineer Water and Energy Dept. NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)
3	藤田　和夫 Kazuo FUJITA	機材・設備計画 Equipment and Facility Planner	日本工営株式会社　-(㈱岩崎) NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)
4	矢澤　和正 Kazumasa YAZAWA	調達計画/積算２ Procurement Planner/Cost Estimator 2	日本工営株式会社プラント事業部 Plant Engineering Dept. NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)
5	田中　哲治郎 Tetsujiro TANAKA	環境社会配慮 Environment & Social Specialist	日本工営株式会社　-(㈱ｴｰ･ｴｽ･ｴﾝｼﾞﾆｱﾘﾝｸﾞ) NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)
6	末澤　洋介 Yousuke SUEZAWA	系統運用／制度・基準 Grid Operation/Institution & Standards	日本工営株式会社　-(有)末沢システムズ) NIPPON KOEI CO., LTD	2013.3.25 – 2013.4.17 (2013.3.26 – 2013.4.15)

MEMBER LIST (THIRD SURVEY)

No.	Name	Job title	Occupation	Period (Dep. -- Arr.)
1	増田　親弘 Chikahiro MASUDA	総括/計画管理 Team Leader/ Planning Management	JICA 産業開発・公共政策部　計画・調整課長 Director, Planning and Coordination Div., Industrial Development and Public Policy Department, JICA	2013.7.16 – 2013.7.27 (2013.7.17-7.25)
2	小林　要昭 Toshiaki KOBAYASHI	業務主任/太陽光発電システム Chief Consultant /PV system	日本工営株式会社プラント事業部 Senior Electrical Engineer Plant Engineering Dept. NIPPON KOEI CO., LTD	2013.7.16 – 2013.7.27 (2013.7.17-7.25)
3	出井　努 Tsutomu DEI	系統連系太陽光発電システム Grid-connected PV system	日本工営株式会社水環境エネルギー部 Senior Mechanical Engineer Water and Energy Dept. NIPPON KOEI CO., LTD	2013.7.16 – 2013.7.27 (2013.7.17-7.25)
4	藤田　和夫 Kazuo FUJITA	機材・設備計画 Equipment and Facility Planner	日本工営株式会社　-(株)岩崎) NIPPON KOEI CO., LTD	2013.7.16 – 2013.7.27 (2013.7.17-7.25)

Appendix-2
Study Schedule

FIRST SURVEY SCHEDULE:

Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System (Bolivia)

No.	Date	Week	Officails	Consultants					
			Mr. Suzuki & Mr. Ishioka	Kobayashi	Dei	Fujita	Suezawa	Egawa	Tanaka
2	2013/2/13	Wed		Lima (01:25) - La Paz (04:30): LA-2561 18:00 Courtesy Calls to JICA Bolivia Office 19:30 TV meeting with JICA HQ					
3	2013/2/14	Thu		9:00 Courtesy Calls to Administration of Airports and Assistant Services to the Air Navigation (AASANA) in La Paz. 10:00 Courtesy Calls to Minister of Hydrocarbons and Energy (MHE) 14:00 Courtesy Calls to University of San Andres (UMSA) 16:00 Courtesy Calls to Viceministrer of Public Investment and External Finance(VIPFE)					
4	2013/2/15	Fri		10:00 Site Survey UMSA 15:00 Visit to Electropaz, la plaza Venezuela de El Prado, 1er piso en la oficina del Ing. Arduz					
5	2013/2/16	Sat		Outline design for UMSA					
6	2013/2/17	Sun		06:30 Move to Santa Cruz 09:00 Site Servey for Viru Viru International Airport					
7	2013/2/18	Mon		08:30 Interview to CRE (Power supply company) 10:30 Meeting with AASANA & SABSA				NRT-Atlanta: DL-296 Atlanta-Lima: DL-151	
8	2013/2/19	Tue	NRT-Atlanta Atlanta-Lima	15:00 Meeting with SABSA at Viru Viru Airport				Lima- La Paz: LA2561	
9	2013/2/20	Wed	Lima- La Paz(LA2567 16:05) Meeting with study team	Outline design for Viru Viru International Airport 19:30 Meeting with JICA Japan				19:00 Meeting with JICA Japan	
10	2013/2/21	Thu	09:30 Courtesy Calls to JICA/Bolivia 16:00 Courtesy Calls to Embassy of Japan 17:00 Courtesy Calls to ViceMinister of Electricity and Alternative Energy			Outline design of PV system at UMSA and Viru Viru Airport		Joint to JICA study team	Interview to VMABCC
11	2013/2/22	Fri	09:00 Courtesy Calls to Univesity of San Andres (UMSA) 11:00 Courtessy Calls to AASANA & Ministry of Public works Site Survey at UMSA 17:00 Courtesy Calls to Viceministrer of Public Investment and External Finance (VIPFE)			14:30 Electropaz & Survey for 69kV Substation in Cota Cota			
12	2013/2/23	Sat	08:10 - 09:10 Move to Santa Cruz (Z8-102) Explanation of Ic/R and MD at Santa Cruz (to AASANA and SABSA) Site Survey at Viru Viru air port		Outline design of PV system			Move to Santa Cruz 08:10 - 09:10 Move to Santa Cruz (Z8-102) Site Survey at Viru Viru air port	
13	2013/2/24	Sun	Site Survey at Viru Viru air port 19:30 - 20:30 Move to La Paz (Z8-107)		Outline design of PV system			Site Survey at Viru Viru air port 19:30 - 20:30 Move to La Paz (Z8-107)	
14	2013/2/25	Mon	Explication to Minister of Planification of Development			Outline design of PV system			
15	2013/2/26	Tue	Explanation of Ic/R and MD at La Paz			Data collection and preparation of survey report			
16	2013/2/27	Wed	Discussion of MD		La Paz - Lima: LA2567			Discussion of MD	Interview to VMA
17	2013/2/28	Thu	Discussion of MD		Lima - Atlanta: DL-150 Atlanta - Narita: DL-295			Discussion of MD	
18	2013/3/1	Fri	Signing on M/D at UMSA from 12:30 pm 15:00 Report to JICA 16:00 Report to Embassy of Japan		Arrive at Narita			Signing on M/D 15:00 Report to JICA 16:00 Report to Embassy of Japan	
19	2013/3/2	Sat	La Paz - Lima（LA2567 16:45)	Preparation of Report				Preparation of Report	
20	2013/3/3	Sun	Lima - Atlanta Atlanta - Narita	Preparation of Report				Preparation of Report	
21	2013/3/4	Mon	Arrive at Narita	Data collection				Data collection from MHE and UMSA	
22	2013/3/5	Tue		La Paz - Lima: LA2567				La Paz - Lima: LA2567	
23	2013/3/6	Wed		Lima - Atlanta: DL-150 Atlanta - Narita:				Lima - Atlanta: DL-150 Atlanta - Narita: DL-295	
24	2013/3/7	Thu		Arrive at Narita				Arrive at Narita	

SECOND SURVEY SCHEDULE:

Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System (Bolivia)

No.	Date	Week	Consultants					
			Kobayashi	Dei	Fujita	Suezawa	Yazawa	Tanaka
1	2013/3/25	Mon	NRT-Atlanta: DL-296 Atlanta-Lima: DL-151					
2	2013/3/26	Tue	Lima (01:25) - La Paz (04:30): LA-2561					
3	2013/3/27	Wed	09:00 Explanation of Survey Schedule to JICA/Bolivia 10:30 Explanation of Survey Schedule to Minister of Hydrocarbons and Energy (MHE) 11:30 Explanation of Survey Schedule to AASANA in La Paz 14:30 Explanation of Survey Schedule to UMSA 15:30 Site Survey at UMSA Cota Cota Campus					
4	2013/3/28	Thu	09:00 Site Survey at UMSA 10:30 Meeting with DELAPAZ 14:00 Meeting with ViceMinister of Transport (Air Control) 15:00 Explanation of Survey Schedule to VIPFE 16:00 Explanation of Survey Schedule to Viceministerio de Transport				Interview to Local Contractors	Interview to VMA
5	2013/3/29	Fri	(Holiday: Good Friday) Outline design for UMSA					
6	2013/3/30	Sat	Outline design for UMSA					
7	2013/3/31	Sun	Move to Santa Cruz					
8	2013/4/1	Mon	08:30 Explanation of Survey Schedule to CRE 10:30 Explanation of Survey Schedule to AASANA 11:00 Site Survey with SABSA at Viru Viru Airport Power House 15:00 Site Survey for Power & Communication Cable Route				Interview to Local Contractor	Interview to Santa Cruz Municipal
9	2013/4/2	Tue	09:00 Site Survey at 69 kV Substation (CRE) Outline design for Viru Viru International Airport				Interview to Transportation Company	Interview to Santa Cruz Region
10	2013/4/3	Wed	Outline design of PV system at Viru Viru Airport Data collection of Questioners 14:00 Meeting with SABSA NACIONALIZADA SCZ (Regional Manager) 15:00 Meeting with AASANA				Survey at Santa Cruz	Interview to AASANA
11	2013/4/4	Thu	09:00 Meeting with CRE 11:00 Meeting with AASANA Move to Cochabanba (OBO-0643 14:10-14:55) 16:00 Meeting with CNDC				Survey at Santa Cruz	Interview to CRE
12	2013/4/5	Fri	09:00 Meeting with CNDC 14:30 Meeting with SABSA NACIONALIZADA (General Manager) Move to La Paz (OBO-616 17:40-18:15)				Survey at Santa Cruz Move to La Paz	Move to La Paz
13	2013/4/6	Sat	Outline design of PV system Preparation of Technical Notes				Preparation of Technical Notes	
14	2013/4/7	Sun	Preparation of Report and Draft Tender Documents					
15	2013/4/8	Mon	Data collection and preparation of survey report and Draft Tender Document				Interview to Local Contractor	Interview to La Paz Municipal
16	2013/4/9	Tue	09:00 Meeting with AASANA for Technical Notes 11:00 Meeting with UMSA Cota Cota campus for Technical Notes 17:00 Meeting with MHE for Technical Notes					
17	2013/4/10	Wed	09:30 Meeting with VIPFE for Technical Notes 11:00 Meeting with AE					
18	2013/4/11	Thu	Signing on Technical Notes with MHE, UMSA and AASANA 08:30 AASANA 10:00 UMSA Engineering Faculty					
19	2013/4/12	Fri	09:30 Meeting with Vice Ministerio de Transportation 15:00 Report to JICA Bolivia 16:00 Report to Emmbacy of Japan					
20	2013/4/13	Sat	Preparation of Report					
21	2013/4/14	Sun	Preparation of Report					
22	2013/4/15	Mon	La Paz - Lima: LA2567					
23	2013/4/16	Tue	Lima - Atlanta: DL-150 Atlanta - Narita: DL-295					
24	2013/4/17	Wed	Arrive at Narita					

THIRD SURVEY SCHEDULE

Preparatory Survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System (Bolivia)

No.	Date	Week	Officials	Consultants		
			Mr. Masuda (JICA HQ)	Kobayashi	Dei	Fujita
1	2013/7/16	Tue	NRT-Atlanta: Atlanta-Lima:	NRT-Atlanta: DL-296 Atlanta-Lima: DL-151		
2	2013/7/17	Wed	Lima - La Paz: LA2561 02:55 Arrival at La Paz 17:30 Courtesy Calls to JICA Bolivia Office	Lima - La Paz: LA2567 16:55 Arrival at La Paz 17:30 Courtesy Calls to JICA Bolivia Office		
3	2013/7/18	Thu	09:00 Explanation of Draft Final Report to AASANA La Paz 10:30 Explanation of Draft Final Report to UMSA 14:30 Explanation of Draft Final Report to VIPFE and MHE			
4	2013/7/19	Fri	07:15-08:15 Move to Santa Cruz (Z8-100) 08:30 Explanation of Draft Final Report to AASANA Santa Cruz 10:00 Explanation of Draft Final Report to SABSA 15:00 Explanation of Draft Final Report to CRE			
5	2013/7/20	Sat	13:30-14:30 Move to La Paz (Z8-105)			
6	2013/7/21	Sun	Documentation (MD Modification)			
7	2013/7/22	Mon	09:30 Meeting with UMSA 15:00 Explanation of Draft Final Report to MOPSV 17:00 Eexplanation of Draft Final Report to Delapaz			
8	2013/7/23	Tue	09:30 Meeting with AASANA 11:30 Meeting with UMSA (Engineering Fuculty) 15:00 Meeting with MHE & VIPFE at VIPFE			
9	2013/7/24	Wed	11:00 Sign on Minuites of Meeting (MD)			
10	2013/7/25	Thu	09:00 Report to JICA 10:30 Report to Embassy of Japan 13:00 Leave Hotel to Airport 16:45 La Paz to Lima	09:00 Report to JICA 10:30 Report to Embassy of Japan 16:45 La Paz to Lima		
11	2013/7/26	Fri	Lima - Atlanta Atlanta - Narita	Lima - Atlanta Atlanta - Narita		
12	2013/7/27	Sat	Arrive at Narita	Arrive at Narita		

Appendix-3
List of Parties Concerned in the Recipient Country

第１次現地調査

相手国関係者（面会者）リスト

Lista de Asistencia de Primer Estudio

(Attendance List of First Survey)

1. 開発企画省 (MPD)

MINISTERIO DE PLANIFICIÓN DEL DESARROLLO (MPD)
(Ministry of Development Planning)

Elba Viviana Caro Espinoza
MINISTRA DE PLANIFICACIÓN DEL DESARROLLO
(Minister of Development Planning)

2. 公共事業省 (MOPSV)

MINISTERIO DE OBRAS PUBLICAS SERVICIOS Y VIVIENDA (MOPSV)
(Ministry of Public Works and Service and Dwelling)

Ing. Alvaro Salazar Cuba
DIRECTOR GENERAL DE TRANSPORTE AÉREO
(General Director of Air Navegation)

3. 開発企画省　公共投資対外融資庁 (VIPFE)

VICEMINISTERIO DE INVERSIÓN PÚBLICA Y FINANCIAMIENTO EXTERNO (VIPFE)
(Vice Ministry of Public Investment and External Financing)

Lic. Harley Jesús Rodriguez Téllez
VICEMINISTRO DE INVERSIÓN PÚBLICA Y FINANCIAMIENTO EXTERNO
(Vice Minister of Public Investment and External Financing)

Lic. Yarminia Escobar
DIRECTORA GENERAL DE PROGRAMACIÓN DE INVERSIÓN

(Investing Programming General Director)

Lic. Miraglia Giles
DIRECTORA GENERAL DE FINANCIAMIENTO
(Financing General Director)

Lic. Boris Calcina
JEFE UNIDAD OPERATIVA DEFINANCIAMIENTO EXTERNO
(External Financing Operations Unit Manager)

Lic. Vladimir Lujan
JEFE UNIDAD DE PROGRAMACIÓN DE FINANCIAMIENTO EXTERNO
(External Financing Programming Unit Manager)

Lic. Stephany Bellot Kalteis
ANALISTA DE FINANCIAMIENTO EXTERNO (COORDINADOR DE PROYECTOS DE JICA)
External Financing Analyst (Coordinator for JICA Projects)

4. 炭化水素エネルギー省電力　電力・代替エネルギー次官室 (VMEEA)
MINISTERIO DE HIDROCARBUROS Y ENERGÍA (MHE)
(Ministry of Hydrocarbons and Energy)

VICEMINISTERIO DE ELECTRICIDAD Y ENERGÍA ALTERNATIVAS (VMEEA)
(Vice Ministry of Electricity and Alternative Energy)

Ing. Juan Manuel Gonzales Flores
DIRECTOR GENERAL DE ENERGÍAS ALTERNATIVAS
(General Director of Alternative Energy)

Ing. Ronald Veizaga
DIRECTOR GENERAL DE ELECTRICIDAD
(General Director of Electricity)

Ing. Raúl Villarroel Barrientos:
RESPONSABLE ENERGÍAS ALTERNATIVAS

(Alternative Energies Responsible)

Dra. Ximena Rodas Sanjinéz
RESPONSABLE DE NORMAS Y CONVENIOS PARA ENERGÍAS ALTERNATIVAS
(Responsible of Norms and Agreements for Alternative Energy

5. 空港サービス運営公社 (AASANA):

ADMINISTRACIÓN DE AEROPUERTOS Y SERVICIOS AUXILIARES A LA NAVEGACIÓN AÉREA (AASANA)
(Administration of Airports and Auxiliary Services of Air Navigation)

Ing. Carlos Pérez Rodi
DIRECTOR REGIONAL SANTA CRUZ
(Santa Cruz Regional Director)

Ing. Hernando Lara Valda:
JEFE UNIDAD NACIONAL DE COMUNICACIÓN, NAVEGACIÓN Y VIGILANCIA
(National Chief of Communication, Navigation and Surveillance Unit)

Ing. Victor Hugo Sandoval
JEFE UNIDAD DE INGENIERÍA ELECTRÓNICA – SANTA CRUZ
(Electronic Engineering Unit Manager – Santa Cruz)

Ing. Luis Sandoval
JEFE UNIDAD DE METEOROLOGÍA – SANTA CRUZ
(Meteorology Unit Manager – Santa Cruz)

Ing. Juan Carpio Quiroz
RESPONSABLE DE NAVEGACIÓN AÉREA Y RADIO AYUDAS – SANTA CRUZ
(Responsible of Air Navegation and Radio Aids – Santa Cruz)

6. ビルビル国際空港、ボリビア空港サービス会社 (SABSA NACIONALIZADA）

SERVICIOS AEROPORTUARIOS DE BOLIVIA S.A. (SABSA)
(Airport Services of Bolivia)

AEROPUERTO INTERNACIONAL DE VIRU VIRU (VVI)
(Viru Viru International Airport)

Armando Torrico T.
JEFE DE AEROPUERTO (DE TURNO)
(Airport Manager on duty)

Aniceto Lazo Vargas
JEFE DE AEROPUERTO (DE TURNO)
(Airport Manager on duty)

Ing. Fidel Leaño
JEFE DE OPERACIÓN Y MANTENIMIENTO DE SISTEMAS ELÉCTRICOS
Electric Systems Operation and Maintenance Chief (Santa Cruz)

7. サンアンドレス大学 (UMSA)

UNIVERSIDAD MAYOR DE SAN ANDRES (UMSA)
(Major University of San Andres)

Ing. Miguel Angel Calla
DECANO FACULTAD DE INGENIERÍA
(Dean of Engineering Faculty)

Ing. Mario Delgadillo
VICEDECANO FACULTAD DE INGENIERÍA
(Vice Dean Engineering Faculty)

Ing. Carlos Tudela Jemio
DIRECTOR DE LA CARRERA INGENIERÍA ELÉCTRICA
(Director of Electric Engineering Carrer)

8. 環境・気候変動庁 (VMA)

MINISTERIO DE MEDIO AMBIENTE Y AGUA (MMAYA)

(Ministry of Environment and Water)

VICEMINISTERIO DE MEDIO AMBIENTE, BIODIVERSIDAD, CAMBIOS CLIMÁTICOS Y GESTIÓN Y DESARROLLO FORESTAL
(Vice Ministry of Environment, Biodiversity, Climate Change, Managment and Forest Development)
DIRECCIÓN GENERAL DE MEDIO AMBIENTE Y CAMBIO CLIMÁTICOS (DGMAYCC)
(Environment and Climate Change Direction)

UNIDAD DE REGISTRO NACIONAL DE CONSULTORES AMBIENTALES (RENCA)
(National Registry of Environmental Consultants Unit)

Ing. America Rios
JEFE DE LA UNIDAD DE FISCALIZACIÓN (RENCA)
(Fiscalization Unit Manager)

Ing. Alejandra Sempertegui
ENCARGADA DE FISCALIZACIÓN (RENCA)
(Responsible of Fiscalization)

9. デラパス配電会社 (DELAPAZ)

DISTRIBUIDORA DE ELECTRICIDAD LA PAZ (DELAPAZ)
(La Paz Electricity Distribuitor)

EMPRESA DISTRIBUIDORA DE ENERGÍA ELÉCTRICA (ELECTROPAZ S.A.)
(Electric Energy Distribution Company)

Ing. Orlando Pérez Rasguido
JEFE NACIONAL DE ATENCIÓN AL CLIENTE
National Chief of Customer Service

Ing. Sergio Bustillos
RESPONSIBLE OF DEPARTMENT OF STANDARDIZATION.

Ing. Ricardo Zambrana

JEFE DEPARTAMENTO DE PROTECCIONES
(Protections Department Manager)

10. クレ社 (CRE)

COOPERATIVA RURAL DE ELECTRIFICACIÓN LTDA. (CRE)
(Rural Electrification Cooperative Ltd.)

Ing. Mario Rojas Sensano
GERENTE UNIDAD DE PLANIFICACIÓN, REGULACIÓNN Y CONTROL DE INVERSIÓN
(Manager of Planning, Regulation and Investment Control Unit)

Ing. Carlos E. Giacoman M.
SUBGERENTE DE GESTIÓN REGULATORIA
(Submanager of Regulation)

Ing. Juan Carlos Ribera A.
ASISTENTE TÉCNICO DE LA UNIDAD DE PLANIFICACIÓN, REGULACIÓN Y CONTROL DE INVERSIÓN
(Technical Assistant of Planning, Regulation and Investment Control Unit)

11. 在ボリビア日本大使館

Embajada del Japón en Bolivia
(Embassy of Japan in Bolivia)

特命全権大使　椿　秀洋
Sr. Hidehiro TSUBAKI
Embajador Extraordinario y Plenipotenciario

参事官　江崎　浩司
Sr. Hiroshi Ezaki
Consejiro

二等書記官　紙屋貴典
Sr. Takanori KAMIYA

Segundo Secretario

Sr. Diego Komori
Asesor (Adviser)

12. 独立行政法人　国際協力機構（JICA）

Agencia de Cooperación Internacional del Japón (JICA)
(Japan International Cooperation Agency)

ボリビア事務所長　丸岡　秀行
Sr. Hideyuki Maruoka
Director Representante Residente

ボリビア事務所　戸村　浩之
Sr. Hiroyuki TOMURA
Representante
(Representative)

Sra. Pilar Illanes
Asistente
(Assistant)

Sra. Misuzu Nakajima
Intérprete
(Interpreter)

第 2 次現地調査

相手国関係者リスト

Lista de Asistencia de Segundo Estudio

(Attendance List of Second Survey)

1. 公共事業省 (MOPSV)

MINISTERIO DE OBRAS PUBLICAS SERVICIOS Y VIVIENDA (MOPSV)
(Ministry of Public Works and Service and Dwelling)

Alvaro Salazar Cuba
DIRECTOR GENERAL DE TRANSPORTE AÉREO
(General Director of Air Navigation)

2. 開発企画省　公共投資対外融資庁 (VIPFE)

VICEMINISTERIO DE INVERSIÓN PÚBLICA Y FINANCIAMIENTO EXTERNO (VIPFE)
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3. 炭化水素エネルギー省　電力・代替エネルギー次官室 (VMEEA):

MINISTERIO DE HIDROCARBUROS Y ENERGÍA (MHE)
(Ministry of Hydrocarbons and Energy)
Viceministerio de Electricidad y Energías Alternativas (VMEEA)
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Ing. Juan Manuel Gonzales Flores
DIRECTOR GENERAL DE ENERGÍAS ALTERNATIVAS
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Ing. Raúl Villarroel Barrientos:
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Dra. Ximena Rodas Sanjinéz
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4. 空港サービス運営公社 (AASANA):

ADMINISTRACIÓN DE AEROPUERTOS Y SERVICIOS AUXILIARES A LA NAVEGACIÓN AÉREA (AASANA)
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Ing. Remigio Blanco Flores
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Ing. Juan Carpio Quiroz
RESPONSABLE DE NAVEGACIÓN AÉREA Y RADIO AYUDAS – SANTA CRUZ
(Responsible of Air Navegation and Radio Aids – Santa Cruz)

5. ビルビル国際空港、ボリビア空港サービス会社(SABSA NATIONALIZADA):

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Electric Systems Operation and Maintenance Chief (Santa Cruz)

Arq. Darwin Arreano
JEFE DE MANTENIMIENTO DE INFRAESTRUCTURA
(Infrastructure Maintenance Manager)

Ing. Carlos Molina
JEFE DE OPERACIONES
(Operation Manager)

6. コチャバンバ国際空港、ボリビア空港サービス会社(SABSA NATIONALIZADA）:

SERVICIOS AEROPORTUARIOS DE BOLIVIA S.A. (SABSA)
(Airport Services of Bolivia)

Ing. Milton Claaras H.
GERENTE GENERAL REGIONAL, COCHABAMBA
(Cochabamba Regional Manager)

7. サンアンドレス大学 (UMSA):

UNIVERSIDAD MAYOR DE SAN ANDRÉS (UMSA)
(Major University of San Andres)

Ing. Miguel Ángel Calla
DECANO FACULTAD DE INGENIERÍA
(Dean of Engineering Faculty)

Ing. Mario Delgadillo
VICEDECANO FACULTAD DE INGENIERÍA
(Vice Dean Engineering Faculty)

Ing. Carlos Alberto Tudela Jemio
DIRECTOR DE LA CARRERA INGENIERÍA ELÉCTRICA
(Director of Electric Engineering Carrer)

8. クレ社 (CRE)

COOPERATIVA RURAL DE ELECTRIFICACIÓN LTDA. (CRE)
(Rural Electrification Cooperative Ltd.)

Ing. Juan Carlos Ribera A.
ASISTENTE TÉCNICO DE LA UNIDAD DE PLANIFICACIÓN, REGULACIÓNN Y CONTROL DE INVERSIÓN
(Technical Assistant of Planning, Regulation and Investment Control Unit)

9. デラパス配電会社 (DELAPAZ)

DISTRIBUIDORA DE ELECTRICIDAD LA PAZ (DELAPAZ)
(La Paz Electricity Distribuitor)

EMPRESA DISTRIBUIDORA DE ENERGÍA ELÉCTRICA (ELECTROPAZ S.A.)
(Electric Energy Distribution Company)

Ing. Orlando Pérez Rasguido
JEFE NACIONAL DE ATENCIÓN AL CLIENTE
National Chief of Customer Service

Ing. Felipe Quisbert
JEFE DEPARTAMENTO TÉCNICO SIN
(SIN Technical Department Manager)

10. 環境・気候変動庁 (RENCA)

MINISTERIO DE MEDIO AMBIENTE Y AGUA (MMAYA)
(Ministry of Environment and Water)

VICEMINISTERIO DE MEDIO AMBIENTE, BIODIVERSIDAD, CAMBIOS CLIMÁTICOS Y GESTIÓN Y DESARROLLO FORESTAL
(Vice Ministry of Environment, Biodiversity, Climate Change, Managment and Forest Development)

DIRECCIÓN GENERAL DE MEDIO AMBIENTE Y CAMBIO CLIMÁTICOS (DGMAYCC)
(Environment and Climate Change Direction)

UNIDAD DE REGISTRO NACIONAL DE CONSULTORES AMBIENTALES (RENCA)
(National Registry of Environmental Consultants Unit)

Ing. America Rios
JEFE DE LA UNIDAD DE FISCALIZACIÓN (RENCA)
(Fiscalization Unit Manager)

Ing. Alejandra Sempertegui
ENCARGADA DE FISCALIZACIÓN (RENCA)
(Responsible of Fiscalization)

11. 国家給電委員会 (CNDC):

Comité Nacional de Despacho de Carga（CNDC）
(National Load Dispatching Committe)

Ing. Humberto Burgos
Presidente A.I.
(President)

Ing. Manuel Fernando Román Arispe
Gerente de Planificación del SIN
(Planning Manager)

Ing. Carlos Gordillo Rosas
Jefe de Planificación
(Planning Chief)

Ing. Ramiro Ulunke
Jefe de Despacho de Carga
(Load Dispatch Chief)

Lic. Pamela Durán Ayoroa
Asistente en Planificación
(Planning Assistant)

12. 電力規制管理局 (AE)

Autoridad de Fiscalización y Control Social de Electricidad (AE)
(Electricity Supervision and Social Control Authority)

Ing. Richard C. Alcócer Garnica
Director Ejecutivo
(Executive Director)

Joaquin Rodriguez Gutiérrez
Director de Precios, Tarifas e Inversiones
(Director of Rates, Fees and Investments)

13. サンタクルス自治政府：

Gobierno Autónomo Departarmental, Samta Cruz
(Santa Cruz Regional Government)

Ing. Manlio Alberto Roca Zamora
Secretario Desarrollo Sostenible y Medio Ambiente
(Secretary of Environment and Sustainable Development)

14. 在ボリビア日本大使館

Embajada del Japón en Bolivia
(Embassy of Japan in Bolivia)

参事官　江崎　浩司
Sr. Hiroshi Ezaki
Consejiro

Sr. Diego Komori
Asesor (Adviser)

12. 独立行政法人　国際協力機構（JICA）

Agencia de Cooperación Internacional del Japón (JICA)
(Japan International Cooperation Agency)

ボリビア事務所長　丸岡　秀行
Sr. Hideyuki Maruoka
Director Representante Residente

ボリビア事務所　戸村　浩之
Sr. Hiroyuki TOMURA
Representante
(Representative)

Sra. Pilar Illanes
Asistente
(Assistant)

第 3 次現地調査

相手国関係者リスト

Lista de Asistencia de Tercer Estudio

(Attendance List of Third Survey)

1. 炭化水素エネルギー省　電力・代替エネルギー次官室 (VMEEA):

MINISTERIO DE HIDROCARBUROS Y ENERGÍA (MHE)
(Ministry of Hydrocarbons and Energy)
Viceministerio de Electricidad y Energías Alternativas (VMEEA)
(Vice Ministry of Electricity and Alternative Energy)

Ing. Juan Manuel Gonzales Flores
DIRECTOR GENERAL DE ENERGÍAS ALTERNATIVAS
(General Director of Alternative Energy)

Ing. Raúl Villarroel Barrientos:
RESPONSABLE ENERGÍAS ALTERNATIVAS
(Alternative Energies Responsible)

Dra. Ximena Rodas Sanjinéz
RESPONSABLE DE NORMAS Y CONVENIOS PARA ENERGÍAS ALTERNATIVAS
(Responsible of Norms and Agreements for Alternative Energy

2. 開発企画省　公共投資対外融資庁 (VIPFE)

VICEMINISTERIO DE INVERSIÓN PÚBLICA Y FINANCIAMIENTO EXTERNO (VIPFE)
(Vice Ministry of Public Investment and External Financing)

Lic. Yarminia Escobar
DIRECTORA GENERAL DE PROGRAMACIÓN DE INVERSIÓN
(Investing Programming General Director)

Lic. Boris Calcina

JEFE UNIDAD OPERATIVA DEFINANCIAMIENTO EXTERNO
(External Financing OperationsUnit Manager)

Lic. Vladimir Lujan
JEFE UNIDAD DE PROGRAMACIÓN DE FINANCIAMIENTO EXTERNO
(External Financing Programming Unit Manager)

Lic. Stephany Bellot Kalteis
ANALISTA DE FINANCIAMIENTO EXTERNO (COORDINADORA DE PROYECTOS DE JICA)
External Financing Analyst (Coordinator of JICA Projects)

Lic. Carla Tamez
ANASLISTA DE PROGRAMACIÓN DE INVERSIÓN
(Investing Programming Analyst)

3. 公共事業省 (MOPSV)

MINISTERIO DE OBRAS PUBLICAS SERVICIOS Y VIVIENDA (MOPSV)
(Ministry of Public Works and Service and Dwelling)

VICEMINISTERIO DE TRANSPORTES
(Transport Vice-Ministry)

Ing. Alvaro Salazar Cuba
DIRECTOR GENERAL DE TRANSPORTE AÉREO
(General Director of Air Navegation)

Ing. Luis Fernando Rada
COORDINADOR PROGRAMA DE DESARROLLO AEROPUERTUARIO
(Airports Development Program Coordinator)

5. 空港サービス運営公社 (AASANA):

ADMINISTRACIÓN DE AEROPUERTOS Y SERVICIOS AUXILIARES A LA NAVEGACIÓN

AÉREA (AASANA)
(Administration of Airports and Auxiliary Services of Air Navigation)

Ing. Hernando Lara Valda
JEFE UNIDAD NACIONAL DE COMUNICACIÓN, NAVEGACIÓN Y VIGILANCIA
(National Chief of Communication, Navigation and Surveillance Unit)

Ing. Hugo Luis Frias Gonez
RESPONSABLE DE LA DIVISIÓN DE ELECTROMECÁNICA
(Responsible of Electromechanichs Division)

Ing. Remigio Blanco Flores
RESPONSABLE NACIONAL DE TELECOMUNICACIONES
(Telecomunications National Responsible)

Ing. Victor Hugo Sandoval
JEFE UNIDAD DE INGENIERÍA ELECTRÓNICA – SANTA CRUZ
(Electronic Engineering Unit Manager – Santa Cruz)

Ing. Juan Carpio Quiroz
RESPONSABLE DE NAVEGACIÓN AÉREA Y RADIO AYUDAS – SANTA CRUZ
(Responsible of Air Navegation and Radio Aids – Santa Cruz)

6. ビルビル国際空港、ボリビア空港サービス会社(SABSA NACIONALIZADA）：

SERVICIOS AEROPORTUARIOS DE BOLIVIA NACIONALIZADA S.A. (SABSA)
(Airport Services of Bolivia S.A.)

