Palestinian Energy Authority,
Palestinian Authority

FINAL REPORT ON THE PREPARATORY SURVEY (OUTLINE DESIGN) ON THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY BY SOLAR ELECTRICITY GENERATION SYSTEM IN PALESTINE

July 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS CO., LTD.

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PREFACE

Japan International Cooperation Agency (JICA) conducted the preparatory survey on the Project for Introduction of Clean Energy by Solar Electricity Generation System in the Palestinian Authority.

JICA sent to Palestine a survey team from 10 October to 23 October 2009 and from 19 November to13 December 2009.

The team held discussions with the officials concerned of the Government of Palestine, 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 Palestine 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 the Palestinian Authority for their close cooperation extended to the teams.

July, 2010

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

July, 2010

Letter of Transmittal

We are pleased to submit to you the preparatory survey report on the Project for Introduction of Clean Energy by Solar Electricity Generation System in Palestinian Authority.

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

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

Very truly yours,

Mitsuo OCHI
Project Manager,
Preparatory Survey Team on
The Project for Introduction of Clean Energy
by Solar Electricity Generation System
in Palestine
Oriental Consultants Co., Ltd.

SUMMARY

SUMMARY

1 Background and Outline of Proposal for Official Grant Aid

(1) Territory and Nature

Palestinian Authority (hereinafter referred to as "Palestine") is located at latitude 29° 30′N - 33° 15′N and longitude 24° 10′E - 35° 40′E and consist of two (2) territories. One is called West Bank which is close to Jordan and having mountainous areas in southern part of Jordan Valley, and another one called Gaza Strip which is close to the Mediterranean Sea and having coastal areas. Palestine is self-interim government having a total land area of 6,020 square kilometers (5,655 km2 for the West Bank and 365 km2 for Gaza Strip) and belongs to the region of the Middle East.

According to the data for the year 2008[1], total population of Palestine is about 3.83 million (about 2.39 million for the West Bank and about 1.44 million for Gaza Strip). And, population density in the West Bank is 422/km^2 which is quite moderate but the population density in Gaza Strip was 3,946/km^2 which is extremely high.

Although Jericho municipality where the project site is located in Jordan Valley and is abundant in water resources compared to other areas of Palestine, annual precipitation is only about 115.2mm[2], most of which are recorded during a couple of months in winter. And, Jericho is quite dry and dudty throughout the year since its annual average humidity is as low as 53% and prone to a sandstorm from Egypt around the month of May in spring. And, Jordan River which is the only stream around this area flow southern direction from the Sea of Galilee which is the largest freshwater lake in this region towards the Dead Sea which contains extremely high concentration of salt.

(2) National Economies

According to the data for the year 2007[3], Gross Domestic Product (GDP) was 4,535.7 million US dollars and its growth rate was 4.94%. Per capita GDP was 1,298 US dollars; US$1,555.30 for the West Bank and US$911.00 for Gaza Strip while rate of price increase (2007-2008) and rate of unemployment were 9.89% and 26.0% (19.0% for the West Bank and 40.6% for Gaza Strip) respectively. On the other hand, according to the data for the year of 2006 published by United Nations Relief and Works Agency (UNRWA), poverty rate was 55.6% (43.2% for the West Bank and 79.8% for Gaza Strip).

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1 Palestine Central Bureau of statistics (PCBS): Palestine in Figures 2008. Ramallah, Palestine May, 2009

2 Annuan precipitation for the year 2007 reported in ERPress2008 news article titled "Palestinian Central Bureau of Statistic Issues a Press Release on the Occasion of World Metrological Day" dated 23/03/2008, and according to the same, annual precipitation of Ramallah for the same year is 543.9mm.

3 Palestine Central Bureau of statistics (PCBS): Palestine in Figures 2005. Ramallah, Palestine May, 2009

Furthermore, according to the above-mentioned data for the year 2007, percentage contributions to GDP by economic activities were agriculture and fishing (5.6%), mining, manufacturing, etc (13.8%), construction (6.2%), financial intermediation (5.2%), public administration and defense (13.9%), transport and communication (7.5%), wholesale and retail (9.2%), services (22.2%) and others (16.4%).

2 Outline of the Study Results and Contents of the Project

In the address of the then Prime Minister Fukuda of Japan during World Economic Forum held in Davos, Switzerland in January 2008, an establishment of "Cool Earth Partnership" was announced as a new financial mechanism for the developing countries making an effort to contribute to the climate change and to promote clean energy by balancing their economic growth with reduction of greenhouses gases emissions. And, as a component of the said new financial mechanism, a new scheme of grant aid called "Program Grant Aid for Environment and Climate Change (GAEC) was also introduced in 2008 by the Government of Japan (hereinafter referred to as "GoJ").

With such background, the Ministry of Foreign Affairs of GoJ conducted the survey in Palestine on the needs for GAEC in utilization of photovoltaic (PV) system. And, as a result of the said survey, the implementation of the preparatory suvey of the Project was decided as Palestine submitted its Application for GAEC of this Project.

On the other hand, in recent years (1999-2005), electricity demands have increased by 6.4% in the West Bank and 10%[4] in the Gaza Strip and Palestinian Authority is having a hard time to bear the increased cost of its procurement.

Therefore, since an energy development is an urgent requisite in Palestine, Palestinian Energy & Environment Research Center (PEC) taking the lead in positive utilization of the renewable energy which is an agency within jurisdiction of Palestinian Energy Authority (PEA) of Palestine established a five-year plan entitled "National Plan for Development of Renewable Energy & Efficiency 2007-2012" in June 2007 which adopts their objectives such as 1) to raise the rate of renewable energy contribution in the Palestine energy balance to reach 20% of the final total consumption of energy and 2) to improve energy usage especially in the industrial and construction sectors and to reduce their needs of imported energy.

A main objective of the said 5 years plan is to raise or improve the balance of clean energy such as solar power to more than 20% of the total energy consumption while Palestine is groping for cooperation in measures for climate change with international organizations and an application of Clean Development Mechanism (CDM).

[4] 1995-2005 World Bank Report, West Bank and Gaza Energy Sector Review

Under these circumstances, Palestine has decided to join the Cool Earth Partnership and to aim balancing economic growth and reduction of greenhouse gases emissions with adaptation activities to climate change.

The Preparatory Survey Team conducted discussions on the Project including the field surveys at the project site with PEA, Ministry of Planning and Administration (MOPAD), Palestine Industrial Estates and Free Zones Authority (PIEFZA) and other relevant authorities while during their stay in Palestine from October 10th to October 23rd 2009 for 1st preparatory survey and from November 19th to December 13th 2009 for 2nd preparatory survey. And, during their stay in Palestine from April 25th to May 2nd 2010 for 3rd preparatory survey, the Preparatory Survey Team explained and conducted deliberation on the outlines of the draft final report (DFR) of the Project to PEA, MOPAD, PIEFZA and other relevant authorities.

Although requested capacity of the PV system of the Project was 550kWp, it was reduced to 300kWp due to budget limitation and the said change was explained to the Palestinian side during 2nd preparatory survey. And, as a result, it was duly agreed by the Palestinian side. However, with consideration of securing an area for the installation of additional PV system in future by an effort of the Palestinian side, the Preparatory Survey Team reconfirmed during 2nd preparatory survey with the Director of PIEFZA, which is responsible for Jericho Agro-Industrial Park, regarding the provision of the site area of 1.3ha which was originally agreed during 1st preparatory survey.

Furthermore, as a result of the preparatory surveys, it wa found that there were no regulations5, experiences and achievements for the grid-connection, reverse power flow and sale of power in connection with the solar power generation in Palestine so as Jerusalem District Electricity Company[6] (hereinafter referred to as "JDECO") which is the only power distribution company in the West Bank. However, it was confirmed that JDECO has agreed in principle as to the grid-connection and reverse power flow as stated in their letter dated 8th of December 2009 which was addressed to PEA.

As for the procurement and installation of the equipment for the PV system for the Project, it is planned to procure and install necessary equipment for the grid-connected (with reverse power flow) PV system described below as a result of discussions and verifications with the Palestinian side and analysis conducted in Japan based on the design policy described in Chapter 2.

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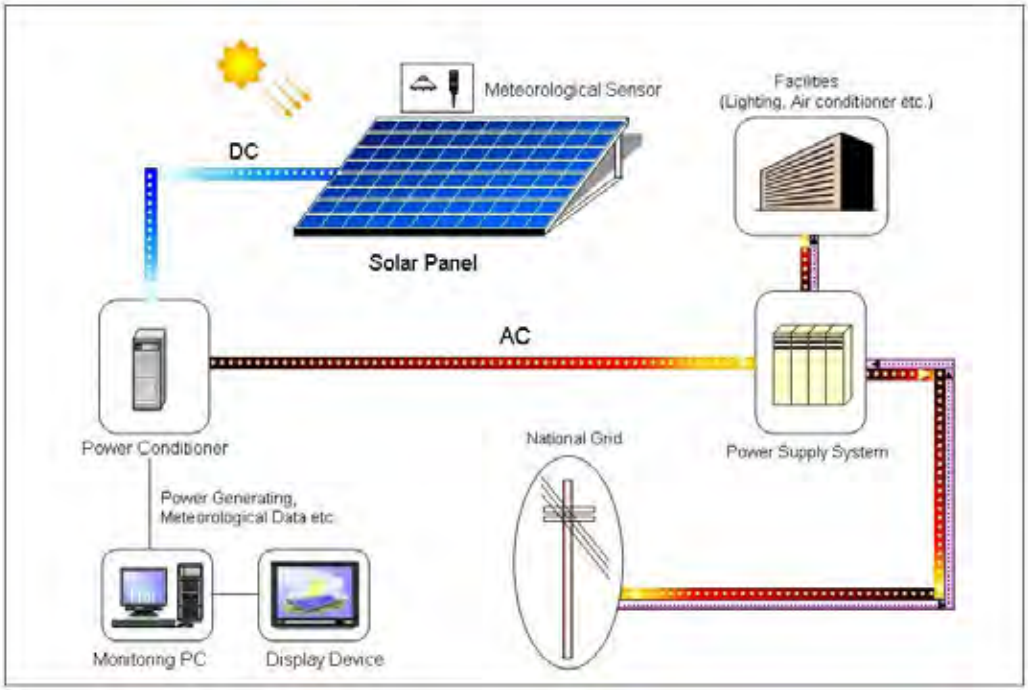
5 New Electrical Law which has taken effect on May, 2009 prescribe establishment of Palestinian Electricity Regulatory Council (PERC) aiming to regulate approval of the electrical industry and its bylaws is currently being discussed at Prime Minister's Office. If approved, PERC will be a regulatory authority for the electrical industry.

6 JDECO was established by Geek man in 1926 as a company to supply electricity within Jerusalem but now it supplies electricity to Ramallah, Jericho and Bethlehem in the West Bank in addition to Jerusalem. Ramallah, Jericho, Bethlehem and other municipalities in the Palestinian Authority hold 49% of JDECO shares while remaining 51% is held by the private sector. Number of employee of JDECO is more than 800.



Source: Preparatory Survey Team

Fig. 1 Conceptual Image of Grid-connected PV System

And, an agreed support plan, image of PV system installation, system description and equipment specification are as shown in the tables and figure below:

Table 1 Support Plan of the Project

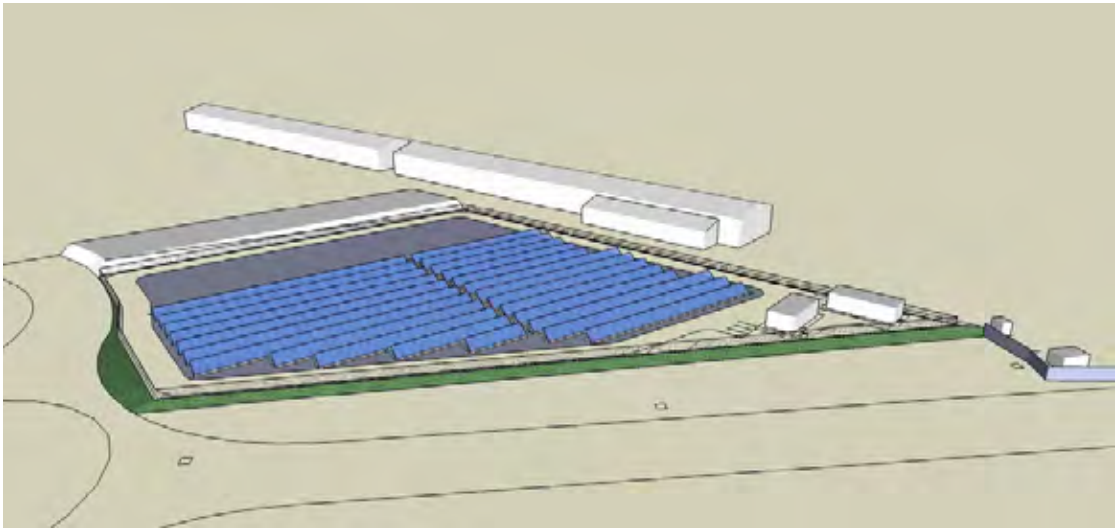
Equipment for Solar Electricity Generation			
1	Equipment	Uses	Needs
	Grid-connected PV System	Power generated by PV system will supply power to Agro-Industrial Estate planned to be constructed in a suburb of Jericho city as well as to supply to Jericho city that will contribute to supplement the power supplies in Jericho by connecting the system to a secondary side of transformer to be placed in newly installed substation which will enable a reverse power flow to an existing 33kv power distribution grid.	Reduction of greenhouse gases by reducing consumption of fossil fuel for power generation; combustion turbine using heavy oil only at present, by utilization of solar energy is sought in Palestine as measures for climate change. And, cost of importing powers from neighboring countries; Israel and Jordan, is weighing heavily on Palestine's national budget.
Technical Assistance for Solar Electricity Generation			
2	Technical Assistance for Grid-connected PV System	Technical training necessary for appropriate operation and maintenance of grid-connected PV system which include basic knowledge, coordination with existing power distribution system, method of inspection and maintenance, troubleshooting, etc.	Since the introduction of a grid-connected PV system will be a first time in Palestine, there are no trained specialists and/or engineers who have knowledge of installation of grid-connected PV system and operation and maintenance thereof. Therefore, it is necessary to acquire and improve such knowledge and relevant technologies.

