

Figure 2-11 Layout Plan of AIU

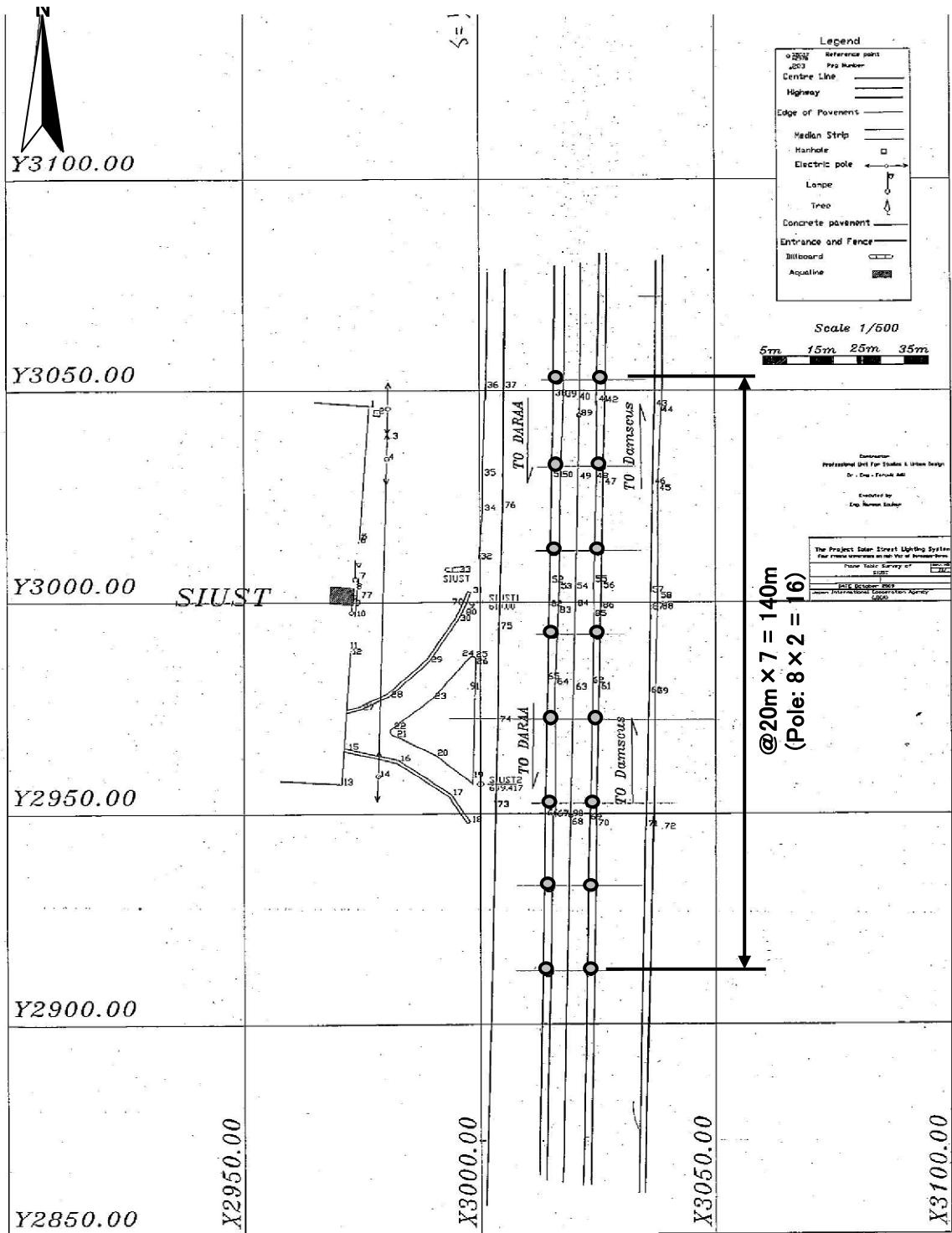


Figure 2-12 Layout Plan of SIUST (South side)

2-2-4 Implementation Plan

2-2-4-1 Implementation Policy

Street lighting is common equipment and construction work in Syria, and so a local company can install the street lighting including wiring work. However, Japanese engineers should attend to the installation works at the site, because all of the equipment of this project including PV Panels, lighting fixtures, Batteries and controllers will be procured from Japan.