Ing. Henry López Acero
GERENTE NACIONAL DE ADMINISTRACIÓN
GERENTE REGIONAL SANTA CRUZ AEROPUERTO VIRU VIRU (interino)
(Santa Cruz Regional Manager INTERIM – Viru viru Airport)

Ing. Fidel Leaño
JEFE DE OPERACIÓN Y MANTENIMIENTO DE SISTEMAS ELÉCTRICOS
Electric Systems Operation and Maintenance Chief (Santa Cruz)

Arq. Darwin Arreano
JEFE DE MANTENIMIENTO DE INFRAESTRUCTURA
(Infrastructure Maintenance Manager)

Ing. Carlos Molina
JEFE DE OPERACIONES
(Operation Manager)

7. サンアンドレス大学 (UMSA):

UNIVERSIDAD MAYOR DE SAN ANDRÉS (UMSA)
(Major University of San Andres)

Ing. Miguel Ángel Calla
DECANO FACULTAD DE INGENIERÍA
(Dean of Engineering Faculty)

Ing. Mario Delgadillo
VICEDECANO FACULTAD DE INGENIERÍA
(Vice Dean Engineering Faculty)

Ing. Carlos Alberto Tudela Jemio
DIRECTOR DE LA CARRERA INGENIERÍA ELÉCTRICA
(Director of Electric Engineering Carrer)

8. クレ (CRE)

COOPERATIVA RURAL DE ELECTRIFICACIÓN LTDA. (CRE)
(Rural Electrification Cooperative Ltd.)

Ing. Mario Rojas Sensano
GERENTE UNIDAD DE PLANIFICACIÓN, REGULACIÓN Y CONTROL DE INVERSIÓN
(Manager of Planning, Regulation and Investment Control Unit)

Ing. Juan Carlos Ribera A.
ASISTENTE TÉCNICO DE LA UNIDAD DE PLANIFICACIÓN, REGULACIÓNN Y

CONTROL DE INVERSIÓN
(Technical Assistant of Planning, Regulation and Investment Control Unit)

9. デラパス配電公社 (DELAPAZ)

DISTRIBUIDORA DE ELECTRICIDAD LA PAZ (DELAPAZ)
(La Paz Electricity Distribuitor)

EMPRESA DISTRIBUIDORA DE ENERGÍA ELÉCTRICA (ELECTROPAZ S.A.)
(Electric Energy Distribution Company)

Ing. Orlando Pérez Rasguido
JEFE NACIONAL DE ATENCIÓN AL CLIENTE
National Chief of Customer Service

Ing. Felipe Quisbert
JEFE DEPARTAMENTO TÉCNICO SIN
(SIN Technical Department Manager)

10. 在ボリビア日本大使館

Embajada del Japón en Bolivia
(Embassy of Japan in Bolivia)

特命全権大使　椿　秀洋
Sr. Hidehiro TSUBAKI
Embajador Extraordinario y Plenipotenciario

一等書記官　長澤　直毅
Sr. Naoki NAGASAWA
Primer Secretario

Sr. Diego Komori
Asesor (Adviser)

12. 独立行政法人 国際協力機構（JICA）

Agencia de Cooperación Internacional del Japón (JICA)

(Japan International Cooperation Agency)

ボリビア事務所長 丸岡 秀行

Sr. Hideyuki Maruoka

Director Representante Residente

ボリビア事務所 戸村 浩之

Sr. Hiroyuki TOMURA

Representante

Sra. Pilar Illanes

Asistente

通訳 滝谷健太郎

Sr. Kentaro TAKIYA

Intérprete

(Translator)

Appendix-4
Minutes of Discussions

Minuta de Discusiones
sobre el Estudio Preparatorio para el "Proyecto para Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar" del Estado Plurinacional de Bolivia

El Gobierno de Japón (en adelante "GdJ") ha anunciado la Asociación Cool Earth (Tierra Fresca) como uno de los esfuerzos para los países en vías de desarrollo que tratan de equilibrar las reducciones de emisiones de gases de efecto invernadero y crecimiento económico, y contribuir a la estabilidad del clima. Se introdujo el "Programa de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático" como parte de dichos esfuerzos.

Considerando la solicitud del Estado Plurinacional de Bolivia (en adelante "Bolivia"), la Agencia de Cooperación Internacional del Japón (en adelante "JICA") en base a las consultas en el GdJ, ha decidido realizar un Estudio Preparatorio (en adelante "el Estudio") para el "Proyecto para Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar" (en adelante "el Proyecto"). JICA ha enviado a Bolivia la Misión de Estudio Preparatorio, la cual están encabezada por el Sr. Kaoru Suzuki, Asesor Especial de Director General, Departamento de Desarrollo Industrial y Políticas Públicas de JICA, desde el 14 de febrero hasta el 5 de marzo de 2013. La Misión ha sostenido discusiones con las autoridades concernientes del Gobierno de Bolivia y ha llevado a cabo estudios del sitio en Bolivia.

Como consecuencia de las discusiones y estudios del sitio, ambas partes confirman los principales ítems descritos en el Documento Adjunto.

La Paz, 1° de marzo de 2013

Suzuki Kaoru
Jefe del Equipo
Equipo de Estudio Preparatorio
Agencia de Cooperación Internacional del Japón

Viviana Caro Hinojosa
Ministra de Planificación del Desarrollo
Estado Plurinacional de Bolivia

Gral. FA.AE. Edwin Marañon Gamboa
Viveministro de Transportes
Ministerio de Obras Públicas, Servicios y Vivienda
Estado Plurinacional de Bolivia

Hortensia Jiménez Rivera
Viceministra de Electricidad y Energías Alternativas
Ministerio de Hidrocarburos y Energía
Estado Plurinacional de Bolivia

Cnl. DAEN Raúl Velasco Ramos
Director Ejecutivo
Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea (AASANA)
Estado Plurinacional de Bolivia

María Teresa Rescala Nemtala
Rectora de la Universidad Mayor de San Andrés
Estado Plurinacional de Bolivia

Documento Adjunto

1. Situación actual

En Bolivia se está adecuando un ambiente para poder aprovechar energías renovables y ecológicas que no sean las existentes, por lo que se espera que se promueva el uso de nuevas energías en un futuro cercano. Por otra parte, la introducción de la nueva energía renovable y conectable con la red en las áreas urbanas es un nuevo intento en Bolivia. Ambas partes han confirmado en analizar para impulsar el proyecto de introducción del sistema de generación de electricidad solar de conexión con la red al Aeropuerto Internacional de Viru Viru y a la Universidad Mayor de San Andrés.

2. Objetivo del Proyecto

El objetivo del Proyecto es promover el uso de la energía limpia y reducir emisiones de gases mediante la introducción del sistema de generación de electricidad solar de conexión con la red.

3. Entidad responsable y Entidades Ejecutoras

La Entidad responsable del Proyecto es el Ministerio de Hidrocarburos y Energía, cuyo organigrama se muestra en el Anexo-1.

Las Entidades Ejecutoras del Proyecto son la Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea y la Universidad Mayor de San Andrés, cuyo organigrama se muestran en el Anexo-2.

La Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea y la Universidad Mayor de San Andrés (en adelante las Entidades Ejecutoras) prestarán su máximo apoyo para la ejecución del Proyecto, en colaboración con el Ministerio de Hidrocarburos y Energía, la entidad responsable, y con otras instituciones concernientes.

4. Ítems y sitios solicitados por el Gobierno de Bolivia

4-1 Tras las discusiones con el Equipo, han sido solicitados los equipos concernientes con el sistema de generación de electricidad solar de conexión con la red, citados a continuación por la parte boliviana.

(1) Módulos de generación de electricidad solar (La capacidad total será de 400 a 500kWp)
(2) Cajas de conexiones.
(3) Acondicionador de Potencia.
(4) Transformador.
(5) Equipo de monitoreo.
(6) Otros equipos auxiliares para la unidad funcional.

4-2 La parte boliviana, a través de las Entidades Ejecutoras, ha ofrecido al Equipo los posibles terrenos como sitios candidatos, mostrando sus ubicaciones en el Anexo-3.

4-3 La parte boliviana ha explicado al Equipo que no existe duplicación del contenido ni de la colaboración entre el presente proyecto y otros proyectos.

4-4 La parte boliviana ha comprendido que los componentes finales y el contenido del Proyecto serán determinados en el siguiente Estudio.

4-5 La parte boliviana se compromete a entregar cuanto antes la solicitud formal en base al contenido de la presente minuta.

4-6 El Equipo informará a la oficina central de JICA y al GdJ sobre las observaciones y los ítems solicitados por la parte boliviana.

En cuanto al contenido y los sitios del Proyecto mencionados anteriormente, se evaluará su pertinencia mediante el Estudio, y se informará al GdJ sobre el resultado del análisis para que éste pueda tomar la última decisión al respecto.

5. Programa de Cooperación Financiera No Reembolsable de Japón para el Medio Ambiente y Cambio Climático

5-1 La parte boliviana a través del Ministerio de Hidrocarburos y Energía y las Entidades Ejecutoras han comprendido la explicación dada por el Equipo sobre el Programa de Cooperación Financiera No Reembolsable de Japón para el Medio Ambiente y Cambio Climático (Anexo-4), Sistema de Implementación (Anexo-5), Flujo General del Programa (Anexo-6) y de las responsabilidades que debe asumir la parte boliviana (Anexo-9).

5-2 En el caso de ejecutar la Cooperación Financiera No Reembolsable de Japón, con el objeto de lograr una ejecución fluida del proyecto, la parte boliviana a través del Ministerio de Hidrocarburos y Energía y las Entidades Ejecutoras se comprometen a realizar una coordinación adecuada entre ellas y otras instituciones ministeriales relacionadas, y establecer una demarcación de roles entre los mismos, así como a tomar las medidas necesarias y provisionar el presupuesto para los gastos de la implementación del Proyecto, asegurando de esta forma el cumplimiento de la ejecución del Proyecto de acuerdo al programa establecido.

6. Programa del Estudio

6-1 La Misión seguirá el estudio local en Bolivia hasta el 5 de marzo.

6-2 La Misión informará sobre resultados de la primera etapa del Estudio a la Oficina Central de JICA y al GdJ, y la Oficina de JICA en Bolivia y llevarán a cabo la segunda etapa del Estudio a finales de marzo de 2013.

7. Otros asuntos relevantes

7-1 Aseguramiento de terrenos para la construcción de la instalación.

La parte boliviana y la Misión han acordado que las Entidades Ejecutoras aseguran los terrenos mencionados en el Anexo-3. Dichos terrenos son administrados por las Entidades Ejecutoras legalmente y confirmaron no tener problema para la implementación del Proyecto

Por otra parte, la parte boliviana y la Misión se han comprometido en demoler construcciones aledañas existentes y muros, realizar la tala de árboles que proyecten sombra, procesar los residuos y preparar el terreno para construcción por la parte boliviana, bajo su responsabilidad antes de implementar el Proyecto.

7-2 Leyes y reglamentos relacionados con los equipos a instalar por el Proyecto, y el derecho de propiedad.

La parte boliviana y la Misión han confirmado que el sistema de generación de electricidad solar instalado por el Proyecto no tiene ningún problema de orden legal en su implementación y el suministro de electricidad a la red sobre la base de leyes y reglamentos de Bolivia.

Por otra parte, el Ministerio de Hidrocarburos y Energía ha confirmado que la nueva Ley de Electricidad a

aplicarse en Bolivia no afectará al Proyecto, lo cual será informado de manera oficial a la oficina de JICA enBolivia.
En caso de existir algunas leyes, decretos u otras normas o reglamentos relacionados con la implementación del Proyecto, la parte boliviana se ha comprometido a realizar el ajuste y arreglos según las necesidades, y de acuerdo con la responsabilidad de las Entidades relacionadas.
La Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea y la Universidad Mayor de San Andrés informaron sobre la posesión del derecho propietario de los terrenos ofertados como Entidades Ejecutoras y la parte boliviana a través del Ministerio de Hidrocarburos y Energía impulsará el Proyecto bajo su responsabilidad.

7-3 Establecimiento del Comité Consultivo y del grupo de trabajo para el Proyecto.
La parte boliviana a través del Ministerio de Hidrocarburos y Energía y las Entidades Ejecutoras han acordado realizar el Comité Consultivo a fin de coordinar con la parte japonesa (Embajada de Japón, la Oficina de JICA y el agente de adquisiciones), lo cual se muestra en el Anexo-5, así como la realización del grupo de trabajo en caso de implementarse el Proyecto. Las funciones del Comité son las que se describen en el Anexo-8.

7-4 Fortalecimiento de las Entidades Ejecutoras del Proyecto y aseguramiento de presupuesto necesario.
La parte boliviana a través de las Entidades Ejecutoras se ha comprometido en asegurar la cantidad suficiente de personal y presupuesto necesario para la implementación del Proyecto, bajo la coordinación y supervisión del Ministerio de Hidrocarburos y Energía.
La parte boliviana se ha comprometido a través de las Entidades Ejecutoras en asumir la responsabilidad sobre la carga tributaria, los impuestos aduaneros y otros trámites generados en relación con la implementación del Proyecto, bajo la coordinación y supervisión del Ministerio de Hidrocarburos y Energía.
En cuanto a las medidas presupuestarias necesarias para el Proyecto que conllevará beneficios medioambientales y sociales, la parte boliviana a través de las Entidades Ejecutoras se ha comprometido a asumir su respectiva responsabilidad, de acuerdo con el convenio firmado, tras las discusiones, con la coordinación y supervisión del Ministerio de Hidrocarburos y Energía y las Entidades Ejecutoras.

7-5 Administración y mantenimiento
La parte boliviana a través del Ministerio de Hidrocarburos y Energía y las Entidades Ejecutoras ha comprendido a cabalidad la importancia de administración y mantenimiento del sistema de generación de energía solar, comprometiéndose en asegurar el personal y el presupuesto necesarios que se requieren para esta finalidad. Asimismo, ha solicitado a la Misión el apoyo en la trasferencia de tecnología para la capacitación de dicho personal necesario para la administración y mantenimiento. El Equipo ha explicado que la capacitación de personal para el matenimiento forma parte del componente blando del Proyecto con el propósito de cooperación técnica, y la parte boliviana ha manifestado su conformidad al respecto.

7-6 Adquisición de equipos y materiales
La Misión ha explicado la adquisición de todos los artículos japoneses para el equipamiento del Proyecto, de acuerdo con la política del GdJ, lo que ha sido comprendido por la parte boliviana.

7-7 Vigilancia y preservación de la seguridad
La parte boliviana, a través de las Entidades Ejecutoras, ha comprendido a cabalidad la importancia sobre

la vigilancia y preservación de la seguridad de las instalaciones construidas por el Proyecto, comprometiéndose a tomar las medidas oportunas respecto al personal y presupuesto necesario.

7-8 Consideraciones medioambientales y sociales

El Equipo ha explicado a la parte boliviana las líneas generales de las Directrices sobre las consideraciones medioambientales y sociales. La parte boliviana ha comprendido que deberá realizar trámites necesarios, teniendo en cuenta dichas directrices, en caso de que se requieren dichas consideraciones.

7-9 Medidas de seguridad

La parte boliviana, a través de las Entidades Ejecutoras, se ha comprometido a tomar las correspondientes medidas de seguridad para los nacionales japoneses que prestarán sus servicios durante la realización del estudio y la implementación del Proyecto, así como a facilitar la información correspondiente, según las necesidades.

7-10 La parte boliviana, a través de las Entidades Ejecutoras, se ha comprometido a disponer de la cantidad necesaria de personal de contraparte que requiere el Equipo.

7-11 La parte boliviana, mediante el Ministerio de Hidrocarburos y Energía, se ha comprometido a dar todas las repuestas al Cuestionario entregado por el Equipo hasta el 30 de marzo.

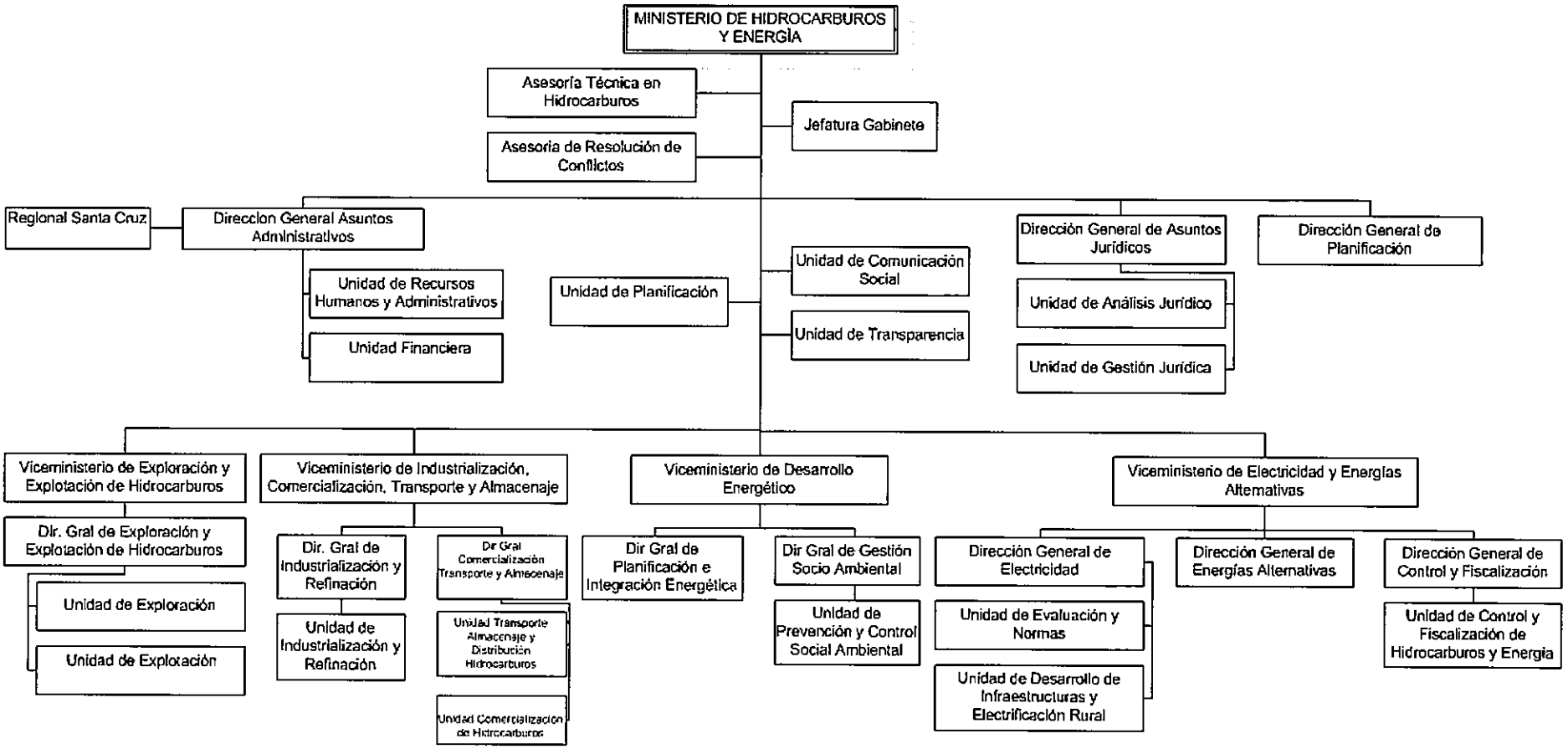
7-12 La parte boliviana, mediante el Ministerio de Hidrocarburos y Energía, se ha comprometido a entregar a la Oficina de JICA en Bolivia los documentos relacionados con el trámite del Proyecto mencionados a continuación, antes del 30 de marzo.

(1) Documentos de consideraciones ambientales y sociales
(2) Documentos respaldatorios de la propiedad del terreno, y de la capacidad de administración y mantenimiento de las instalaciones
(3) Documento de compromiso entre las entidades involucradas relacionado con la carga tributaria ya sea para su exención o para su inclusión en el presupuesto (en relación con el artículo 7-4)
(4) Carta oficial de compromiso del Ministerio de Hidrocarburos y Energía, manifestando que la Nueva Ley de Electricidad no afectará la ejecución del Proyecto.

Lista de Anexo

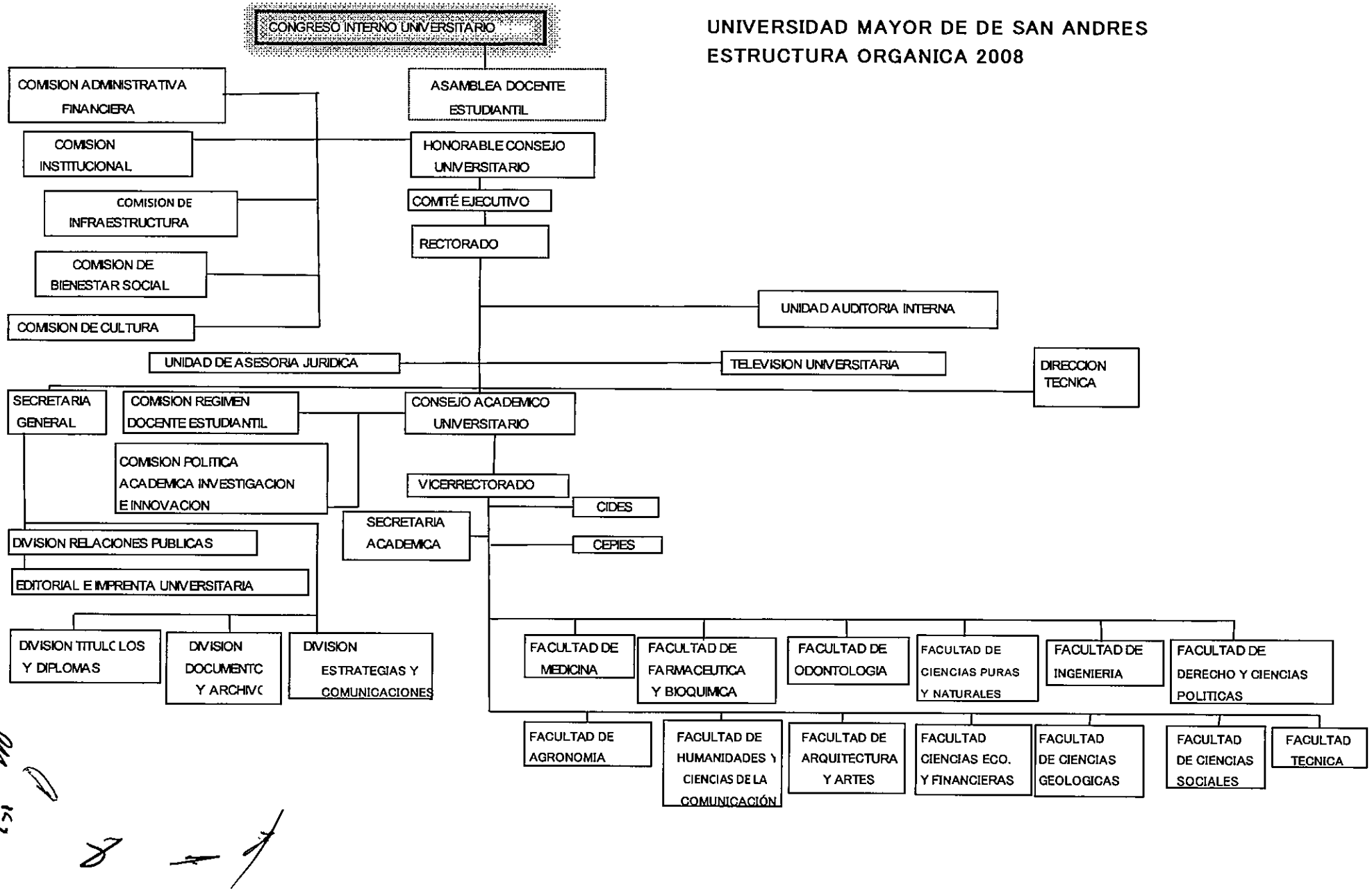
1. Organigrama del Ministerio de Hidrocarburos y Energía
2. Organigrama de la Entidades Ejecutoras
3. Mapa de ubicación de los sitios del Proyecto
4. Programa de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático
5. Sistema de Implementación del Proyecto
6. Flujo General del programa de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático
7. Flujo de Fondos para la Implementación del Proyecto
8. Términos de Referencia del Comité Consultivo
9. Principales responsabilidades a asumir por ambos Gobiernos

Organigrama del Ministerio de Hidrocarburos y Energía



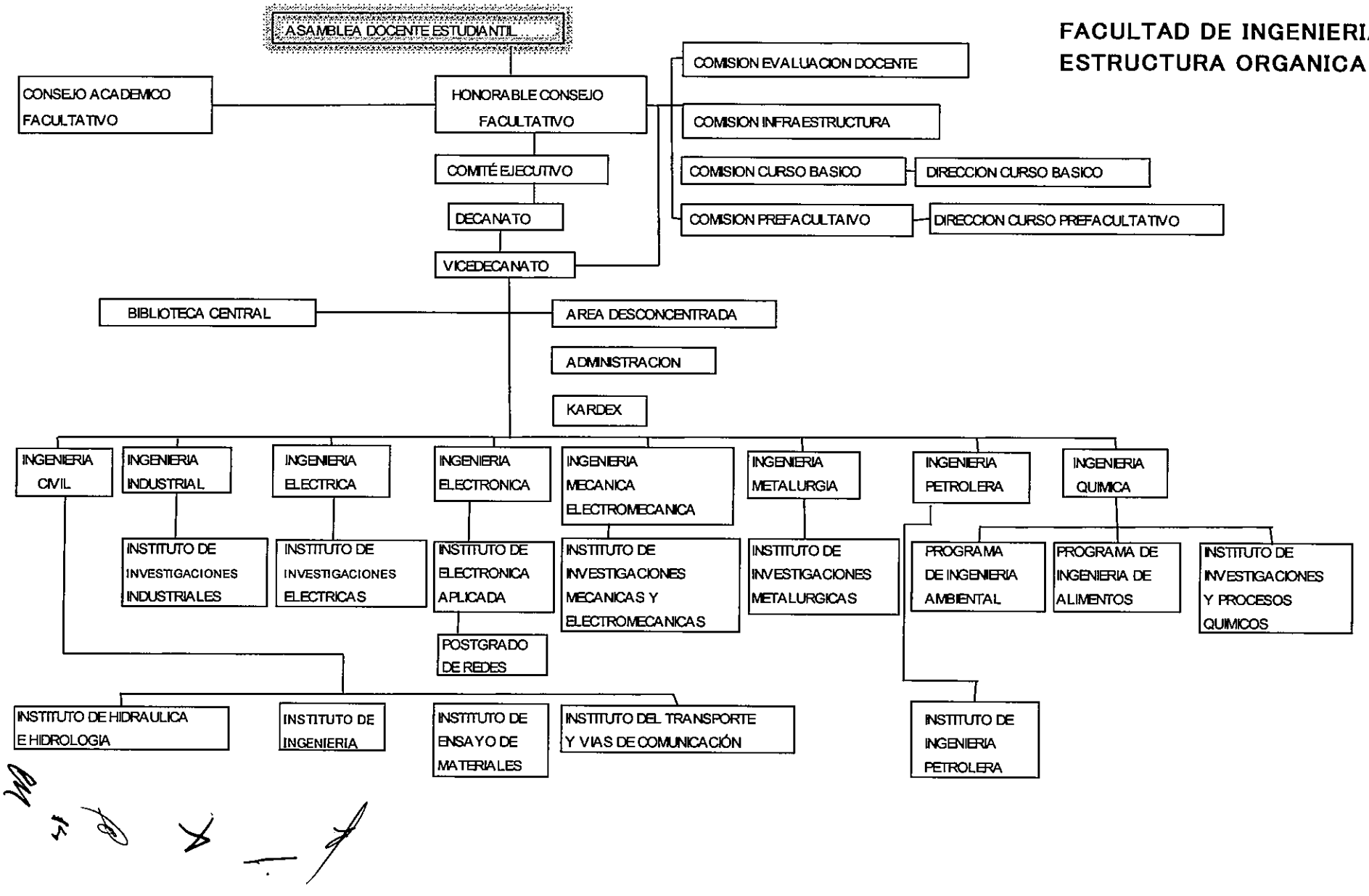
Appendix-4 MD (First Survey)

UNIVERSIDAD MAYOR DE DE SAN ANDRES
ESTRUCTURA ORGANICA 2008



Appendix-4 MD (First Survey)

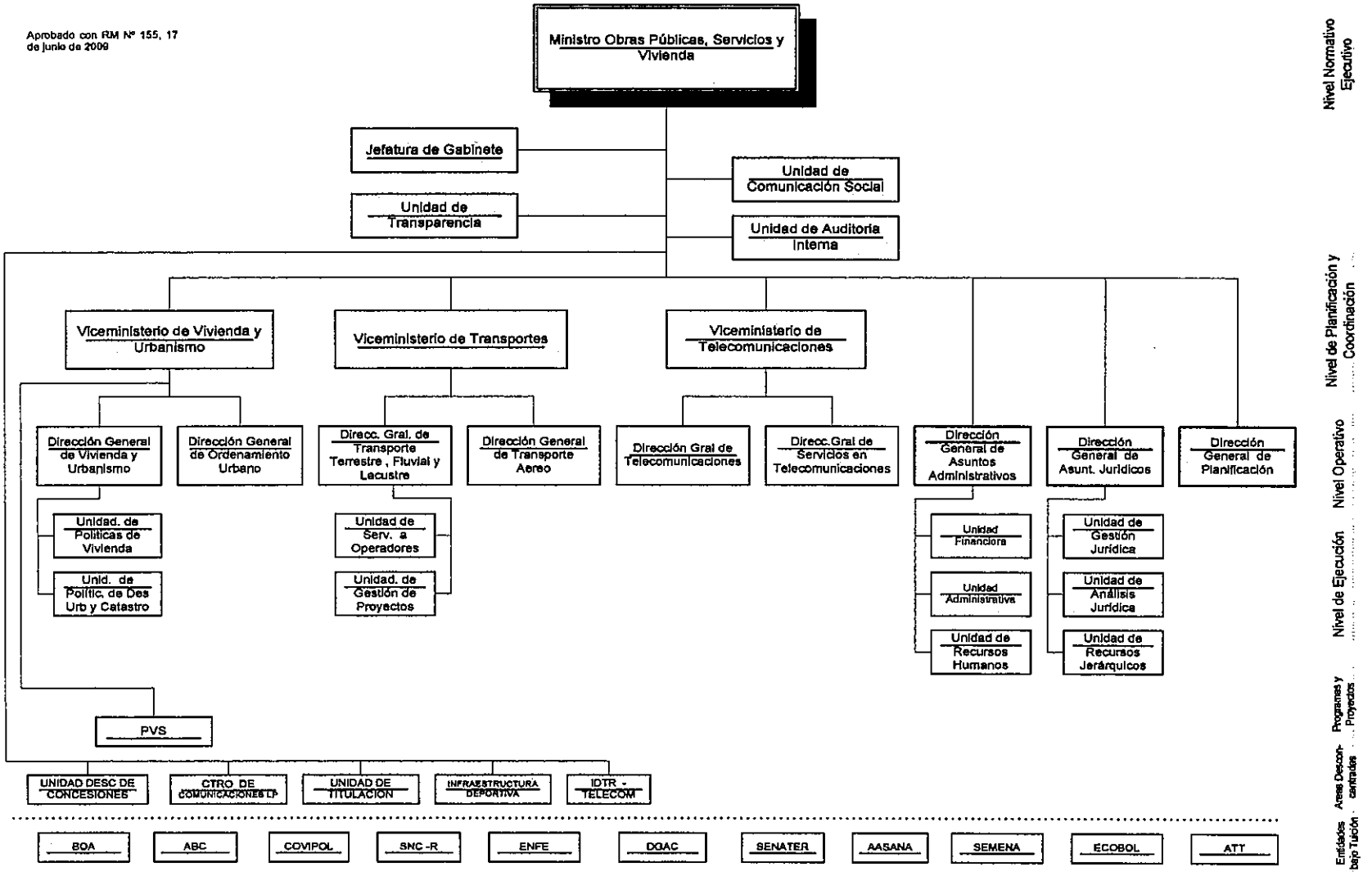
FACULTAD DE INGENIERIA
ESTRUCTURA ORGANICA