Source: Preparatory Survey Team

Table 2　System Description

Implementing Agency	Palestinian Energy Authority
Candidate Site	Jericho Agro-Industrial Park (Phase 1)
Location	Developed land in the suburbs of Jericho Municipality in West Bank, Palestine
Land Owner	Palestine National Authority
License Holder	PIEFZA
Rating Capacity	300KWp
Expected Amount of Power Generation	Approx. 422,000KWh
Amount of reduction of carbon dioxide[7]	Approx. 290.6 tons
Area of Installation	13,000 ㎡（Including area for future extension）
Expected Consumers	Common utility power for the Agro-Industrial Park（Commercial and residential consumers in Jericho Municipality in the initial stage）

Source: Preparatory Survey Team



Source: Preparatory Survey Team

Fig. 2　Image of PV System Installation

[7] Amount of reduction of carbon dioxide is calculated based on the data provided by NEDO (refer to Chapter 3 for details)

Table 3　Equipment Specification

Item	Specification	Qty	Uses
PV modules	Mono or poly-crystalline cells or thin film amorphous cells with rating capacity of 300KWp or more	1 lot	To transform solar light to electricity.
Supporting structures for PV modules	Hot-dipped galvanized steel frames	1 lot	Supporting frame to fix PV modules which will be placed on concrete slab foundation.
Power conditioners	Rating capacity of 300KW or more and output voltage shall be 380V Efficiency: not less than 90% Harmonic distortion of output current: Total; not more than 5%, Each harmonics; not more than 3% Power factor: not less than 0.95 Grid- connected protection relay ・Over voltage relay ・Under voltage relay ・Over frequency relay ・Under frequency relay ・Individual operation detecting relay: (Passive protection and Active protection) Ingress protection rating: not less than IP20	1 lot	To convert direct current power generated by PV modules to alternating current power and to be with protective function for grid-connected PV system
Connection boxes	Devices to be installed: DC circuit breakers, By-pass current diodes, Protector for induced lightning stroke (ZNR), Terminal block etc. Ingress protection rating： not less than IP53	1 lot	To collect DC power generated by PV modules and to feed it to collection box
Collection boxes	Device to be installed: DC circuit breaker Ingress protection rating: not less than IP53	1 lot	To collect DC power from connection boxes by putting it together systematically and feed it to power conditioners
Data management and monitoring system (incl. personal computer)	・Personal computer ・CRT（19 inch or bigger） ・Data sensing instruments ・Signal transmitter ・UPS（more than 10 minutes capacity） ・Color printer (compatible with A3 size printing) ・Software for data monitoring ・Software for display	1 lot	To track the amount of generated power, input and output voltage to and from power conditioners, solar radiation and air temperature as well as to record and display them in the specified format to be set, and in addition, it shall keep monitoring of the performance of the whole PV system and shall control operation of display system.
Meteorological observation instruments	Solar radiation meter	1 No.	To observe solar radiation.
	Thermometers	1 No	To observe air temperature
		1 No.	To observe PV module surface temperature.
Display	Flat panel 32 inch or bigger （Liquid crystal or PDP）	1 No.	To indicate the amount of generated power (present, daily, monthly and annual), meteorological data (air temperature, solar radiation), the expected reduction of carbon dioxide gas and general description of the PV system.
Substation equipment	Including a network transformer （33KV→380V、630kVA）	1 lot	To reverse the output power (380V) generated by PV system to 33 KV high tension grid with protective devices.
Camera	Fixed outdoor colored camera	14 No.	To observe the boundary of project site for security and to transmit image data to a LCD monitor
LCD Monitor	Flat panel 21 inch or bigger (Liquid crystal)	1 No.	To monitor the images captured by cameras
Digital Video Recorder	Digital image recorder with hard disk (600GB or more)	1 No.	To record and store the images captured by cameras
Additional Hard Disk	Internal hard disk (2.4TB or more)	1 No.	To reserve additional capacity for storage of image data
Power Supply Unit	Input: AC 220V, Output: AC 24V, 5 ampere or more	1 No.	To distribute 24V power to the cameras
Cabinet Rack	Indoor self standing type Dimension: 570 mm (W) x 440 mm (D) x 2000mm (H)	1 No.	To enclose LCD monitor, Digital Video Recorder, Additional Hard Disk and Power supply unit, etc.

Source: Preparatory Survey Team

3 Implementation Schedule and Project Cost

The implementation period of the Project will be 4.5 months for detailed design and tender process and 12.5 months for procurement and installation works which includes manufacturing of equipment, transportation, adjustment and commissioning, initial operation guidance, final inspection and handover. And, 1.5 months for soft component which includes 0.5 month overlapping period with the procurement and installation works. Thus, the total implementation period of the Project will be 18months after conclusion of consulting services agreement.

And, an estimated cost to be borne by the Recipient for the implementation of the Project is as follows:

(1) Cost to be borne by the Recipient (Palestine) : 1.2 Million Japanese Yen (NIS 48,000)

4 Project Evaluation and Recommendations

As the Project meets necessary conditions of a new scheme of grant aid project of Japan called "GAEC", it is judged that implementation of the Project is recommendable giving consideration of that the Project will greately contribute to extension and expansion of solar power generation as taking the initiative in utilization of the renewable energy in Palestine although the magnitude of undertaking of solar power generation to be implemented by the Project is relatively quite small.

And, grounds for indicating the validity of the Project are as follows:

(1) By taking opportunity of the implementation of this Project, beneficial of the Project will expand to an entire population of the West Bank including the poor and needy which is counted as much as 240 million through further extension and/or expansion of the PV system.

(2) This Project will enable to contribute for stable power supply in Palestine through extension and/or expansion of the PV system. And, allied industries, such as power supply, housing, construction, manufacturing, etc., involving PV system which is expected world-wide extension and/or expansion from now on will be promoted.

(3) The PV system is "maintenance-free" in principle and can be operated and maintained with limited fund and personnel in Palestine since it is not required an advanced or a high degree of technical skill.

(4) This Project is the project which was requested from Palestine in response to invitation by the Government of Japan in order to achieve objectives set for mid-term and long-term development plan in Palestine.

(5) This Project will become a test case and/or pilot project for extension and/or expansion of the PV system for the people in Palestine that is groping for developing and/or exploiting renewable energy.

(6) The Project will fulfill the objectives of "Cool Earth Partnership" which is a new financial mechanism for developing countries willing to contribute for stabilization of the climate through balancing reduction of greenhouse gases emission with economic growth and will contribute for the reduction of carbon dioxide (CO_2) and mitigation of global warming.

(7) The Project can be implemented by a new scheme of grant aid called "GAEC" without any difficulties.

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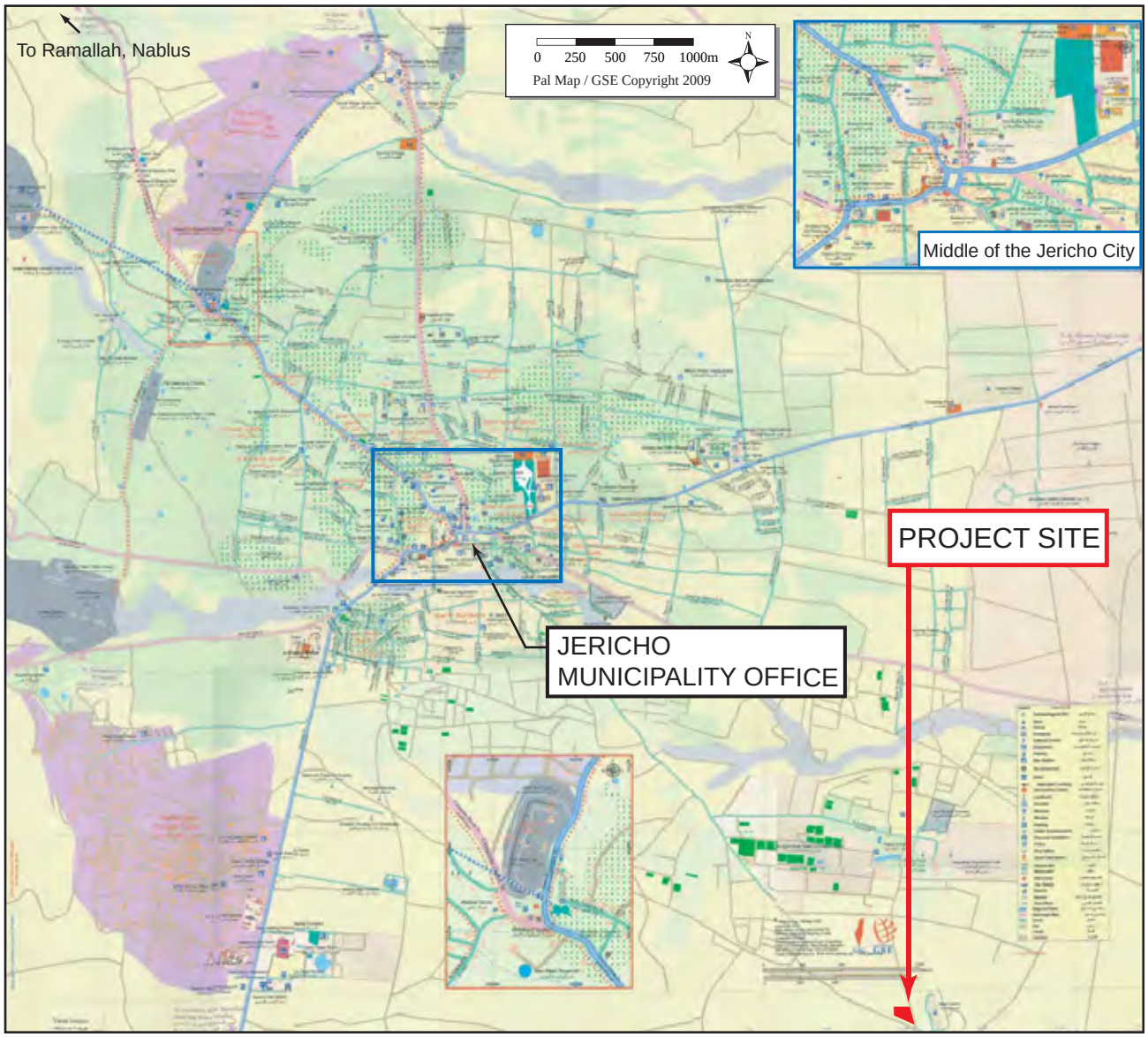
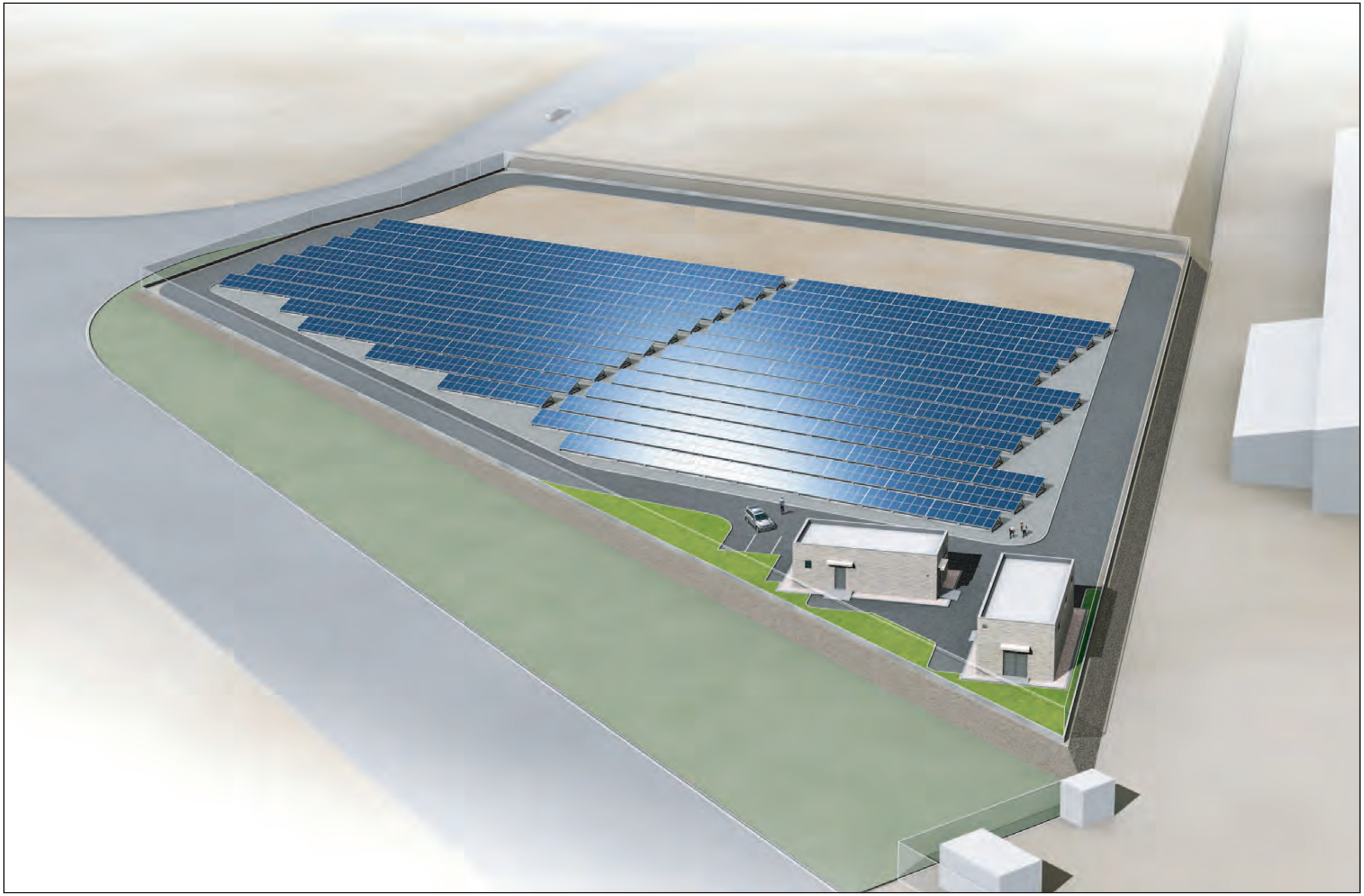


Location Maps



THE PROJECT FOR INTRODUCTION OF CLEAN ENERGY
BY SOLAR ELECTRICITY GENERATION SYSTEM
IN PALESTINE

ORIENTAL CONSULTANTS CO.,LTD.