Installation of ordinary street lighting is in the scope of MoT service, and traffic safety measures including lane control and speed control should be pursuant to MoT regulations. Organization of O&M of the equipment is by cooperation of NERC and MoT, and installation work should be implemented under the presence of NERC and MoT engineers. At the installation work, Japanese engineers will instruct NERC and MoT engineers regarding the initial operation, inspection work and maintenance of the equipment.

2-2-4-2 Implementation Conditions

As mentioned above, street lighting installation is common work in Syria, and all of the material and construction machinery for the installation works can be procured. Required material and construction machinery for the installation works is shown in the following table.

Table 2-7 Required Material and Construction Machinery

Material and Machinery		Intended Use
Material	Crushed rock	Consolidation of base
	Reinforced concrete	Base of light poles
	Formwork	Formwork for base concrete
Machinery	Truck and trailer	Transportation of the equipment
	Excavator	Excavation of base
	Crane	Hoist the equipment
	Bucket crane	Installation of PV Panels and lights

At storage site of the equipment, PV Panels should not be piled more than 10 panels deep to prevent break up by their own weight, and avoid direct sunlight.

PV Panels generate under the direct sunshine at any time. Open-circuit voltage of PV Panel of this project generates over 50V and measures to prevent electric shock are essential. During cable connection work, PV Panels should be covered by light shielding sheet and installers must wear insulated gloves.

Speed limit on the project road is 110km/hr, and traffic safety measures are needed during installation works on the highway. Basic traffic safety measures are as follows.

- i) 2km before construction site: Information sign “Road Construction in Road 2 km Ahead”
- ii) 1km before construction site: Information sign “Road Construction in Road 1 km Ahead”
- iii) 500 m before construction site: Information sign “REDUCE SPEED, Road Construction in Road 500 m Ahead”
- iv) 200 m before construction site: Information sign “MERGE RIGHT, Road Construction in Road 200 m Ahead”
- v) At construction site: Reduce to one lane.

2-2-4-3 Scope of Works

The Japanese side undertakes all costs of procurement including transportation and installation works for the Solar Power Street Lighting System of the project. On the other hand, The Syrian side undertakes the installation of protection barriers that protect the street lighting from impact of moving vehicles. And if underground utilities are found in the construction site, the Syrian side must move or remove the underground utilities as their own responsibility.

2-2-4-4 Consultant Supervision

The equipment for the Solar Power Street Lighting System will be procured from Japan. Inspection of quality and quantity and construction supervision at site by a consultant should be implemented. The items that should be inspected and supervised are as follows.

- Manufacturer's inspection in Japan
- Lighting test before shipment in Japan
- Inspection for shipment of the equipment in Japan
- Inspection of the equipment at the site
- Construction supervision at the site

2-2-4-5 Quality Control Plan

There are two kinds of quality control in the project, the quality of the equipment and the quality of the installation works.

Production of the Solar Power Street Lighting System for highways is the first time for Japanese manufacturers, and inspection of the equipment and lighting tests should be carried out in Japan to make certain of the products.

At the installation works at the site, quality control of concrete for the bases of the light poles is needed. Concrete will be purchased from a local manufacture, and they must submit certificates of the laboratory test as follows.

- Slump of the concrete (cm)
- Air content of the concrete (kg)
- Chloride content of the concrete (kg/m³)
- Strength of the concrete(20 ± 2°C underwater curing)

2-2-4-6 Procurement Plan

All of the equipment will be procured from Japan. Existing street light components that are common in Syria are shown in the following table, and it is expected that the light poles will be imported from other countries.

Table 2-8 Countries from which Syria Currently Imports Existing Street Lighting Equipment

Component	Country
Light Pole	Local products
Light fitting and bulb	Euro countries, China
Other Equipment	Euro countries, China

Light bulbs will be replaced after their life time, and replacements are limited to Japanese products. Until 2003, a Japanese trade company had a branch office in Syria, however they now closed that office and have offices Jordan and Turkey. Many Japanese products such as vehicles and electric appliances that are being used in Syria can be purchased on consignment from the trade company in Jordan or Turkey.