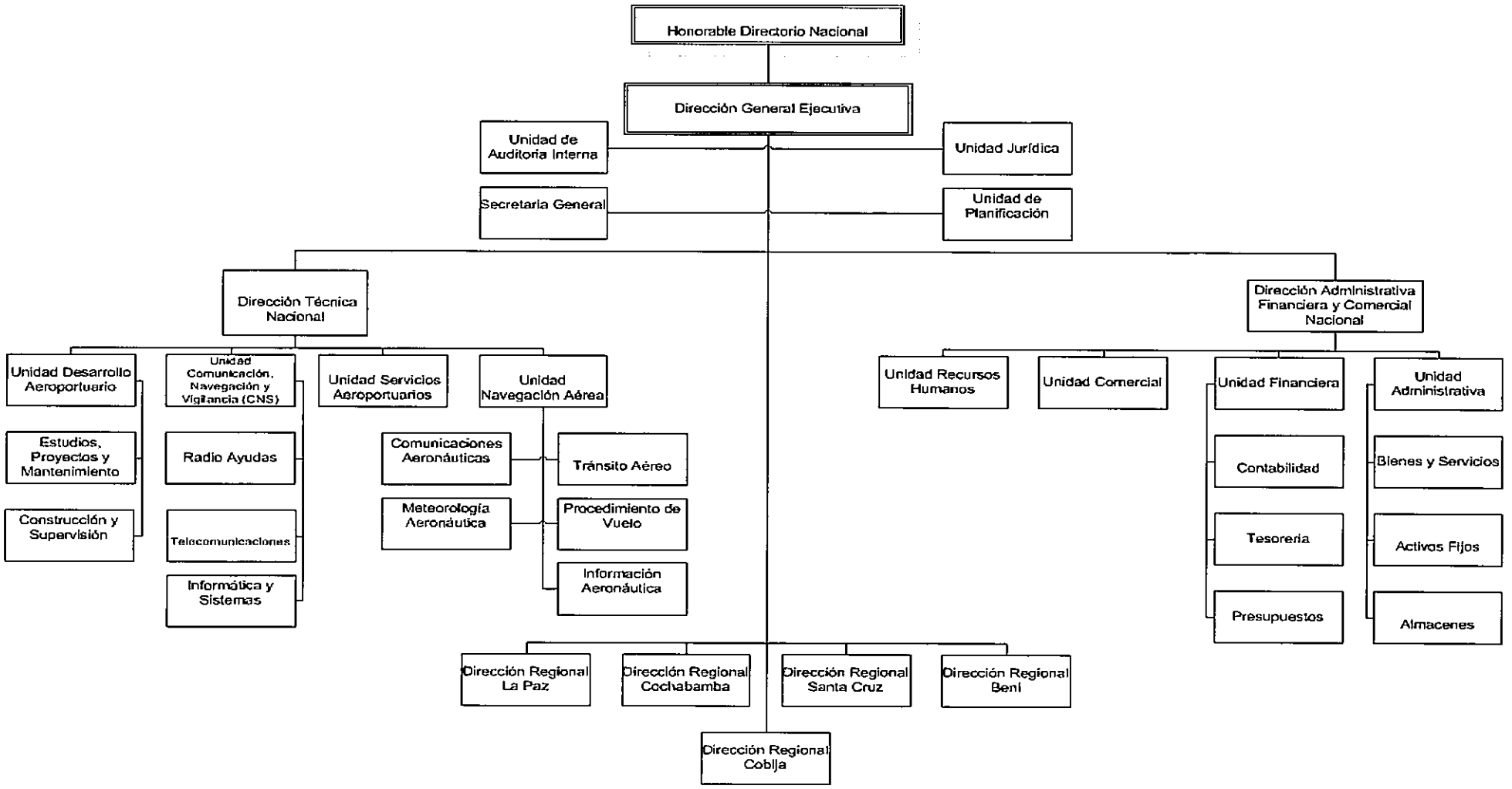
Appendix-4 MD (First Survey)

ORGANIGRAMA
MINISTERIO DE OBRAS PUBLICAS, SERVICIOS Y VIVIENDA - MOPSV

Aprobado con RM Nº 155, 17 de junio de 2009



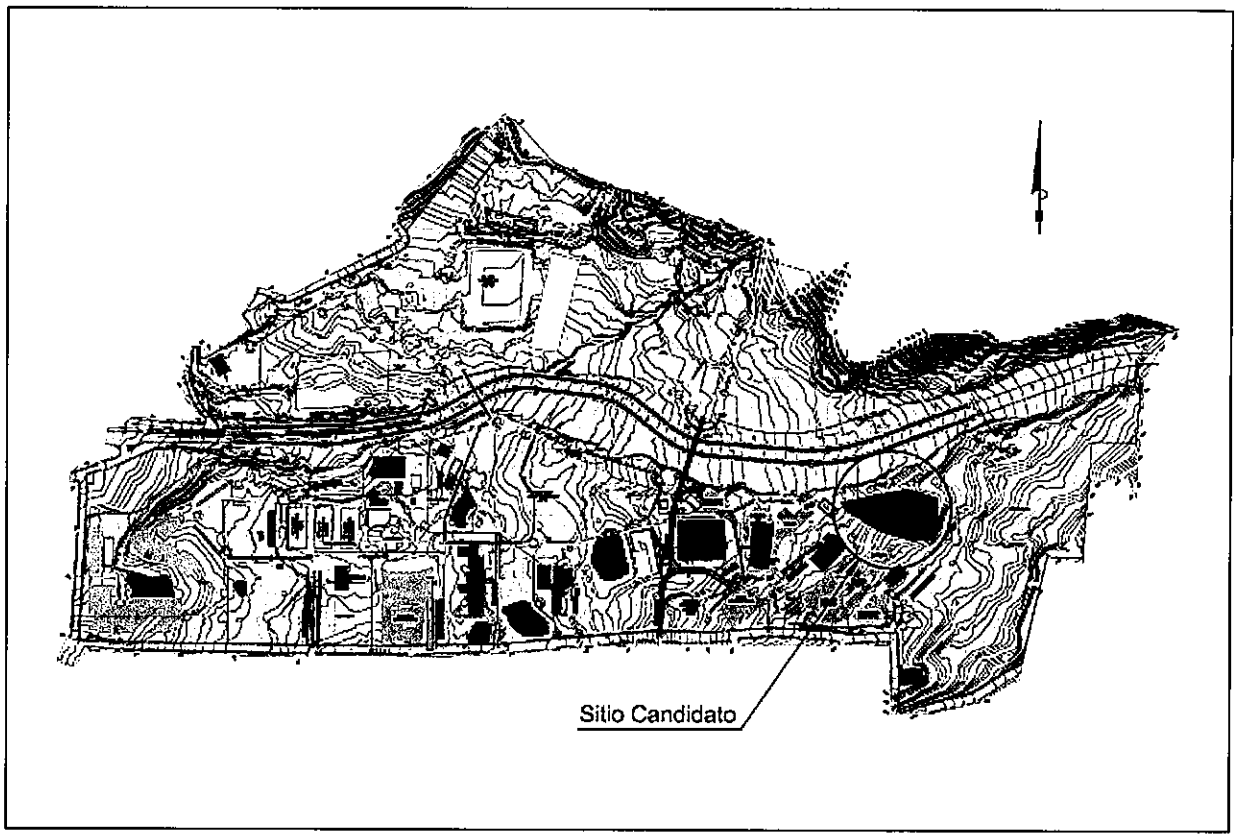
Organigrama de la AASANA



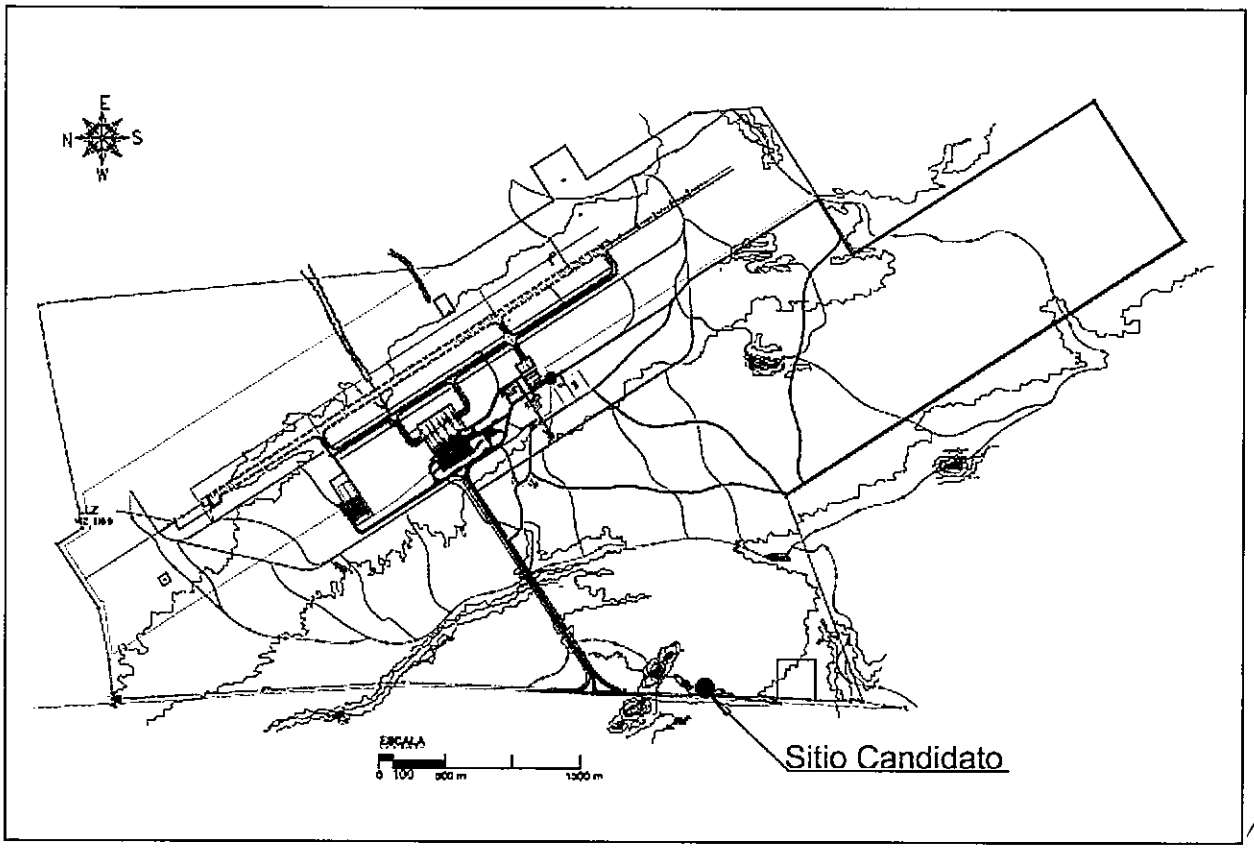
Appendix-4 MD (First Survey)

Anexo-3

Mapa de Ubicación del Sitio Candidato en la UMSA (Campus Cota Cota)



Mapa de Ubicación del Sitio Candidato en el Aeropuerto Internacional de Viru Viru



Anexo-4

Programa de Cooperación Financiera No Reembolsable

para el Medio Ambiente y Cambio Climático

del Gobierno de Japón

El Gobierno del Japón (en adelante denominado "GdJ") realiza la reforma organizacional para mejorar la calidad de operaciones de la Asistencia Oficial para el Desarrollo (AOD). Como una parte de este reajuste, una nueva ley de JICA entró en vigencia el 1 de octubre de 2008. Sobre la base de la ley y la decisión de GdJ, JICA llegó a ser la agencia ejecutora de los programas de la Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático (en adelante denominado "CFMAC").

La Cooperación Financiera No Reembolsable es el fondo no reembolsable a un país receptor para adquirir facilidades, equipos y servicios (servicios de ingeniería, transporte de los productos y etc.) con el fin de contribuir al desarrollo económico y social del país bajo los principios de las leyes y reglamentos relevantes de Japón. La Cooperación Financiera No Reembolsable no se realiza a través de la donación de materiales.

La CFMAC tiene como objetivo reducir las emisiones de gases de efecto invernadero, así como realizar el ahorro de energía y control de daños medioambientales causados por el cambio climático. Se puede combinar múltiples componentes para responder eficazmente a las necesidades. Los Contratistas, proveedores o consultores no se limitan a las empresas japonesas. y la construcción puede ser basada en el método local.

1. Procedimientos de la CFMAC

Se realiza la CFMAC por los procedimientos siguientes:

Aplicación	(Solicitud del Receptor)
Estudio	(Estudio de Concepto General ejecutado por JICA)
Evaluación y aprobación	(Aprobación por el GdJ y aprobación por el Gabinete de ministros)
Decisión de ejecución	(las Notas canjeadas entre el GdJ y el país receptor)
Acuerdo de Donación	(en adelante denominado "A/D") (el acuerdo suscrito entre JICA y el país receptor)

En primer lugar, el GdJ (el Ministerio de Relaciones Exteriores) estudia la solicitud formulada por el país receptor si el Proyecto es apropiado para la Cooperación Financiera No Reembolsable. Si se confirma que la solicitud tiene alta prioridad como Proyecto para la Cooperación Financiera No Reembolsable, JICA efectúa el Estudio Preparativo si es necesario.

En segundo lugar, JICA realiza el estudio de concepto general, en principio bajo el contrato con un consultor japonés.

En tercer lugar, el GdJ evalúa el programa si existe factibilidad como CFMAC sobre la base del informe del Estudio preparado por JICA. El resultado será presentado al Gabinete de ministros.

Una vez aprobado el Proyecto por el Gabinete, en la cuarta etapa de Decisión de Ejecución, se firma el Canje de Notas (en adelante denominado "C/N") por los representantes del GdJ y del Gobierno receptor. Simultáneamente, la donación será disponible después de la suscripción del A/D entre el Gobierno receptor y JICA.

JICA ha sido designada por el GdJ como una organización responsable de ejecución de Donación.

El Agente (en adelante denominado "Agente") ha sido designado para efectuar los servicios de adquisición y otros servicios (incluyendo gestión de fondo, preparación de licitación, contratos y otros) para la CFMAC en nombre del país receptor. El Agente es un organismo imparcial y especializado y debe ofrecer los servicios en función del acuerdo de agente (en adelante denominado "A/A") con el país receptor. El Agente es recomendado al país receptor por el GdJ y acordado entre ambos Gobiernos en la Minuta de Acuerdo anexado con el C/N (en adelante denominado "M/A").

2. Estudio de Diseño del Concepto General

1) Contenido del Estudio

El objetivo del Estudio que ejecuta JICA sobre el programa solicitado es proveer un documento básico necesario para la evaluación del Programa por el GdJ. Los contenidos del Estudio son los siguientes:

(1) Verificar los antecedentes, objetivo y efectos esperados del Programa, al igual que la capacidad de la Entidad responsable y las comunidades concernientes del país receptor necesarias para la realización del Programa.

(2) Evaluar su viabilidad, desde los puntos de vista técnico y socio-económico.

(3) Confirmar los ítems acordados por ambas partes acerca del concepto básico del Programa.

(4) Preparar un diseño conceptual del Programa.

(5) Estimar el costo del Programa.

La totalidad de la solicitud no será automáticamente objeto de la cooperación, sino que se confirmará el concepto básico del Proyecto conforme al esquema de la Cooperación Financiera No Reembolsable de nuestro país.

Los contenidos de la solicitud original no son necesariamente aprobados en su forma inicial como los contenidos del Programa. Se confirma el Estudio de concepto general considerando las directivas del esquema de la Cooperación Financiera No Reembolsable del Japón.

El GdJ exigirá que el Gobierno del país receptor tome todas las medidas necesarias para promover su autonomía. Tales medidas deben estar garantizadas a pesar de que estén fuera de la jurisdicción de la organización en el país receptor. Por lo tanto, la ejecución del Proyecto será confirmada por todas las organizaciones relevantes en el país receptor mediante las Minutas de Discusiones.

2) Selección de la compañía consultora

Al realizar el Estudio, JICA selecciona una de las compañías consultoras - entre aquellas registradas en JICA - mediante una licitación en la que presentan sus propuestas. La compañía seleccionada realiza el Estudio de Concepto General y elabora el Informe bajo la supervisión de JICA.

Las empresas consultoras que trabajarán en la realización del Programa después de la suscripción del C/N y el A/D pueden ser, en principio, de cualquier nacionalidad mientras que las empresas satisfagan las condiciones especificadas en los documentos de licitación.

3. Realización de la CFMAC después de la suscripción del C/N y del A/D

1) Canje de Notas (C/N) y Acuerdo de Donación (A/D)

Se extiende la CFMAC de acuerdo con las notas canjeadas por los dos Gobiernos. En las cuales los objetivos del Programa, período de ejecución, condiciones y el monto de la Donación y otros serán confirmados. La suscripción del A/D entre JICA y el país receptor seguirán para definir los procedimientos necesarios para llevar a cabo el Programa tales como condiciones de pago, responsabilidades del país receptor y condiciones de licitación.

2) Detalles de Procedimiento

Los detalles de procedimiento sobre la adquisición de productos y servicios bajo la CFMAC serán acordados entre el país receptor y JICA al momento de las firmas del C/N y del A/D.

Los puntos esenciales a ser acordados se enmarcan como sigue:

a) JICA supervisará la buena ejecución del Proyecto.

b) Los productos y servicios deben ser adquiridos y provistos conforme a las Directivas de Adquisición para el Medio Ambiente y Cambio Climático de JICA.

c) El país receptor suscribirá un contrato de empleo con el Agente.

d) El Agente es el representante asignado en nombre del país receptor acerca de transferencia de fondos al Agente.

3) Puntos Focales de las Directivas de Adquisición de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático (Tipo I – E) (en adelante denominado "las Directivas").

a) El Agente

El Agente es la organización que provee servicios de adquisición de productos y servicios a favor del país receptor conforme al A/A con el país receptor. El Agente será recomendado al país receptor por el GdJ y acordado entre ambos gobiernos en la M/A.

b) Acuerdo de Agente (A/A)

El país receptor suscribirá un A/A dentro de un mes después de la fecha de entrada en vigor del A/D conforme a la M/A. Se especificará el alcance de los servicios de agente en el A/A.

c) Aprobación del A/A

El Acuerdo de Agente, preparado en dos documentos idénticos, será presentado a JICA por el país receptor a través del Agente. JICA confirmará si el A/A está suscrito o no conforme al A/D y a las Directivas y aprobará el A/A.

El A/A suscrito entre el país receptor y el Agente entrará en vigor después de la aprobación de JICA en forma escrita.

d) Métodos de Pago

El A/A estipulará "en relación con todas las transferencias de los fondos al Agente"; el país receptor designará al Agente como el representante autorizado para actuar en nombre del país receptor y emitirá una Autorización General de Desembolso (en adelante denominado "BDA") para transferir el fondo (anticipos) a la cuenta de adquisición desde la cuenta del país receptor.

El A/A debe indicar claramente que el pago de los Anticipos al Agente será efectuado en yenes japoneses y que el pago final al Agente será efectuado cuando el monto restante quede a menos de 3 % de la Donación y los intereses derivados.

e) Productos y servicios elegibles para la adquisición

Los productos y servicios a ser adquiridos serán seleccionados entre aquellos definidos en el A/D.

f) Empresas

En principio, una empresa de cualquier nacionalidad puede ser contratada mientras dicha empresa satisfaga las condiciones especificadas en los documentos de licitación.

g) Expertos de Asistencia Técnica

Se puede enviar expertos para llevar a cabo la asistencia técnica. Los expertos pueden ser recomendados por JICA cuando se requiera la consistencia conceptual con el Estudio. En principio, se prefiere que los expertos sean nacionales japoneses.

h) Método de Adquisición

Durante la ejecución de adquisición, se tiene que prestar atención suficiente con el fin de que no haya injusticia entre los licitantes elegibles para la adquisición de productos y servicios.

A este fin, se emplea la licitación competitiva en principio.

i) Documentos de Licitación

Los documentos de licitación tienen que contener toda la información necesaria para permitir a los licitantes preparar ofertas válidas de productos y servicios en la CFMAC.

j) Examen de Pre-Calificación de Licitantes

El Agente podrá efectuar un examen de pre-calificación de licitantes antes de la licitación para que se difunda la invitación de licitación solo a las empresas elegibles. El examen de la pre-calificación deberá ser efectuado solo en respecto de que los potenciales licitantes tengan la capacidad de realizar los contratos sin falta. En este caso, se considera los siguientes puntos:

(1) Experiencia y rendimiento en el pasado de los contratos de similar naturaleza.

(2) Propiedad fundación o la credibilidad financiera.

(3) Existencia de oficinas, y etc. a ser especificada en los documentos de licitación.

k) Evaluación de Licitación

La evaluación de licitación tiene que ser implementado sobre la base de las condiciones especificadas en los documentos de licitación.

Las licitaciones substancialmente conformes a las especificaciones técnicas y sujetos a otras estipulaciones de los documentos de licitación, deben ser juzgadas, en principio, sobre la base del precio presentado, y el licitante que ofrece el precio más bajo deberá ser designado como el adjudicador.

El Agente redactará un informe detallado de evaluación de licitación que clarifique las razones de la adjudicación y descalificación, y lo presentará al país receptor para obtener la confirmación antes de suscribir el contrato con el adjudicador.

El Agente proveerá a JICA un informe detallado de evaluación sobre la licitación, dando las razones de aceptación o rechazo de dicha licitación.

l) Adquisición Adicional

Si existe un fondo adicional después de la licitación concurrente y/o selectiva, y/o negociación directa para un contrato, y el país receptor desea una adquisición adicional, el Agente le está permitido efectuar una licitación adicional respetando los siguientes puntos:

(1) Adquisición de los mismos productos y servicios

Cuando los productos y servicios a ser adquiridos sean idénticos a la licitación inicial, y una licitación competitiva sea juzgada como desventajosas, se puede llevar a cabo la licitación adicional a través del contrato directo con el adjudicador de la licitación inicial.

(2) Otras adquisiciones

Cuando productos y servicios otros que los que se menciona en (1) arriba se adquieran, se emplea una licitación competitiva. En este caso, los productos y servicios para adquisición adicional tiene que ser seleccionados dentro de aquellos que se menciona en el A/D.

m) Modalidades de Pago

El contrato debe indicar las modalidades de pago. El Agente deberá efectuar el pago desde los Anticipos a cambio de la presentación de los documentos necesarios de las empresas sobre la base de las condiciones especificadas en el contrato, después que las empresas cumplan sus obligaciones. Cuando los servicios son el objeto de adquisición, el Agente podrá pagar cierta porción del monto contratado a las empresas, bajo las condiciones que tales empresas presentan la garantía de pago anticipado (vale al monto del pago anticipado) al Agente.

4) Las Obligaciones para el país peceptor

Dentro de la ejecución del Programa se requiere que el país receptor tome las medidas necesarias siguientes:

(a) Adquirir los lotes de terrenos necesarios para la implementación del Proyecto y nivelar los sitios;

(b) Proveer de instalaciones para la distribución de electricidad, suministro de agua y el sistema de desagüe y otras instalaciones adicionales necesarias para la implementación del Proyecto fuera de los sitios referidos en (a) arriba;

(c) Asegurar los edificios antes de la adquisición en caso de la instalación de equipos;

(d)Asegurar el pronto desembarque y despacho aduanero de los productos mencionados en el Artículo 3 del Acuerdo de la Donación en los puertos de desembarque en el país receptor y facilitar el transporte interno de los productos mencionados en el Artículo 3 del Acuerdo de la Donación;

(e) Asegurar que los pagos de derechos aduaneros, impuestos internos y otras cargas fiscales que se impongan en el país receptor con respecto al suministro de los productos y los servicios mencionados en el Artículo 3 del Acuerdo de la Donación, sean eximidos o cubiertos por las Entidades Ejecutoras sin utilizar la Donación;

(f) Otorgar a las partes concernientes, cuyos servicios sean requeridos en conexión con el suministro de los productos y los servicios mencionados en el Artículo 3 del Acuerdo de la Donación, tantas facilidades como sean necesarias para su ingreso y estadía en el país receptor para el desempeño de sus funciones;

(g) Asegurar que las Instalaciones y/o los productos mencionados en el Artículo 3 del Acuerdo de la Donación sean debida y efectivamente mantenidos y utilizados para la implementación del Proyecto;

(h) Sufragar todos los gastos necesarios, excepto aquellos cubiertos por la Donación, para la implementación del Proyecto; y

(i) Integrar debidamente las consideraciones medioambientales y sociales en la implementación del Proyecto.

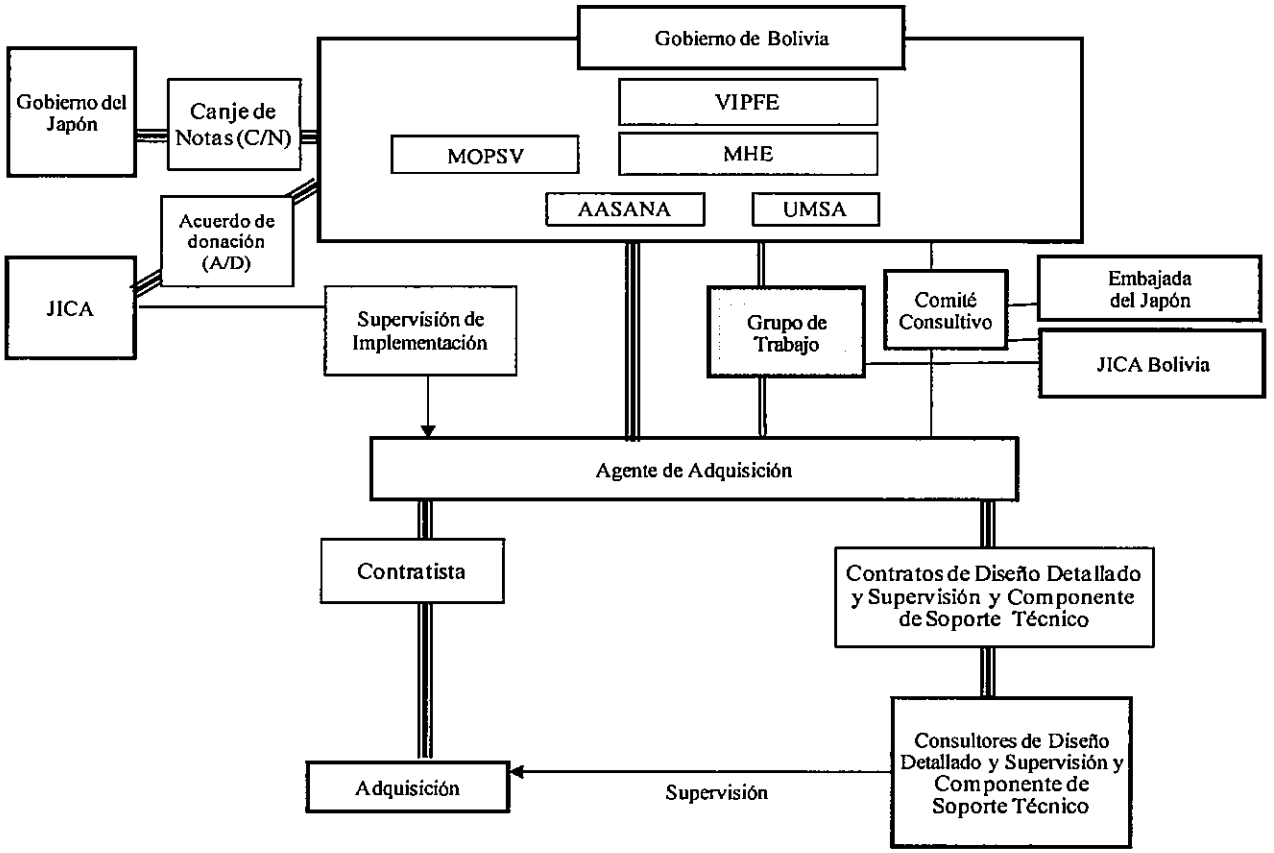
5) Uso Adecuado

El país receptor deberá asegurar que las instalaciones construidas y los productos adquiridos bajo la Cooperación Financiera No Reembolsable sean debida y efectivamente mantenidos y utilizados para la ejecución del Proyecto, y asignar el personal necesario a tal fin. Deberá también sufragar todos los otros gastos necesarios para la ejecución del Programa que no cubra la Donación.

6) Reexportación

Los productos adquiridos bajo la Donación no deberán ser reexportados desde el país receptor.

SISTEMA DE IMPLEMENTACIÓN DEL PROYECTO

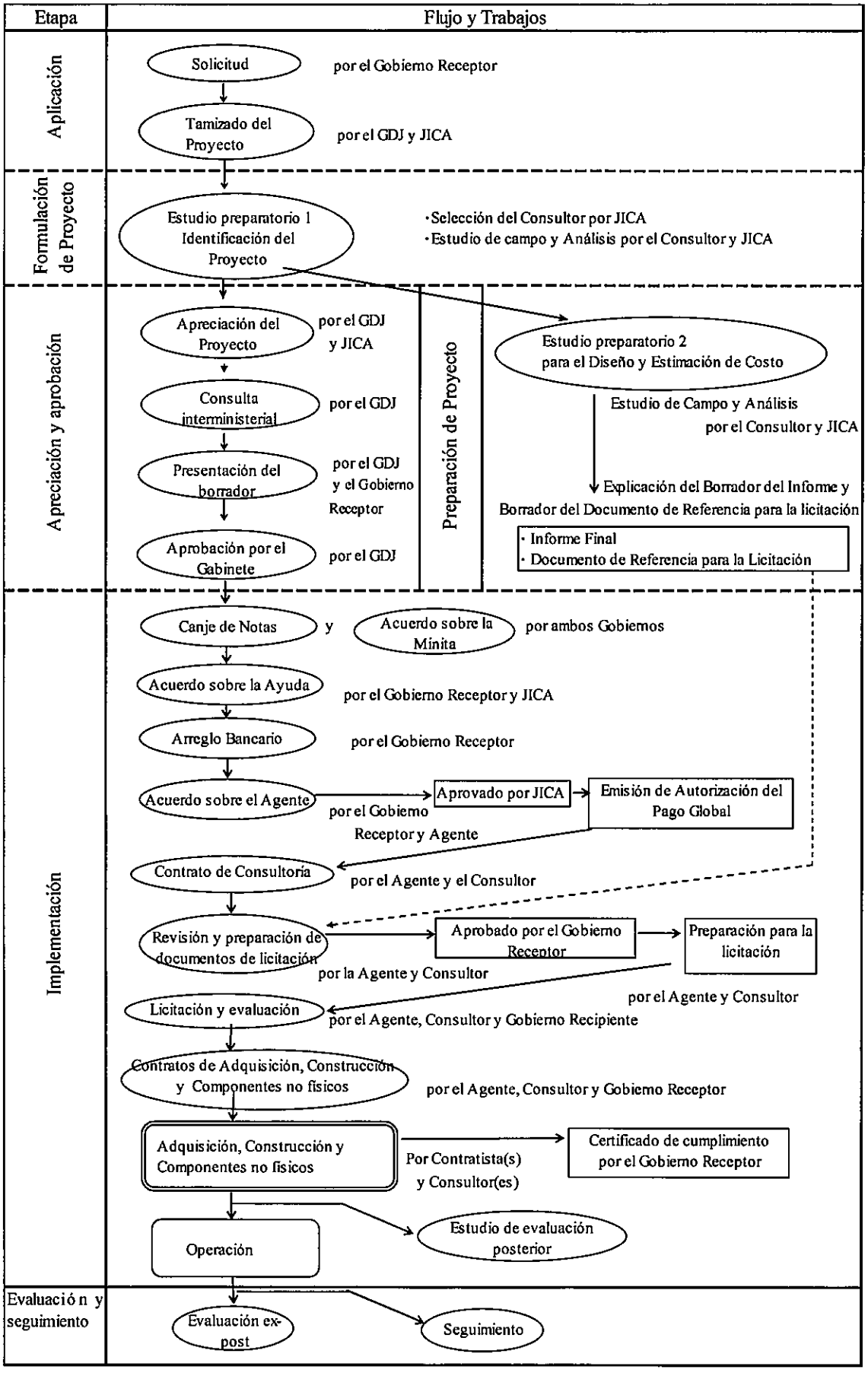


ABREVIATURA

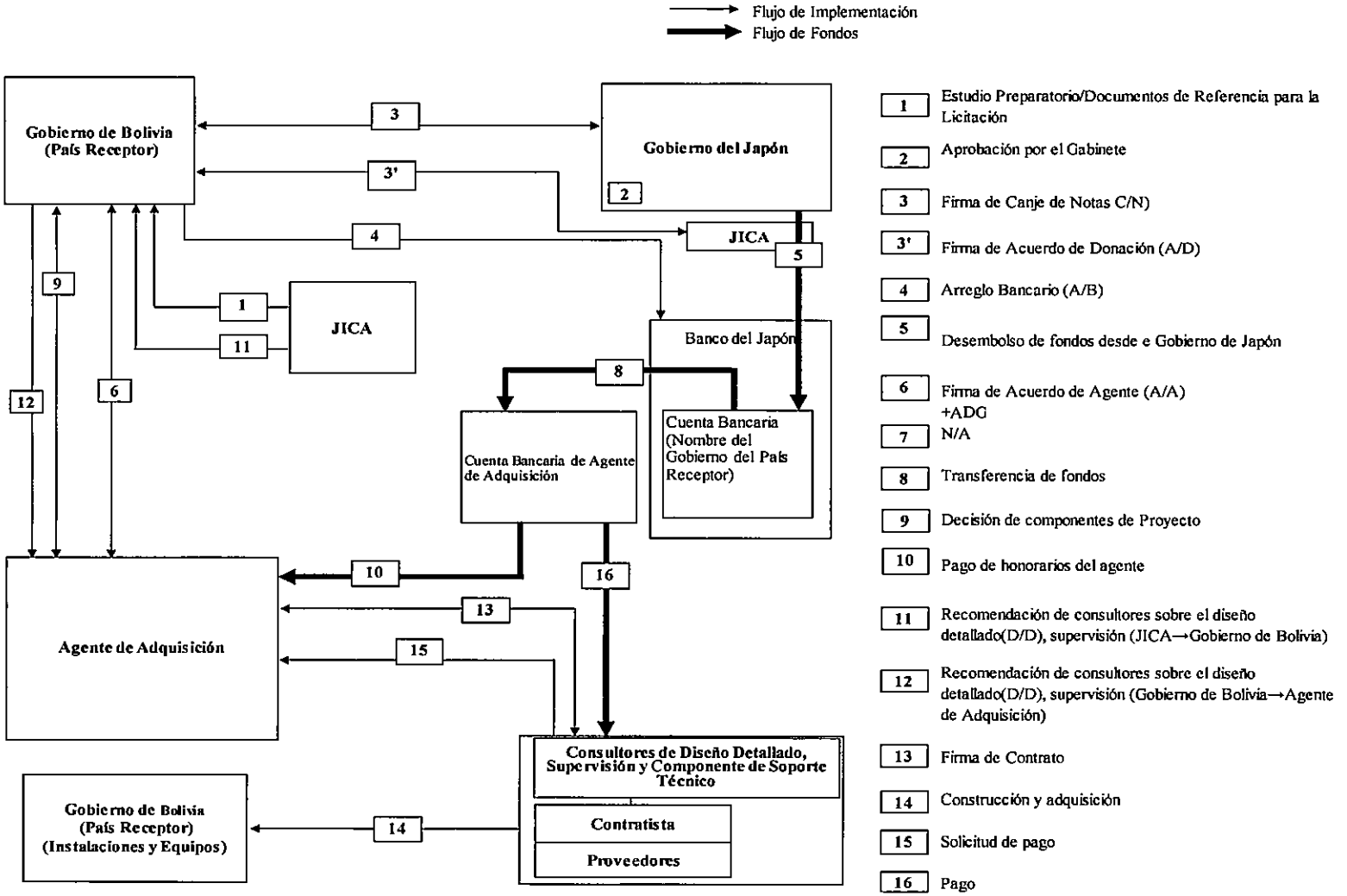
VIPFE: VICEMINISTERIO DE INVERSIÓN PÚBLICA Y FINANCIAMIENTO EXTERNO
MHE: MINISTERIO DE HIDROCARBUROS Y ENERGÍA
MOPSV: MINISTERIO DE DE OBRAS PÚBLICAS, SERVICIOS y VIVIENDA
AASANA: ADMINISTRACIÓN DE AEROPUERTOS Y SERVICIOS AUXILIARES A LA NAVEGACIÓN AÉREA
UMSA: UNIVERSIDAD MAYOR DE SAN ANDRÉS

Anexo-6

Flujo General del Programa de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático



Flujo de Fondos para Implementación del Projecto



Anexo-8

Términos de Referencia del Comité Consultivo

1. Confirmar el cronograma de implementación del Programa para un aprovechamiento rápido y efectivo de la Donación y sus intereses adquiridos.