PERSPECTIVE

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS

AC	Alternate Current
A/M	Agreed Minutes
A/P	Authorization to Pay
ASTM	American Society for Testing and Materials
B/A	Banking Arrangement
BS	British Standard
CCTV	Closed Circuit Television
CDM	Clean Development Mechanism
CO_2	Carbon Dioxide
CRT	Cathode Ray Tube
CSP	Concentrated Solar Power
DC	Direct Current
DFR	Draft Final Report
EIA	Environmental Impact Assessment
E/N	Exchange of Notes
F/S	Feasibility Study
G/A	Grant Agreement
GAEC	Grant Aid for Environment and Climate Change
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoJ	Government of Japan
HT	High Tension
IEC	Israel Electric Corporation Limited
IEC Standard	International Electro technical Commission Standard
JAIP	Jericho Agro-Industrial Park
JASS	Japanese Architectural Standard Specification
JCS	Japanese Cable Makers' Association Standard
JDECO	Jerusalem District Electricity Company
JEAC	Japan Electric Association Code
JEC	Japanese Electro-technical Committee Standard
JEM	Japan Electrical Manufacturers' Association Standard
JICA	Japan International Cooperation Agency
JIS	Japanese Industrial Standards
LCD	Liquid Crystal Display
M/D	Minutes of Discussions
MoEA	Ministry of Environmental Affairs
MOPAD	Ministry of Planning and Administrative Development

NASA	The National Aeronautics and Space Administration
NEDO	New Energy and Industrial Technology Development Organization
NETSU	National Energy Technology Supporting Unit
NIS	New Israel Shekel
OFR	Over Frequency Relay
OVGR	Over Voltage Grounding Relay
OVR	Over Voltage Relay
PC	Personal computer
PCBS	Palestine Central Bureau of Statistics
PDM	Project Design Matrix
PDP	Plasma Display Panel
PEA	Palestinian Energy Authority
PEC	Palestinian Energy & Environment Research Center
PERC	Palestinian Electricity Regulatory Council
PIEFZA	Palestine Industrial Estate and Free Zone Authority
PTEL	Palestine Transmission Electrical Limited
PV System	Photovoltaic System
R.H.	Relative Humidity
RMU	Ring Main Unit
RPS	Renewable Portfolio Standards
SPD	Surge Protective Device
TPA	Third Party Access
UFR	Under Frequency Relay
UNDP	United Nations Development Programme
UNRWA	United Nations Relief and Works Agency
UPS	Uninterruptible Power-supply System
UVR	Under Voltage Relay
VAT	Value-Added Tax

CHAPTER 1
BACKGROUND OF THE PROJECT

Chapter 1 Background of the Project

1-1 Present Conditions and Issues of the Sector

1-1-1 Present Conditions and Issues

Palestinian Authority (hereinafter referred to as "Palestine" is studying development and implementation of policies and measures for climate change as one of the priority subject as Palestine is seriously concerned about the effects by the climate change on national economy and eco-system, welfare, health and a menace to the life of the people of Palestine and the fact that ignoring the menace and delaying of taking measures at not only national level but also world level are worsening the effects by the climate change and consequently delaying sustainable development and creating problems for next generation.

Palestine imports most of its energy supplies such as oil, gas, electricity, etc. As for the electricity supply, there is a gas combined cycle power plant[1] with nominal capacity of 140MW in Gaza Strip. Although it was originally planned to use natural gas in the sea along the cost of Gaza Strip as a main fuel, it still uses heavy oil since exploitation of the gas field is not realized yet to date and the plant can only generate and supply electricity up to 90MW at the moment because of inadequate power transmission and distribution lines. Other electricity demands depend on the supplies from Israel by Israel Electric Corporation Limited (IEC) and from Jordan[2] which commenced as a part of diversification of procurement of the electricity.

However, in recent years, electricity demands have increased by 6.4% in the West Bank and 10%[3] in the Gaza Strip according to 1999-2005 World Bank Report entitled "West Bank and Gaza Energy Sector Review" and Palestinian is having a hard time to bear the increased cost of its procurement.

On the other hand, a five-year plan entitled "National Plan for Development of Renewable Energy & Efficiency 2007-2012" which was established in June 2007 by Palestinian Energy & Environment Research Center (PEC) which is an agency within jurisdiction of Palestinian Energy Authority (PEA), as a part of the policies and measures for the climate change, adopts their objectives such as 1) to raise the rate of renewable energy contribution in the Palestine energy balance to reach 20% of the final total consumption of energy and 2) to improve energy usage especially in the industrial and construction sectors and to reduce their needs of imported energy.

However, Palestine lacks implementing abilities and funds to manage reduction of

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1 A power generating plant that operates by combination of gas turbine and steam turbine.

2 Electricity from Jordan is imported from National Electric Power Co. (Max. 20MWA) and all electricity demand in Jericho is covered by the supplies from Jordan with occasional supplies from Israel in emergency.

3 1995-2005 World Bank Report, West Bank and Gaza Energy Sector Review

greenhouse gases (GHG) emission and economic growth at the same time although Palestine is willing to contribute for stabilization of the climate. Furthermore, no policies and/or measures for the renewable energy as well as no systems for grid connection with reverse power flow from producers of the renewable energy such as solar power, wind power etc to the power distributor have yet been established in Palestine.

1-1-2 Development Plans

In Palestine, since the measures for the climate change are to be placed as one of the top priority subjects in view of destruction of an ecosystem, increment of material, human and/or social damages associated with climatic disasters and so on, the following policies are declared in the above-mentioned five-year plan entitled "National Plan for Development of Renewable Energy & Efficiency 2007-2012" for the promotion of introduction of the renewable energy:

- Development and adaptation of a clear policy for renewable energy and energy efficiency and approving measures and regulations in this respect.
- Enhancement use and manufacturing of renewable energy by encouraging investment especially in solar thermal energy, photo-electric energy, biomass and agricultural wastes, wind energy, geothermal thermal energy, and residential solid wastes.
- Development and implementation of national programs that aim at reducing energy consumption in housing, commercial, industrial, and transport sectors especially in the fields of lighting, water heating, steam production, refrigeration, space heating and freight.
- Upgrading of the local market for clean and efficient technology through evaluation of the technology available in the local market (whether imported or locally-produced) and identification of standards and key factors for improving the level of quality.
- Awareness dissemination, know-how transfer and upgrading of technical capacities for the new and efficient technologies those contribute to sustainable development and enhancement of the national economy.
- Provision of suitable scientific and technological research & testing facilities that support researches and encourage investment in clean and efficient technologies. As a first stage, laboratories of solar heaters, and household electric appliances.
- Contribution to the regional efforts and global initiatives (CDM, GEF, etc) of the climate change that aim at sustainable and clean development through introducing Palestine to international energy programs and projects that serve the Palestinian energy sector.

Furthermore, Palestine is aiming at implementing the preventive measures for the climate

change and reduction of GHG emissions. And, the following objectives are declared in the action plans of the above-mentioned five-year plan:

- To participate in the Mediterranean Partnership Projects
- To propose national policies for renewable energy and raise energy efficiency and to prepare regulational and motivational recommendations and suggestions to encourage investments in renewable energy as well as law draft of energy control
- To establish the National Energy Technology Supporting Unit (NETSU)
- To mobilize the use and manufacturing of renewable energy (including the development of the renewable energy services in the rural areas)
- To implement projects of energy conservation (including assessment and identification of the energy-saving and clean technology appliances through carrying out a survey of the Palestinian market)
- To implement national awareness campaigns and training in renewable energy (including provision of information and technical consultations in order to help in awareness campaigns and training and to reinforce investment in the Palestinian market)
- To participate in regional conferences/ seminars and periodic meetings of energy-saving and renewable energy, and to organize workshops in energy efficiency and national exhibitions for the relevant products
- To install demonstration system of the renewable energy at PEC (including photovoltaic (PV) system, wind turbine, etc)
- To develop and rehabilitate the information system at PEC
- To upgrade the technical capacities of the staff at PEC

1-1-3 Socioeconomic Conditions

From 1967 onwards, all territorial boundaries of the West Bank and Gaza Strip were under control of Israel; thus, Palestine has lost economic independence due to underdeveloped economy-related associations and financial institutions since trading with foreign countries has been extremely difficult.

And then, along with the progress of the peace process from 1993 onwards, Palestinian economy has grown steadily since economic supports and assistance by donor countries and International Organizations have progressed, and at the same time, cooperation of Palestinian companies and/or corporations with western companies and/or corporations and trading with Egypt, Jordan, etc have increased.

However, Palestinian economy has been heavily damaged since September 2000 because of territorial closer and restriction on movement which has enforced by Israel. Magnitude of damages since such economic set back in Palestine, according to the World Bank, exceeds the Great Depression and economic crisis in Argentine.

In Palestine, although cultivation of citrus fruits, olives, etc and livestock farming are popular in the West Bank, their production is quite small since fertile lands and water resources are occupied by Israeli settlers. And, although cultivation of citrus fruits and vegetables and fishery are popular in Gaza Strip, commerce and industry has been underdeveloped because of an occupation policy and destructive actions taken by Israel. Palestine exports nonmetallic mineral products, vegetable and fruits, furniture, etc and imports oil and oil products, grain, nonmetallic mineral products, etc. Principle trading nation of Palestinian exports is Israel.

According to the data for the year 2007[4], Gross Domestic Product (GDP) was 4,535.7 million US dollars and its growth rate was 4.94%. Per capita GDP was 1,298 US dollars; US$1,555.30 for the West Bank and US$911.00 for Gaza Strip while rate of price increase (2007-2008) and rate of unemployment were 9.89% and 26.0% (19.0% for the West Bank and 40.6% for Gaza Strip) respectively. On the other hand, according to the data for the year of 2006 published by United Nations Relief and Works Agency (UNRWA), poverty rate was 55.6% (43.2% for the West Bank and 79.8% for Gaza Strip).

Furthermore, according to the above-mentioned data for the year 2007, percentage contributions to GDP by economic activities were agriculture and fishing (5.6%), mining, manufacturing, etc (13.8%), construction (6.2%), financial intermediation (5.2%), public administration and defense (13.9%), transport and communication (7.5%), wholesale and retail (9.2%), services (22.2%) and others (16.4%).

1-2 Background and Outline of Proposal for Official Grant Aid

Government of Japan (hereinafter referred to as "GoJ") announced establishment of "Cool Earth Partnership" in the address made by the then Prime Minister Fukuda of Japan during World Economic Forum held in Davos, Switzerland in January 2008 as a new financial mechanism for the developing countries making an effort to contribute to the climate change and to promote clean energy by balancing their economic growth with reduction of GHG emissions, and decided that GoJ will positively involve with reduction of GHG in the developing countries and support such developing countries receiving severe damages due to the climate change.

And, as a component of the said new financial mechanism, a new scheme of grant aid called "Program Grant Aid for Environment and Climate Change (GAEC) was also introduced in 2008

[4] Palestine Central Bureau of statistics (PCBS): Palestine in Figures 2005. Ramallah, Palestine May, 2009

by GoJ in order to support developing countries struggling to contribute for the climate change due to lack of abilities and funds for balancing their economic growth with reduction of GHG emissions..

Following the above-mentioned decision made by GoJ, Japan International Cooperation Agency (hereinafter referred to as "JICA") has set a policy to positively utilize Japanese advanced technologies including the technologies among private sector and to utilize clean energy including the renewable energy as a sample of co-benefit type assistance to be promoted.

Under these circumstances, Palestine has decided to join the Cool Earth Partnership and to aim balancing economic growth and GHG emissions with adaptation activities to climate change.

With such background, JICA was requested to positively utilize PV technologies which are clean energy technologies that Japan has extremely high advantage and consequently implementation of "GAEC" to utilize PV system for countries participated in "Cool Earth Partnership" using a supplementary budget for 2009 Fiscal Year was decided. And, based on the said decision, implementation of the preparatory survey was approved and directed by the Ministry of Foreign Affairs.