Life time of the light bulbs of Euro countries is longer than the Japanese product, and only the initial purchase of light bulbs should be considered in order to reduce the maintenance cost of the Syrian side . Batteries will also be replaced after their life time. Japanese batteries will be procured initially in order to ensure the proper function of the Japanese Solar Power Street Lighting System, but at replacement other countries' products can be purchased.

2-2-4-7 Operational Guidance Plan

O&M training by Japanese engineers is needed because all of the equipment will be procured from Japan.

- 1) Training by technical manual

Training regarding the Solar Power Street Lighting System must be given to the engineers of NERC and MoT who are to be in charge of O&M of the equipment. Contents of O&M manuals will include the following items.

- i) Inspection, repair and maintenance for PV Panels, batteries, inverter/converters, charge controllers, light fixture and bulbs
 - ii) Technical specifications and manufacturer's data sheets for all equipment and components
- 2) Training using samples of the actual equipment

Implement demonstrations regarding the mounting arrangements of the control devices, PV Panels, batteries, lighting fixtures and bulbs for the Solar Power Street Lighting System.

3) Items that should be listed in the manual

i) PV Panels

- a) Standards and Specifications
- b) Brand name
- c) Value of I_{sc} , V_{oc} , I_{max} , V_{max} and P_{max}

ii) Batteries

- a) Self discharge rate
- b) Capacity of charge or discharge characteristics
- c) Capacity of temperature characteristics
- d) Cycle life of discharge current rate characteristics

iii) Electronic devices (controllers)

- a) Self consumption of power
- b) Normal operating voltage
- c) Input voltage variation
- d) Output voltage variation
- e) Output current
- f) Overvoltage disconnect and voltage re-connect
- g) Low voltage load disconnect and voltage re-connect
- h) Explanation of charging strategy and significance of indicators

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

Soft components will not be included in the project.

2-2-4-9 Implementation Schedule

Implementation schedule of the project is shown in the following figure. Total implementation period from signing of E/N is estimated to be 14 months and that includes 4.5 months for manufacturing of the equipment, 1.5 months for transportation to the site and 3.0 months for

installation work. Installation will not be delayed by the rainy season which will have no effect on the work.