2. Discutir modificaciones del Programa, incluyendo las del diseño de las instalaciones.

3. Intercambiar opiniones sobre la asignación de la Donación y sus intereses adquiridos, igual que sobre potenciales usuarios finales.

4. Identificar problemas que puedan retrasar el aprovechamiento de la Donación y sus intereses adquiridos, y buscar soluciones de tales problemas.

5. Intercambiar opiniones sobre la promoción relacionada al aprovechamiento de la Donación y sus intereses adquiridos.

6. Discutir cualquier tema que surja en relación con el Acuerdo de la Donación.

Anexo-9

Principales responsabilidades a asumir por ambos Gobiernos

	Ítems	Cubierto por el Gobiemo de Japón	Cubierto por el País Receptor
1	Asegurar el terreno		●
2	Limpiar, nivelar y reclamar el lugar cuando sea necesario		●
3	Construir portones y cercos en y alrededor del lugar		●
4	Construir un estacionamiento de vehículos	N/A	N/A
5	Construir caminos		
	1) Dentro del lugar	●	
	2) Fuera del lugar		●
6	Construir los edificios	●	
7	Proporcionar instalaciones para la distribución de electricidad, suministro de agua, drenaje y otras instalaciones incidentes		
	1) Electricidad		
	a. La línea de distribución al lugar		●
	b. El cableado descendente e interior dentro del lugar	●	
	c. El disyuntor del circuito principal y transformador	●	
	2) Abastecimiento de agua		
	a. Tubería principal de distribución de agua de la ciudad al lugar		●
	b. Sistema de abastecimiento dentro del lugar (recepción y tanques elevados)	●	
	3) Drenaje		
	a. Tubería principal de drenaje de la ciudad (para tormentas, aguas servidas y otros) al lugar		●
	b. El sistema de drenaje (de aguas de lavabo, residuos ordinarios, drenaje de tormentas y otros) dentro del lugar	●	
	4) Suministro de gas		
	a. Tubería principal de gas al lugar		●
	b. Sistema de suministro de gas dentro del lugar	●	
	5) Sistema telefónico		
	a. Línea troncal de teléfono al bastidor/panel de distribución principal (MDF) del edificio		●
	b. El MDF y las extensiones después del bastidor/panel	●	
	6) Muebles y equipo		
	a. Muebles en general		●

	Ítems	Cubierto por el Gobierno de Japón	Cubierto por el País Receptor
	b. Equipo del Proyecto	•	
8	Pagar al Banco de Cambio Exterior de Japón lo siguiente en base al Acuerdo Bancario (A/B)		
	1) Comisión de Pago		•
9	Asegurar el desembarque y despacho aduanero de los bienes en el puerto de desembarque del país beneficiario		
	1) Transporte marítimo (aéreo) de los bienes del Japón al país beneficiario.	•	
	2) Exención de impuestos y despacho aduanero de los bienes al ser desembarcados en el puerto		•
	3) Transporte interno desde el puerto de desembarque hasta el lugar del proyecto	(•)	(•)
10	Realizar las gestiones necesarias para que los japoneses, cuyos servicios puedan ser necesarios en conexión con el suministro de los bienes y servicios suministrados bajo el contrato verificado, cuenten con las facilidades necesarias para la entrada en el país beneficiario y su estadía durante la realización de su trabajo.		•
11	Exonerar a los japoneses del pago de impuestos tales como impuestos aduaneros, impuestos internos y otros gravámenes imponibles en el país beneficiario con respecto al suministro de los bienes y servicios provistos dentro del marco del contrato verificado.		•
12	Mantener y utilizar eficiente y apropiadamente las instalaciones construidas y los equipos dentro de la Cooperación Financiera No Reembolsable.		•
13	Asumir todos los gastos, aparte de los cubiertos por la Cooperación Financiera No Reembolsable, que sean necesarios para la construcción de las instalaciones al igual que para el transporte e instalación de equipos.		•
14	Asegurar consideraciones ambientales y sociales para el Programa.		•

Technical Notes

On the Preparatory Survey on
The Project for Introduction of Clean Energy by Solar Electricity Generation System
In the Plurinational State of Bolivia

The Minutes of Discussion for the captioned Project was signed between Mr. Kaoru Suzuki, leader of Preparatory Survey Team of JICA, Ms. Elba Viviana Caro Espinoza, Ministra de Planificación del Desarrollo, Gral. FA. AE. Edwin Marañon Gamboa, Viceministro de Transportes, Ing. Hortensia Jiménez Rivera, Viceministra de Electricidad y Energias Alternativas, Cnl. Daen Raúl Velasco Ramos, Director Ejecutivo Nacional de AASANA, and M.Sc. María Teresa Rescala Nemtala Rectora UMSA on March 1st 2013.

The Team had carried out detailed survey at the sites and held discussion with the engaged staffs of Ministerio de Hidrocarburos y Energía; AASANA and UMSA. In the course of discussion, among the parties have confirmed the additional items described in the attached sheets for supplementary documents of the Minutes of Discussion.

La Paz, April 11th, 2013

Toshiaki Kobayashi
Team Leader of the Consultant
Preparatory Survey Team
Nippon Koei Co., Ltd.

Ing. Juan Manuel Gonzales Flores
Director General de Energías Alternativas
Viceministerio de Electricidad y Energías Alternativas
Ministerio de Hidrocarburos y Energía
Estado Plurinacional de Bolivia

Ing. Hernando Rubén Lara Valda
Jefe Unidad Nacional de Comunicación, Navegación y Vigilancia
Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea (AASANA)

Ing. Miguel Ángel Calla Carrasco
Decano Facultad de Ingeniería
Universidad Mayor de San Andrés (UMSA)

ATTACHMENT

1. Implementation Schedule

In response to the request about implementation schedule, the Team explained of the tentative expected implementation schedule of the Project as follows; and schedule shown in ANNEX-1. According to the schedule, the Project is scheduled to be completed in the end of February 2015.

1)	Draft final Report:	July 2013
2)	Agent Agreement:	August 2013
3)	Selection of Consultant:	October 2013
4)	Tender call:	Middle of December 2013
5)	Tender open:	February 2014
6)	Implementation of Project:	March 2014
7)	Installation of PV module:	November 2014
8)	Completion of Project:	February 2015

2. Candidate Project Sites

The Team has surveyed for UMSA Cota Cota Campus,in La Paz and Viru Viri International Airport in Santa Cruz. We mutually confirmed the necessary dimension for the PV systems. Based on the confirmed dimension, the Team explained necessary preparation works that temporary fencing, access road and land leveling in the sites.

We mutually confirmed that necessary preparation works for the installation as such the above will be executed before starting the installation works. (Layouts of PV system are shown in ANNEX-2)

3. Design of PV System

The Team has explained about the design of PV System regarding following items:

3.1 Electrical System

The Team explained the electrical single line diagram of PV system and methodology and principle of the grid-connection. Based on the explanation, we mutually have agreed on the basic idea and composition of single line diagram shown in ANNEX-3.

3.2 Technical Specification of PV System

The Team has explained about technical specifications and necessary grid-connection matters (ANNEX-4) which has been determined based on confirmation about compatibility with the Grid System of Delapaz and CRE. Grid-connection matters described in Minutes of Meeting with Delapaz and CRE (ANNEX-5).

3.3 Display Panel

The Team has explained about Display Panel that is specified to indicate in order to demonstrate available data to be collected from PV systems. Based on the discussion, we mutually confirmed that the Display Panel will be installed nearby the sites. Besides, the Display Panel have some possibilities to install in the Terminal Building at Viru Viru International Airport. Therefore, we confirmed that a communication routes from site to Terminal Building using optical fiber cable and/or radio communication. These cost evaluation will be done after return to Japan.

The Display Panel is planned to be demonstrated for Power output (kW), Solar irradiation (kW/m^2), Temperature (degree Celsius), Solar power generation (kWh/day, kWh/month) and CO_2 gas emission deduction ($kg\text{-}CO_2/day$), etc.

3.4 Organization Setup for Operation and Maintenance

The Team has confirmed that necessary organization (personnel) for operation and maintenance will be organized for the PV systems prior to the commissioning and Soft Component as follows;

1) UMSA Cota Cota Capmus

Executing institution:	Engineering Faculty of UMSA
Operation and maintenance:	Engineering Faculty for PV system and low voltage side
	Delapaz for Medium voltage side

2) Viru Viru International Airport

Executing institution:	AASANA
Operation and maintenance:	SABSA for PV system and low voltage side
	CRE for Medium voltage side

ANNEX-1

Tentative Implementation Schedule

ANNEX-2

Layout drawings of PV system in UMSA Cota Cota Campus and Viru Viru International Airport

ANNEX-3

Single lind diagram of PV system

ANNEX-4

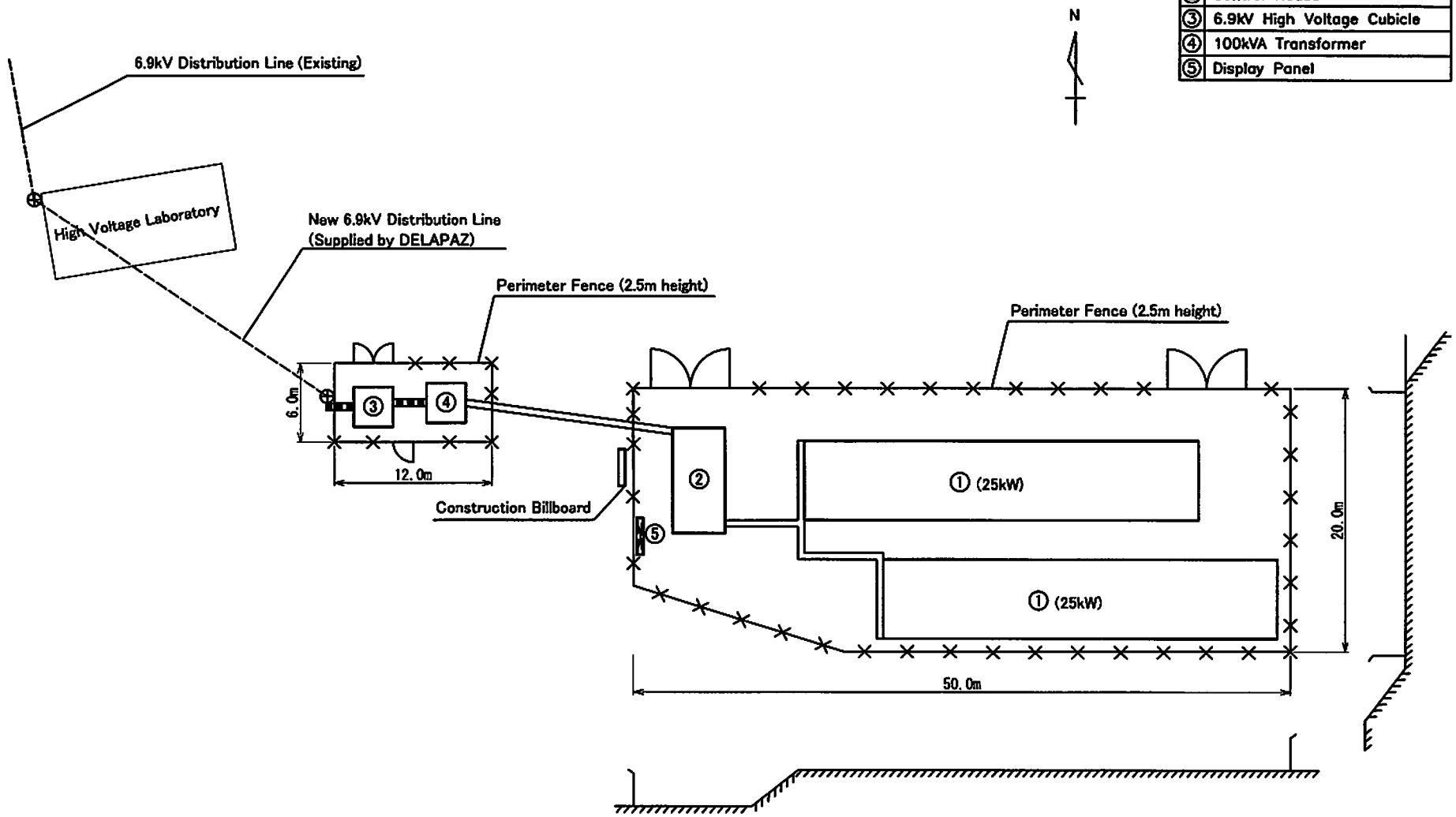
Technical Specification of PV System

ANNEX-5

Minutes of Meeting with DElapaz and CRE

(ANNEX-1) Tentative Implementation Schedule

For Explanation Purpose Only

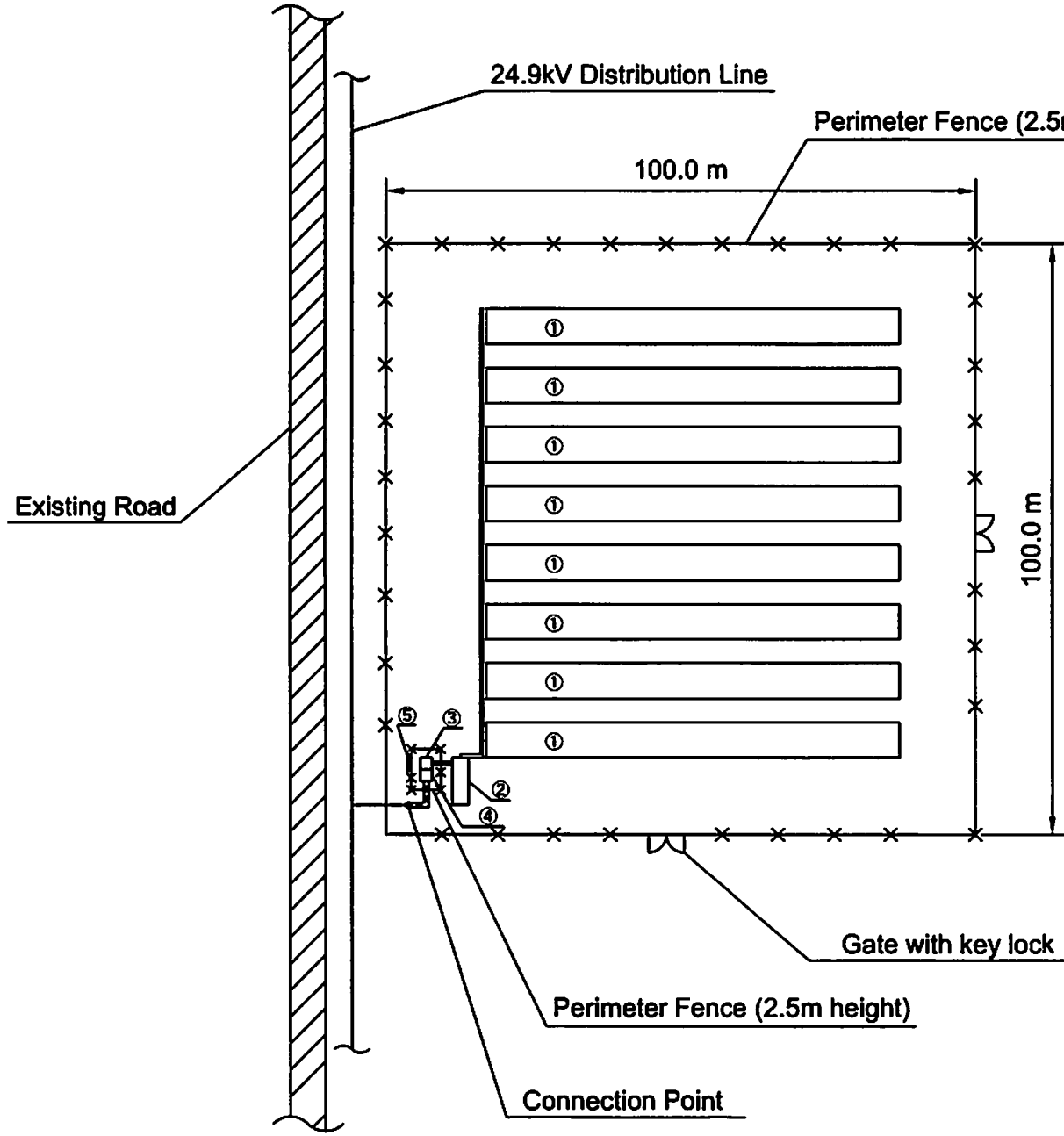


	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE: UNIVERSIDAD MAYOR DE SAN ANDRÉS LAYOUT DRAWING OF PV SYSTEM(50kW)	DRAW. NO.: BO-E-101	PREPARED BY: K.YAZAWA CHECKED BY: H.EGAWA APPROVED BY: T.KOBAYASHI DATE: 2013.4.1	NIPPON KOEI CO., LTD

For Explanation Purpose Only

6/13

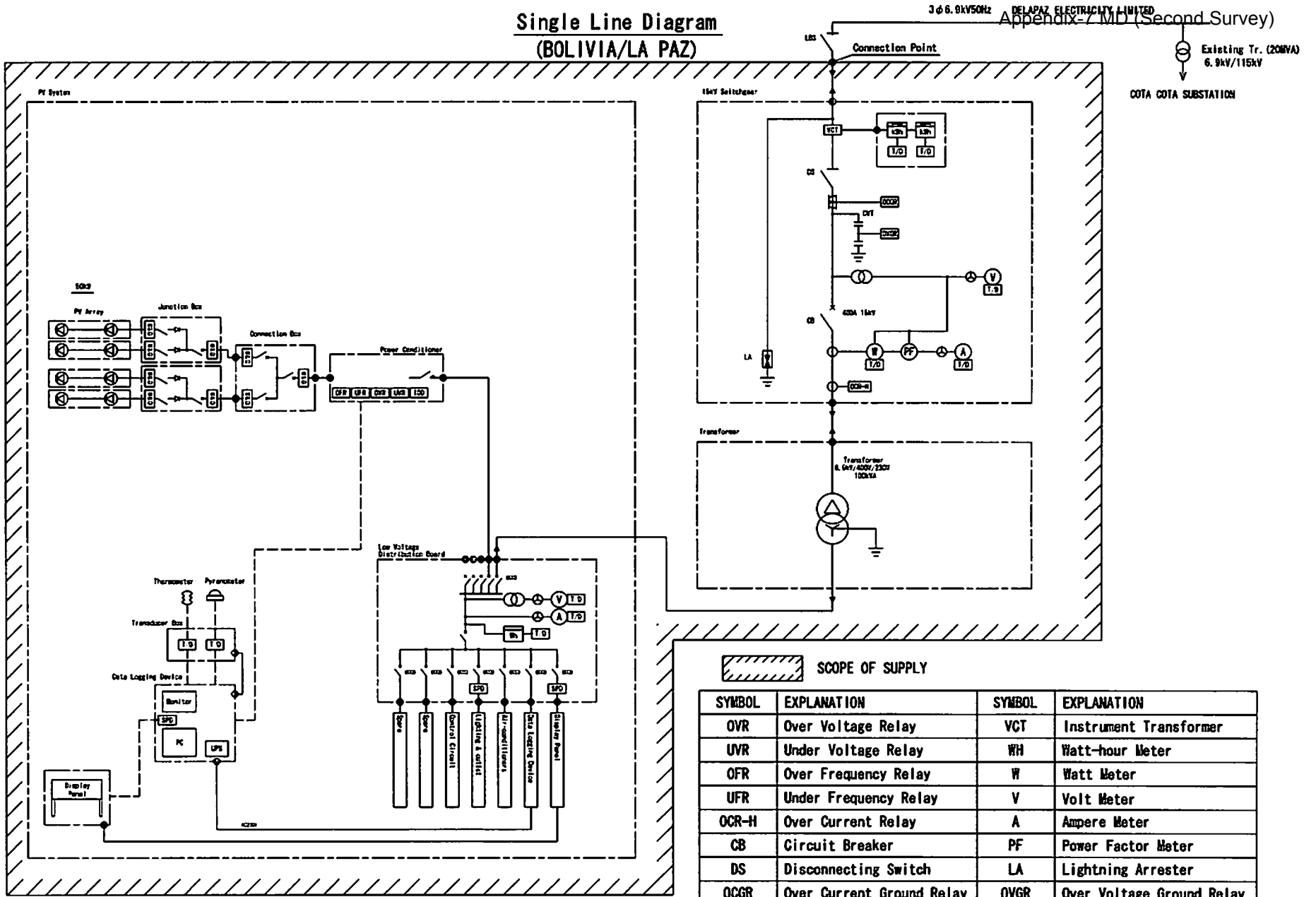
①	PV Array 400kW (50kWx8)
②	Control House
③	Transformer 500kVA
④	High Voltage Cubicle
⑤	Display Panel
	24.9kV Power Cable
	Cable Route for Display Panel



For Reference

	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA
		AEROPUERTO INTERNACIONAL VIRU VIRU LAYOUT DRAWING OF PV SYSTEM(400kW)	BO-E-201	CHECKED BY	H.EGAWA
				APPROVED BY	T.KOBAYASHI
				DATE	2013.4.1
					NIPPON KOEI CO., LTD.

Single Line Diagram
(BOLIVIA/LA PAZ)



SCOPE OF SUPPLY

SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
OVR	Over Voltage Relay	VCT	Instrument Transformer
UVR	Under Voltage Relay	WH	Watt-hour Meter
OFR	Over Frequency Relay	W	Watt Meter
UFR	Under Frequency Relay	V	Volt Meter
OCR-H	Over Current Relay	A	Ampere Meter
CB	Circuit Breaker	PF	Power Factor Meter
DS	Disconnecting Switch	LA	Lightning Arrester
OCGR	Over Current Ground Relay	OVGR	Over Voltage Ground Relay
IOD	Islanding Oper. Detector	LBS	Load Break Switch
T/D	Transducer	SPD	Surge Protection Device

For Reference

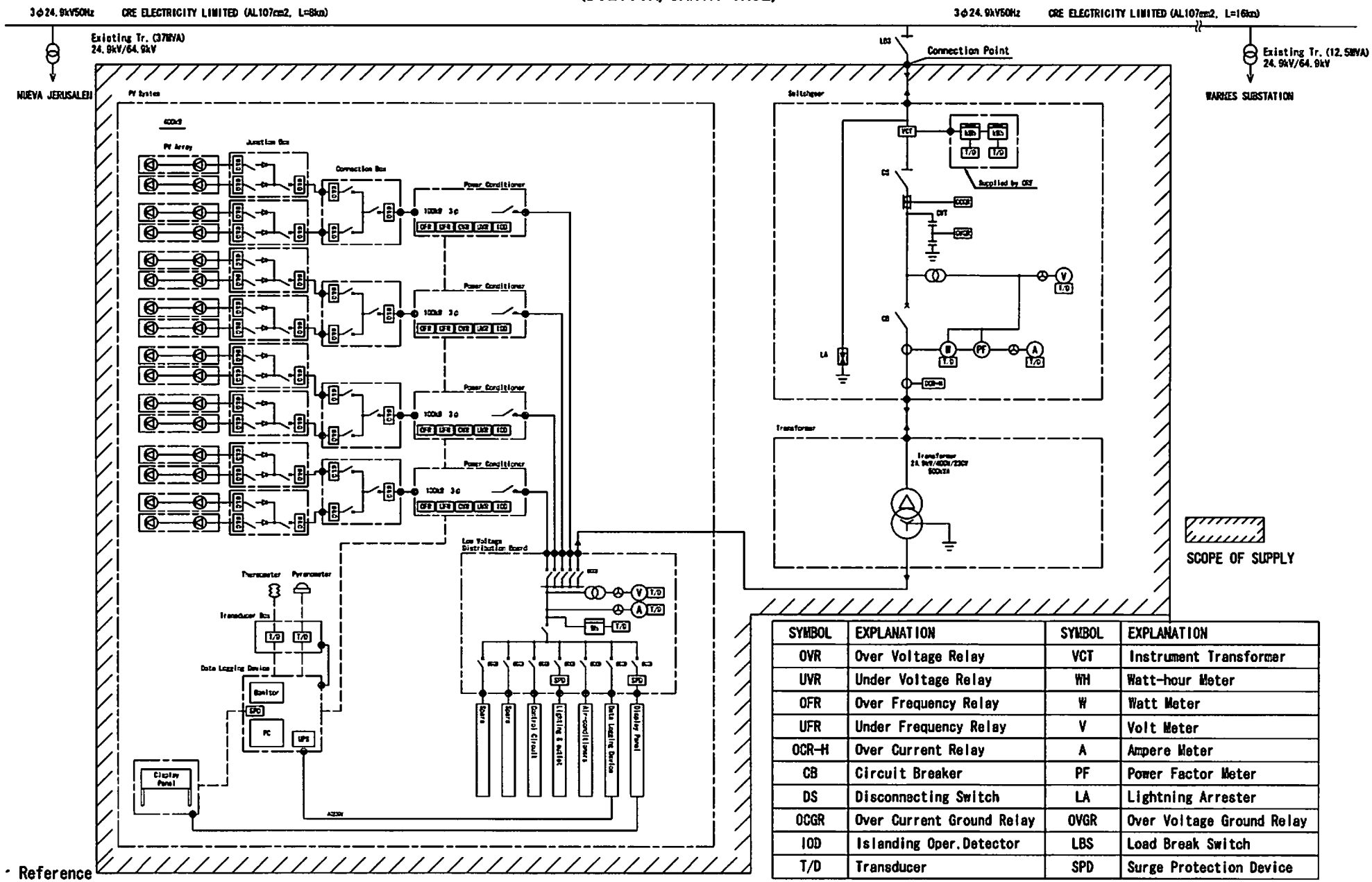
For Explanation Purpose Only

7/13

	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE: UNIVERSIDAD MAYOR DE SAN ANDRÉS SINGLE LINE DIAGRAM	DRAW. NO.: BO-E-102	PREPARED BY: K.YAZAWA CHECKED BY: H.EGAWA APPROVED BY: T.KOBAYASHI DATE: 2013.4.1	NIPPON KOEI CO., LTD.

For Explanation Purpose Only

Single Line Diagram
(BOLIVIA/SANTA CRUZ)



SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
OVR	Over Voltage Relay	VCT	Instrument Transformer
UVR	Under Voltage Relay	WH	Watt-hour Meter
OFR	Over Frequency Relay	W	Watt Meter
UFR	Under Frequency Relay	V	Volt Meter
OCR-H	Over Current Relay	A	Ampere Meter
CB	Circuit Breaker	PF	Power Factor Meter
DS	Disconnecting Switch	LA	Lightning Arrester
OCGR	Over Current Ground Relay	OVGR	Over Voltage Ground Relay
IOD	Islanding Oper.Detector	LBS	Load Break Switch
T/D	Transducer	SPD	Surge Protection Device

・ Reference

THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA	NIPPON KOEI CO., LTD.
	AEROPUERTO INTERNACIONAL VIRU VIRU SINGLE LINE DIAGRAM	BO-E-202	CHECKED BY	H.EGAWA	
			APPROVED BY	T.KOBAYASHI	
			DATE	2013.4.1	

(ANNEX-4)

Technical Specification of PV System

1. PV Module

(1) Type : Crystalline

(2) Capacity : Rated capacity of PV module is specified by manufacturer

(3) Performance : The modules supplied are required to be tested at Standard Test Condition (STC). The copy should be supplied with the modules. The following data should be available in the module report.

- maximum power
- open circuit voltage
- short circuit current
- maximum power voltage / current

(STC: Surface temp.:25 degree Celsius, Air mass:1.5, Radiation 1000W/m^2)

2. PV Array

(1) Tilting Angle and Azimuth Direction

: The tilting angle is 20 degrees

: The azimuth direction is the North

(2) Layout

Sufficient number of modules in series and parallel will be used to obtain the required PV array current, voltage and power output. The designed total capacity of the PV array shall be as follows; (after cost estimation, the capacity shall be decided)

(2-1) UMSA Cota CotaCampus: approximate 50 kW

(2-2) Viru Viru International Airport: approximate 400 kW

3. Structure

The support structure of PV array shall be hot dip galvanized steel. The bolts and nuts for the support structure shall be stainless steel. The structure must be designed to withstand wind speed at 30 meters per second.

4. Junction Box

(1) A diode for reverse power protection shall be provided for each DC input circuit.

(2) The protection system for induced lightning shall be provided in the junction box.

(3) The box shall be both waterproof and dustproof

5. Power Conditioner

(1) Capacity : UMSA site (50 kW), Viru Viru International Airport Site (400 kW)

(2) DC Input : Specified by manufacturer.

(3) AC Output : AC 400V

(4) Power Factor : Over 85%

(5) Conversion Efficiency : Over 90%

(6) Protection System

The protection system must be provided the following functions.

> Monitoring function of voltage and frequency

> Control function of output voltage

> Islanding operation prevent function

> Control function of automatic voltage

(7) Protection Device

The protection device must be provided the following relays.

> Over Voltage Relay (OVR), Under Voltage Relay (UVR)

> Under Frequency Relay (UFR), Over Frequency Relay (OFR)

6. Medium Voltage Switchgears

Nominal grid-connection voltages are as follows:

(3-1) UMSA Cota Cota Campus: 6.9 kV

(3-2) Viru Viru International Airport: 24.9 kV

7. Power Transformers

Nominal Voltage and capacity of power transformers are as follows:

(3-1) UMSA Cota Cota Campus: 6.9 /400-230 V, 100 kVA

(3-2) Viru Viru International Airport: 24.9 / 400-230 V, 500 kVA or 540 kVA

8. Data Logging System

(1) Personal Computer

Monitor, Hard disk, Data logger, UPS

(2) Meteorological data

Solar irradiation, Ambient temperature

(3) System data

Power output (kW), DC current / voltage, AC current / voltage

9. Display Panel

Display Indication: Power output (kW), Solar irradiation (kW/m^2), Temperature (degree

Celsius), Solar power generation (kWh/day, kWh/month) and CO_2 gas emission deduction (kg-CO_2/day)

(ANNEX-5)

Minutes of Meeting
Confirmation of Technical Matters
Grid-connection of PV System
(Delapaz)

(ANNEX-5)

Minutes of Meeting
Confirmation of Technical Matters
Grid-connection of PV System in UMSA

1. Preamble

50 kW Photovoltaic generating system will be connected to the 6.9 kV distribution overhead line of Delapaz. The following items were confirmed with Delapaz for preparation of technical specifications for grid-connection of PV system. The technical specifications for the 50 kW PV system Project provided by Nippon Koei (NK), NK explained the Project of JICA as Inception report.