Outline of the application for the Project submitted by Palestine is as follows:

(1) Date of Application	:	12 July, 2009
(2) Requested Amount	:	5.0 Million US Dollars
(3) Contents of Request	:	Procurement of equipment for grid-connected PV system and technical assistance for operation and maintenance thereof
(4) Target Site	:	A part of land for Agro-Industrial Park (JAIP) (Phase-1) being planned at suburb of Jericho Municipality

A preparatory survey on the Project consists with two (2) stages, 1st of which is to formulate the Project including embodiment thereof and advance to 2nd stage which includes outline design, cost estimate and preparation of tender documents (provisional) after conducting further field survey.

Originally requested capacity of the PV system of the Project was 550kWp and it was confirmed in the Minutes of Discussions (M/D) signed on 15th of October 2009 that the PV system with the capacity of 550kWp would be positively examined although it might be reduced for some reasons. And, during the joint meeting held among parties concerned, it was also confirmed that the construction of ancillary facilities such as high tension (HT) substation building[5], monitor building and security fence along perimeter of the project site which were deemed necessary had to be included in the scope of works undertaken by Japanese side.

[5] It is planned that all HT equipment to be installed in the substation building including HT transformer (380V/33kV) shall be conform to the technical specifications set by JDECO.

Thereafter, giving consideration of the results of 1st preparatory survey, the capacity of the PV system of the Project was reduced to 300kWp due to budget limitation and the said change was explained to the Palestinian side during 2nd preparatory survey. And, as a result, change of the capacity was duly agreed by the Palestinian side. And, with consideration of securing an area for the installation of additional PV system in future by an effort of the Palestinian side, the Preparatory Survey Team reconfirmed during 2nd preparatory survey with the Director of Palestine Industrial Estate and Free Zone Authority (PIEFZA), which is responsible for JAIP, regarding the provision of the site area of 1.3ha which was originally agreed during 1st preparatory survey.

1-3 Japan's Past Assistance

A quite few Japan's grant aid projects such as schools in education sector etc have been implemented in Palestine. And, as for the economic and social development related fields, list of Japan's grant aid project are as shown in the Table 1-1 below:

Table1-1 List of Japan's Grant Aid Project in Recent Years
(Economic and Social Development Program Related Fields)

Fiscal Year	Project	100 Million Japanese Yen	Summary
2008	Programme for Construction of Sewage System for Promoting Mutual Confidence (through UNDP)	5.66	This Project is for providing the necessary funds to implement the following items. (1) Construction of Sewage Facilities in the three cites located on the northern border of West Bank and Israel, to collect the swage in a sanitary manner and sent to the Israel Sewage Facilities. (2) To hold workshops to Promote Mutual Confidence for both sides in Israel and Palestine in Sewage System and Environment Field, and training about the Environment.
2008	The Project for Improvement of Internal City Roads in Jericho	8.09	This Project is to improve the internal city road in Jericho, and provide the equipments for operate and maintenance the road. The detail is below. - Road pavement (61 roads, about 20km) - Installing of street lightings (10 roads, about 9km) - Improvement of sidewalk (5 roads, about 3km)
2007	Jericho-Taybeh Road Rehabilitation Project (through UNDP)	(USD 1.32 Million)	The movement of West Bank people and products is necessary to develop the economic field in the West Bank. As the Palestinian is limited to go to the Jordan Valley, The Japanese government decided to implement the project of Jericho - Taybeh Road through UNDP for accommodate the flow of West Bank people and products.

Source：Prepared by the Preparatory Survey Team

1-4 Other Donor Assistance

In the field of electricity, the feasibility study for 5-10MW concentrated solar power (CSP) project which is financed by the World Bank and being implemented since December 2009. And, it is expected that the feasibility study report will be submitted to PEA in June 2010. Other renewable energy related projects implemented and/or being implemented in Palestine are as shown in the Table 1-2 below:

Table1-2 List of Project by Other Donor in Recent Years
(Renewable Energy Related Fields)

Year	Donor	Project	Amount (USD)	Outline
2008	Spanish Government	Village Electrifications	100,000	Installation of 12kW PV system at Atouf Village (incl. batteries)
2009	UNDP	Village Electrifications	Not Known[6]	Installation of 1.3kW PV system at Jeb Al Theeb Village.
2009	UNDP	Village Electrifications	30,000	Installation of 3.5kW PV system at Beit illo Village.

Source: Prepared by the Preparatory Survey Team based on the data received from PEA.

1-5 Current Situation of the Project Sites

1-5-1 Status of Infrastructures

As for the electric power related system and/or regulation, New Electrical Law which has taken effect on May, 2009 prescribe establishment of Palestinian Electricity Regulatory Council (PERC) aiming to regulate approval of the electrical industry and its bylaws is currently being discussed at Prime Minister's Office. And, if approved, PERC will be a regulatory authority for the electrical industry.

Furthermore, along with the establishment of PERC, establishment of Palestine Transmission Electrical Limited (PTEL) in the West Bank that is a comprehensive management entity for power transmission lines is also being prepared. And, if approved, third party access (TPA) that is grid-connection by the third party i.e. reverse flow connection will become possible.

Although there is no power plant in the West bank, there is a gas combined cycle power plant[7] with nominal capacity of 140MW in Gaza Strip that supplies electricity by using 22kV power transmission network since 2003. However, the plant can only generate and supply electricity up to 90MW at the moment because of inadequate power transmission and distribution lines it still uses costly heavy oil since there is no supply of the natural gas yet to date.

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6 The project is currently being implemented but the project cost is unknown (there was no figures in the data received from PEA).

7 A power generating plant that operates by combination of gas turbine and steam turbine.

All electricity demands for Jericho are being supplied by Jerusalem District Electricity Company (JDECO[8]), all of which are being supplied from National Electric Power Co. in Jordan except in case of an emergency when the electricity is to be supplied from Israel by Israel Electric Corporation Limited (IEC).

Through the implementation of the Project, a first relatively large-scale PV system will be installed in Palestine. Outline of the status of infrastructure around JAIP where the project site is located at, quality of electricity and reliance on power supply and tariff for electricity which may have an impact on the implementation of the project are described here-in-below:

(1) Status of Infrastructure around JAIP

At the moment, there are no power distribution lines and substation within the land for J where the project site is located at. However, there is a high tension (33kV) overhead power distribution line which supplies the electricity to neighboring Iron Factory. JDECO is also planning to establish 33kV power distribution network surrounding JAIP including construction of substations.

The electricity generated by the PV system to be procured and installed by the Project will be fed into the existing JDECO power distribution grid i.e. reverse power flow through a new substation with 630kVA (33kV to 380V) transformer to be built at east-south corner of JAIP by the Project and Ring Main Unit (RMU) being installed in JDECO owns Switchgear Station located at neighboring Iron Factory. Thus, the electricity generated by the PV system to be procured and installed by the Project will be used for nearby people's livelihood for the moment until commencement of operation of JAIP.

(2) Quality of Electricity and Reliance on Power Supply

1) Quality of Electricity

The Preparatory Survey Team tested voltage and frequency of electrical power by setting a measuring device to distribution panel in electrical room for JDECO Technical & Academic Training Center in Jericho during 1st and 2nd preparatory surveys (see photos below). As a result of the said tests, it is considered to be fine since voltage fluctuation was within ±5% over nominal voltage of 380V although there had been voltage drops temporarily for a short period which is assumed to be due to fluctuation of power demand of the said training center. And, as for the frequency, it is also considered to be fine since its fluctuation was

[8] JDECO was established by Geek man in 1926 as a company to supply electricity within Jerusalem but now it supplies electricity to Ramallah, Jericho and Bethlehem in the West Bank in addition to Jerusalem. Ramallah, Jericho, Bethlehem and other municipalities in the Palestinian Authority hold 49% of JDECO shares while remaining 51% is held by the private sector. Number of employee of JDECO is more than 800

within ±1% over nominal frequency of 50Hz and with constant value. It is therefore assumed that grid management of both valid and invalid power supplies is stable since both voltage and frequency are quite stable.

Photo Left : Measuring voltage and frequency
Photo Right : Connection of measuring device

2) Reliance on Electricity Supply

JDECO is the only power distribution company authorized by PEA in the West Bank and supplies power mainly imported from Jordan to the consumers in Jericho municipality using overhead distribution lines and supplies power imported from Israel in an emergency. Frequency and hours of power-cuts due to lightening etc have been drastically decreased in recent years according to the information given by JDECO although it was unable to collect detailed data and figures as to frequency and hours of power-cuts in Jericho.

(3) Tariff for Electricity

Consumption of electricity will be measured by a sealed high-tension (33kV) or low-voltage (380V-220V) watt-hour meter to be installed by JDECO and will be charged specifically according to the measured consumption. There is no tariff system with basic charge set on maximum power demand. Also, there is no tariff system with classification of consumers such as residential use, commercial use and industrial use. Thus, tariff for electricity is set at NIS 0.43/kWh excluding VAT regardless of usage[9].

[9] According to hearing at JDECO Jericho Branch

1-5-2 Natural Conditions

(1) Climate in Jericho and Palestine

Palestine is located at latitude 29° 30′N - 33° 15′N and longitude 24° 10′E - 35° 40′E and consists of two (2) territories. One is called West Bank which is close to Jordan and having mountainous areas in southern part of Jordan Valley, and another one called Gaza Strip which is close to the Mediterranean Sea and having coastal areas. Palestine is self-interim government having a total land area of 6,020 square kilometers (5,655 km2 for the West Bank and 365 km2 for Gaza Strip) and belongs to the region of the Middle East.

In the middle of the West Bank, hilly areas stretch south-north direction and its temperature falls down according to the latitude. The western slope of the West Bank is with the Mediterranean climate and with rainfall during winter. And, the eastern slope and the southern part of the West Bank are with the desert climate. On the other hand, Gaza Strip that is close to the Mediterranean Sea is with the Mediterranean climate and is mild throughout the year.

Although Jericho municipality where the project site is located in Jordan Valley and is abundant in water resources compared to other areas of Palestine, annual precipitation is only about 115.2mm[10], most of which are recorded during a couple of months in winter. And, Jericho is quite dry and dusty throughout the year since its annual average humidity is as low as 53% and prone to a sandstorm from Egypt around the month of May in spring. And, Jordan River which is the only stream around this area flow southern direction from the Sea of Galilee which is the largest freshwater lake in this region towards the Dead Sea which contains extremely high concentration of salt.

Climate in Jericho is dried desert climate and, because of latitude of minus 300m, daytime temperature during summer is 35 to 40 degrees centigrade and 10 to 15 degrees centigrade even during winter. And, there are many sunshine days throughout the year and average daily sunshine hours exceed eight (8) hours and annual sunshine hours exceeds 3,000 hours (1,800 to 1,900 hours in Tokyo).

According to the meteorological data for the year 2008 issued by the Palestine Meteorology Bureau, monthly mean air temperature recorded at Jericho Observatory is as shown in the Table 1-3 below:

[10] Annual precipitation for the year 2007 reported in ERPress2008 news article titled “Palestinian Central Bureau of Statistic Issues Press Release on the Occasion of World Metrological Day” dated 23/03/2008, and according to the same, annual precipitation of Ramallah for the same year is 543.9mm.

Table 1-3 Monthly Mean Air Temperature in Jericho in 2008

Item	Jan	Feb	Mar	Apr	May	Jun
Mean Air Temp. (℃)	11.8	14.7	21.6	24.9	26.6	31.4

Item	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean Air Temp. (℃)	32.4	32.9	30.7	25.9	21.0	16.4	24.2

Source : Prepared by Preparatory Survey Team based on the data provided by Palestine Meteorology Bureau

(2) Solar Radiation in Jericho

Jericho city where the project site is located lies in the Jordan Valley. It is approximately 8 kilo-meters away from the Dead Sea that is the lowest place[11] in the Globe. The altitude of the JAIP is approximately minus 300 meters below sea level where procured equipment will be installed and then operated. Although the project site is adjoining with iron factory along east boundary, its building will not cast any shadows to the areas where PV modules to be placed.

Preparatory Survey Team conducted the survey to observe the actual measurement of solar radiation and air temperature at JDECO Training Center in Jericho during 1st and 2nd preparatory surveys. The data recorded are as shown in the Table 1-4 below:

Table 1-4 Recorded Data (Solar Radiation and Air Temperature in Jericho)

1st Preparatory Survey	16 Oct. (Fine)	17 Oct. (Fine)	18 Oct. (Fine)	-	Mean Value
Daily Solar Radiation ($KWh/m^2/d$)	3.50	3.42	3.60	-	3.50 ($KWh/m^2/d$)
Max. Temperature (℃)	37.0	37.7	37.7	-	
2nd Preparatory Survey	22 Nov. (Fine)	23 Nov. (Fine)	24 Nov. (Cloudy)	25 Nov. (Fine)	
Daily Solar radiation ($KWh/m^2/d$)	2.95	3.00	1.65	2.40	2.40 ($KWh/m^2/d$)
Max. temperature (℃)	26.2	27.6	26.4	23.7	

Note : Mean daily solar radiation shows its value on the horizontal surface.
Source : Preparatory Survey Team

[11] Altitude of minus 418 meters


Photo Left : The device (left) used for measuring solar radiation and temperature
Photo Right : Device used for observation "Weather Hawk"

Palestine Meteorology Bureau in jurisdiction of the Ministry of Transportation has observed merely the average hours of solar radiation per day and had not observed the amount of solar radiation until the end of 2008. And, the observation of the amount of solar radiation has only started at the beginning of 2009 at eight (8) meteorological stations in the West bank. On the other hand, NASA provides extensive meteorological data world-wide, and their data of solar radiation and air temperature in Jericho is as shown in the Table 1-5 below:

Table 1-5 Monthly Mean Solar Radiation and Air Temperature in Jericho (NASA)

Item	Jan	Feb	Mar	Apr	May	Jun
Daily Solar Radiation ($kWh/d/m^2$)	2.80	3.50	4.60	6.00	7.10	7.90
Mean Air Temp. (℃)	10.6	11.4	14.2	18.9	22.2	24.3

Item	Jul	Aug	Sep	Oct	Nov	Dec	Mean.
Daily Solar Radiation ($kWh/d/m^2$)	7.80	7.20	6.00	4.70	3.40	2.60	5.31
Mean Air Temp. (℃)	26.0	26.4	25.0	21.7	17.0	12.3	19.2

Note : Mean daily solar radiation shows its value on the horizontal surface.
Source : Prepared by Preparatory Survey Team based on the data provided by NASA

Compared NASA data shown in the Table 1-5 above to the observed actual data shown in the Table1-4, both actual data observed in November and December are considered to be quite similar to the NASA data, taking the observation period into account.