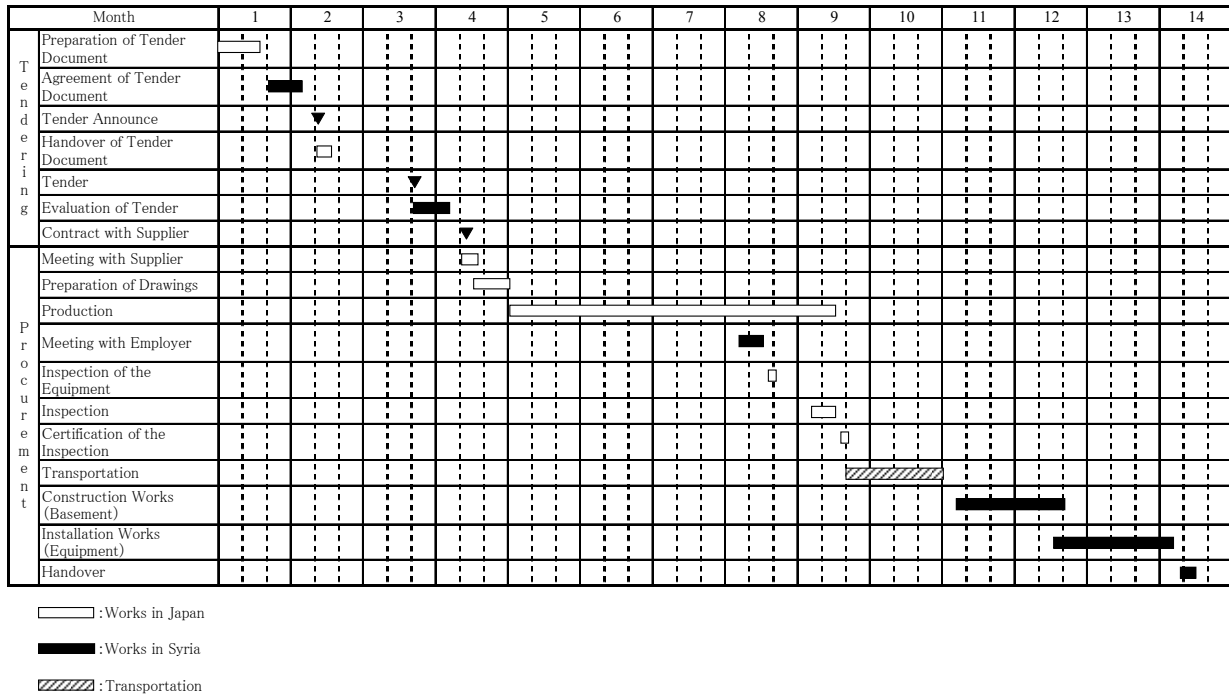


Figure 2-13 Implementation Schedule of the Project

2-3 Obligations of Recipient Country

This project is for procurement, transportation and installation of the equipment and will be implemented as the responsibility of the Japanese side. Obligations of the Syrian side are shown in following table.

Table 2-9 Obligations of Syrian Side

Obligation	Content
Organization of O&M	NERC and MoT must establish the organization of O&M of the procured equipment.
Tax Exemption	NERC must provide a tax exemption for the procured equipment at discharging in Latakia port.
Development of Temporary Depository	A depository for the procured equipment will be inside of Der Ali Power Plant located 8 km from Der Ali Interchange. Security and area is adequate for storing the equipment. A temporary warehouse will be built by NERC to serve until transportation of the equipment.
Installation of Traffic Protection Barriers	MoT will install traffic protection barriers in front of the Solar Power Street Lights on the project road. Concrete barriers will be installed that are the property of MoT. The barriers can not be procured using Grant Aid from the Japanese Government, and so this matter is an obligation of the Syrian side.

Obligation	Content
Application Procedure for Installation Works	Roads will be reduced to one lane from the existing two lanes to secure traffic safety at the installation works. Suppliers must submit traffic regulation application forms to the traffic police, and MoT will support the process for supplier.
Relocation of Underground Utilities	If underground utilities are discovered in the project, NERC must move or remove the underground utilities.

2-4 Project Operation Plan

NERC is the implementation agency for this project, however operation of existing street lighting is implemented by MoT, and the Solar Power Street Lighting System of this project will be operated and maintained by a cooperative between NERC and MoT. Annual budget of NERC is less than that of MoT, however MoT annual budget is enough to operate the Solar Power Street Lighting of the project.

O&M Items of a solar power generating system are less than ordinary other electric power generating systems such as thermal power or hydro power systems. General maintenance is carried out by monthly inspections and periodic inspections. Monthly inspections are visual checks and periodic inspections should be carried out every six months. Items of inspection are as follows.

【 PV Panels】

- blemishes or damage on surface
- decay or rust on fittings
- deterioration of outside wiring

【 Connection Boxes】

- decay or rust of exterior
- damage to outside wiring

【 Inverter/Controllers 】

- decay or rust of exterior
- damage to outside wiring
- abnormal noise or odor
- clogging of ventilators

【 Batteries】

- normality of generation checked using a measuring instrument
- cracks, deformations or liquid leakage of electrolyte cell or cover

- abnormality of packing
- rust of cubicles, counters and terminals
- charging voltage
- electric cell voltage
- estimation of lifetime by capacity of electric cell
- actual loading test

Regarding changing battery after 5 years of lifetime, other manufacturers' batteries can be used if they have the same as original dimensions and capacity, however lifetime will not be the same as the original batteries, and refilling of water will be required for liquid type batteries.

2-5 Project Cost Estimation

2-5-1 Initial Cost Estimation

There will be no burden of expense on the Syrian side in this project.

2-5-2 Operation and Maintenance Cost

The O&M cost that will be a burdened for the Syrian side is estimated based on the following conditions.

- Total number of Solar Power Street Lights is 176.
- Replacement equipment is light bulbs and batteries.
- Period of O&M is assumed 20 years. (lifetime of PV Panels)
- Unit cost applied is the Japanese manufacturers' price.
- Periodic maintenance cost is not included.