2. Attendance and Date

Mar.28,2013 at Delapaz

Delapaz: Ing. Orlando Perez
Ing. Ricardo Zambrana
Ing. Sergio Bustillos

NK: Ing. K. Fujita
Ing. Y. Suezawa
Ing. K. Yazawa
Ing. S. Nin

3. Subject for discussion and results

The results of discussion are as follows.

3.1 The date of grid-connection

Please refer to attached implementation schedule.

3.2 Standards

Following standard will be applied;

JIS (Japanese Industrial Standards)
IEC (International Electrotechnical Commission)

3.3 Connection Points

The PV generating system will be connected to 6.9 kV distribution line (D/L) of Delapaz as follows:

(1) 50 kW power from PV system will be connected to 6.9 kV D/L
(2) 6.9 kV D/L is feeded from 20 MVA transformer in Cota Cota substation. Pole mounted

with 3 monopole load break switch will be provided by Delapaz and 15kV cable from PV system will be connected to 3 monopole load break switch by the Project of JICA as the connection point.

3.4 Single Line Diagram

Single line diagram is designed and specified by NK.

Protection system is included in the power conditioner and the outdoor type closed cubicle for medium voltage switchgear which is including circuit breaker, disconnecting switch, lightning arrester, PT, CT, measuring equipment and protection relays, etc.

3.5 Stability and Quality of Grid of Delapaz

Fluctuation range of V, F, Pf, etc. at the connected points will be designed as follows:

(1) Fluctuation range of voltage : ±7.5% at 6.9 kV

(2) Fluctuation range of frequency : ±0.25 Hz at 50 Hz (49.1 Hz for load shedding)

(3) Power factor : more than 85 %

(4) High Harmonic distortion:

Total current distortion rate is 5% or less

Each current distortion rate is 3% or less

(5) Short circuit current : 12.5 kA at 6.9 kV

3.6 Protection devices for Grid-interconnection

The following protection devices will be provided under this Project for both accident/trouble of PV system side.

(1) Protection for PV generating system:

OVR (Over Voltage Relay), UVR (Under Voltage Relay)

(2) Protection for Grid side:

OFR (Over Frequency Relay), UFR (Under Frequency Relay)

3.7 Countermeasure for isolated operation of PV system

The following countermeasures when the failure of Grid system will be considered for reliability and security of PV system. Basically PV system has no isolated operation.

When any abnormality is detected in the system by protection relays, PV generating system shall be separated from the Grid and manually reconnected.

3.8 The following data/specifications supplied as CD-R by Delapaz.

(1) Watt-hour meter of 0.5 class for dealing including memory

(2) 15 kV Power cable

(3) Circuit breaker, etc

(4) Short circuit current at connection point

(5) Test items for commissioning before interconnected

3.9 Transformer of 100 kVA

(1) Altitude: 3,700 m (note: Standard of Delapaz is 4,000m)

(2) Temperature: −15 to 40 deg. C

(3) Type : Outdoor, ONAN

(4) Ratings : 50Hz, 6.9 kV/400-230 V,

It is noted that the winding for 6.9 kV shall has delta-connection and taps are 7,245-7,072-6,900-6,727-6,555 V

(5) Connection Group: Dyn

Primary side: Dyn 6.9 kV Delta-connection

Secondary side: 400 - 230V: Y - connection & Neutral ground

(6) Withstand impulse voltage:

Primary side: 1.2x50 μsec, 95 kV for 6.9 kV.

Secondary side: 30 kV for 400-230 V

(7) Withstand voltage 50 Hz:

6.9 kV: 38 kV one min., 400-230 V: 10 kV one min.

3.10 Grounding resistance

(1) Transformer neutral: less than 10 Ω

(2) PV mounting structure, cubicle: less than 100 Ω

(3) Others: less than 100 Ω

3.11 Phase arrangement: IEC

R – S – T – N : from left to right, from top to bottom, from front to back for AC

N – P : from left to right, P-N from top to bottom, front to back for DC

3.12 Commissioning test before grid-connection

Test items will be informed from Delapaz .

3.13 Power Consumption of the Electro Mechanical Institution (PV generation Site)

(1) Power consumption based on a typical one-day curve, which is 24 hours by x-axis and consumption (kW or kWh) by y-axis.

(2) Power consumption: Maximum is 14kW and Minimum is 2kW.

(Above two data is shown in the file "23) Puesto 100 kVA Cia 9562 Trifasico Cota Cota")

3.14 Power Consumption of the Hydraulic Institute building

Power consumption: Maximum is 47kW and Minimum is 18kW.

3.15 ACHUMANI&UMSA feeders at Cota Cota Substation

(1) Electrical energy based on a typical one-day curve, which is 24 hours by x-axis and consumption (kW or kWh) by y-axis.
(Data is shown in the file "3) Alimentador Achumani A02 marzo 2012- marzo 2013")

(2) Set Points of the CB: Over current, ground faults
Set points of 51, 51N and 67N are included in the file "29) OVERCURRENT PROTECTION"

(3) Total length of the power line.
It is shown in the file "24) Salida alin A02 UMSA and 27) ubic_pstoA02017

(4) Specification of the power-line wires
It is shown in the file "8) FT- LB 020 Cable multifilar flexible de BT V2"

3.16 Substation data

(1) Set point of the under voltage (27) is shown on the file of "31) Under Voltage protection

(2) Set point of the under frequency (81) is shown in the file of "30) UNDER FREQUENCY PROTECTION LOAD SHEDDING"

3.17 The type of the Watthour Meter

Watthour Meter shall be supplied by Customer, so a type of Watthour Meter will be discussed on the engineering stage.

3.18 Schedule of changing the line voltage up

Line voltage up from 6.9kV to 12kV is under proceeding in the DeLapaz, however The schedule of the Cota Cota Substation area does not decide.

4. Documents and drawings from DeLapaz

(1) AE Reglamento de Calidad DS 26607
(2) AE Reglamento de Servicio Público de Electricidad DS 26302
(3) Alimentador Achumani A02 marzo 2012- marzo 2013
(4) Alimentador Achumani con potencia A02 abril - dic 2012
(5) Alimentador Achumani con potencias A02 enero - marzo 2013
(6) Datos Transformador LT 107 SE Cota Cota
(7) EDAC_2013_1T
(8) FT- LB 020 Cable multifilar flexible de BT V2
(9) FT- LM 011 Cuchilla Seccionadora 15kV V2
(10) FT- LM 030 Cable de Cobre Aislado - Tripolar Clase 15kV V2
(11) Lectura 24 horas Puesto Laboratorio Hidraulica UMSA 3035T

(12) Ley 1604 de Electricidad

(13) MTD 2.03.02 Puesta a Tierra del Sistema de Baja Tensión de ELECTROPAZ

(14) MTD 2.03.03 Medición de Sistemas de Puesta a Tierra

(15) NE 42.02.01 Medidores Electrónicos Trifásicos sin Memoria Masiva para Medida de Energía Eléctrica

(16) NE 42.02.02 Medidores Electrónicos con Memoria Masiva para Medida de Energía Eléctrica

(17) NE 72.30.01 Transformadores trifásicos sumergidos en aceite para distribución en BT V2

(18) NE 72.54.01 Transformadores de Potencial para Medida en Media Tensión

(19) NE 72.58.01 Transformadores de Corriente para Medida en Baja Tensión

(20) NE 72.58.02 Transformadores de Corriente para Medida en Media Tensión

(21) NE 75.30.01 Pararrayos de óxido metálico con envolvente polimerica hasta 25kV

(22) Proyecto JICA

(23) Puesto 100 kVA Cia 9562 Trifasico Cota Cota

(24) Salida alin A02 UMSA

(25) SSDE_162-01

(26) subestacion Cota cota

(27) ubic_pstoA02017

(28) valores de cortocircuito UMSA v1

(29) OVERCURRENT PROTECTION

(30) UNDER FREQUENCY PROTECTION LOAD SHEDDING

(31) UNDER VOLTAGE PROTECTION

5. Attachment

Single Line Diagram

The above are confirmed by NK and Delapaz on Mar.Feb.28,2013 and Mar. 28,2013

NK: Y. Suezawa , K. Fujita, :

Delapaz :Ing. Orlando Perez R

Lapaz, April 10th, 2013

Ing. Orlando Perez Rasguido
DELAPAZ

Toshiaki KOBAYASHI
Nippon Koei Co., Ltd.

(ANNEX-5)

Minutes of Meeting
Confirmation of Technical Matters
Grid-connection of PV System
(CRE)

(ANNEX-5)

Minutes of Meeting
Confirmation of Technical Matters
Grid-interconnection of PV System
(SANTA CRUZ)

1. **Preamble**

Photovoltaic generating system will be interconnected to the 24.9 kV distribution line of CRY grid network. The following items were confirmed with CRY for preparation of technical specifications for grid-interconnection of PV (Photovoltaic Power Generation) system. The technical specifications for the Contract of PV system Project will be provided by Nippon Koei (NK). NK will explain the Project of JICA as per attached sheet inception report.

2. **Attendance and Date** : Feb.18 2013 and April 04, 2013 at CRY office

CRE : Mario Rojas Sensano:Regulatory Manager,

NK : Y. Kobayashi, T. Dei, K.Yazawa, K.Fujita, Y. Suezawa, Nin

3. Subject for discussion and results

The results are added after above discussion.

3.1 Connection Points

The PV generating system will be connected to 24.9kV distribution line (D/L) of CRE as follows:

(1) Approx.400 kW power from PV system will be connected to 24.9 kV D/L

(2) 24.9 kV D/L of Jerusalem substation is always fed from 28/37 MVA transformer.

24.9 kV D/L of Warnes substation is supplied power by stand-by when Jerusalem substation shall shut down, etc.

(3) Pole mounted with load break switch will be provided by CRE and 24.9kV cable from PV system will be connected to load break switch by the Project of JICA as the connection point.

Please refer Attachment Single line diagram.

3.2 Standards:

JIS (Japanese Industrial Standards)

IEC (International Electrotechnical Commission)

3.3 Single Line Diagram

Single line diagram prepared by NK attached will be designed and specified. Protection system including CB, DS, PT, CT, relays, etc. enclosed in outdoor cubicle as mentioned on the single line diagram will be provided under this Project of JICA.

3.4 Stability and Quality of Grid of CRE.

Fluctuation range of V, F, Pf, etc. at the interconnected points will be designed as follows:

(1) Fluctuation range of voltage : ±5.0 % at 24.9 kV(regulated by CNDC)

(2) Fluctuation range of frequency : ± 0.8~ ± 1.4 Hz at 50 Hz(as citizen consumer)

(3) Power factor : more than 90 %peak period (operation standard by CNDC)

(4) High harmonic distortion: (IEC standard)

Total current distortion rate is 5% or less

Each current distortion rate is 3% or less

(5) Short circuit current: about 6kA at 24.9 kV (CRE substation)

3.5 Protection devices for Grid-interconnection (Regulation in Japan)

The following protection devices will be provided under this Project for both accident/trouble of PV system side and Grid side.

(1) Protection for PV generating system:

OVR (over voltage relay), UVR (under voltage relay)

(2) Protection for Grid side:

OFR (over frequency relay), UFR (under frequency relay)

3.6 Countermeasure for isolated operation of PV system

The following countermeasures when the failure of Grid system will be considered for reliability and security of PV system. Basically PV system has no isolated operation.

When any abnormality is detected in the system by protection relays, PV generating system shall be separated from the Grid by Isolated Operation Detector(IOD).

3.7 The following data/specifications supplied by CRE

Watt-hour meter of 0.5 class for dealing including memory

(1) 24.9 kV Power wire/cable

(2) CB, etc

(3) Short circuit current at connection point

(4) Test items for commissioning before interconnected

3.8 Transformers of 24.9kV medium voltage by JICA project (Altitude: about 600m)

(1) Temperature : −10℃ to 40℃

(2) Type : Outdoor, ONAN

(3) Ratings : 50Hz, 24.9kV/400-230V,

(4) Connection Group : Dyn

Primary side: Dyn 24.9kV Delta-connection

Secondary side : 400-230V: Y-connection & Neutral ground

(5) Withstand impulse voltage(LIWV) :

Primary side : 1.2x50μsec, 125kV for 24.9kV

Secondary side : 30kV for 400-230V

(6) Withstand voltage 50Hz (for local test)

24.9 kV : 38kV one min.,

400-230V : 10kV one min.

3.9 Grounding resistance

(1) Transformer neutral : less than 10 Ω

(2) PV mounting structure, cubicle : less than 100Ω

(3) Others : less than 100Ω

3.10 Phase arrangement: IEC

R – S – T – N : from left to right, from top to bottom, from front to back for AC

N – P : from left to right, P-N from top to bottom, front to back for DC

3.11 Commissioning test before interconnection

Test items will be informed letter from CRE

****

Attendance and Date : April 04, 2013 at CRY office

3.12 One line diagram

NK received both one line diagram of the Nueva Jerusalen and Warnes Substation (SS)

Note) 1) Normally the feeder of the 7-13 CELDA 6 of New Jervsalen SS wil supplies to the grid-connection line with PV generator in the Viru Viru Airport.

2) The feeder of the A12-21 of Warnes SS CELDA 4B is back up for 7-13.

3.12 Set point of a under voltage and under frequency of the bus at the Substation.

CRE will inform them later to us.

3.13 Data of the feeder

1) CRE informed us of electric energy based on typical monthly curve, which was days by x-axis and consumption (kW) by y-axis.

2) Data of the CB:

Short circuit current of the feeder is shown on the clause 3.5 (5)

3) Set value of the CB

Over current,

ground protection (phase(s) and zero-phase) and if any

CRE will inform it later to us.

3.14 Specification of the overhead aluminum conductor and concrete pole and total length of the line for the feeder

Overhead aluminum conductor is 4/0.

Total length of the line from new Jerusalen SS to PV Site is about 8km, and PV site to Warnes SS is about 16km.

3.15 The type of the Watthour Meter

If CRE supply a Watthour meter, please inform a type and catalogue.

This item is hold, because CRE does not decide which CRE supplies or Customer supplies?

4. Drawings supplied by NK

Single Line Diagram of the sample of the Grid-Connection

Layout Drawing of PV System

5. Documents and drawing supplied by CRE

Detail information is showa on the file "NIPPON KOEI-respuesta" informed by CRE.

Note: Information on point 3.4 will be confirmed later by CRE.

Santa Cruz 04, de abril de 2013

Mario Rojas Sensano
por CRE

Toshiaki KOBAYASHI
por NIPPON KOEI

Minuta de Discusiones

sobre el Estudio Preparatorio para "El Proyecto para Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar" en el Estado Plurinacional de Bolivia

(Explicación sobre el borrador del informe final)

La Paz, 24 de Julio de 2013

Chikahiro MASUDA
Jefe del Equipo
Equipo de Estudio Preparatorio
Agencia de Cooperación Internacional del Japón

Viviana Caro Hinojosa
Ministra de Planificación del Desarrollo
Estado Plurinacional de Bolivia

Almte. Raúl Viscarra Escobar
Viceministro de Transportes
Ministerio de Obras Públicas, Servicios y Vivienda
Estado Plurinacional de Bolivia

Hortensia Jiménez Rivera
Viceministra de Electricidad y
Energías Alternativas
Ministerio de Hidrocarburos y Energía
Estado Plurinacional de Bolivia

Cnl. DAEN Raúl Velasco Ramos
Director Ejecutivo
Administración de Aeropuertos y Servicios
Auxiliares a la Navegación Aérea (AASANA)
Estado Plurinacional de Bolivia

Fátima Consuelo Dolz de Moreno
Rectora de la Universidad Mayor de San
Andrés a.i.
Estado Plurinacional de Bolivia

En julio del 2013, la Agencia de Cooperación Internacional del Japón (en adelante denominada "JICA") envió una Misión al Estado Plurinacional de Bolivia (en adelante denominada "Bolivia") para realizar el Estudio Preparatorio para el Proyecto para Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar en Bolivia (en adelante denominado "el Proyecto") y mediante las conversaciones, estudios en Bolivia y el examen técnico de los resultados de la investigación en Japón, JICA preparó un Borrador del Informe Final del Estudio Preparatorio.

Con el fin de explicar y consultar con las autoridades correspondientes del Gobierno de Bolivia sobre el contenido del Borrador del Informe Final, JICA envió a Bolivia la Misión del Estudio Preparatorio (en adelante denominada "la Misión"), la cual está encabezada por el Sr. Chikahiro MASUDA, Director de la División de Planificación y Coordinación, Departamento de Desarrollo Industrial y Políticas Públicas de JICA Casa Matriz, desde el 17 al 25 de Julio del 2013.

Como resultado de las conversaciones, ambas partes han confirmado los principales puntos descritos en el Documento Adjunto.

DOCUMENTO ADJUNTO

1. Contenido del Borrador del Informe Final

El Ministerio de Hidrocarburos y Energía como Entidad Responsable (en adelante denominada "MHE"), la Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea (en adelante denominado "AASANA") y la Universidad Mayor de San Andrés (en adelante denominado "UMSA") como Entidades Ejecutoras han acordado y aceptado el contenido del Borrador del Informe Final explicado por la Misión.

2. Sistema de Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático del Gobierno de Japón

MHE, UMSA y AASANA (en adelante denominados "la parte boliviana") confirmaron que el contenido de la Minuta de Discusiones firmada el 1 de Marzo de 2013 (en adelante denominada "la M/D anterior") sigue siendo vigente y tomarán las medidas necesarias consensuadas en la M/D anterior para la correcta implementación del Proyecto, de acuerdo al procedimiento de la Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático del Gobierno del Japón, señalado en el ANEXO 1.

3. Avances respecto a la M/D anterior

3.1 Lugar del Proyecto y la capacidad del Sistema Fotovoltaico

Ambas partes confirmaron que los sitios para la implementación del Proyecto estarán dentro del Campus Cota Cota de la UMSA en La Paz y del Aeropuerto Internacional de Viru Viru en Santa Cruz. También confirmaron que las capacidades del Sistema Fotovoltaico (en adelante denominado "Sistema FV") son de 50kW en la UMSA y de 315kW en el Aeropuerto Internacional de Viru Viru.

4. Ítems de equipamiento que serán adquiridos

La Misión explicó que los ítems de equipamiento detallados en el ANEXO 2, serán adquiridos conforme al resultado del Estudio Preparatorio realizado desde Mayo del 2013.

5. Proceso de adquisiciones del Proyecto

Ambas partes reconfirmaron que el proceso de adquisición será supervisado por el Agente de Adquisiciones llamado Crown Agents (en adelante denominada "el Agente") con la consulta respectiva al Comité Consultivo (en adelante denominado "el Comité"). Asimismo, ambas

partes confirmaron las tareas del Agente mencionadas abajo.

(1) El Agente ofrecerá los servicios estipulados en los artículos del Canje de Notas (en adelante denominado "C/N") y Acuerdo de Donación (en adelante denominado "A/D").
(2) El Agente se encargará de los procedimientos necesarios de adquisiciones para el Proyecto, de acuerdo a los artículos de C/N, A/D y otras guías relacionadas.
(3) JICA suministrará el Borrador del Informe Final y el Informe Final al Agente.
(4) El Agente iniciará la adquisición de acuerdo al contenido del Informe Final.

La Misión ha explicado que si el precio de licitación sobrepasa lo acordado en el C/N y A/D, se disminuirá la cantidad de ítems de equipamiento hasta que el costo del Proyecto se reduzca al monto acordado en el C/N y A/D, y la parte boliviana lo acordó.

La parte boliviana acordó que si existe excedente en el monto del Proyecto después de la licitación, se adquirirían ítems adicionales para el equipamiento. La decisión para aumentar o reducir adquisición del equipamiento será definida con la consulta respectiva a los miembros del Comité Consultivo.

Ambas partes acordaron que la UMSA y AASANA como entidades ejecutoras, firmarían conjuntamente el Acuerdo de Agente (en adelante denominado "A/A") con el Agente,, hasta el fin de agosto de 2013.

6. Costo del Proyecto

La parte boliviana acordó que el costo del Proyecto no debería sobrepasar el límite del monto acordado en el C/N. Asimismo, ambas partes están de acuerdo que el costo total del Proyecto incluye los costos mencionados abajo.

- El costo de la adquisición de equipamiento
- El costo del transporte hasta el sitio del Proyecto
- El costo de la instalación
- Los honorarios del Agente
- El costo de la supervisión técnica de servicio de consultoría (en adelante denominado "el Consultor")
- El costo de la asistencia técnica tanto de operación como mantenimiento del equipamiento (en adelante denominado "Asistencia Técnica")

Asimismo, en cuanto al costo del Proyecto, este se encuentra definido debido a la suscripción del C/N y A/D. Al respecto, la parte boliviana acordó que serían necesarias las siguientes consideraciones y atenciones.

(1) De presentarse infraestructuras necesarias adicionales como resultado de la presente discusión, existe la posibilidad de reducir la capacidad de generación eléctrica del Aeropuerto Internacional de Viru Viru.

(2) Si el resultado de la estimación de costo supera el costo del Proyecto, existe la posibilidad de reducir la capacidad de generación eléctrica del Aeropuerto Internacional de Viru Viru.

(3) Si el precio de licitación es menor al precio planificado, se atenderá la situación incrementando la capacidad de generación eléctrica del Aeropuerto Internacional de Viru Viru.

(4) En este caso de cooperación, se maneja un sistema que ejecuta la totalidad del monto suscrito. Por lo tanto, se confirmará la metodología de uso final de aquellos montos residuales en el Comité Consultivo.

7. Confidencialidad del Proyecto

(1) Especificaciones detalladas de los equipamientos a ser instalados

Ambas partes confirmaron que toda la información relacionada con el Proyecto (diseños, especificaciones, el equipamiento, información técnica, etc. de los equipamientos a ser instalados) no deben ser divulgados por ninguna de las partes (JICA, la parte boliviana, y el Agente) antes de la conclusión de los siguientes contratos especificados para el Proyecto.

1) Contrato entre el Agente y el Proveedor para adquisición del equipamiento
2) Contrato entre el Agente y el Consultor para el diseño detallado, supervisión y Asistencia Técnica

(2) Confidencialidad de la estimación del costo

La Misión explicó sobre la estimación del costo del Proyecto. Ambas partes acordaron que el costo estimado detallado del Proyecto no debe ser publicado o divulgado por ninguna de las partes (JICA, la parte boliviana y el Agente) hasta la adjudicación de la licitación. La parte boliviana acordó que el costo estimado del Proyecto es preliminar y está sujeto a cambios según el resultado de la revisión del Informe Final.

8. El Comité Consultivo

La parte boliviana ha entendido que el MHE en su calidad de Presidente del Comité, fomentará las discusiones y procesos en casos donde surjan modificaciones en el alcance de las

adquisiciones, a causa de factores descritos en el punto 6 de la presente M/D. Los aspectos referenciales del Comité están citados en el ANEXO 8 de la M/D anterior.

Los miembros del Comité son los siguientes.

(1) Autoridad Representativa del MHE (presidente)
(2) Autoridad Representativa de AASANA
(3) Autoridad Representativa de la UMSA
(4) Representante de JICA
(5) El Agente

La primera reunión del Comité se llevará a cabo después de la firma de contrato entre el Agente y el Consultor. Las reuniones posteriores se realizarán a pedido de la parte boliviana o de JICA. El Agente podrá convocar al Comité con ambas partes según las necesidades.

9. Otros asuntos relevantes

9.1. Obligaciones del país receptor

La parte boliviana aceptó las obligaciones descritas en el M/D anterior y en el ANEXO 3 de la presente M/D.

(1) Uso del terreno para el Sistema FV

UMSA y AASANA son propietarios de los terrenos dentro del Campus Cota Cota de UMSA y del Aeropuerto Internacional de Viru Viru para la instalación de los equipamientos del Sistema FV que están citados en el ANEXO 2. UMSA y AASANA no necesitan realizar gestiones para obtener legítima posesión del Sitio del Proyecto, por tanto, la parte boliviana reconfirmó que no existe objeción a la implementación del Proyecto.

Respecto a las obligaciones de la parte boliviana adjuntas en la M/D, se confirmó que los siguientes trabajos con influencia directa en la obra, deben iniciarse bajo responsabilidad de la parte boliviana, luego de definirse la empresa constructora y completarse el diseño.

1) Preparación del terreno del lugar planificado de construcción
2) Instalación de vallas temporales
3) Instalación de vías de acceso temporales
4) Canales de drenaje externo del lugar planificado de construcción
5) Alimentación de agua al lugar planificado de construcción
6) Fuente temporal de energía eléctrica

7) Remoción y traslado de estructuras enterradas
8) Remoción de otros obstáculos

(2) Generación de Electricidad por el Sistema FV

La parte boliviana, la UMSA y AASANA gestionaran ante autoridad competente el registro –que corresponda para la generación de energía eléctrica a través de sistemas FV, hasta antes de iniciar las pruebas de entrega en octubre del 2014. (Esto bebido a que la premisa de la prueba de entrega, es la conexión al sistema eléctrico). Luego de recibir la aprobación de la Autoridad Competente, es necesario que la UMSA con la Empresa Distribuidora de La Paz (en adelante denominada DELAPAZ), y AASANA con la Cooperativa Rural de Electrificación (en adelante denominada CRE), suscriban respectivamente los contratos de compra/venta de energía eléctrica y sistema de mantenimiento/administración de equipos de alta tensión hasta diciembre de 2014.

(3) Consideraciones medioambientales y sociales

La parte boliviana confirmó que UMSA y AASANA cumplieron con todos los requisitos establecidos en la norma ambiental, antes de la entrega del Informe Final.

(4) Aplicación de las leyes y regulaciones relacionadas

La parte boliviana acordó que el diseño estructural de la instalación del Sistema FV se realizará de acuerdo con la regulación arquitectónica tanto del Japón como de Bolivia.

El diseño eléctrico para el Sistema FV interconectado a la red debe concordar con los parámetros definidos por JIS/IEC.

La parte boliviana acordó que UMSA y AASANA serán responsables en la aplicación de las leyes y regulaciones relacionadas para la operación del Sistema FV al igual que la interconexión con las líneas de distribución antes de la realización del Proyecto.

(5) Aduana y Exención de impuestos

La UMSA y AASANA acordaron tomar respectivamente las medidas necesarias para la exención de aranceles aduaneros sobre los equipos a entregarse, así como las medidas presupuestarias para la devolución del IVA. Los equipos tienen previsto arribar a Bolivia 6 meses después de la suscripción del contrato de adquisición de equipos (aprox. febrero de 2014),

por lo que las gestiones para la exención de aranceles aduaneros deben ser implementadas antes de su arribo (aprox. agosto de 2014).

(6) Asignación del personal de contraparte

1) Administración general del proyecto

La parte boliviana asignó a las siguientes personas para la administración general del proyecto y la coordinación dentro cada organización.

MHE: Director(a) General de Energías Alternativas
UMSA: Director(a) de la Carrera de Ingeniería Eléctrica
AASANA: Jefe(a) de la Unidad Nacional de Comunicación, Navegación y Vigilancia

2) Asistencia Técnica (capacitación)

La parte boliviana acordó asignar el personal necesario de acuerdo al plan de Asistencia Técnica propuesto por la Misión. La parte boliviana informará los nombres del personal de contraparte a la Oficina de JICA en Bolivia hasta el 30 de Agosto del 2013.

- Dos funcionarios de MHE
- Dos funcionarios de UMSA
- Personal de DELAPAZ (Por lo menos un funcionario)
- Dos funcionarios de AASANA
- Dos funcionarios de SABSA
- Personal de la Cooperativa Rural de Electrificación (Por lo menos un funcionario)

9.2. Responsabilidad de Propiedad, Operación y Mantenimiento (en adelante denominado "O & M") del equipamiento

La parte boliviana reconfirmó que los propietarios del equipamiento serán la UMSA y AASANA quienes a su vez asumen la responsabilidad de la O & M del mismo.

La parte boliviana mediante la UMSA y AASANA se comprometió a asegurar un presupuesto mínimo de 4.950 dólares americanos (AASANA: 4.250 USD, UMSA: 700 USD) para la O & M del Sistema FV interconectado a la red adquirido e instalado bajo el Proyecto. El personal adecuado y oportuno asignados para la O & M, son personal de planta de la UMSA y AASANA.

La parte boliviana mediante la UMSA y AASANA, necesita acordar con DELAPAZ y CRE la supervisión del sistema interconectado de las líneas de alta tensión de DELAPAZ y CRE de 6.9 kV (DELAPAZ) y 24.9 kV (CRE) con los Sistemas FV dentro del Campus Cota Cota de la UMSA y del Aeropuerto Internacional de Viru Viru. UMSA y AASANA se encargarán de la O

& M de los Sistemas considerando la atención en caso de generarse un accidente en la línea de media tensión o sistema FV.

DELAPAZ planifica incrementar la tensión del suministro eléctrico de 6.9 kV a 12 kV. De darse dicho incremento a 12 kV, la UMSA, en coordinación con DELAPAZ considerará las medidas adecuadas como el reemplazo de transformadores y otros equipos descritos en el ANEXO 2, de manera que permita una operación continua del Sistema FV. Para tal fin, el MHE brindará el apoyo necesario para que las discusiones entre la UMSA y DELAPAZ deriven en acuerdos sin demoras. .

Los ítems de obligaciones de la parte boliviana, contenidos a implementar y sus entidades ejecutoras, son descritos en el ANEXO 3.

9.3 Del régimen administrativo del Aeropuerto Internacional de Viru Viru

El régimen administrativo del Aeropuerto Internacional Viru Viru, se realizará en el marco del Contrato de Concesión de Aeropuertos vigente, suscrito entre SABSA y AASANA. Los trabajos previstos a realizarse por AASANA, o SABSA bajo supervisión de AASANA, son las siguientes:

(1) Construcción de vías de acceso, preparación del terreno, instalación de vallas temporales, instalación de canales de drenaje
(2) Operación, mantenimiento y administración
(3) Participación a la Asistencia Técnica (Selección de candidatos a participar)

9.4 Plan de ampliación o construcción de las edificaciones del Campus Cota Cota de la UMSA y del Aeropuerto Internacional de Viru Viru alrededor del área de implementación de los equipos

Ambas partes confirmaron que en caso de existir algún plan de ampliación o de construcción de edificaciones dentro del Campus Cota Cota de la UMSA, del Aeropuerto Internacional de Viru Viru y/o alrededor del área de implementación de los paneles, estos no deberán generar sombras sobre los Sistemas FV, debido a que se imposibilitaría la generación eléctrica.

9.5 Borrador del Informe Final y Documentos de Licitación

JICA solicitó a la parte boliviana analizar el Borrador del Informe Final y los documentos de licitación entregados. En caso de existir, temas adicionales a incluir, la parte boliviana comprometió enviarlos a la Oficina de JICA en Bolivia hasta el 9 de agosto de 2013.

(Lista de Anexos)

ANEXO-1 Sistema de Cooperación Financiera No Rembolsable para el Medio Ambiente y Cambio Climático del Gobierno de Japón

ANEXO-2 Lista de equipamiento

ANEXO-3 Obligaciones principales que debe realizar la parte boliviana

ANEXO-4 Cronograma de Implementación

ANEXO-1

Sistema de Cooperación Financiera No Reembolsable
para el Medio Ambiente y Cambio Climático
del Gobierno de Japón

El Gobierno del Japón (en adelante denominado "GdJ") realiza la reforma organizacional para mejorar la calidad de operaciones de la Asistencia Oficial para el Desarrollo (AOD). Como una parte de este reajuste, una nueva ley de JICA entró en vigencia el 1 de octubre de 2008. Sobre la base de la ley y la decisión de GdJ, JICA llegó a ser la agencia ejecutora de los programas de la Cooperación Financiera No Reembolsable para el Medio Ambiente y Cambio Climático (en adelante denominado "CFMAC").

La Cooperación Financiera No Reembolsable es el fondo no reembolsable a un país receptor para adquirir facilidades, equipos y servicios (servicios de ingeniería, transporte de los productos y etc.) con el fin de contribuir al desarrollo económico y social del país bajo los principios de las leyes y reglamentos relevantes de Japón. La Cooperación Financiera No Reembolsable no se realiza a través de la donación de materiales.

La CFMAC tiene como objetivo reducir las emisiones de gases de efecto invernadero, así como realizar el ahorro de energía y control de daños medioambientales causados por el cambio climático. Se puede combinar múltiples componentes para responder eficazmente a las necesidades. Los Contratistas, proveedores o consultores no se limitan a las empresas japonesas. y la construcción puede ser basada en el método local.

1. Procedimientos de la CFMAC

Se realiza la CFMAC por los procedimientos siguientes:

Aplicación	(Solicitud del Receptor)
Estudio	(Estudio de Concepto General ejecutado por JICA)
Evaluación y aprobación	(Aprobación por el GdJ y aprobación por el Gabinete de ministros)
Decisión de ejecución	(las Notas canjeadas entre el GdJ y el país receptor)
Acuerdo de Donación	(en adelante denominado "A/D") (el acuerdo suscrito entre JICA y el país receptor)

En primer lugar, el GdJ (el Ministerio de Relaciones Exteriores) estudia la solicitud formulada por el país receptor si el Proyecto es apropiado para la Cooperación Financiera No Reembolsable. Si se confirma que la solicitud tiene alta prioridad como Proyecto para la Cooperación Financiera No Reembolsable, JICA efectúa el Estudio Preparativo si es necesario.