1-5-3 Socio-environmental considerations

Although the implementation of Environment Impact Assessment (EIA) is compulsory in Palestine for any relatively large-scale projects which may give environmental impacts, EIA is not required for a solar power generation project such as installation of PV system. However, submission of a project brief which describes the outline of the project to the Ministry of

Environmental Affairs is compulsory for any projects.

PV system to be introduced by the Project will not give any grave environmental impacts and/or create harmful influence to the project site and its surrounding areas. As for the classification of categories (A, B or C) giving consideration of socio-environmental impacts to the project site and its surrounding areas, it is judged that this Project will fall into Category "C" after screening with "JICA Guidelines for Environmental and Social Consideration".

In Palestine, the internal situation in the West Bank and Gaza are quite different from each other and peace and order in Gaza is still precarious. On the other hand, the West Bank is relatively quite stable compared to Gaza and general situation of peace and order has been fairly improved compared to the past. The Preparatory Survey Team has never encountered with any troubles concerning security and safety measures in Ramallah where government function of Palestine is concentrated in and the Preparatory Survey Team frequently visited during the preparatory surveys. However, since there will be a possibility of occurrence of unforeseen state of affairs concerning security and safety measures, it is essential to be well prepared for such incident.

Although Jericho where the project site is located is most stable area in the West Bank, tensions escalated in elsewhere in the West Bank can easily be spread to all over the West Bank. Israeli settlements scattered in and around the West Bank are also an element of conflict and there will be a possibility of escalating tensions in the West Bank at any time.

CHAPTER 2
CONTENTS OF THE PROJECT

Chapter 2 Contents of the Project

2-1 Basic Concept of the Project

2-1-1 Overall Goal and Project Objectives

According to the data for the year 2008, Palestinian Authority (hereinafter referred to as "Palestine") imports about 90.40% (100% for West Bank) of its total electrical energy consumption as shown in Table 2-1 below:

Table 2-1 Summary of Electrical Energy Purchase in the Palestinian Territory

Unit: GWh

Area	Israel	Jordan	Egypt	Sub-total	Gaza Power Plant	Total
West Bank	2,735.65	64.34	-	2,799.99	-	2,799.99
Gaza Strip	930.45	-	134.37	1,064.82	410.31	1,475.13
Total	3,666.10	64.34	134.37	**3,864.81**	410.31	**4,275.12**

Source: Prepared by the Preparatory Survey Team based on the data for the year 2008

In Palestine, the renewable energy is restricted on solar energy used in heating water for residential buildings, and biomass (firewood, charcoal and solid olive wastes), and exploited volume of renewable resources is estimated at about 18%[1] of total consumption of energy.

(1) Overall Goal

Palestinian Energy & Environment Research Center (PEC) which is an agency within jurisdiction of Palestinian Energy Authority (PEA) of Palestine established a five-year plan entitled "National Plan for Development of Renewable Energy & Efficiency 2007-2012" which adopt their objectives such as 1) to raise the rate of renewable energy contribution in the Palestine energy balance to reach 20% of the final total consumption of energy and 2) to improve energy usage especially in the industrial and construction sectors and to reduce their needs of imported energy.

The Project will contribute to build an energy supply system that will contribute to the diversification of source of energy and measures for climate change by utilizing the energy that can be obtained in Palestine.

(2) Needs on Measures for Climate Change

In Palestine, PEC takes the lead in positive utilization of the renewable energy since an energy development is an urgent requisite. A main objective of the five-year plan established for the period of 2007-2012 by PEC is to raise or improve the balance of

[1] National Plan for Development of Renewable Energy & Efficiency 2007-2012, June 2007

clean energy such as solar power to more than 20% of the total energy consumption and PEC is groping for cooperation in measures for climate change with international organizations and an application of Clean Development Mechanism (CDM).

Under these circumstances, Palestine has decided to join the Cool Earth Partnership and to aim balancing economic growth and reduction of greenhouse gases emissions with adaptation activities to climate change.

Provision of the photovoltaic (PV) system by the Project is expected to contribute significantly to supplement electricity supplies by the renewable energy and to measures for climate change for Palestine that has weak capability of the electricity supplies.

(3) Project Objectives

The objectives of the Project are to promote clean energy utilization and to achieve stable power supply including financial aspect in Palestine through the operation of the grid-connected PV system as well as to contribute to reduction of greenhouse gases emissions.

It is to supply the electricity to Jericho Agro-Industrial Park (JAIP) which is placed as an important foreign aid contribution for the peace in the Middle East by the Japanese Government and the feasibility study and the preparatory study thereof have already completed. However, since the operation of JAIP is expected to commence in 2013 or later, the electricity will be supplied to the existing distribution line operated and maintained by the Jerusalem District Electricity Company (JDECO[2]) by the grid-connected PV system that will supplement the electricity supplies in Jericho.

This project is also expected to contribute to the development of JAIP as a renewable energy supply facility. Moreover, it aims that the Project will help the Palestinian Authority that is groping for cooperation in measures for climate change with international organizations and an application of CDM.

(4) Project Goal

The project goal is to establish an energy supply system utilizing the energy that can be obtained in Palestine that will contribute to the diversification of source of energy and measures for climate change.

[2] JDECO was established by Geek man in 1926 as a company to supply electricity within Jerusalem but now it supplies electricity to Ramallah, Jericho and Bethlehem in the West Bank in addition to Jerusalem. Ramallah, Jericho, Bethlehem and other municipalities in the Palestinian Authority hold 49% of JDECO shares while remaining 51% is held by the private sector. Number of employee of JDECO is more than 800

2-1-2 Outline of the Project

(1) Outline of the Planed PV System

To achieve the above-mentioned objectives, the Project will procure and install a grid-connected PV system and to provide technical assistance for operation and maintenance.

As a result of the preparatory surveys, it is found out that there are no laws[3] or regulations for the grid-connection, reverse power flow and sale of power in connection with the solar power generation and that no one has any experience and achievement of the installation of the grid-connected PV system so as JDECO which is the only power distribution company in the West Bank. Although JDECO has agreed in principle as to the grid-connection and reverse power flow as stated in their letter dated 8th of December 2009 which was addressed to the PEA, the agreement is scheduled to be concluded prior to the commencement of the Project by and between the PEA, as the responsible and implementing agency of the Project, and JDECO. Therefore, the Project will introduce the grid-connected PV system with reverse power flow (please refer to Clause 2-2-3 (2) Outline Design Drawings).

The support plan of the Project is as shown in Table 1-2-1 below. Further, it was confirmed that the agreement regarding the grid-connection and reverse power flow shall be concluded between the PEA and JDECO promptly. And, since the PEA is willing to implement the reverse power flow in Palestine in future by establishing necessary regulations, the Project will provide the equipment necessary for the said reverse power flow.

By implementing this Project, a first grid-connected PV system will be introduced in Palestine which will contribute to promotion of renewable energy in Palestine.

[3] New Electrical Law which has taken effect on May, 2009 prescribe establishment of Palestinian Electricity Regulatory Council (PERC) aiming to regulate approval of the electrical industry and its bylaws is currently being discussed at Prime Minister's Office. If approved, PERC will be a regulatory authority for the electrical industry.

Table 2-2 Support Plan of the Project

Equipment for Solar Electricity Generation			
1	Equipment	Uses	Needs
	Grid-connected PV System	Power generated by PV system will supply power to Agro-Industrial Estate planned to be constructed in a suburb of Jericho city as well as to supply to Jericho city that will contribute to supplement the power supplies in Jericho by connecting the system to a secondary side of transformer to be placed in newly installed substation which will enable a reverse power flow to an existing 33kv power distribution grid.	Reduction of greenhouse gases by reducing consumption of fossil fuel for power generation; combustion turbine using heavy oil only at present, by utilization of solar energy is sought in Palestine as measures for climate change. And, cost of importing powers from neighboring countries; Israel and Jordan, is weighing heavily on Palestine's national budget.
Technical Assistance for Solar Electricity Generation			
2	Technical Assistance for Grid-connected PV System	Technical training necessary for appropriate operation and maintenance of grid-connected PV system which include basic knowledge, coordination with existing power distribution system, method of inspection and maintenance, troubleshooting, etc.	Since the introduction of a grid-connected PV system will be a first time in Palestine, there are no trained specialists and/or engineers who have knowledge of installation of grid-connected PV system and operation and maintenance thereof. Therefore, it is necessary to acquire and improve such knowledge and relevant technologies.

Source: Preparatory Survey Team

2-2 Outline Design of the Requested Japanese Assistance

2-2-1 Design Policy

2-2-1-1 Basic Policy

(1) Scope of cooperation

Based on the policy and goal of the Palestinian Authority as mentioned in "2-1-1 Overall Goal and Project Objectives", it is planned to install grid-connected PV system with reverse power flow aiming at managing to reduce greenhouse gas emissions and awareness of climate change with economic growth at the same time and in order to contribute to tackling with stabilization of the climate change.

In the Application for Japanese Grant Aid Assistant presented by the Palestinian Authority, a part of the land allocated for JAIP Phase-1. However, since JAIP is currently in the process of planning, there are no facilities and/or buildings which demand power which means there will be no facilities and/or buildings which the

electricity would be fed into after completion of the installation of the PV system. Therefore, it is planned for the moment to feed the power being generated by the PV system into nearby power distribution line (33kV) network which is owned and managed by JDECO by providing grid-connected system.

The existing power distribution line (33kV) network mentioned above supplies power imported from Jordan using the transmission line (10MVA, 33kV, 3 phase 3 wires, 50Hz) to Jericho Municipality including planned site for JAIP which is supplied via Dead Sea Switching Gear Station located about 4km from JAIP.

(2) Overall design guidelines

The outline design of the Project is based on the following guidelines

1) Although there are no relevant laws and regulations as well as proven experiences and/or achievement of grid-connected PV system in Palestine, the Project will install the grid-connected PV system with reverse power flow since it was agreed in principle by JDECO in writing, a letter of which was sent to the PEA in December 2009.

2) The Project will procure and install equipment necessary for the grid-connected PV system and relevant technical assistance.

3) In planning of the grid-connected PV system, it is quite important to plan the grid-connection appropriately and provide reliable equipment so that the grid-connection will not adversely affect the quality of power distribution system.

4) In the case of a grid-connection with reverse power flow, it is essential to have substation including transformer and auxiliary equipment which shall be protected with protection devices such as Over Voltage Grounding Relay (OVGR). Therefore, the project will provide the substation with transformer and other auxiliary equipment which shall be equipped with OVGR.

5) As for the connection point of PV system and power distribution system, it is planned at low voltage side of the substation.

6) Although the Project will provide PV system with grid-connection with reverse power flow, the PV system shall carefully be designed so as to enable an effective use of the power generated by the PV system when operation of JAIP has been started.

2-2-1-2 Policy for natural conditions

(1) Altitude

Jericho city where the project site is located lies in the Jordan Valley. It is approximately 8 kilo-meters away from the Dead Sea that is the lowest place[4] in the Globe. The altitude of the JAIP is approximately minus 300 meters below sea level where procured equipment will be installed and then operated. Although the equipment will be operated in the condition of under sea level, the influence that the altitude and atmospheric pressure could cause to such equipment is assumed to be allowable. Therefore, all equipment shall be designed with manufacturers' standard specifications for the altitude and pressure.

(2) Solar radiation and air temperature

Preparatory Survey Team conducted the survey to observe the actual measurement of solar radiation and air temperature at JDECO Training Center in Jericho during 1st and 2nd preparatory surveys. The data recorded are as shown in the Table 2-3 below:

Table 2-3 Recorded Data (Solar Radiation and Air Temperature in Jericho)

1st Preparatory Survey	16 Oct. (Fine)	17 Oct. (Fine)	18 Oct. (Fine)	-	Mean Value
Daily Solar Radiation ($kWh/m^2/d$)	3.50	3.42	3.60	-	3.50 ($kWh/m^2/d$)
Max. Temperature (℃)	37.0	37.7	37.7	-	
2nd Preparatory Survey	22 Nov. (Fine)	23 Nov. (Fine)	24 Nov. (Cloudy)	25 Nov. (Fine)	
Daily Solar radiation ($kWh/m^2/d$)	2.95	3.00	1.65	2.40	2.40 ($kWh/m^2/d$)
Max. temperature (℃)	26.2	27.6	26.4	23.7	

Note: Mean daily solar radiation shows its value on the horizontal surface
Source: Preparatory Survey Team

Palestine Meteorology Bureau in jurisdiction of the Ministry of Transportation has observed merely the average hours of solar radiation per day and had not observed the amount of solar radiation until the end of 2008. And, the observation of the amount of solar radiation has only started at the beginning of 2009 at eight (8) meteorological stations in the West bank. On the other hand, NASA provides extensive meteorological data world-wide, and their data of solar radiation and air temperature in Jericho is as shown in the Table 2-4 below:

[4] Altitude of minus 418 meters

Table 2-4 Monthly Mean Solar Radiation and Air Temperature in Jericho (NASA)

Item	Jan	Feb	Mar	Apr	May	Jun
Daily Solar Radiation (kWh/d/m^2)	2.80	3.50	4.60	6.00	7.10	7.90
Mean Air Temp. (℃)	10.6	11.4	14.2	18.9	22.2	24.3

Item	Jul	Aug	Sep	Oct	Nov	Dec	Mean.
Daily Solar Radiation (kWh/d/m^2)	7.80	7.20	6.00	4.70	3.40	2.60	5.31
Mean Air Temp. (℃)	26.0	26.4	25.0	21.7	17.0	12.3	19.2

Note: Mean daily solar radiation shows its value on the horizontal surface
Source: Preparatory Survey Team

Compared NASA data shown in the Table 2-4 above to the observed actual data shown in the Table2-3, both actual data observed in November and December are considered to be quite similar to the NASA data, taking the observation period into account. Consequently, the meteorological data of NASA will be adopted to simulate the amount of power which will be generated by the PV system to be procured and installed by the Project.

Incidentally, the records of the monthly mean air temperature in 2008 prepared and published by the Palestine Meteorology Bureau is as shown in the Table 2-5 below.

Table 2-5 Monthly Mean Air Temperature in Jericho in 2008

Item	Jan	Feb	Mar	Apr	May	Jun
Mean Air Temp. (℃)	11.8	14.7	21.6	24.9	26.6	31.4

Item	Jul	Aug	Sep	Oct	Nov	Dec	Mean
Mean Air Temp. (℃)	32.4	32.9	30.7	25.9	21.0	16.4	24.2

Source: Preparatory Survey Team

(3) Precipitation

According to the meteorological data obtained from the Palestine Meteorology Bureau, the annual precipitation observed at Jericho meteorological station is very nominal; that is, annual recorded precipitation of 115.2mm to 194.0mm since the year 2000. And, the maximum daily precipitation of 15.3mm was recorded in January, 2008.

On the other hand, the data of evaporation has always been recorded much higher than the precipitation; that is, annual recorded evaporation of 1,608mm to 2,227mm since the year 2000.

Taking the above-mentioned meteorological conditions into account, the ground water drainage plan for the Project will not be considered on the project site having an area of 1.3 ha of which runoff coefficient is estimated at less than 0.5.

(4) Wind

The meteorological station in Jericho has recorded a wind velocity of 7.1 meter per second (7.1m/s) as the annual mean wind velocity in 2008 according to the data obtained from the Palestine Meteorology Bureau. And, a maximum wind velocity of 31.0 meter per second (31m/s) was recorded in January, 2008.

For the verification of resistance to wind of PV modules, supporting steel structure, anchor bolts and reinforced concrete foundations, the wind velocity of 34.0 meters per second (34m/s) will be adopted as the design wind velocity. And, in addition, the design wind pressure of 2,000 Pa will be adopted in accordance with the calculation method of wind load defined by the Japanese Building Code, giving consideration of that the project site belongs to a category of "relatively flat area which is not urbanized and without any obstacles on the ground".

(5) Lightning

Occurrence of lightning and the damages caused thereby has not been observed by the Palestine Meteorology Bureau. Even in the hearing investigations conducted during the field surveys, not many people mentioned anything about damages caused by the lightning. However, the damage to electronic devices, computers, etc caused by lightning has become a serious issue lately in most countries. In case of the lightning, the equipment will be damaged because an abnormal current and voltage caused by direct lightning or induced lightning will enter into electronic device of the equipment. Therefore, the Project will consider of the provision of reliable power supply to the power conditioners, measurement and monitoring equipment, and a display in order to avoid such damages caused by an abnormal current and voltage and so as to enable to provide stable power supply.

(6) Ground

The substructure will be concrete foundation that will support PV modules of the Project. During the field survey, such problems as subsidence or rising of the foundation of the existing buildings in the vicinity of the project site were not observed. Therefore, structural design of the substructure will be prepared in accordance with the local standard and guideline.

(7) Salt damage

Since the project site is located in the inland area, any countermeasures for salt damage will not be considered in the technical specifications for the Project. However, in order to avoid deterioration of supporting steel frames for PV modules

by salt contents in the soil, all steel-frame supports shall be hot-dip galvanized and the foundation that steel-frame supports will be placed onto shall be flat type.

(8) Seismic load

Although most areas of Palestine have experienced very few earthquakes, a couple of serious earthquakes have been historically recorded in Jericho that is located in the Dead Sea Transform. "Seismic Hazard Map for Building Codes in the Levant" categorizes the area including Jericho as "Zone 3" which means high possibility of having hazardous earthquakes and defines that the design horizontal seismic intensity should be 0.3G.

Design criteria for structural calculation on supporting steel frames, fixing anchor bolts and reinforced concrete foundations should be complied with "JIS C8955 Design Standard for supporting structures of PV Modules". Design dead load should be referred to total weight of both PV modules and supporting steel frames as a long term load. On the other hand, design short term load shall be equivalent to a larger value either total load of dead load and wind load or total load of dead load and seismic load.

Since Jericho is an earthquake prone area and the PV modules are planned to be installed on the concrete foundations, design condition of the horizontal seismic intensity for the PV modules should be 0.3G. And, the design condition of the horizontal seismic intensity for supporting steel frames and fixing anchor bolts should be 1.0G

(9) Snowfall

Since snow fall has never been observed in Jericho according to the meteorological data obtained from the Palestine Meteorology Bureau, the Project will neglect snow load.

2-2-1-3 Policy relating to socio-economic conditions

The Palestine has insufficient capacity and fund to balance economic growth with reduction of greenhouse gas (hereinafter referred to as "GHG"). Consequently, infrastructure required for promotion of the utilization of renewable energy is not ready for use and there is no incentives provided and it has become an issue; that is to raise nation-wide consciousness for introduction of the renewable energy from now on. And, therefore, the PV system shall be planned and designed giving consideration of raising showcase effects with outlook of that the introduction of the PV system will contribute to extension and promotion of the utilization of the renewable energy.

2-2-1-4 Policy concerning procurement affairs and special situations/commercial customs of industry

(1) Permits and approval and laws related to the implementation of the Project

The Project includes foundation work, small-scale construction work including road work etc., supporting structure work, electrical work and equipment installation work. In Palestine, there is a labor law5 that defines contract and employment, gender equality, working hours and intermissions, wage and salary, rules and regulations, working environment and so on; thus, the said labor law will be applied for the equipment installation work of the Project. And, as for the construction work and installation of supporting structures, the outline design shall be prepared in conformity with relevant Palestinian standard and regulation and design documents thereof shall be submitted to relevant agencies to obtain their confirmation and/or approval prior to the commencement of the work.

As described in Chapter 1, PV system to be introduced by the Project will not give any grave environmental impacts and/or create harmful influence to the project site and its surrounding areas. It is therefore EIA is not required for the Project. However, PEA which is the implementation agency for the Project is required to submit a project brief which describes the outline of the project to the Ministry of Environmental Affairs (MoEA) prior to the commencement of the Project. And thereafter, MoEA will forward their comments in writing probably in terms of security and safety matters to PEA. It is expected to take about a month for the said procedures.

However, submission of a project brief which describes the outline of the project to the MoEA is compulsory for any projects.

(2) Applicable laws, regulations and standards

In order to promote extension of solar power generation from now on in Palestine, all equipment shall be compatible with international standards in principle. However, since major equipment of the Project shall be Japanese products, some products can also be compatible with Japanese standards which are equivalent to applicable international standards.

On the other hand, since there are no regulations and/or guidelines for grid-connected PV system in Palestine yet to date, Japanese guidelines will be applied for the equipment to be used for grid connection. Applicable standards are as follows:

[5] Labor Law No (7) Year 2000, Office of the President, Palestinian National Authority

- Japan Electrical Law
- Japan Laborer's Safety and Health Law
- Japan Technical Standard for Electrical System
- Japanese industrial Standard（JIS）
- Japan Electrical Manufacture's Association Standard(JEM)
- Japanese Electro-technical Committee Standard (JEC)
- Japan Cable Maker's Association Standard (JCS)
- "Guidelines for technical requirements on interconnection to grids"
- Code for interconnection to grids (JEAC)
- International Electro-technical Commission Standards (IEC) (IEC61215, IEC61646, IEC61730-1 and IEC61730-2)

(3) Design standards to be complied with for installation work

Although applicable standards and regulations for civil/construction work, mechanical and electrical work and so on shall be the ones available in Palestine in principle, such local standards and regulations shall be supplemented with relevant international standards such as BS, ASTM, etc., as the local standards and regulations are insufficient.

2-2-1-5 Policy for utilizing local company

It is a first time for Palestine to install the PV system of this scale and local companies have no experiences of the installation of equipment to be procured by the Project it is absolutely necessary to provide training and guidance to local companies by experts; thus, Japanese companies which will be the suppliers for this Project shall supervise entire installation work and provide training and instruction to local companies.

And, as for the civil/construction work, transportation of equipment and materials, etc which can be executed by local companies, it is planned to utilize the local companies.

2-2-1-6 Policy concerning operation and maintenance abilities of the executing agency

The PV system of this scale to be provided by the Project will be a first case in Palestine and will be a first experience for not only the staff of PEA but also JDECO staff; thus, they have no technical knowledge as to the grid-connected PV system. As for the operation and maintenance of the said PV system, PEA that is the Implementation Agency of the Project is planning to employ two (2) engineers and a security guard for the purpose of the operation and maintenance of the system to be provided by the Project.

Therefore, the Project will include provision of initial operation guidance to be conducted either by an engineer dispatched from manufacturers of the equipment of the system or an expert who was engaged in the installation of the said equipment, and educational training to be conducted by the Consultant as a soft component of the Project for the engineers who will be responsible for the operation and maintenance of the system from PEA, selected engineers from JDECO and engineers from Palestine Industrial Estates and Free Zones Authority (PIEFZA) who will be responsible for the operation and maintenance of JAIP as their cooperation will be indispensable.

2-2-1-7 Policy for grades of equipment and materials

As the Project is expected to continuously exhibit its intended effects, equipment and materials to be procured must be of general-use, durable types, and have high cost-performance ability. In addition, such equipment shall be easily repairable and maintainable. For these reasons, those types of equipment that have proved good performance shall be procured.

There are many kinds of PV cells which are the components of the PV modules such as mono-crystal, poly-crystal, thin layer amorphous, chemical compound and hybrid materials. And, all these different types of PV modules have their own characteristic of power generation efficiency, temperature-maximum output, and voltage-current performance and so on.

Based on the above-mentioned requirements and the current situation of developing PV cells, the type of the PV cells shall be proposed by bidders from among various types of cells having long and good performance records so that many bidders would be able to participate; thus, the tender shall be called upon with the specifications that specify required functions and characteristics and that define minimum output capacity, maximum area for installation and so on.

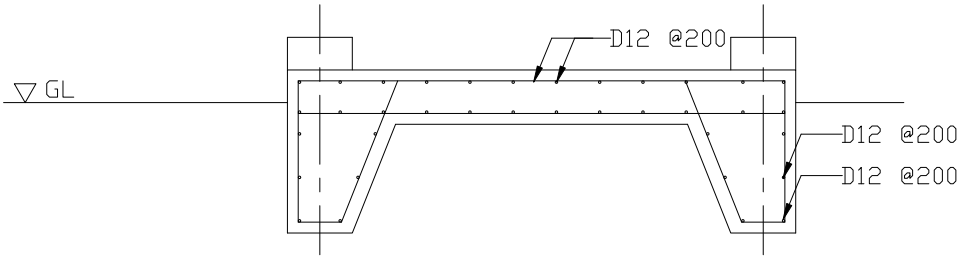
2-2-1-8 Policy concerning installation/procurement method and installation schedule

(1) Installation method

Foundations that steel support structures for PV modules will be placed on shall be slab-type foundation which is shown in Fig. 2-1 in order to avoid deterioration of the steel support structures from salt contents in the soil. In addition, the said foundation shall be reinforced concrete structure in order to avoid structural damage and shall be constructed with the methods commonly adopted in Palestine like construction of ancillary facilities.

And further, since there are some doubts concerning welding skills and its inspection,

the steel support structures shall be fabricated in and shipped from Japan, and assembling thereof shall be carried out by local workers under the supervision of an technical expert from Japan or so.



Source: Preparatory Survey Team

Fig. 2-1 Foundation for Steel Support Structure

(2) Procurement method

Procurement of the equipment and materials for the Project shall be implemented with consideration of the followings:

1) Connection between PV modules, support structures, power conditioners, measuring and monitoring system and so on shall be guaranteed to function as an integrated system.

2) Establishment of an appropriate support structure for operation and maintenance of the system is essential since introduction of grid-connected PV system is first time in Palestine.

3) The Project shall be implemented within a limited time period so specified without fail in accordance with the guidelines for Japanese grant aid scheme.

4) Even if major equipment for the Project such as PV modules and power conditioners are to be procured from Japanese manufacturers, competitiveness among those manufacturers are maintained.