En segundo lugar, JICA realiza el estudio de concepto general, en principio bajo el contrato con un consultor japonés.

En tercer lugar, el GdJ evalúa el programa si existe factibilidad como CFMAC sobre la base del informe del Estudio preparado por JICA. El resultado será presentado al Gabinete de ministros.

Una vez aprobado el Proyecto por el Gabinete, en la cuarta etapa de Decisión de Ejecución, se firma el Canje de Notas por los representantes del GdJ y del Gobierno receptor. Simultáneamente, la donación será disponible después de la suscripción del A/D entre el Gobierno Receptor y JICA.

JICA ha sido designada por el GdJ como una organización responsable de ejecución de Donación.

El Agente (en adelante denominado "Agente") ha sido designado para efectuar los servicios de adquisición y otros servicios (incluyendo gestión de fondo, preparación de licitación, contratos y otros) para la CFMAC en nombre del país receptor. El Agente es un organismo imparcial y especializado y debe ofrecer los servicios en función del acuerdo de agente (en adelante denominado "A/A") con el país

receptor. El Agente es recomendado al país receptor por el GdJ y acordado entre ambos Gobiernos en la Minuta de Acuerdo anexado con el C/N (en adelante denominado "M/A").

2. Estudio de Diseño del Concepto General

1) Contenido del Estudio

El objetivo del Estudio que ejecuta JICA sobre el programa solicitado es proveer un documento básico necesario para la evaluación del Programa por el GdJ. Los contenidos del Estudio son los siguientes:

(1) Verificar los antecedentes, objetivo y efectos esperados del Programa, al igual que la capacidad de la organización responsable y las comunidades concernientes del país receptor necesarias para la realización del Programa.

(2) Evaluar su viabilidad, desde los puntos de vista técnico y socio-económico.

(3) Confirmar los ítems acordados por ambas partes acerca del concepto básico del Programa.

(4) Preparar un diseño conceptual del Programa.

(5) Estimar el costo del Programa.

La totalidad de la solicitud no será automáticamente objeto de la cooperación, sino que se confirmará el concepto básico del Proyecto conforme al esquema de la Cooperación Financiera No Reembolsable de nuestro país.

Los contenidos de la solicitud original no son necesariamente aprobados en su forma inicial como los contenidos del Programa. Se confirma el Estudio de concepto general considerando las directivas del esquema de la Cooperación Financiera No Reembolsable del Japón.

El GdJ exigirá que el Gobierno del país receptor tome todas las medidas necesarias para promover su autonomía. Tales medidas deben estar garantizadas a pesar de que estén fuera de la jurisdicción de la organización en el país receptor. Por lo tanto, la ejecución del Proyecto será confirmada por todas las organizaciones relevantes en el país receptor mediante las Minutas de Reuniones.

2) Selección de la compañía consultora

Al realizar el Estudio, JICA selecciona una de las compañías consultoras - entre aquellas registradas en JICA - mediante una licitación en la que presentan sus propuestas. La compañía seleccionada realiza el Estudio de Concepto General y elabora el Informe bajo la supervisión de JICA.

Las empresas consultoras que trabajarán en la realización del Programa después de la suscripción del C/N y el A/D pueden ser, en principio, de cualquier nacionalidad mientras que las empresas satisfagan las condiciones especificadas en los documentos de licitación.

3. Realización de la CFMAC después de la suscripción del C/N y del A/D

1) Canje de Notas (C/N) y Acuerdo de Donación (A/D)

Se extiende la CFMAC de acuerdo con las notas canjeadas por los dos Gobiernos. En las cuales los objetivos del Programa, período de ejecución, condiciones y el monto de la Donación y otros serán confirmados. La suscripción del A/D entre JICA y el país receptor seguirán para definir los procedimientos necesarios para llevar a cabo el Programa tales como condiciones de pago, responsabilidades del país receptor y condiciones de licitación.

2) Detalles de Procedimiento

Los detalles de procedimiento sobre la adquisición de productos y servicios bajo la CFMAC serán acordados entre el país receptor y JICA al momento de las firmas del C/N y del A/D.

Los puntos esenciales a ser acordados se enmarcan como sigue:

a) JICA supervisará la buena ejecución del Proyecto.

b) Los productos y servicios deben ser adquiridos y provistos conforme a las Directivas de Adquisición para el Medio Ambiente y el Cambio Climático de JICA.

c) El país receptor suscribirá un contrato de empleo con el Agente.

d) El Agente es el representante asignado en nombre del país receptor acerca de transferencia de fondos al Agente.

3) Puntos Focales de las Directivas de Adquisición de Cooperación Financiera No Reembolsable para el Medio Ambiente y el Cambio Climático (Tipo I – E) (en adelante denominado "las Directivas").

a) El Agente

El Agente es la organización que provee servicios de adquisición de productos y servicios a favor del país receptor conforme al A/A con el país receptor. El Agente será recomendado al país receptor por el GdJ y acordado entre ambos gobiernos en la M/A.

b) Acuerdo de Agente (A/A)

El país receptor suscribirá un A/A dentro de un mes después de la fecha de entrada en vigor del A/D conforme a la M/A. Se especificará el alcance de los servicios de agente en el A/A.

c) Aprobación del A/A

El Acuerdo de Agente, preparado en dos documentos idénticos, será presentado a JICA por el país receptor a través del Agente. JICA confirmará si el A/A está suscrito o no conforme al A/D y a las Directivas y aprobará el A/A.

El A/A suscrito entre el país receptor y el Agente entrará en vigor después de la aprobación de JICA en forma escrita.

d) Métodos de Pago

El A/A estipulará "en relación con todas las transferencias de los fondos al Agente"; el país receptor designará al Agente como el representante autorizado para actuar en nombre del país receptor y emitirá una Autorización General de Desembolso (en adelante denominado "BDA") para transferir el fondo (anticipos) a la cuenta de adquisición desde la cuenta del país receptor.

El A/A debe indicar claramente que el pago de los Anticipos al Agente será efectuado en yenes japoneses y que el pago final al Agente será efectuado cuando el monto restante quede a menos de 3 % de la Donación y los intereses derivados.

e) Productos y servicios elegibles para la adquisición

Los productos y servicios a ser adquiridos serán seleccionados entre aquellos definidos en el A/D.

f) Empresas

En principio, una empresa de cualquier nacionalidad puede ser contratada mientras dicha empresa satisfaga las condiciones especificadas en los documentos de licitación.

g) Expertos de Asistencia Técnica

Se puede enviar expertos para llevar a cabo la asistencia técnica. Los expertos pueden ser recomendados por JICA cuando se requiera la consistencia conceptual con el Estudio. En principio, se prefiere que los expertos sean nacionales japoneses.

h) Método de Adquisición

Durante la ejecución de adquisición, se tiene que prestar atención suficiente con el fin de que no haya injusticia entre los licitantes elegibles para la adquisición de productos y servicios.

A este fin, se emplea la licitación competitiva en principio.

i) Documentos de Licitación

Los documentos de licitación tienen que contener toda la información necesaria para permitir a los licitantes preparar ofertas válidas de productos y servicios en la CFMAC.

j) Examen de Pre-Calificación de Licitantes

El Agente podrá efectuar un examen de pre-calificación de licitantes antes de la licitación para que se difunda la invitación de licitación solo a las empresas elegibles. El examen de la pre-calificación deberá ser efectuado solo en respecto de que los potenciales licitantes tengan la capacidad de realizar los contratos sin falta. En este caso, se considera los siguientes puntos:

(1) Experiencia y rendimiento en el pasado de los contratos de similar naturaleza.

(2) Propiedad fundación o la credibilidad financiera.

(3) Existencia de oficinas, y etc. a ser especificada en los documentos de licitación.

k) Evaluación de Licitación

La evaluación de licitación tiene que ser implementado sobre la base de las condiciones especificadas en los documentos de licitación.

Las licitaciones substancialmente conformes a las especificaciones técnicas y sujetos a otras estipulaciones de los documentos de licitación, deben ser juzgadas, en principio, sobre la base del precio presentado, y el licitante que ofrece el precio más bajo deberá ser designado como el adjudicador.

El Agente redactará un informe detallado de evaluación de licitación que clarifique las razones de la adjudicación y descalificación, y lo presentará al país receptor para obtener la confirmación antes de suscribir el contrato con el adjudicador.

El Agente proveerá a JICA un informe detallado de evaluación sobre la licitación, dando las razones de aceptación o rechazo de dicha licitación.

l) Adquisición Adicional

Si existe un fondo adicional después de la licitación concurrente y/o selectiva, y/o negociación directa para un contrato, y el país receptor desea una adquisición adicional, el Agente le está permitido efectuar una licitación adicional respetando los siguientes puntos:

(1) Adquisición de los mismos productos y servicios

Cuando los productos y servicios a ser adquiridos sean idénticos a la licitación inicial, y una licitación competitiva sea juzgada como desventajosas, se puede llevar a cabo la licitación adicional a través del contrato directo con el adjudicador de la licitación inicial.

(2) Otras adquisiciones

Cuando productos y servicios otros que los que se menciona en (1) arriba se adquieran, se emplea una licitación competitiva. En este caso, los productos y servicios para adquisición adicional tiene que ser seleccionados dentro de aquellos que se menciona en el A/D.

m) Modalidades de Pago

El contrato debe indicar las modalidades de pago. El Agente deberá efectuar el pago desde los Anticipos a cambio de la presentación de los documentos necesarios de las empresas sobre la base de las condiciones especificadas en el contrato, después que las empresas cumplan sus obligaciones. Cuando los servicios son el objeto de adquisición, el Agente podrá pagar cierta porción del monto contratado a las empresas, bajo las condiciones que tales empresas presentan la garantía de pago anticipado (vale al monto del pago anticipado) al Agente.

4) Las Obligaciones para el país peceptor

Dentro de la ejecución del Programa se requiere que el país receptor tome las medidas necesarias siguientes:

(a) adquirir los lotes de terrenos necesarios para la implementación del Proyecto y nivelar los sitios;

(b) proveer de instalaciones para la distribución de electricidad, suministro de agua y el sistema de desagüe y otras instalaciones adicionales necesarias para la implementación del Proyecto fuera de los sitios referidos en (a) arriba;

(c) asegurar los edificios antes de la adquisición en caso de la instalación de equipos;

(d) asegurar el pronto desembarque y despacho aduanero de los productos mencionados en el Artículo 3 del Acuerdo de la Donación en los puertos de desembarque en el país receptor y facilitar el transporte interno de los productos mencionados en el Artículo 3 del Acuerdo de la Donación;

(e) asegurar que los pagos de derechos aduaneros, impuestos internos y otras cargas fiscales que se impongan en el país receptor con respecto al suministro de los productos y los servicios mencionados en el Artículo 3 del Acuerdo de la Donación, sean eximidos o cubiertos por la Autoridad sin utilizar la Donación;

(f) otorgar a las partes concernientes, cuyos servicios sean requeridos en conexión con el suministro de los productos y los servicios mencionados en el Artículo 3 del Acuerdo de la Donación, tantas facilidades como sean necesarias para su ingreso y estadía en el país receptor para el desempeño de sus funciones;

(g) asegurar que las Instalaciones y/o los productos mencionados en el Artículo 3 del Acuerdo de la Donación sean debida y efectivamente mantenidos y utilizados para la implementación del Proyecto;

(h) sufragar todos los gastos necesarios, excepto aquellos cubiertos por la Donación, para la implementación del Proyecto; y

(i) integrar debidamente las consideraciones medioambientales y sociales en la implementación del Proyecto.

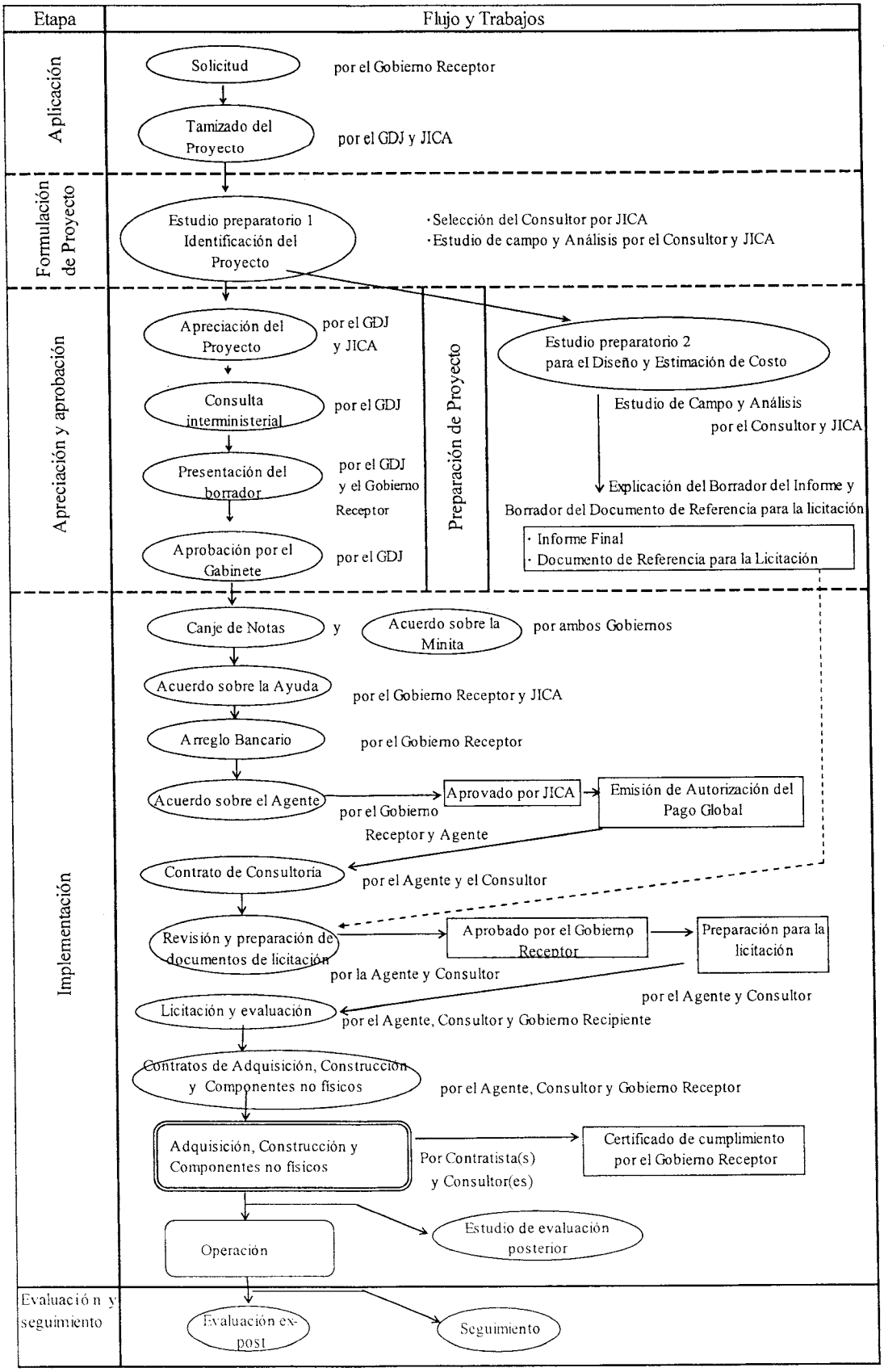
5) Uso Adecuado

El país receptor deberá asegurar que las instalaciones construidas y los productos adquiridos bajo la Cooperación Financiera No Reembolsable sean debida y efectivamente mantenidos y utilizados para la ejecución del Proyecto, y asignar el personal necesario a tal fin. Deberá también sufragar todos los otros gastos necesarios para la ejecución del Programa que no cubra la Donación.

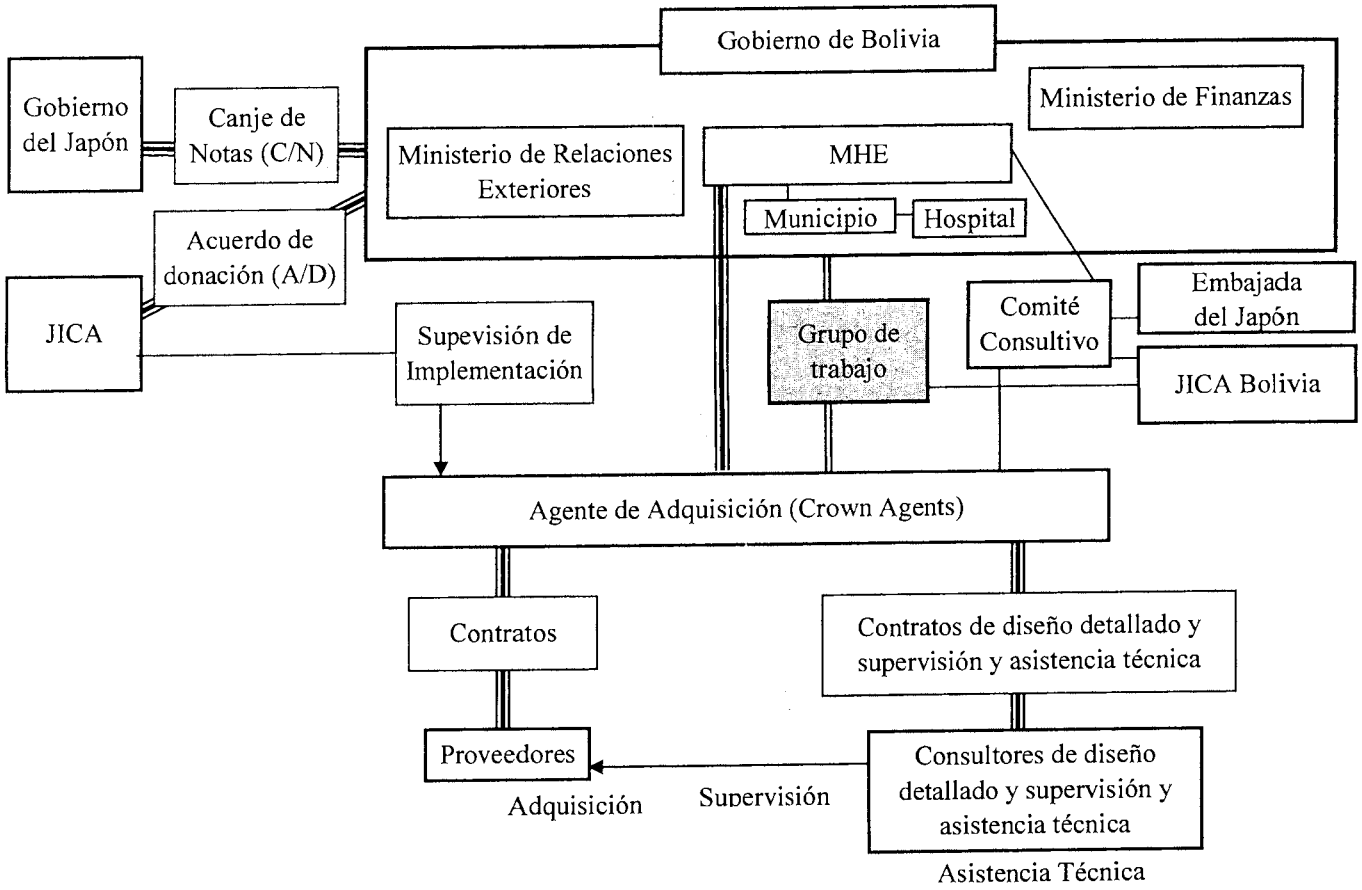
6) Reexportación

Los productos adquiridos bajo la Donación no deberán ser reexportados desde el país receptor.

Flujo General del Programa de Asistencia Financiera No Reembolsable para el Medio Ambiente y Cambio Climático



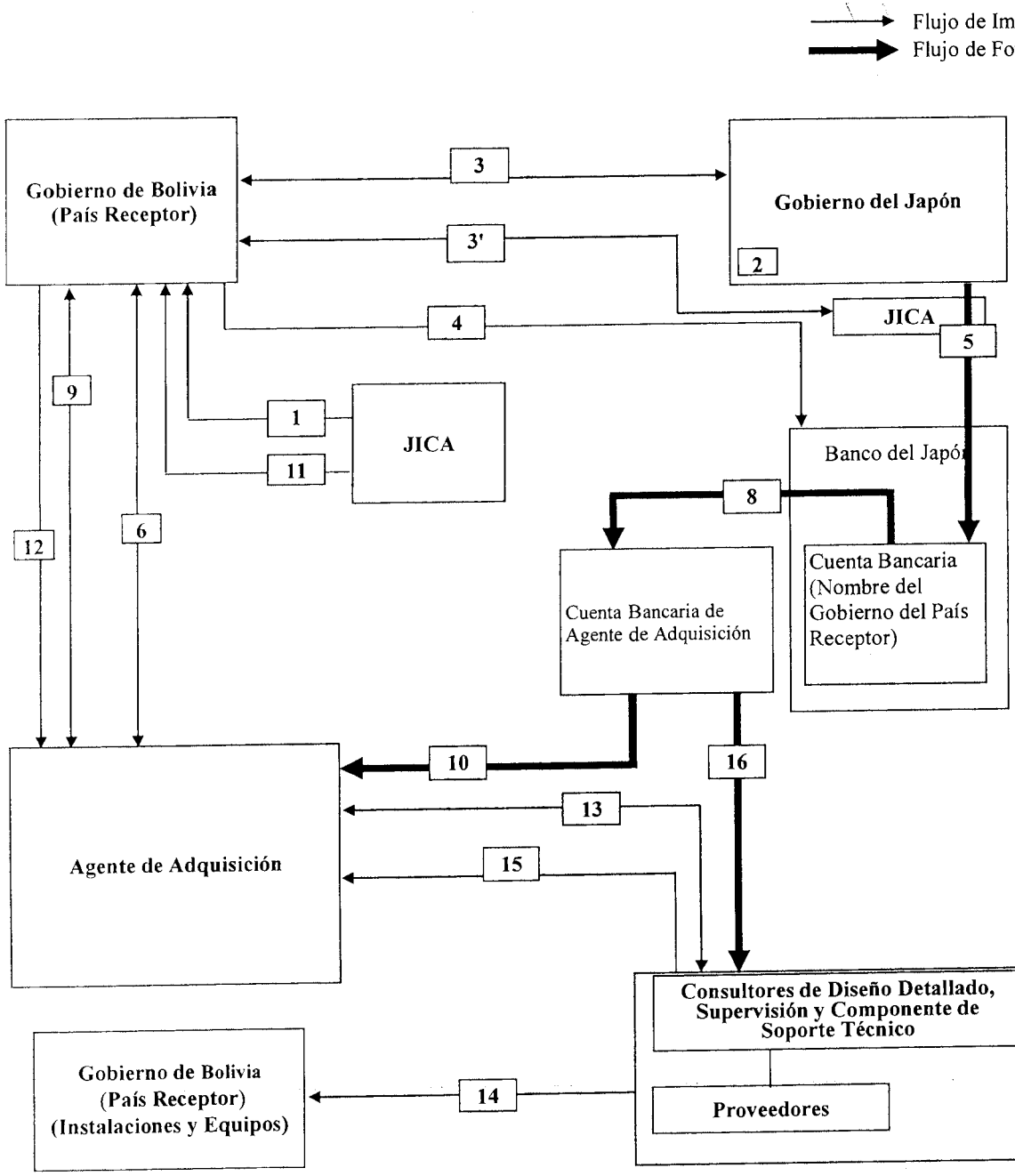
SISTEMA DE IMPLEMENTACIÓN



MHE: Ministerio de Hidrocarburos y energía

Appendix-4 MD (Third Survey)

Flujo de Fondos para Implementación del Projecto



1 Estudio Preparatorio/Documentos de Referencia para la Licitación

2 Aprobación por el Gabinete

3 Firma de Canje de Notas C/N)

3' Firma de Acuerdo de Donación (A/D)

4 Arreglo Bancario (A/B)

5 Desembolso de fondos desde e Gobierno de Japón

6 Firma de Acuerdo de Agente (A/A) +ADG

7 N/A

8 Transferencia de fondos

9 Decisión de componentes de Proyecto

10 Pago de honorarios del agente

11 Recomendación de consultores sobre el diseño detallado(D/D), supervisión (JICA→Gobierno de Bolivia)

12 Recomendación de consultores sobre el diseño detallado(D/D), supervisión (Gobierno de Bolivia→Agente de Adquisición)

13 Firma de Contrato

14 Construcción y adquisición

15 Solicitud de pago

16 Pago

Appendix-4 MD (Third Survey)

Lista de Equipos

ANEXO-2

No.	NOMBRE DE LOS COMPONENTES	ESPECIFICACION PRINCIPAL	CANTIDAD	UNIDAD
1	Módulo FV	(a) Tipo: Silicio Cristalino (b) Capacidad del Módulo: no inferior a 200 W (c) Capacidad total del Arreglo: 365 kW (UMSA: 50kW + Aeropuerto Internacional VIRU VIRU:315kW	2	lote
2	Estructura de montaje para los módulos FV	(a) Tipo: Estructura de montaje para módulos FV (b) Material: SS400 y galvanizado por inmersión en caliente (hot dip) (c) Altura sobre el nivel del suelo: UMSA:no inferior a 1m. y Aeropuerto Internacional VIRU VIRU: no inferior a 0.6 m.	2	lote
3	Tablero y Caja de Conexión	(a) Configuración: tipo intemperie (b) Material: Hoja de Acero laminada SPC (c) Equipos instalados: Interruptor de desconexión, Interruptor automático (disyuntor), Dispositivo de protección contra sobretensiones	2	lote
4	Acondicionador de Potencia (incluyendo un juego como repuesto)	(a) Configuración: tipo de uso en interiores, tipo autónomo (b) Tipo de Circuito principal: tipo autoexcitado (c) Tipo de Interruptor: de alta frecuencia PWM (d) Tipo de Aislamiento: Transformador de aislamiento (e) Enfriamiento: refrigeración por aire forzado (f) Total de la energía nominal producida: 365kW (UMSA: 50kW + Viru Viru: 315kW) (g) Tipo de control de energía: el seguimiento del punto de máxima potencia (h) Función de protección de conexión a red: UVR, OVR, UFR, OFR, prevención para Operación en isla (detección pasiva y activa), previniendo la inyección de energía hasta después de la recuperación	2	lote
5	Transformador de potencia	a) Total de la energía nominal producida: 500kVA (UMSA: 100kVA + Aeropuerto Internacional Viru Viru: 400kVA) b) Tensión primaria / secundaria: - UMSA: 6.9kV/400V/230V, 3 fases 4 líneas, 50 Hz - Aeropuerto Internacional Viru Viru: 24.9kV/400V/230V, 3 fases 4 líneas, 50 Hz c) Especificaciones particulares: A la intemperie, Caja de conexiones para los terminales de tipo nariz de elefante, Tipo: auto-refrigeración por aceite, Cableado para transformador: Δ-Y, neutro tierra	2	set

6	Conmutador de media tensión para conexión con la red	(a) Conmutador tipo intemperie con gabinete metálico (b) Disyuntor (CB): - UMSA: 15 kV, 400 A, 12.5 kA - Aeropuerto Internacional Viru Viru: 24.9kV, 400 A, 12.5 kA (c) El equipamiento incluido: a) Transformador de Voltaje y Corriente (VCT) b) Interruptores de desconexión (DS) c) Pararrayos (LA) d) Transformadores de Medición (VT, CVT) e) Transformador de corriente de fase cero (ZCT) f) Interrptor de vacío (VCB) g) Transformador de corriente (CT) h) Relé de protección: OCGR, OVGR, OCR i) Medidores: V, A, W, PF, WH j) Medidores de Watt/ Hora para ambos flujos	2	panel
7	Tablero de distribución de baja tensión	(a) Configuración: Intemperie, colgando o de pie (b) Material: placas de acero SPHC (c) Equipos incluidos: Disyuntores de caja moldeada (MCCB) Dispositivo de protección contra sobretensiones, Instrumentos: V, A, WH	2	panel
8	Panel de la Pantalla de Monitoreo	(a) Configuración: Intemperie, colgando o de pie (b) Material: placas de acero SPHC (c) Datos de visualización: Potencia generada/día (kWh), Potencia instantánea (kW), la irradiación (kWh/m2), reducción de emisiones de CO2 (kg-C) Temperatura ambiente (° C) (d) Dimensiones: * A: 1000 x L: 800 x H: 200	2	panel
9	Registro de datos y Sistema de monitoreo	(a) Piranómetro: ISO 9060, Segunda Clase 6-8 mV / (kW/m2) (b) Termómetro: sensor reistente a la temperatura Pt 100 Ω, tipo 4 líneas, desde - 50 ° C a (+)100 ° C (c) Transductor meteorológico para el sistema de registro de datos (d) Equipos de monitoreo (en interiores)	2	lote
* Otras especificaciones de los componentes se encuentran mencionados en el Documento de Licitación				

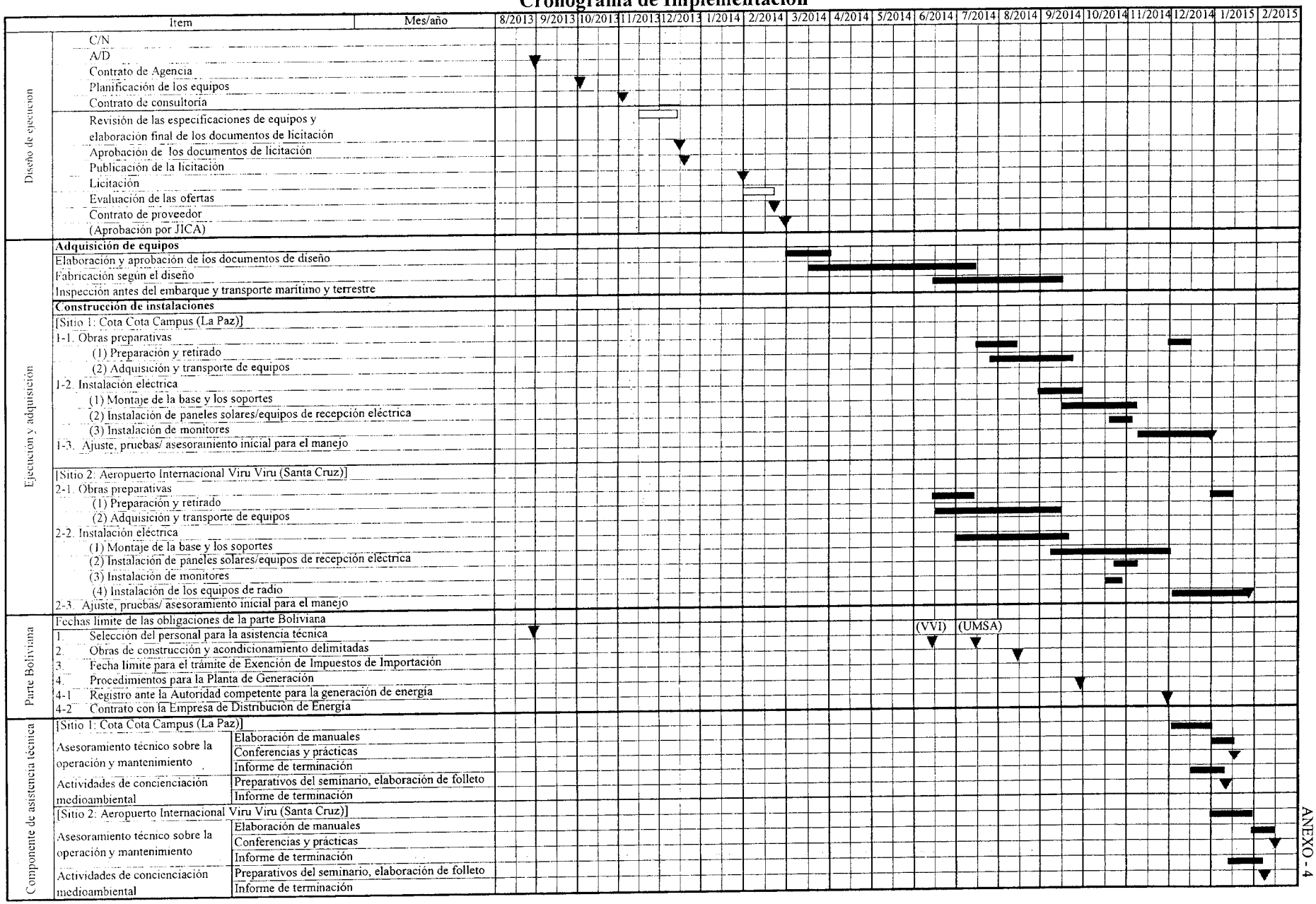
ANEXO - 3

Medidas necesarias a ser tomadas por ambos Gobiernos

	Ítems	Cubierto por el Gobierno del Japón	VIPFE	MHE	UMSA	AASANA / SABSA	Delapaz	CRE
1	Asegurar el terreno				•	•		
2	Limpiar, nivelar y reclamar el lugar cuando sea necesario				•	•		
3	Construir portones y cercos alrededor del lugar				•	•		
4	Construir un estacionamiento de vehículos si fuese necesario	•						
5	Construir caminos de acceso							
1)	Dentro del lugar.	•						
2)	Fuera del lugar y camino del acceso al sitio				•	•		
6	Construir la facilidad e instalar el equipamiento.	•						
7	Proporcionar instalaciones para la distribución de electricidad, suministro de agua, drenaje y otras instalaciones incidentes, si fuera necesario.							
1)	Electricidad							
a.	La línea de distribución principal al lugar.						•	•
b.	El cableado descendente y cableado interno en el lugar.	•						
c.	El disyuntor del circuito principal y transformador.	•						
2)	Suministro de agua							
a.	Tubería principal de distribución de agua de la ciudad al lugar.				•	•		
b.	Sistema de abastecimiento dentro del lugar (recepción y tanques elevados).	•						
3)	Drenaje							
a.	Tubería principal de drenaje de la ciudad (para tormentas, aguas servidas y otros) desde el lugar.				•	•		
b.	El sistema de drenaje en el lugar (de aguas de lavado, residuos ordinarios, drenaje de tormentas y otros).	•						
4)	Suministro de Gas							
a.	Tubería principal de gas al lugar.				N/A	N/A		
b.	Sistema de abastecimiento dentro del lugar.	•						
5)	Sistema de telefonía							
a.	Línea troncal del teléfono al bastidor/panel de distribución principal (MDF) del edificio.				•	•		
b.	El MDF y las extensiones después del bastidor/panel.	•						
6)	Mobiliario y Equipamiento							
a.	Mobiliario General				•	•		
b.	Equipos del proyecto.	•						
8	Pagar las siguientes comisiones aplicables por el Banco de Cambio Exterior de Japón, en base al Acuerdo Bancario (A/B).							
1)	Comisión bancaria del Pago				•	•		
9	Asegurar el apropiado desembarque y despacho aduanero de los bienes en el puerto de desembarque del país receptor.							
1)	Transporte marítimo o aéreo de los bienes del Japón o de un tercer país al país receptor.	•						

2)	Asegurar la Exención de impuestos y apropiado despacho aduanero de los bienes al ser desembarcados en el puerto de desembarcación.				•	•		
3)	Transporte interno desde el puerto de desembarque hasta el lugar del proyecto.	•						
10	Realizar las gestiones necesarias para que los japoneses o ciudadanos de un tercer país cuyos servicios puedan ser necesarios en conexión con el suministro de los bienes y servicios suministrados bajo contrato verificado, cuenten con las facilidades necesarias para la entrada en el país receptor y su estadía durante la realización de su trabajo.				•	•		
11	Exonerar o realizar el reembolso correspondiente a los Japoneses del pago de impuestos internos y otros gravámenes fiscales tales como impuestos aduaneros y otros imponibles en el país receptor con respecto al suministro de los bienes y servicios previstos dentro del marco del contrato verificado.				•	•		
12	Mantener y utilizar eficiente y apropiadamente las instalaciones construidas y los equipos proveídos por la Cooperación Financiera No Reembolsable.				•	•	•	•
13	Asumir todos los gastos, aparte de los cubiertos por la Cooperación Financiera No Reembolsable, que sean necesarios para la construcción de las instalaciones al igual que para el transporte e instalación de equipamientos y compra de componentes.				•	•		

Cronograma de Implementación



ANEXO - 4

Appendix-4 MD (Third Survey)

Appendix-5
Soft Component (Technical Assistance) Plan

THE PREPARATORY SURVEY
ON
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM
IN
THE PLURINATIONAL STATE OF BOLIVIA

Soft Component Plan

September 2013

Japan International Cooperation Agency

NIPPON KOEI CO., LTD.