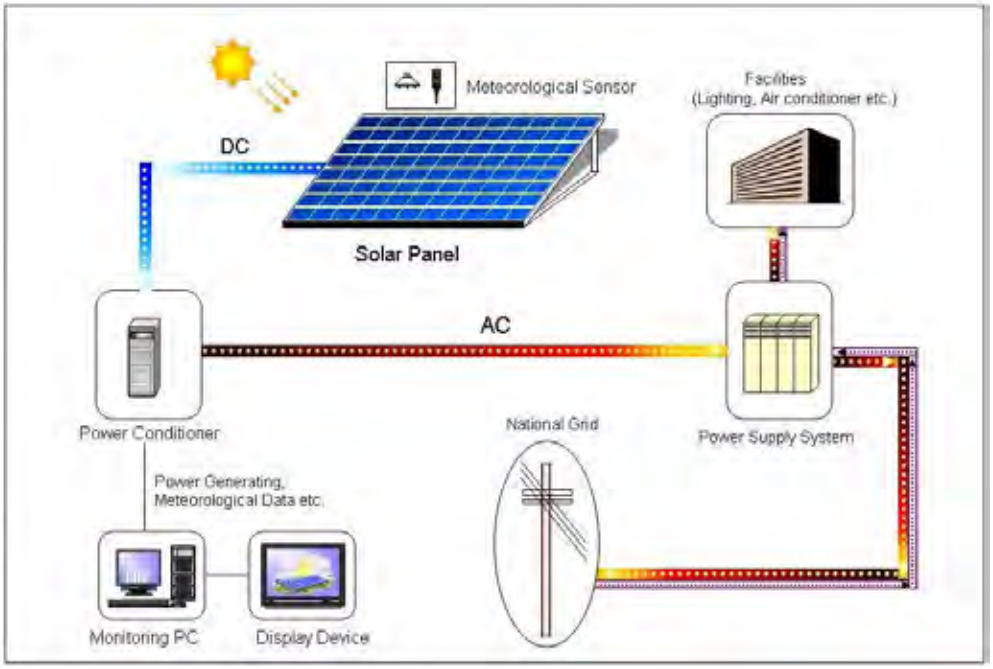
5) Since construction materials and other materials such as cables for the electrical work and so on to be used for the installation of equipment and construction of the foundation shall be procured in Palestine in order to reduce the cost for the installation work since it is judged that such materials have no problems in quantity and quality.

2-2-2 Basic plan (Equipment plan)

2-2-2-1 Formulation of basic plan

(1) Study of the equipment plan

As a result of studies and discussions conducted with Palestinian side as well as necessary analysis conducted in Japan thereafter regarding the equipment for the PV system to be procured for the Project, the Project will include the procurement of the following equipment for the grid-connected PV system with reverse power flow.



Source: Preparatory Survey Team

Fig. 2-2 Conceptual Image of Grid-connected PV System

1) PV modules

There are different types of PV modules of which cells are made of such as mono-crystal, poly-crystal, thin layer amorphous, chemical compound and hybrid materials. All these different types of PV modules have their own characteristic of power generation efficiency, temperature-maximum output, and voltage-current performance. In the technical specifications, therefore, the type of PV modules will not be specified in order to procure the most durable, economical and efficient PV system in the condition of ambient environment and available space for the installation thereof. In other words, the technical specifications will merely define the required performance or efficiency for different types of PV modules.

In addition, the project site has sufficient space that could accommodate the

installation of any type of PV modules.

Table 2-6 Required Performance for PV Modules

Type	Nominal Max. Output (W/m^2)	Conversion Efficiency (%)	Remarks
Poly-crystalline Cell	130 or more	12.5 or more	
Thin Film amorphous cell	85 or more	8.0 or more	

Note: Nominal maximum output rate is defined under the condition of AM1.5 or "Air Mass 1.5" that means solar radiation is 1,000 watts per square meter, at cell temperature of 25℃.

Source: Preparatory Survey Team

2) Power conditioners

The project site for the PV system to be installed is a part of land allocated for JAIP Phase I that is in the planning stage. The PV system is expected to supply its generated power to the estate in the future. At the present time, a feasible study for the project of JAIP has been completed and the land development including cutting and filling as well as leveling of the land to the designed level is scheduled to start soon.

During the initial stage that is until the operation of the estate has been commenced, most of the power generated by the PV system to be provided by the Project will be fed into the existing grid since its own load will be relatively non-existent. Therefore, the planned PV system should be a grid-connected system with reverse power flow. The power conditioners to be procured shall be equipped with protective functions on both the grid and the PV system itself that include preventative function from individual running in case of a grid failure. In addition, the power conditioner shall be composed of more than two (2) units in order to avoid the whole system shutdown.

3) Data Management and Monitoring System

Data management and monitoring system shall consist of a personal computer, a solar radiation meter, a thermometer, sensing instruments and signal transmitters. The system shall be able to track the amount of generated power, input and output voltage from and to power conditioners, solar radiation and air temperature as well as to record and display them in the specified format to be set. In addition, it shall keep monitoring the performance of the PV system as a whole. And, if unusual state of the PV system takes place, it shall display and record it accordingly.

Data management and monitoring system shall consist of equipments as shown in the following subparagraph ①, and shall collect, process and record automatically the data as specified in the following subparagraph ③ under the

conditions specified in subparagraph ②.

① Component of Data management and monitoring system
- Desktop PC : 1 unit
- Solar radiation meter : 1 unit
- Thermometer : 1 unit
- Sensing instruments and signal transmitter : 1 lot

② Measuring period, Calculation period and Data storage period
- Measuring period : 6 seconds
- Calculation period : 6 seconds (or 1 hour)
- Data storage period : 1 minute or 1 hour

③ Items to be observed

Table 2-7 Items to be observed

Items	Measuring Point	Data Storage
1. Solar radiation	One	Yes
2. Air temperature	One	Yes
3. Input voltage to power conditioner	One or more	Yes
4. Output voltage from power conditioner	One or more	Yes
5. Amount of generated power by PV	One	Yes
6. Amount of Power Sold to JDECO	One	Yes

Source: Preparatory Survey Team

4) Display system

The Project will provide a display system in the monitor room in the monitor building by which the maintenance staff of the PEA and many visitors could see the running state of the PV system and its effectiveness on a reduction of carbon dioxide gas emission.

The display system shall indicate the amount of generated power (present, daily, monthly and annual), meteorological data (air temperature and solar radiation), the expected reduction of carbon dioxide gas and general description of the PV system. It is also required that the viewing contents shall be set and changed by using the personal computer of the data management and monitoring system.

5) Substation

The PV system shall be connected to the existing high tension grid (33KV) owned and managed by JDECO through a substation incorporating a network transformer that could transform low voltage power of 400V being generated by the PV system to 33KV high tension. Since such grid-connection with high

tension grid (33KV) is fall under the category of “grid-connection with reverse power-flow” according to the guidelines in Japan, it is planned to provide protection device specified in the said guideline.

None of substation in Palestine is equipped with OVGR. However, OVGR will be added onto the high tension panel for this Project in order to disconnect PV system from the grid by detecting grounding accident on the grid and to keep the PV system from being damaged caused by the grid failure although the outline design of the new substation has been prepared in compliance with JDECO design standard from maintenance point of view.

6) Spare parts and consumables

The following spare parts and consumables shall be included in the project:

① Spare parts:
Two percent (2%) of total amount of the PV modules which is approximately 6.0 KW of the PV Modules shall be provided.

② Consumables:
One pieces each fuse and lamp for the power conditioners and distribution panels shall be provided.

(2) Study of the ancillary facilities and external works plan

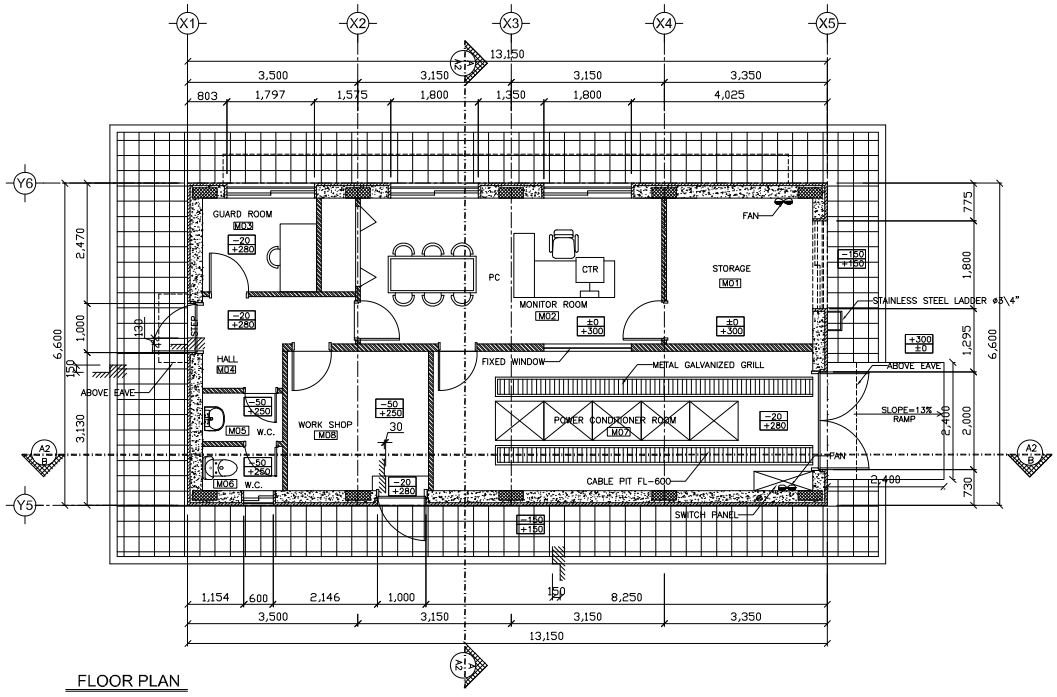
The Project will include two (2) buildings as ancillary facilities; namely, the monitor building and substation building and, the required space and utilities thereof have been verified and prepared through discussions with concerned engineers in charge from the PEA and JDECO. Floor plans of those buildings are shown in Fig. 2-3 and Fig. 2-4 below.

In addition, the project is supposed to start its operation in the stage of the phase-one of the JAIP project when it will not implement its infrastructural services such as water supply and waste water treatment. However, it was confirmed during 2nd preparatory study that the relevant department of Jericho Municipality would be able to offer the public services such as delivering potable water and collecting sludge from septic tank.

1) Monitor Building

This building will accommodate the power conditioners, data management and monitoring system and display system that are part of the major equipment of the PV system. The building will also be used as a work place for operation and maintenance staff of the PV system and will be furnished with HVAC system, plumbing system, septic tank, power and electrical feeder system, lighting and

power outlet system, automatic fire alarm system and grounding system.



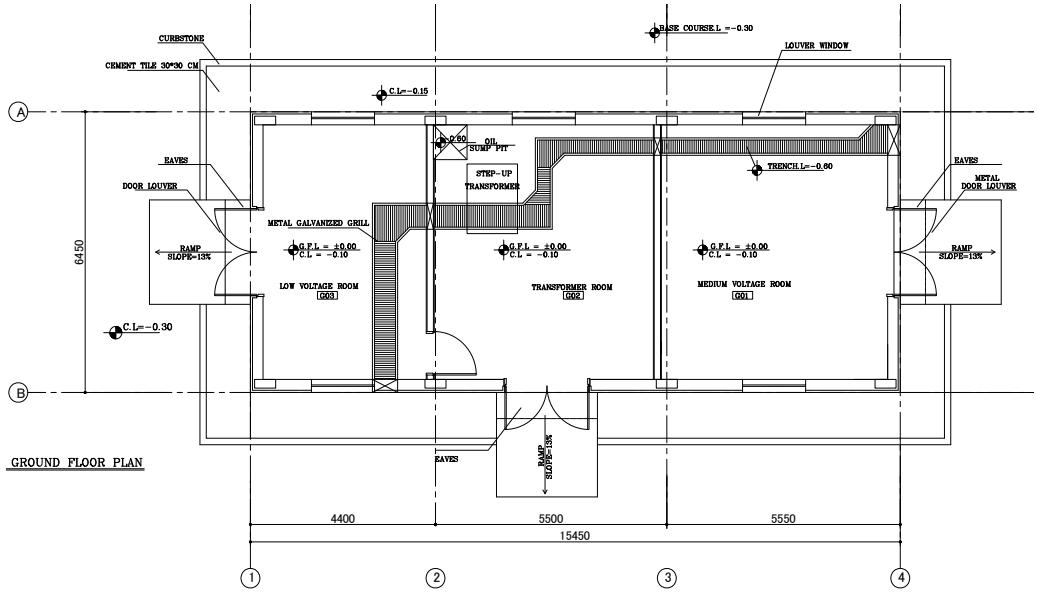
Source: Preparatory Survey Team

Fig. 2-3 Outline Design Floor Plan for Monitor Building

2) Substation Building

This building will accommodate high tension switchgears, a network transformer and a low voltage distribution panel that will be required for the PV system which will be connected to the existing JDECO high tension grid (33KV).

The building will be furnished with an electrical substation, power and electrical feeder system, lighting and power outlet system, automatic fire alarm system, lightning protection system, grounding system and mechanical ventilation system.



Source: Preparatory Survey Team

Fig. 2-4 Outline Design Floor Plan for Substation Building

And further, taking security measures for the PV system into consideration, security fence and gates, compound lighting poles (5 meters high) and surveillance cameras along the perimeter of the project site will be provided by the Project. Monitors of the surveillance cameras will be installed in the monitor room of the monitor building.