CONTENTS

1. Background of the Soft Component Plan

"The Project for Introduction of Clean Energy by Solar Electricity Generation System in Bolivia" aims to introduce solar PV systems of 50 kW capacity in the Cota Cota Campus of Faculty of Engineering at the Higher University of San Andres *(Universidad Mayor de San Andrés*: UMSA) in La Paz City, and 315 kW capacity in the area of Viru Viru International Airport (VVI) in Santa Cruz City. The generated power will be supplied to the existing power grid. This Project is the first attempt to install a grid-connected solar PV system in Bolivia. Therefore, it is necessary to assist in capacity improvement and basic technical training for engineers in the aspect of technical transfer.

(1) Current Condition

Power generation projects in Bolivia depend on hydropower and thermal power generation (natural gas, diesel, etc.). The total capacity of power generation is about 1,682.3 MW, which is mostly supplied by thermal power and fossil fuel (about 30% is supplied by hydropower and about 70% by thermal power).

In the medium- and long-term energy policies of Bolivia, encouraging related research works and introducing renewable energy are indicated. As described above, it is considered that the installation of a power generation system using renewable energy is an option in mitigating climate change.

(2) Need for Soft Component

This is the first attempt to introduce a grid-connected solar PV system in Bolivia. To secure smooth operation, it is necessary to introduce further technical information, documents, and human resources on PV systems, as follows:

i. Lack of electrical engineers who work on operation and maintenance (O&M) and repair.
ii. Lack of training manuals for O&M engineers.
iii. Lack of human resources to act as guides to visitors of PV system and enable them to explain its effects by the introduction of PV system.

Thus, the following activities have to be conducted for (i) smooth operation in the initial stage and (ii) secure the sustainability of project outcomes as soft component program:

i. Training for O&M engineers.
ii. Prepare and organize necessary manuals for O&M.
iii. Training for the person in charge in guiding visitors to the facility and explaining its effectiveness through the introduction of PV system.

The details of activities to be implemented are explained below.

A. Operational Management/Monitoring

An appropriate management structure on solar PV system is necessary to secure sustainability of the project outcome. Therefore, UMSA and the Administration of Airports and Auxiliary Services of Air Navigation (*Administración de Aeropuertos y Servicios Auxliares a la Navegación Aérea*: AASANA) have to confirm the activities by referring to O&M reports submitted by daily and periodic maintenance staff members of UMSA and AASANA. In addition, it is necessary to collect data on power generation and the amount of carbon dioxide (CO_2) emission reduction for analysis.

B. Basic Technology/O&M/Troubleshooting

It is necessary to transfer appropriate O&M skills for sustainable use of solar PV system. It is desirable to conduct repair or replacement of faulty parts of the PV system locally. Therefore, in addition to O&M techniques, troubleshooting techniques have to be transferred. A troubleshooting table has to be included in the Project. Moreover, it is necessary to maintain the manuals on O&M and troubleshooting, which will be utilized as materials for training technicians locally.

C. Education/Awareness Raising

As for the PV system which was introduced in this Project, showcase effect of the Japanese technical cooperation is expected. It is necessary to train the person in charge in guiding visitors to the installed facility and explaining its effects. In the Project, brochures have to be prepared as guide to those visiting the installed facility.

2. Objectives of Soft Component

The following objectives have to be accomplished within 1.5 months during and after installation of the PV system:

- Management of operation and monitoring of data can be conducted by UMSA and AASANA staff.
- Daily inspection can be conducted by UMSA and the Bolivia Airport Services S.A. (*Servicios de Aeropuertos Bolivianos*: SABSA) personnel.
- Periodic inspection can be conducted by the UMSA and SABSA staff.
- Finding out malfunctioning parts and determining corresponding countermeasures can be conducted by UMSA and SABSA maintenance staff.
- Visitors can be guided by UMSA and SABSA personnel to see the PV system.

3. Output of Soft Component

A. Operational Management/Monitoring

Management of operation and monitoring data at the PV facility are conducted by UMSA and AASANA/SABSA. It is necessary to transfer the technology to UMSA and AASANA on confirming operational data such as power output, solar irradiation, and the amount of reduction of CO_2 emission. In addition, inspection reports written by O&M staff have to be confirmed and adequate countermeasures have to be carried out.

- Understanding of PV system, power conditioner, and grid connection technology.
- Understanding of preparation of inspection reports and countermeasures in response to troubles.
- Analysis of monitored data (power output, irradiation, and CO_2 emission reduction).
- Training system of O&M technicians.

B. Basic Technology/O&M/Troubleshooting

The technical staff of UMSA and SABSA will need to understand the basic technology on solar PV to carry out O&M appropriately. In accordance with the prepared manual, periodic inspection has to be conducted by UMSA and SABSA. In addition, a troubleshooting table will be prepared to find malfunctioning parts and the corresponding countermeasure. The following outputs through the above training are expected:

- Understanding of the PV system, power conditioner, and grid-connected technology.
- Understanding of daily maintenance and confirmation of generating condition.
- Acquisition of knowledge on maintenance checkpoints such as operating panel, indicator panels, and protection instruments and detailed operational instruction for each facility and equipment.
- Acquisition of knowledge on measurement device for maintenance, equipment adjustment device, special tools, machine proofing, adjustment, etc.
- Acquisition of reporting skills for operational records, accidents, repairs and inspections.
- Acquisition of knowledge on management of spare parts and tools.
- Acquisition of knowledge on locating faulty parts and their corresponding replacement.

- Acquisition of knowledge on forecasting of the exchange period for parts, identification of faulty parts and the necessary countermeasures.

C. Education/Awareness Raising

Using the installed solar PV systems in UMSA and VVI, explanation of installed PV systems and their effectiveness will be conducted by UMSA and AASANA staff to visitors and concerned people. Brochures introducing the installed facility will be prepared. Furthermore, a simulated seminar to raise awareness will be held using the developed brochure. The following outputs through the above training are expected:

- Development of skills and expertise of the person in charge in guiding visitors to the installed system.
- Development of human resources that are capable of explaining the effectiveness of the installed system.
- Brochures for the activities mentioned above are developed.

4. Confirmation Methods for Achievement

The confirmation method for achievement of the soft component will be prepared and the results will be reported in the final report. The contents are shown in Table -1.

Table-1 Confirmation Methods for Achievement

Term of Technical Transfer	Confirmation Methods	Items to be Confirmed
Operational Management/ Monitoring	・Conduct analysis and confirmation of the monitored data at the end of the training.	・Acquisition level of data analysis
Basic Technology/ O&M/Trouble shooting	・Comprehension test ・Conduct inspection and maintenance services at the end of the training ・Conduct technical transfer using prepared manuals at the end of the training ・Conduct O&M simulation using troubleshooting table at the end of the training	・Acquisition level of basic knowledge ・O&M operation acquisition level ・Training system for O&M engineer ・Acquisition level for repair and replacement of faulty parts
Awareness Raising	・At the end of the training, the trainee organizes a simulation seminar	・To confirm contents of the simulation seminar

Source: JICA Study Team

5. Activities

5.1 Contents and Activities for the Soft Component

Two persons from each organization will participate for the soft component. Depending on the role of the organization, the required technologies to be transferred are different as needed.

Table-2 shows the contents of the activities, and the number of attendees and organizations for the soft component. During the training at the site, mainly practical training will be conducted for UMSA and SABSA staff. Delapaz and CRE, which are publicly recognized as the only power supply organization in La Paz City and Santa Cruz City, respectively, can be the candidates to participate in the implementation of the soft component.

As an implementation organization, the persons from the Ministry of Hydrocarbon and Energy (*Ministerio de Hidrocarburos y Energia*: MHE) who are in charge of the Project have to have knowledge on O&M for its management. Therefore, MHE will participate in the soft component as an observer.

Technical transfer will be conducted using prepared manuals and troubleshooting table.

Table-2 Number of Participants According to Technical Transfer

Technical Transfer		No. of Participants	Organization (No.).
A.	Operational Management/Monitoring	8	La Paz: MHE (2), UMSA (2) Santa Cruz: AASANA (2), SABSA (2)
B.	Basic Technology of PV System/ O&M/Troubleshooting	12	La Paz: MHE (2), UMSA (2), Delapaz (2) Santa Cruz: AASANA (2), SABSA (2), CRE (2)
C.	Education/Awareness Raising	4	La Paz: UMSA (2) Santa Cruz: AASANA (2)

Source: JICA Study Team

Details of the work items on technology transfer are presented and discussed below.

Requirement from the participants

Operational Management/Monitoring:

Engineer (Education: University graduate, Work experience: Five years or more)

Basic technology of PV system/O&M/Troubleshooting

Electrical Engineer or Electrical Technician (Work experience: Five years or more)

Education/Awareness Raising

Permanent staff (Work experience: Five years or more)

A. Operational Management/Monitoring

Technical skills on operational management and monitoring will be transferred. After the training, it is possible to confirm the contents of the O&M report and monitoring data such as power output. Table-3 below shows the details of the training.

Table-3 Operational Management/Monitoring

	Item	Contents and Activities
1.	Basics of Solar PV	Basic knowledge on solar PV
2.	Operation and Maintenance	Contents of O&M reports based on daily and periodic maintenance; Understand necessary procedure for carrying out countermeasures against malfunctions.
3.	Data Analysis/Operational Management	Confirm procedure for data collection and analysis in the PV system.

Source: JICA Study Team

B. Basic Technology of PV System/O&M/Troubleshooting

The basic technology of a PV system will be taught. At first, a comprehension test on basic knowledge on the PV system will be conducted to grasp current knowledge level of the trainee. The training items and contents are shown in Table-4 below.

Table -4 Basic Technology of PV System

	Item	Contents and Activities
1.	Comprehension Test	Confirmation of the basic technical knowledge of trainee
2.	Basics of PV System	Actual system; international trend
3.	PV System, Power Conditioner	Specifications and details of the PV system and power conditioner
4.	Grid Connection	The principle of a grid-connected system, its specifications and details

Source: JICA Study Team

Before and after completion of the trial operation, O&M training will be conducted with emphasis on the purpose of improvement of O&M skills. Training items and contents are

as shown in Table-5. Instruction of installed equipment such as initial operation and O&M procedures will be conducted by the contractor. In the soft component, training will be conducted considering the situation and personnel required at each site. It is important to conduct the O&M training repeatedly for further understanding on O&M.

Table-5 O&M/Troubleshooting

	Item	Contents and Activities
1.	Daily Maintenance	Confirmation of generation facilities, operational and surrounding conditions
2.	Periodic Inspection, Maintenance	Periodic inspection, maintenance
3.	Handling of Measuring Equipment and Special Tools	Handling of electrical and adjustment equipment
4.	Reporting	Report writing related to O&M
5.	Operating Inspection	Operating inspection and testing Testing and confirmation of safety operation
6.	Troubleshooting	Confirmation of possible faulty parts
7.	Diagnosis of Repair and Fault	Diagnostic flowchart repair and fault
8.	Confirmation of O&M	Confirmation of the results of soft component

Source: JICA Study Team

C. Education/Awareness Raising

Brochures for the introduction of the PV system and manuals on raising awareness will be developed. Consequently, each staff officer can give a guided tour in the PV facility and explain its effectiveness. The training items and contents are shown in Table-6 below.

Table-6 Awareness-Raising Activities

	Item	Contents and Activities
1.	Comprehension Test	Confirmation of basic knowledge
2.	Preparation of Brochure for Awareness-Raising Activity	Preparation of brochure on solar PV and the Project for dissemination to visitors
3.	Holding of Awareness-Raising Simulation Seminar	A simulation seminar for UMSA and AASANA staff is conducted using the prepared manuals and brochure

Source: JICA Study Team

5.2 Input Plan

The PV systems will be installed at the Cota Cota Campus of UMSA in La Paz City and VVI in Santa Cruz City. The distance between La Paz City and Santa Cruz City is around 800 km. Both sites have their own O&M staff. Therefore, it is necessary to conduct the soft component for both sites.

In Bolivia, it is necessary to prepare documents and conduct lectures in Spanish. However, it is very difficult to find an engineer who can conduct the soft component's training in Spanish. Therefore, it is necessary to hire local staff to assist and who can work both in English and Spanish for interpretation and translation works. The input by Japanese engineers and local assistant is summarized below.

Total Input of Japanese Engineers： 4.6 MM

（Detail： Solar PV/O&M: 3.0 MM (1.5 x 2 sites)

Education/Awareness Raising: 1.6 MM (0.8 x 2 sites))

Local Assistant： 4.6 MM

(Detail： Translation of documents prepared in the soft component (English–Spanish), Assistance in lectures (interpreter), Input is the same as Japanese experts (1.5 MM x 2 + 0.8 MM x 2))

Detailed input plan is explained below.

5-2-1 UMSA

(1) Operation Management and Maintenance for PV System (A, B)

Japanese side

- Necessary technology/category of business：PV system/O&M Engineer
- Needed technical level：

  A. Operational management/monitoring

  B. Periodic inspection of PV system and technical knowledge on spare parts
- Implementation measure：

  Transfer basic technology of PV system and O&M for daily maintenance and periodic inspection. Transfer procedures of troubleshooting.

・Implementation resource：

Dispatched engineer:	Solar Energy Engineer (1 person)
Dispatch period:	1.5 M/M
Local assistance:	1 person
Contract period:	1.5 M/M

・Implementation content

Table-7 Operational Management/Monitoring

	Contents	M/M
1.	Preparation of training materials (Basics of Solar PV)	0.1
2.	Preparation of training materials (O&M/Data Analysis/Monitoring)	0.1
3.	Lecture/Comprehension Test	0.1
	Subtotal	0.3

Source: JICA Study Team

Table-8 Basic Technology of PV System

	Contents	M/M
1.	Preparation of Training Materials (Basic Information on PV system)	0.1
2.	Preparation of Training Materials (PV, Power Conditioner)	0.1
3.	Preparation of Training Materials (Grid Connection)	0.1
4.	Lecture/Comprehension Test	0.1
	Subtotal	0.4

Source: JICA Study Team

Table -9 O&M/Troubleshooting

	Contents	M/M
1.	Preparation of Training Materials (Daily maintenance, Periodic Inspection and Maintenance)	0.2
2.	Preparation of Training Materials (Handling of Measuring Equipment and Special Tools, Reporting Skills)	0.1
3.	Practice (Operating Inspection)	0.1
4.	Preparation of Training Materials (Troubleshooting, Replacement of Faulty Parts)	0.2
5.	Lecture/Comprehension Test	0.2
	Subtotal	0.8

Source: JICA Study Team

Bolivian side: UMSA

- Necessary technology/category of business
  Periodic inspection of PV system/Electrician
- Current technical level： O&M of power distribution equipment
- Needed technical level： Daily and periodic inspection of PV system, O &M technology
- Target person：
  A. Operational management/monitoring: MHE, UMSA
  B. Basic technology/O&M/troubleshooting: UMSA, Delapaz
- Implementation measure：
  Using installed PV facility and prepared O&M manual
- Trainee resource：
  A. Operational management/monitoring:
  MHE, UMSA: 4 persons (2 for each site)
  B. Basic technology/O&M/troubleshooting:
  UMSA, Delapaz: 4 persons (2 for each site)

(2) Education/Awareness Raising (C)

Japanese side

- Necessary technology/category of business：
  Environmental awareness raising and education through reduction of GHG emission using PV system /consultant
- Needed technical level：

Environmental education on energy conservation or global warming

・Implementation measure：

Explanation and guidance using brochure and holding a simulation seminar

・Implementation resource：

Dispatched engineer: Environmental Educator (1 person)

Dispatched period: 0.8 MM

・Implementation contents

Table -10 Education/Awareness Raising

	Contents	M/M
1.	Preparation of Brochure for Awareness-Raising Activity	0.5
2.	Holding of Awareness-Raising Seminar Activity	0.3
	Subtotal	0.8

Source: JICA Study Team

Bolivian side

・Necessary technology/category of business：

Environment/education/awareness raising/environment and publication

・Current technical level：UMSA personnel

・Needed technical level: Basics of PV system

Implementation of awareness-raising activities using prepared brochure

・Target person: UMSA personnel

・Implementation measure: Awareness raising using installed PV system and prepared brochure

・Trainee resource : 2 persons

5-2-2 AASANA/SABSA

(1) Operation Management and Maintenance for PV System (A, B)

Japanese side

・Necessary technology/category of business：PV system/O&M Engineer

・Needed technical level：

A. Operational management/monitoring

B. Periodic inspection of PV system and technical knowledge on spare parts

・Implementation measure：

Transfer basic technology of PV system and O&M for daily maintenance and periodic inspection. Transfer

procedures of trouble shooting.

・Implementation resource：

Dispatched engineer: Solar Energy Engineer (1 person)
Dispatch period: 1.5 M/M
Local assistance: 1 person
Contract period: 1.5 M/M

・Implementation content

Table-11 Operational Management/Monitoring

	Contents	M/M
1.	Preparation of training materials (Basic of solar PV)	0.1
2.	Preparation of training materials (O&M/data analysis/monitoring)	0.1
3.	Lecture/comprehension Test	0.1
	Subtotal	0.3

Source: JICA Study Team

Table-12 Basic Technology of PV system

	Contents	M/M
1.	Preparation of training materials (Basic information on PV system)	0.1
2.	Preparation of training materials (PV, Power conditioner)	0.1
3.	Preparation of training materials (Grid connection)	0.1
4.	Lecture/comprehension Test	0.1
	Subtotal	0.4

Source: JICA Study Team

Table -13 Operation and Maintenance/Troubleshooting

	Contents	M/M
1.	Preparation of training materials (Daily maintenance, periodic inspection and maintenance)	0.2
2.	Preparation of training materials (Handling of measuring equipment and special tools , reporting skills)	0.1
3.	Practice (Operating inspection)	0.1
4.	Preparation of training materials (Troubleshooting, replacement of faulty parts)	0.2
5.	Lecture/Comprehension test	0.2
	Subtotal	0.8

Source: JICA Study Team

Bolivian side: AASANA/SABSA

- Necessary technology/category of business
  Periodic inspection of PV system/Electrician
- Current technical level： O&M of power distribution equipment
- Needed technical level： Daily and periodic inspection of PV system, O &M technology
- Target person：
  A. Operational management/monitoring: AASANA, SABSA
  B. Basic technology/O&M/troubleshooting: SABSA, CRE
- Implementation measure：
  Using installed PV facility and prepared O&M manual
- Trainee Resource：
  A. Operational management/Monitoring:
  AASANA, SABSA: 4 persons (2 for each site)
  B. Basic technology /O&M/troubleshooting:
  SABSA, CRE: 4 persons (2 for each)

(2) Education/Awareness Raising (C)

Japanese side

- Necessary technology/category of business：
  Environmental awareness raising and education through reduction of GHG emission using PV system/consultant

・Needed technical level：

Environmental education on energy conservation or global warming

・Implementation measure：

Explanation and guidance using brochure and holding a simulation seminar

・Implementation resource：

Dispatched engineer: Environmental Educator (1 person)

Dispatched period: 0.8 MM

・Implementation contents

Table -14 Education/Awareness Raising

	Contents	M/M
1.	Preparation of Brochure for Awareness-Raising Activity	0.5
2.	Holding of Awareness-Raising Seminar Activity	0.3
	Subtotal	0.8

Source: JICA Study Team

Bolivian side

・Necessary technology/category of business：

Environment/education/awareness raising/environment and publication

・Current technical level：AASANA personnel

・Needed technical level: Basics of PV system

Implementation of awareness-raising activities using prepared brochure

・Target person: AASANA personnel

・Implementation measure: Awareness raising using installed PV system and prepared brochure

・Trainee resource : 2 persons

6. Procurement Method of Implementation Resource

In the soft component plan, the direct support method is applied since it is difficult to find any subcontractor as it is the first attempt on PV system installation in Bolivia. Under the Project, the main components will be procured in Japan. Therefore, it is necessary to dispatch experts from Japan to transfer O&M technology.

7. Implementation Schedule

A. Operational Management/Monitoring

Technical transfer will commence after the trial operation of solar PV facility.

B. Basic Technology of PV system / O&M / Troubleshooting

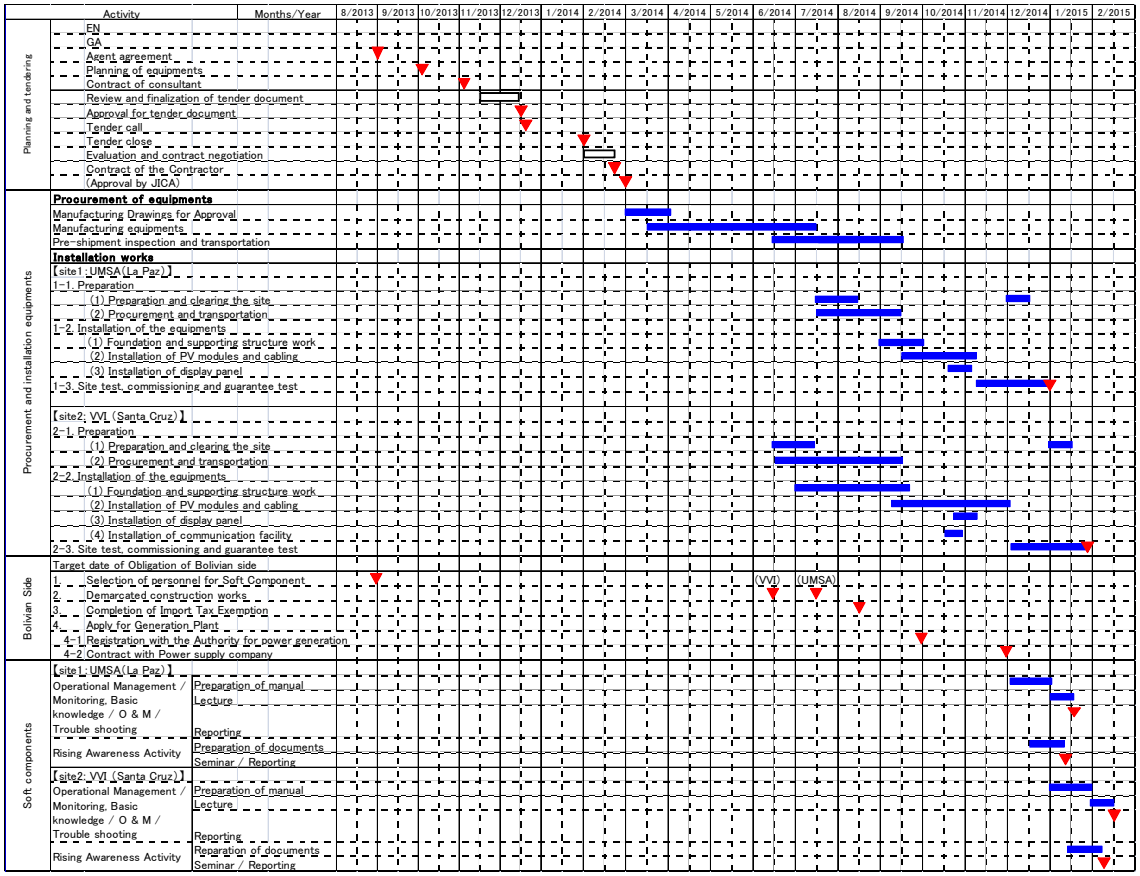
Technical transfer on daily maintenance will commence after completion of the PV system installation. The training schedule for periodic inspection is planned to overlap with the installation period for deeper understanding on the PV system. The training on troubleshooting will commence after the installation and will also conduct in parallel with the field test, acceptance test and initial operation test term.

C. Awareness raising

The training on raising awareness has to coincide with the initial operation term since visitors are expected at that time. The soft component has to be completed within 1.5 months after completion of installation. There are two purposes of soft component, i.e., preparation of O&M structure for installed PV system, and awareness-raising activities using introduced PV facility. Therefore, the soft component on O&M and raising awareness will be conducted at each site.

The schedule for implementing the soft component is shown in Table-15.

Table-15 Implementation Schedule of Soft Component



Source: JICA Study Team

8. Output

Output documents

Manual： ・Manual of daily and periodic O&M (in Spanish): 2 copies
・Awareness-raising materials (brochure, etc.) (in Spanish): 300 copies

Progress Report:	Spanish:	10 copies
	English:	10 copies
	Japanese (Summary):	10 copies
Final Report：	Spanish:	10 copies
	English:	10 copies
	Japanese (Summary):	10 copies

9. Responsibilities of the Implementation Organization

For the achievement of the objectives of the soft components, UMSA, AASANA/SABSA and related entities are required to have sustainable operations, maintenance and awareness-raising activities. For achieving the continued efforts described, the following are the requirements, disincentives, and necessary measures:

Requirements：

The target personnel of the soft component are the O&M staff of UMSA, AASANA, Delapaz, CRE and MHE. The responsibilities of the implementation organization are as follows:

(1) Selection of candidate trainee considering sustainability;
(2) Provide spaces for training and working; and
(3) Training system for O&M technicians at each organization.

Disincentives：

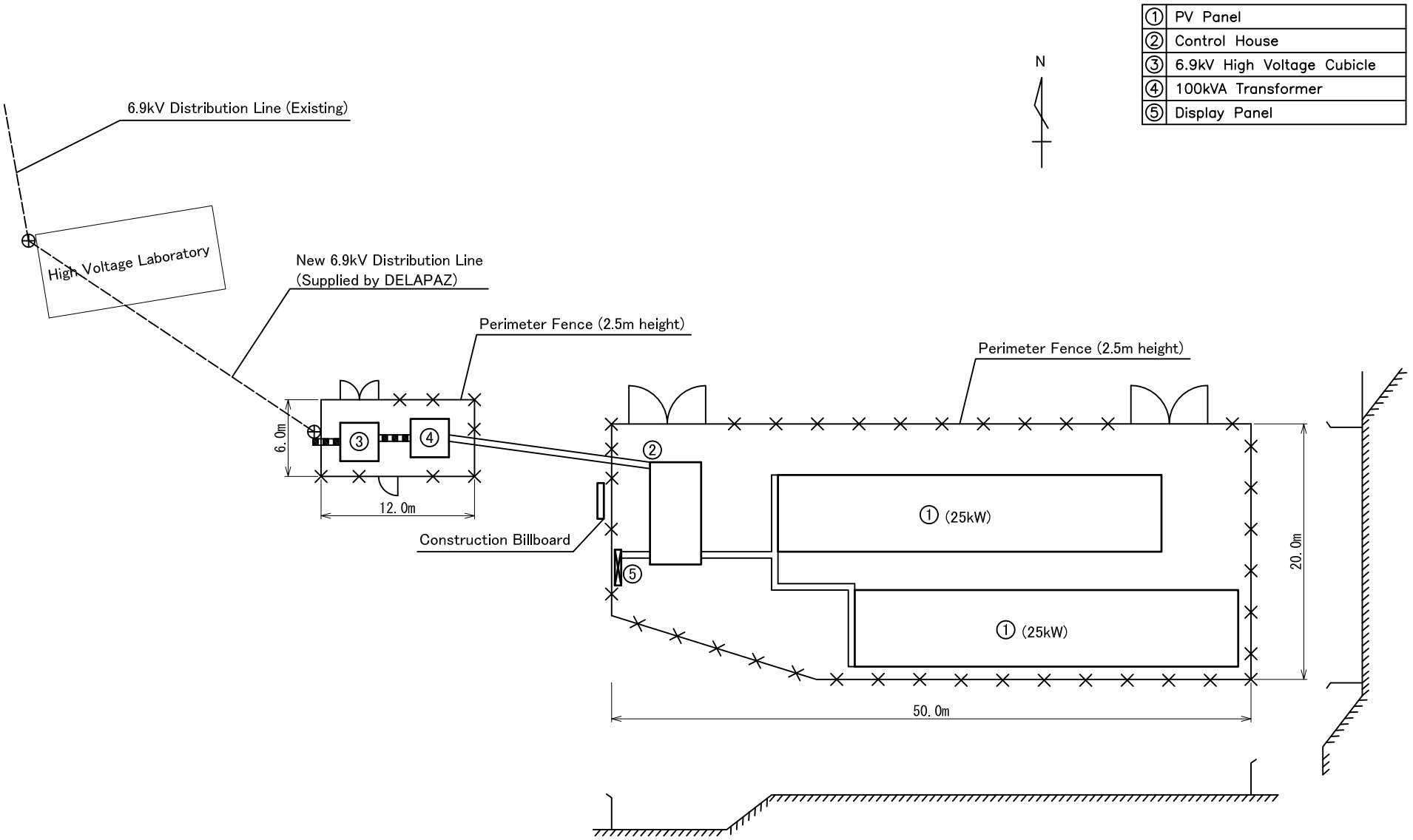
(1) Continuous O&M is not executed because of job changes and dislocation of trained staff.
(2) In the soft component, language to be used is Spanish. Manuals and seminar materials have to be prepared in Spanish.

Necessary measures：

(1) Technologies have to be transferred to several persons. The training manuals and system for O&M technicians have to be maintained in each organization.
(2) Spanish translator is required.

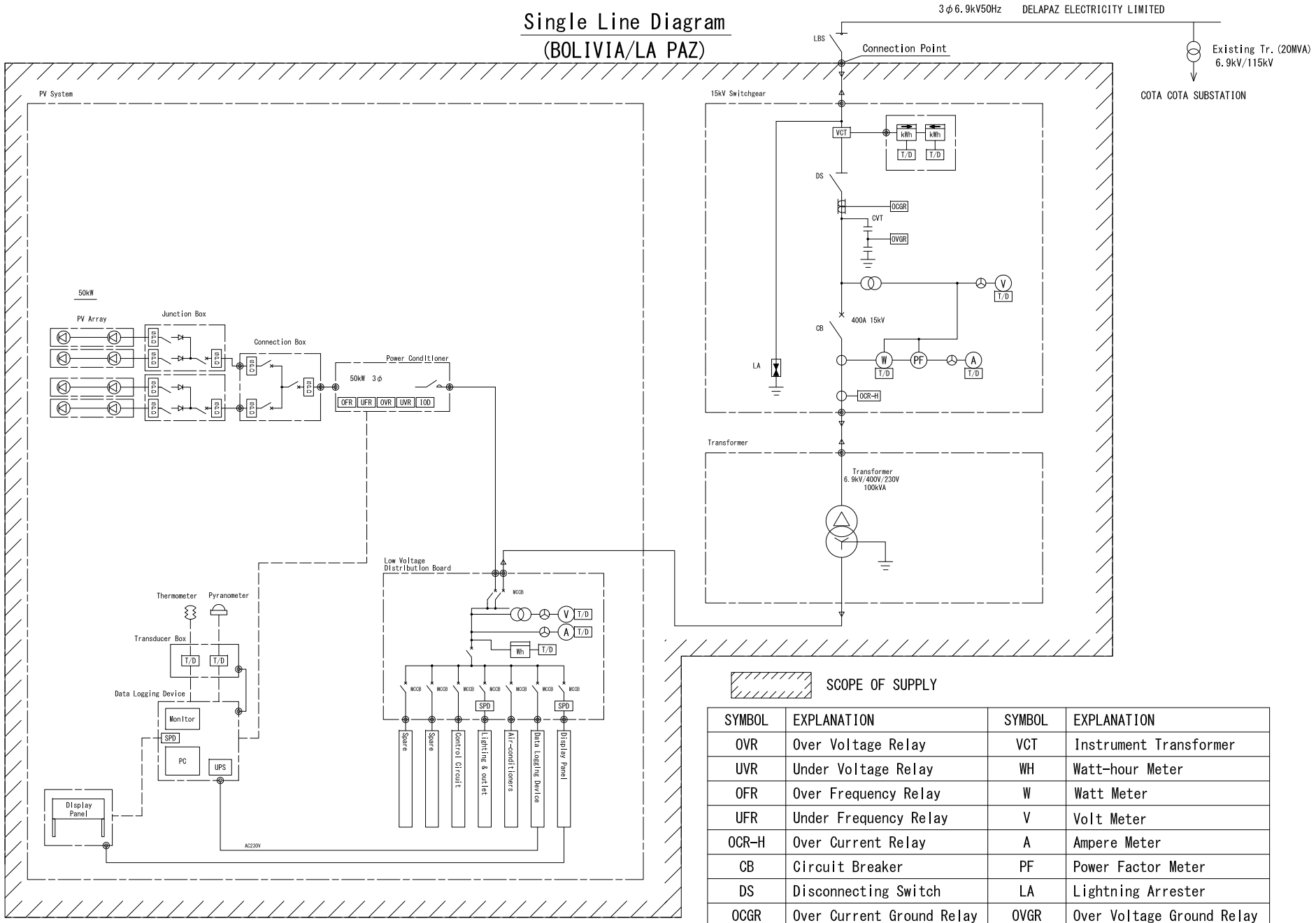
Appendix-6
Drawings

NO	DWG NO	TITLE
1	BO-E-101	UNIVERSIDAD MAYOR DE SAN ANDRÉS LAYOUT DRAWING OF PV SYSTEM (50 KW)
2	BO-E-102	UNIVERSIDAD MAYOR DE SAN ANDRÉS SINGLE LINE DIAGRAM
3	BO-E-103	UNIVERSIDAD MAYOR DE SAN ANDRÉS CIVIL WORKS AND PV SYSTEM FOUNDATION
4	BO-E-201	AEROPUERTO INTERNATIONAL VIRU VIRU LAYOUT DRAWING OF PV SYSTEM (315 KW)
5	BO-E-202	AEROPUERTO INTERNATIONAL VIRU VIRU SINGLE LINE DIAGRAM
6	BO-E-203	AEROPUERTO INTERNATIONAL VIRU VIRU CIVIL WORKS AND PV SYSTEM FOUNDATION



	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA	NIPPON KOEI CO., LTD
		UNIVERSIDAD MAYOR DE SAN ANDRÉS LAYOUT DRAWING OF PV SYSTEM(50kW)	BO-E-101	CHECKED BY	H.EGAWA	
				APPROVED BY	T.KOBAYASHI	
				DATE	2013.4.1	

Single Line Diagram
(BOLIVIA/LA PAZ)

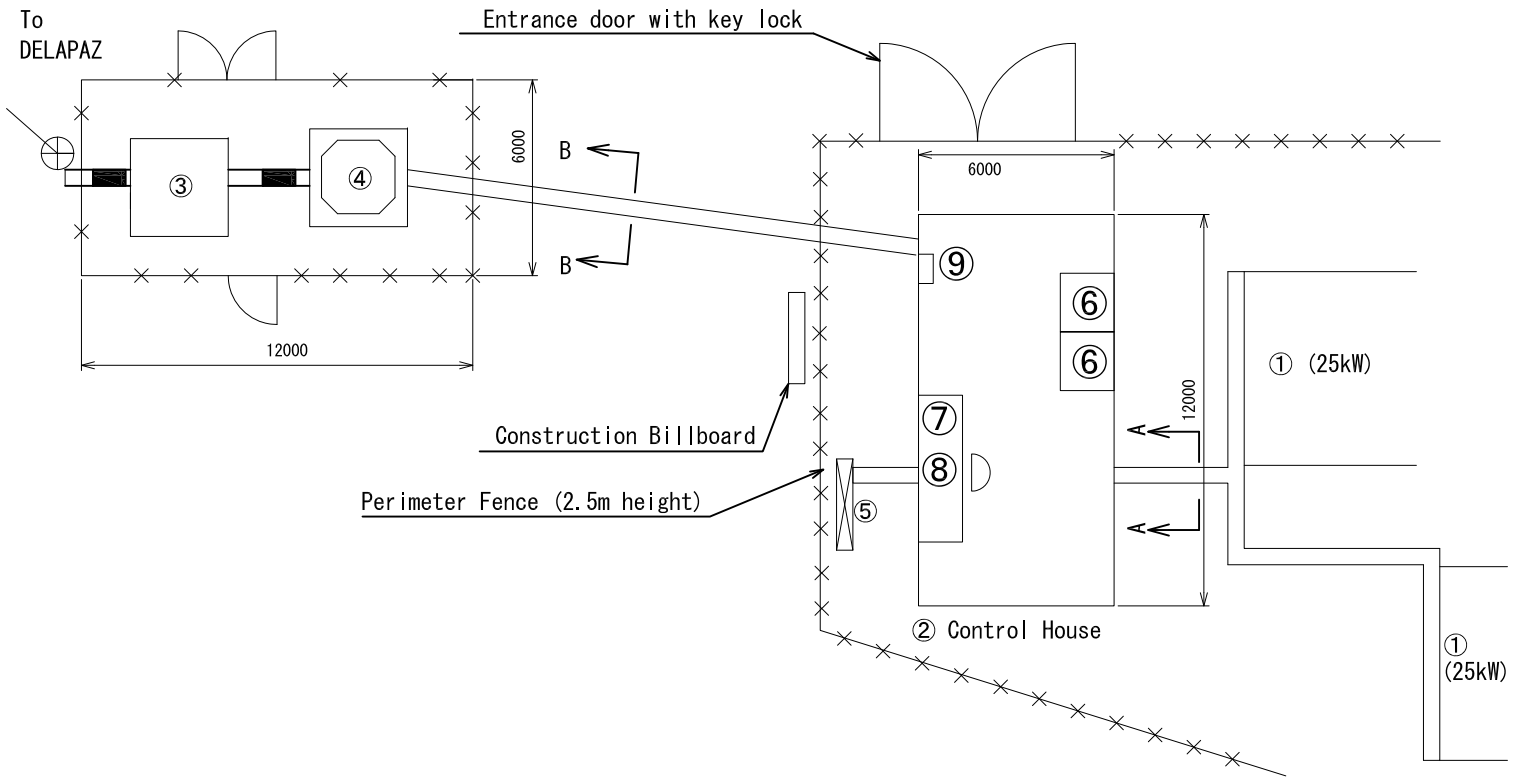


SCOPE OF SUPPLY

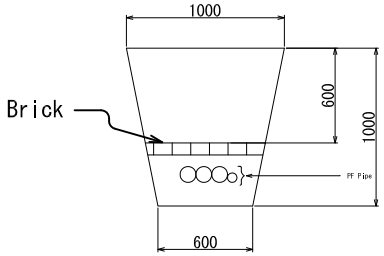
SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
OVR	Over Voltage Relay	VCT	Instrument Transformer
UVR	Under Voltage Relay	WH	Watt-hour Meter
OFR	Over Frequency Relay	W	Watt Meter
UFR	Under Frequency Relay	V	Volt Meter
OCR-H	Over Current Relay	A	Ampere Meter
CB	Circuit Breaker	PF	Power Factor Meter
DS	Disconnecting Switch	LA	Lightning Arrester
OCGR	Over Current Ground Relay	OVGR	Over Voltage Ground Relay
IOD	Islanding Oper.Detector	LBS	Load Break Switch
T/D	Transducer	SPD	Surge Protection Device

For Reference

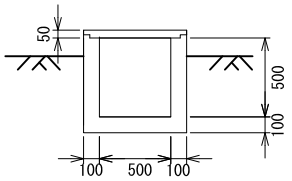
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA	NIPPON KOEI CO., LTD.
	UNIVERSIDAD MAYOR DE SAN ANDRÉS SINGLE LINE DIAGRAM	BO-E-102	CHECKED BY	H.EGAWA	
			APPROVED BY	T.KOBAYASHI	
			DATE	2013.4.1	



①	PV Panel
②	Control House
③	6.9kV High Voltage Cubilcle
④	100kVA Transformer
⑤	Display Panel
⑥	Power Conditioner
⑦	Date Logging Device
⑧	PC Console / desk & chair
⑨	Low Voltage Distribution Board
	22kV Power Cable Route

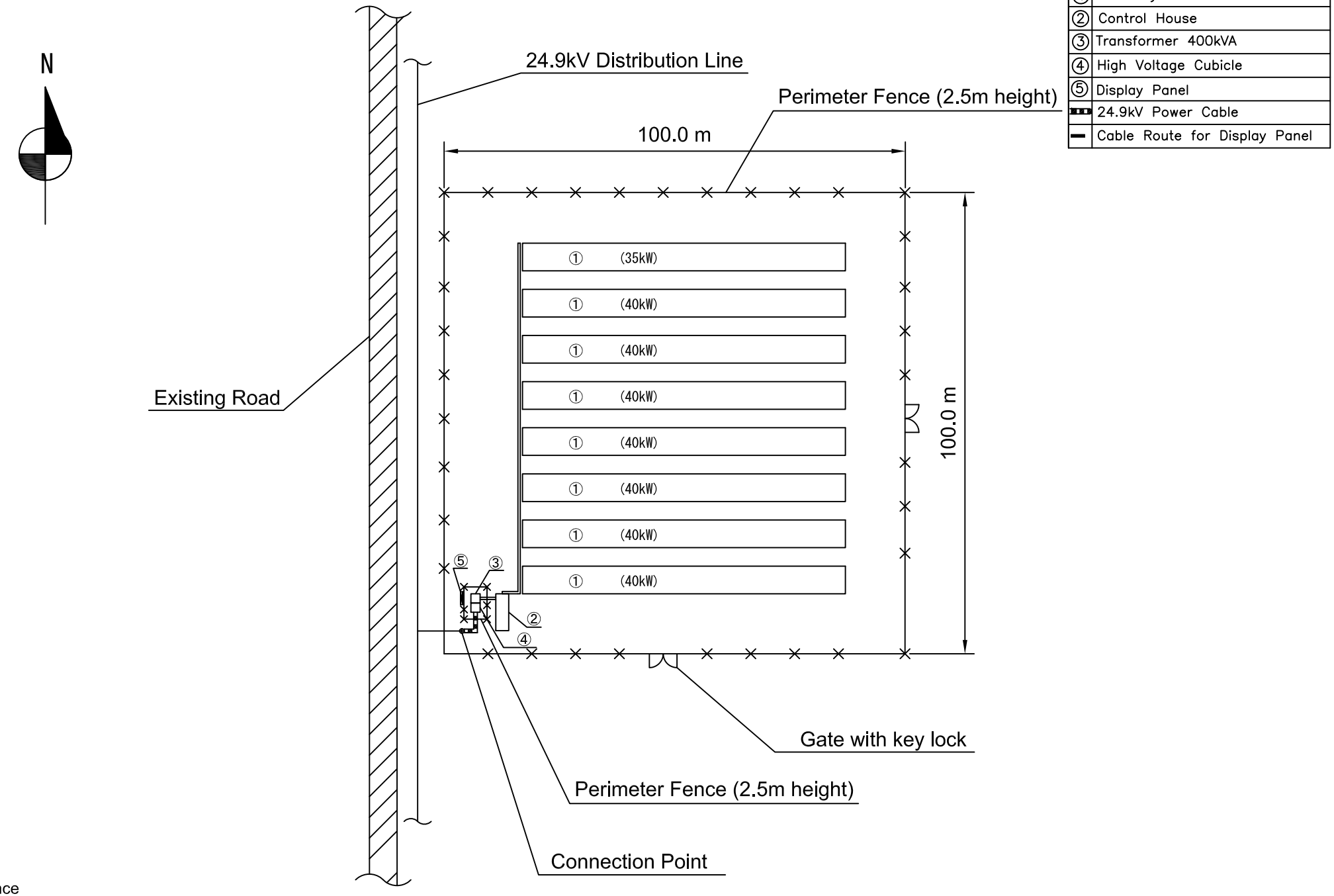


SECTION B-B



SECTION A-A Cable Pit

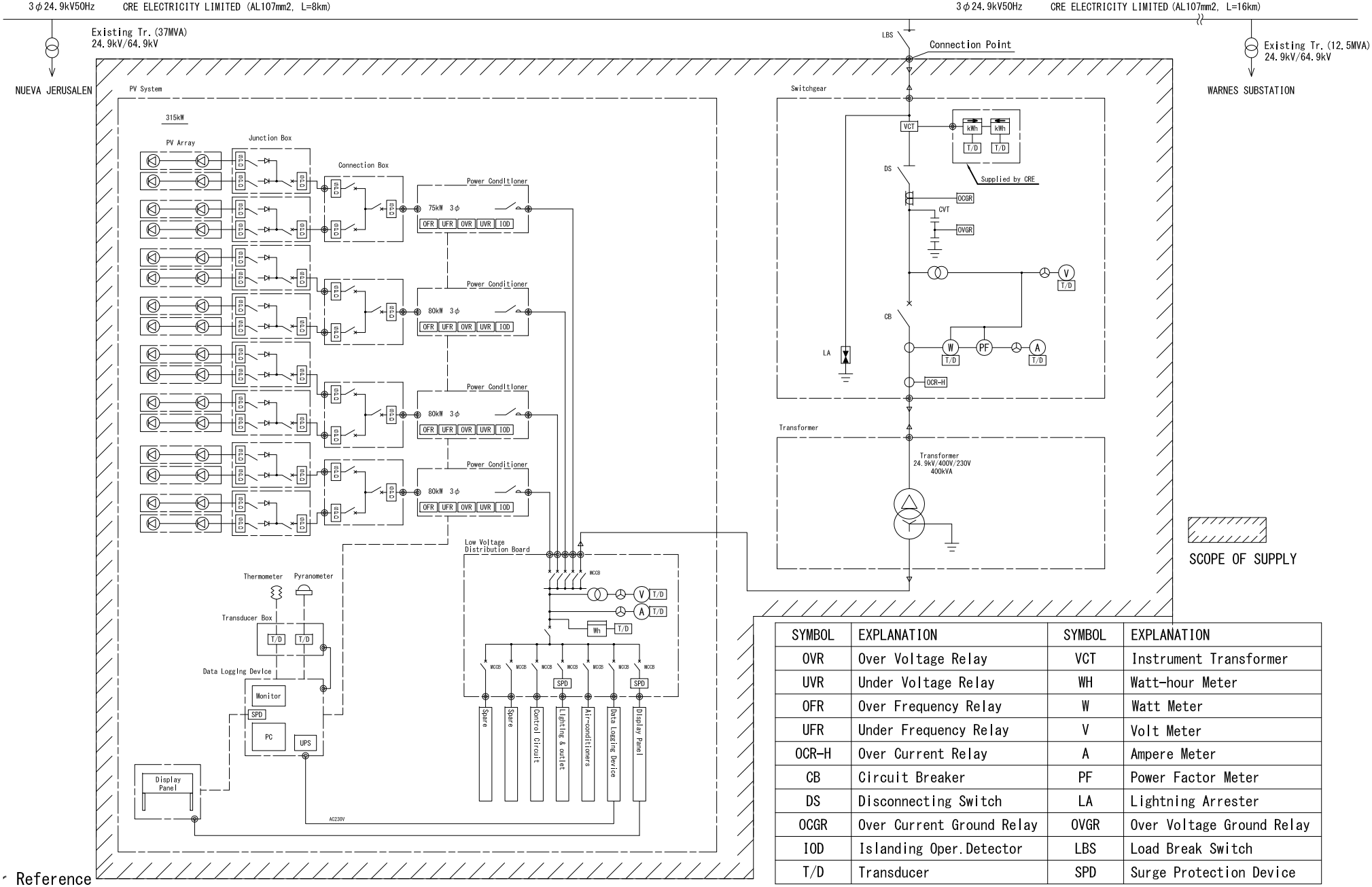
	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA
		UNIVERSIDAD MAYOR DE SAN ANDRÉS CIVIL WORKS	BO-E-103	CHECKED BY	H.EGAWA
				APPROVED BY	T.KOBAYASHI
				DATE	2013.4.1
					NIPPON KOEI CO., LTD.



For Reference

	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA
		AEROPUERTO INTERNACIONAL VIRU VIRU LAYOUT DRAWING OF PV SYSTEM (315kW)	BO-E-201	CHECKED BY	H.EGAWA
				APPROVED BY	T.KOBAYASHI
				DATE	2013.4.1
					NIPPON KOEI CO., LTD.

Single Line Diagram
(BOLIVIA/SANTA CRUZ)

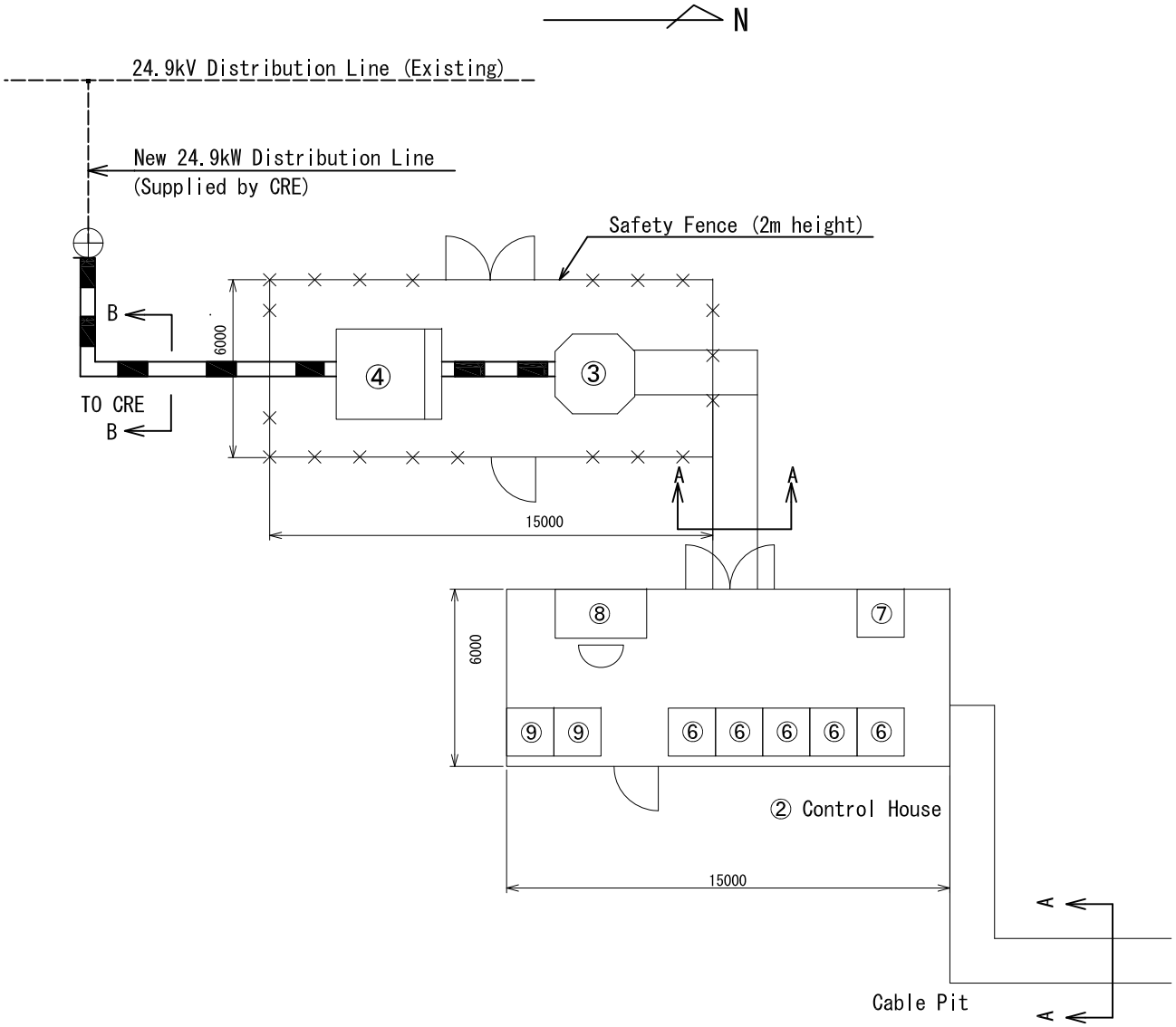


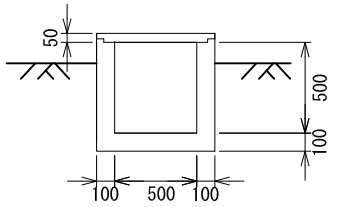
SYMBOL	EXPLANATION	SYMBOL	EXPLANATION
OVR	Over Voltage Relay	VCT	Instrument Transformer
UVR	Under Voltage Relay	WH	Watt-hour Meter
OFR	Over Frequency Relay	W	Watt Meter
UFR	Under Frequency Relay	V	Volt Meter
OCR-H	Over Current Relay	A	Ampere Meter
CB	Circuit Breaker	PF	Power Factor Meter
DS	Disconnecting Switch	LA	Lightning Arrester
OCGR	Over Current Ground Relay	OVGR	Over Voltage Ground Relay
IOD	Islanding Oper.Detector	LBS	Load Break Switch
T/D	Transducer	SPD	Surge Protection Device

Reference

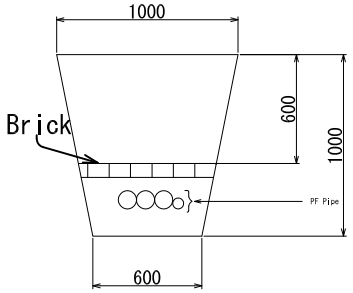
THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA	NIPPON KOEI CO., LTD.
	AEROPUERTO INTERNACIONAL VIRU VIRU SINGLE LINE DIAGRAM	BO-E-202	CHECKED BY	H.EGAWA	
			APPROVED BY	T.KOBAYASHI	
			DATE	2013.4.1	

②	Control House
③	Transformer 400kVA
④	11kV Switchgear
⑥	Power Conditioner 80kW×3sets, 75kW×1set
⑦	Date Logging Device
⑧	PC Console ／ desk & chair
⑨	Low Voltage Distribution Board
▬	22kV Power Cable Route





SECTION A-A Cable Pit



SECTION B-B

	THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM	DRAWING TITLE	DRAW. NO.	PREPARED BY	K.YAZAWA
		AEROPUERTO INTERNACIONAL VIRU VIRU CIVIL WORKS	BO-E-203	CHECKED BY	H.EGAWA
				APPROVED BY	T.KOBAYASHI
				DATE	2013.4.1

NIPPON KOEI CO., LTD.

Appendix-7
References

ESTADO PLURINACIONAL DE BOLIVIA
Ministerio de Hidrocarburos y Energía

La Paz, 21 OCT. 2009
MHE - 5614 DESP - 2868

Señor
Hirofumi Matsuyama
DIRECTOR
AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON
JICA
Presente

Ref.: Proyecto de generación fotovoltaica en Hospitales

De mi consideración:

El Ministerio de Hidrocarburos a través del Viceministerio de Electricidad como cabeza de sector, desea expresarle que la promoción y el desarrollo de la energías renovables están establecidas en nuestro Plan de Desarrollo y en la Nueva Constitución Política del Estado Plurinacional de Bolivia, en ese sentido, el marco normativo actual y el futuro marco a desarrollarse para el sector eléctrico, no afectaran a la implementación del proyecto de generación con sistemas fotovoltaicos conectados a la red en centros de salud del Municipio de La Paz.

Sin otro particular, lo saludo.

Oscar Coca Antezana
MINISTRO DE HIDROCARBUROS
Y ENERGIA

AGENCIA DEL JAPON
22 OCT. 2009
1128
Gaby
Omoya
BOLIVIA

VICEMINISTERIO DE ELECTRICIDAD Y ENERGIAS ALTERNATIVAS
VOBO

OCA/MYC
Cc: Arch.

PLURINATIONAL STATE OF BOLIVIA
HYDROCARBONS AND ENERGY MINISTRY

La Paz, Oct. 21, 2009-12009
MHE-5614 DESP-2868

Sir:
Hirofumi Matsuyama
DIRECTOR
JAPAN INTERNATIONAL COOPERATION AGENCY
JICA
Present

Ref: Photovoltaic generation project in Hospitals

Dear Sir:

The Ministry of Hydrocarbons through the Vice Ministry of Electricity as head of sector, wishes to express that the promotion and development of renewable energy are set out in our Development Plan and the New Political Constitution of Plurinational State of Bolivia, in that sense, the current regulatory framework and to develop future framework for the electricity sector, will not affect the implementation of the project generation with photovoltaic systems connected to the grid on the health centers in the municipality of La Paz.

Without further ado, I salute you.

Coca Oscar Antezana
HYDROCARBONS AND ENERGY MINISTRY

OCA / MYCH
CC: Arch

ESTADO PLURINACIONAL DE BOLIVIA
Ministerio de Hidrocarburos y Energía

La Paz, 14 de Junio de 2013
MHE – 04667 VMEEA – 00505

AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON
CORRESPONDENCIA RECIBIDA
Fecha: 25-06-13
Hora: 0581 ADJ
Recibido por: Carla
Firma: Pilar San
LA PAZ---BOLIVIA

Señor
Hydeyuki Maruoka
Director Representante
Residente JICA en Bolivia
Agencia de Cooperación Internacional del Japón
Presente.-

REF. Proyecto Energía Solar

De mi consideración:

De acuerdo a la documentación comprometida en la minuta de discusión suscrita por el Viceministerio de Electricidad y Energías Alternativas - VMEEA, la Agencia de Cooperación Internacional del Japón - JICA, la Universidad Mayor de San Andrés - UMSA y la Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea - AASANA. Adjunto a la presente las licencias ambientales de los proyectos de instalación de paneles fotovoltaicos:

- Certificado de Dispensación (CD-4) 020101-05-CD-4N°5433/13 a favor del proyecto: "Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar" - UMSA
- Certificado de Dispensación (CD-4) 070201/05/CD-4/N°5437/13 a favor del proyecto: "Introducción de Energía Limpia por Sistema de Generación de Electricidad Solar en el Aeropuerto de Viru Viru" - AASANA

Sin otro particular, saludo a usted con las consideraciones más distinguidas,

Ing. Hortensia Jimenez Rivera
VICEMINISTERIO DE ELECTRICIDAD Y ENERGÍAS ALTERNATIVAS
MINISTERIO DE HIDROCARBUROS Y ENERGIA

Adjunto lo citado
HJR/JMGF/rvb/lrb
cc. Arch.

Quinua
2013 Año Internacional
El futuro sembrado hace miles de años

Estado Plurinacional de Bolivia

Ministerio de Medio Ambiente y Agua

MMAyA
Ministerio de Medio Ambiente y Agua

CERTIFICADO DE DISPENSACIÓN (CD-4)
070201/05/CD-4/N° 5437/13

LA AUTORIDAD AMBIENTAL COMPETENTE NACIONAL

CERTIFICA:

Que, dando cumplimiento al artículo 25° de la Ley N° 1333 del Medio Ambiente y con ajustes al Procedimiento de Evaluación de Impacto Ambiental del Reglamento de Prevención y Control Ambiental, la Administración de Aeropuertos y Servicios Auxiliares a la Navegación Aérea.(A.A.S.A.N.A.), representada legalmente por el Cnl. Raúl Velasco Ramos ha presentado el Formulario de Solicitud de Certificado de Dispensación N° 5437, tal como dispone el Decreto Supremo N° 27173 del 15 de septiembre de 2003, del proyecto: **"INTRODUCCIÓN DE ENERGÍA LIMPIA POR SISTEMA DE GENERACIÓN DE ELECTRICIDAD SOLAR EN EL AEROPUERTO DE VIRU VIRU"**, ubicado en el municipio de Warnes, provincia Warnes del Departamento de Santa Cruz, tal como dispone el Decreto Supremo N° 27173 del 15 de septiembre de 2003, quedando DISPENSADO DE LA ELABORACIÓN DEL ESTUDIO DE EVALUACIÓN DE IMPACTO AMBIENTAL (EEIA), habiendo cumplido con los requisitos mínimos, de acuerdo a lo establecido en el informe Técnico – Jurídico MMAyA-VMABCCDGF-DGMACC-FSCD 5437(a) N° 1821/13, por lo cual queda autorizado, para la ejecución del proyecto.

El presente **Certificado de Dispensación (CD)** se constituye conjuntamente con el Formulario de Solicitud del Certificado de Dispensación, en la referencia técnico legal, para la realización de los procedimientos de Control de Calidad Ambiental establecidos en el Reglamento de Prevención y Control Ambiental.

Finalmente, la Autoridad Ambiental Competente Nacional (AACN) requerirá en el momento necesario el cumplimiento a las disposiciones establecidas en los reglamentos ambientales conexos.

Es cuanto certifico para los fines consiguientes.

La Paz, 06 de junio de 2013

Ing. Por. Juan Pablo Cardozo Arnez
VICEMINISTERIO DE MEDIO AMBIENTE, BIODIVERSIDAD CAMBIOS CLIMÁTICOS Y DE GESTIÓN Y DESARROLLO FORESTAL
MMAyA

Ing. Francisco Salvatierra Iwanami
DIRECTOR GENERAL DE MEDIO AMBIENTE Y CAMBIOS CLIMÁTICOS
VMA - MMAyA

Estado Plurinacional de Bolivia

Ministerio de Medio Ambiente y Agua

MMAyA
Ministerio de Medio Ambiente y Agua

CERTIFICADO DE DISPENSACIÓN (CD-4)

020101-05-CD-4 Nº 5433/13

LA AUTORIDAD AMBIENTAL COMPETENTE NACIONAL

CERTIFICA:

Que, dando cumplimiento al artículo 25º de la Ley Nº 1333 del Medio Ambiente y con ajustes al Procedimiento de Evaluación de Impacto Ambiental del Reglamento de Prevención y Control Ambiental, la Universidad Mayor de San Andrés, representada legalmente por la **Sra. Maria Teresa Rescala Nemtala** ha presentado el Formulario de Solicitud de Certificado de Dispensación N°5433, tal como dispone el Decreto Supremo Nº 27173 del 15 de septiembre de 2003, del proyecto: **"INTRODUCCIÓN DE ENERGÍA LIMPIA POR SISTEMA DE GENERACIÓN DE ELECTRICIDAD SOLAR"**, ubicado en el municipio de La Paz, Provincia Murillo del Departamento de La Paz, tal como dispone el Decreto Supremo Nº 27173 del 15 de septiembre de 2003, quedando DISPENSADO DE LA ELABORACIÓN DEL ESTUDIO DE EVALUACIÓN DE IMPACTO AMBIENTAL (EEIA), habiendo cumplido con los requisitos mínimos, de acuerdo a lo establecido en el informe Técnico - Legal MMAyA-VMABCCDF-DGMACC Nº 1353/13 – FSCD 5433(a), por lo cual queda autorizado, para la ejecución del proyecto.

El presente **Certificado de Dispensación (CD)** se constituye conjuntamente con el Formulario de Solicitud del Certificado de Dispensación, en la referencia técnico legal, para la realización de los procedimientos de Control de Calidad Ambiental establecidos en el Reglamento de Prevención y Control Ambiental.

Finalmente, la Autoridad Ambiental Competente Nacional (AACN) requerirá en el momento necesario el cumplimiento a las disposiciones establecidas en los reglamentos ambientales conexos.

Es cuanto certifico para los fines consiguientes.

La Paz, 26 de abril de 2013

Ing. Francisco Salvatierra Iwanami
DIRECTOR GENERAL DE MEDIO AMBIENTE
Y CAMBIOS CLIMÁTICOS
VMA - MMAyA

Ing. Por Juan Pablo Cardozo Arnez
VICEMINISTRO DE MEDIO AMBIENTE
BIODIVERSIDAD, CAMBIOS CLIMÁTICOS Y DE
GESTIÓN Y DESARROLLO FORESTAL
MMAyA