(3) System plan

Design conditions for the PV system are as follows:-

1) Meteorological conditions

Meteorological conditions for planning and outline design of the PV system shall be complied with "Section 2-2-1-2 Policy for natural conditions" and the engineering practice in Palestine shall also be taken into consideration. (Refer to the following data)

a. Air temperature

1) Annual Mean	:	24.2℃
2) Maximum (August)	:	43.8℃
3) Minimum（January）	:	11.8℃
4) Average in summer	:	32.9℃(August)
5) Average in winter	:	11.8℃(January)
6) Design outdoor temperature	:	Based on product standard

b.	Air humidity	:	Monthly mean in August R.H.47.0% Annual mean R.H.50%
c.	Wind velocity	:	Annual mean 7.1 m/sec. Maximum 31.0m/s (in January)
d.	Precipitation	:	Annual 118.8mm Monthly maximum 52.5mm (in January)
e.	Snow load	:	0 kN/㎡
f.	Freeze depth	:	N/A

2) Condition of electrical requirement

It is indispensable for the Project that an agreement for grid-connection shall be concluded by and between the PEA that is the responsible and implementing agency of the Project and JDECO that is responsible for the existing grid in order to realize the installation of this gird-connected PV system with reverse power flow. During the 2nd preparatory survey, its agreement in principle between the parties concerned has been confirmed. And therefore, the output power from the PV system shall be consistent and synchronized with the one distributed by JDECO grid. The electrical characteristics of the power being supplied by JDECO are as follows:

a. High tension power supply

33 kV 50Hz 3Phase No earthling

b. Low voltage power supply

・Voltage	380V/220V 5-wires（TN-S）
・Frequency	50Hz
・Voltage range	±4%
・Frequency range	±0.02%

Since the above-mentioned electrical supply conditions indicate a steady fluctuation range, the electrical equipment to compose the PV system shall meet the following design conditions that reflect transient fluctuation range:

・Steady voltage range	±10%
・Instantaneous voltage range	±15%
・Steady frequency range	±3%
・Instantaneous frequency range	±5%

3) System requirement for PV system

Operation and control of the PV system shall be as follows:

a. PV cells convert sunlight to electricity with direct current and feed it to power conditioners.

b. Power conditioners convert this direct current power into an alternating current power that shall synchronize with the voltage, frequency and phase of the grid to be connected. The alternating power converted by power conditioners will be distributed to the electrical load in the premise.

c. If the power generated by the PV system exceeds the power demand of the premise, the power conditioners shall reverse the excess power to the connected grid.（PV system to be provided by the Project will reverse most of the generated power to the grid during the initial operation period of the system）

d. Power conditioners shall be incorporate with protective functions that will shut off the connection between the grid and itself in case of its own faults and failures of the grid.

e. Data management and monitoring system shall monitor the performance of the PV system and record its operating data.

4) Operation of Power conditioners

Power conditioners shall run and stop automatically in the following manners:

a. Power conditioners shall keep monitoring the performance of PV modules and automatically start when the output voltage of the PV modules reaches the set value.

b. Power conditioners shall automatically stop when either output voltage or power generated by the PV modules comes down to below the set value.

c. In principle, PV system shall distribute its generated power during daytime only. PV system shall automatically stop its power distribution in case of the shortage of sunlight. (There will be no consumer to which the PV system supplies its generated power during the initial stage of its operation.)

d. When the performance of the PV system recovers, power conditioners shall resume its operation automatically after a specified period of delay time in order to avoid an excess in runs and stops.

e. In case the electrical system to be connected to the PV system has accidents or power conditioners themselves fail, the PV system shall automatically shut down and disconnect the electrical system

immediately.

f. When an accident takes place in the grid to be connected to the PV system, the PV system shall shut down. When the grid recovers, it shall restart automatically after specified period of delay time.

5) Protective measures for Grid-connected PV system

In Palestine, there is no regulation or guideline with regard to grid-connected PV system. And therefore, protective measures for the grid-connected PV system for the Project are planned in accordance with "Quality Assurance Guidelines Relating to Power System Integration Requirements" and "Grid-Interconnection Code" of Japan. Protection relays shall be provided and descriptions thereof are as shown in Table 2-8 below.

Table 2-8 Schedule of Protection Relays

Type of Protection Relay	No. of Phase	Detecting Location
1. Over Voltage Grounding Relay (OVGR) Activation Value: 2 to 30% (5 stages +) Activation Time: 0.1 to 10 seconds (5 stages +)	Zero Phase Circuit	High Tension Distribution Panel in the substation
2. Over Voltage Relay (OVR) Activation Value: 105-110-115-120% Activation Time: 0.5-1.0-1.5-2.0 seconds	1 phase	Power conditioner
3. Under Voltage Relay (UVR) Activation Value: 95-90-85-80% Activation Time: 0.5-1.0-1.5-2.0 seconds	3 phases	
4. Over Frequency Relay (OFR) Activation Value: 100.3-100.5-101-102% Activation Time: 0.5-1.0-1.5-2.0 seconds	1 phase	
5. Under Frequency Relay (UFR) Activation Value: 99.7-99.5-99-98% Activation Time: 0.5-1.0-1.5-2.0 seconds	1 phase	
6. Detection of individual run (Passive・Active) Activation Value: 3-5-7-9 times Activation Time: 0.35-0.7-1.5-3.0 seconds	―	

Source: Preparatory Survey Team

6) Grounding work

In Palestine, TS-S system in compliance with the relevant International Electro-technical Commission standard (IEC) is adopted for grounding of electrical system and equipment; thus, neutral line and grounding line are separately installed. Grounding resistance for the electrial equipment and system to be installed in the substation building shall be less than one (1) ohm in accordance with JDECO standards.

On the other hand, as for the components of the PV system such as power

conditioners, supporting structures for PV modules, connection boxes and collection boxes etc., grounding resistance shall be less than 10 (ten) ohm in accordance with Japanese Electrical Standard and the electrical system and the PV system shall be designed to be connected with ring grounding conductor in order to assure grounding resistance of less than 10 (ten) ohms.

7) Cabling and wiring works for the PV system

DC power generated by PV modules will be distributed to connection boxes after connecting cables attached to each PV module. A couple of collection boxes will be electrically connected to connection boxes by using DC power cables to be laid on/in cable ladders/racks which are fixed to supporting structures for PV modules. These collection boxes will be connected to power conditioners to be installed in the monitor building using underground DC power cables with a depth of not less than 60cm.

AC low voltage power (AC 380V) converted by the power conditioners from DC power will be distributed to a low voltage main distribution panel via a low voltage switch panel by using AC underground cables. As for grounding system, all electrical system and PV system components shall be connected to ring grounding conductor installed along perimeter of the project site as mentioned above.

8) Seismic Restraint

Calculation of seismic restraints for anchorages of equipment shall be done in accordance with “Guidelines for Design and Installation for Seismic Restraints of Equipment 2005” issued by Ministry of Land and Transportation, Japan..

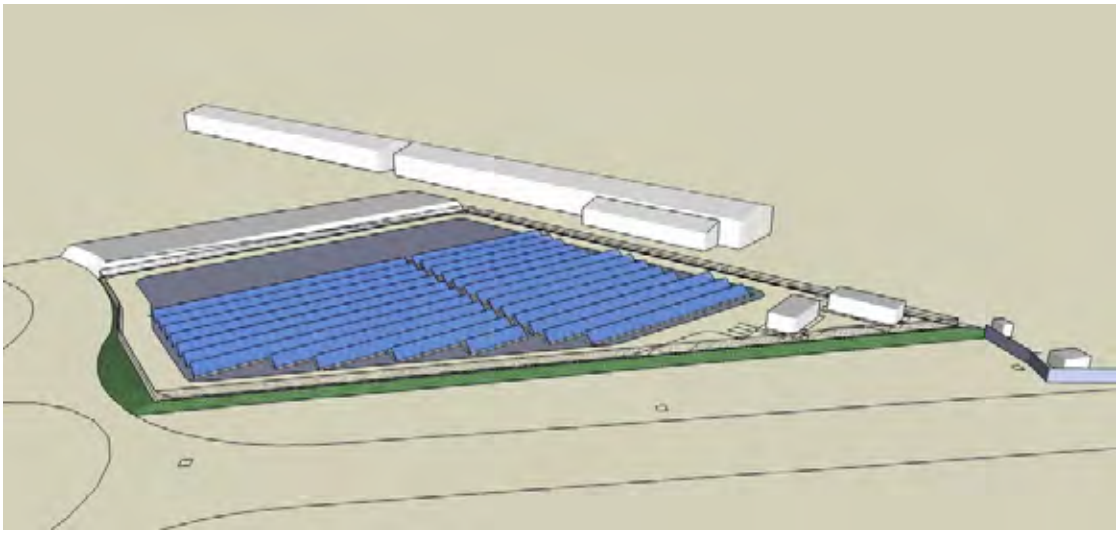
(4) System Description

Based on the aforementioned equipment planning, facility planning and system analysis, the proposed PV system shall be planned as follows:

Table 2-9 System Description

Implementing Agency	Palestinian Energy Authority
Candidate Site	Jericho Agro-Industrial Park (Phase 1)
Location	Developed land in the suburbs of Jericho Municipality in West Bank, Palestine
Land Owner	Palestine National Authority
License Holder	PIEFZA
Rating Capacity	300KWp
Expected Amount of Power Generation	Approx. 422,000kWh
Amount of reduction of carbon dioxide[6]	Approx. 290.6 tons
Area of Installation	13,000 ㎡（Including area for future extension）
Expected Consumers	Common utility power for the Agro-Industrial Park（Commercial and residential consumers in Jericho Municipality in the initial stage）

Source: Preparatory Survey Team



Source: Preparatory Survey Team

Fig. 2-5 Image of PV System Installation

2-2-2-2 Equipment plan

Specifications for the equipment to be provided for the Project with its corresponding quantity and uses which have been prepared based on examinations and analysis described in Section 2-2-2-1 “Formulation of basic plan” is as shown in Table 2-10 below.

[6] Amount of reduction of carbon dioxide is calculated based on the data provided by NEDO (refer to Chapter 3 for details)

Table 2-10 Equipment Specification

Item	Specification	Qty	Uses
PV modules	Mono or poly-crystalline cells or thin film amorphous cells with rating capacity of 300KWp or more	1 lot	To transform solar light to electricity.
Supporting structures for PV modules	Hot-dipped galvanized steel frames	1 lot	Supporting frame to fix PV modules which will be placed on concrete slab foundation.
Power conditioners	Rating capacity of 300KW or more and output voltage shall be 380V Efficiency: not less than 90% Harmonic distortion of output current: Total; not more than 5%, Each harmonics; not more than 3% Power factor: not less than 0.95 Grid- connected protection relay ・Over voltage relay ・Under voltage relay ・Over frequency relay ・Under frequency relay ・Individual operation detecting relay: (Passive protection and Active protection) Ingress protection rating: not less than IP20	1 lot	To convert direct current power generated by PV modules to alternating current power and to be with protective function for grid-connected PV system
Connection boxes	Devices to be installed: DC circuit breakers, By-pass current diodes, Protector for induced lightning stroke (ZNR), Terminal block etc. Ingress protection rating : not less than IP53	1 lot	To collect DC power generated by PV modules and to feed it to collection box
Collection boxes	Device to be installed: DC circuit breaker Ingress protection rating: not less than IP53	1 lot	To collect DC power from connection boxes by putting it together systematically and feed it to power conditioners
Data management and monitoring system (incl. personal computer)	・Personal computer ・CRT（19 inch or bigger） ・Data sensing instruments ・Signal transmitter ・UPS（more than 10 minutes capacity） ・Color printer (compatible with A3 size printing) ・Software for data monitoring ・Software for display	1 lot	To track the amount of generated power, input and output voltage to and from power conditioners, solar radiation and air temperature as well as to record and display them in the specified format to be set, and in addition, it shall keep monitoring of the performance of the whole PV system and shall control operation of display system.
Meteorological observation instruments	Solar radiation meter	1 No.	To observe solar radiation.
	Thermometers	1 No	To observe air temperature
		1 No.	To observe PV module surface temperature.
Display	Flat panel 32 inch or bigger （Liquid crystal or PDP）	1 No.	To indicate the amount of generated power (present, daily, monthly and annual), meteorological data (air temperature, solar radiation), the expected reduction of carbon dioxide gas and general description of the PV system.
Substation equipment	Including a network transformer （33KV→380V、630kVA）	1 lot	To reverse the output power (380V) generated by PV system to 33 KV high tension grid with protective devices.
Camera	Fixed outdoor colored camera	14 No.	To observe the boundary of project site for security and to transmit image data to a LCD monitor
LCD Monitor	Flat panel 21 inch or bigger (Liquid crystal)	1 No.	To monitor the images captured by cameras
Digital Video Recorder	Digital image recorder with hard disk (600GB or more)	1 No.	To record and store the images captured by cameras
Additional Hard Disk	Internal hard disk (2.4TB or more)	1 No.	To reserve additional capacity for storage of image data
Power Supply Unit	Input: AC 220V, Output: AC 24V, 5 ampere or more	1 No.	To distribute 24V power to the cameras
Cabinet Rack	Indoor self standing type Dimension: 570 mm (W) x 440 mm (D) x 2000mm (H)	1 No.	To enclose LCD monitor, Digital Video Recorder, Additional Hard Disk and Power supply unit, etc.

Source: Preparatory Survey Team