(1) Light Bulbs

- Light bulb replacement will not be required for the Initial seven (7) years.
- Replacement will be required every two and a-half (2.5) years after the initial seven years.
- The total number of replacements is five (5) times for 20 years.
- Unit cost of one bulb is \$100 and total cost is estimated to be \$88,000. ($176 \times \$ 100 \times 5 =$
\$ 88,000)

(2) Batteries

- Battery replacement will not be required for the Initial five (5) years.
- Replacement will be required every five (5) years after the initial five years.

- The total number of replacements is three (3) times for 20 years.
- Unit cost of one battery is \$3,000 and total cost is estimated to be \$1,584,000. ($176 \times \$3,000 \times 3 = \$1,584,000$)
- Cost of battery disposal is SP5,600/m³, and cubic volume is 0.08m³/1 unit. Total cost of battery disposal is estimated to be \$6,700. ($176 \times 0.08\text{m}^3 \times 5,600\text{SP} \times 4 = 315,000\text{SP} = \$6,740$)

Total maintenance cost = \$88,000 + \$1,584,000 + \$6,700 = \$1,678,700 (\$84,000/year)

2-6 Other relevant Issues

A solar power street lighting pilot project by the Syrian government is now on going, and equipment will be procured from other countries for the pilot project. Japanese equipment will be procured for this project, and so initial instruction and maintenance training for counterparts of the related agencies is essential. Especially, simple maintenance, for example cleaning of PV Panel surfaces, is important, and without this simple maintenance, efficient PV Panel power generation will not be possible.

The project road is located on a little used highway with few people and only high speed vehicles, especially, the number of passage vehicles and people will be reduced in the night time. Procured equipment is expensive, therefore, the battery boxes are specified to be equipped with rugged lock systems because the batteries will be put on the ground level. However, protection of the equipment against theft is the responsibility of the Syrian side.

CHAPTER 3 PROJECT EVALUATION AND RECOMMENDATIONS

3-1 Project Effects

The implementation of the project will effectively contribute to the environment through reduction of CO₂ emissions and improved traffic safety. The following benefits are expected from the implementation of the project.

Table 3-1 Project Effects

Actual Conditions and Issues	Action of the Project	Direct Effects	Indirect Effects
Street lighting is not installed. Visibility in night time is bad. Traffic safety is not secured.	Solar Power Street Lighting System will be developed.	Lamp wattage of conventional street lights is 180W to 400W. In case of 200W lamps and average operation time of 10.75 hours per day, 1.034 kg of CO ₂ will be emitted due to one street light per day. This value is the same as 0.45 liters of combusted gasoline. A total of 66,424 kg of CO ₂ and 28,908 liters of gasoline will be reduced per annum by the Solar Street Lighting System of this project. Traffic accidents and street lighting has an affinitive relation, and it is reported by International Commission of Illumination that after development or improvement of street lighting, traffic accidents in the night time were reduced to 21%~76%. Improvement of visibility by street lighting will contribute to reduce traffic accidents in night time on the highway.	Syrian government is now implementing several solar power generation project by own budget. Dissemination and enlightenment activities of solar power generation will be intensified by this project in Syria.

CO₂ emission coefficient is normally calculated based on actual data of fuel quantities consumed. In this project, an accurate CO₂ emission coefficient in Syria can not be figured, and so the above is calculated using the CO₂ emission coefficient of Japan.

In Japan, the CO₂ emission coefficient is calculated by each electric power company, and specified 0.3~0.5kg-CO₂/kWh. This differential is set for each type of electric power plant; this means that the CO₂ emission coefficients of atomic and hydro power generation have small values, and alternately, the coefficient of thermal electric power generation is the large value.

Tangible data of CO₂ emission coefficients for each electric power company is as follows.

- Tokyo Power Electric Power Company.: 0.339-CO₂/kWh
- Chubu Power Electric Power Company: 0.481-CO₂/kWh
- Kyushu Power Electric Power Company: 0.375-CO₂/kWh

Most of the power generation in Syria is thermal, and the percentage of hydro power generation was only 2.3% in 2003. This power generation condition is close to the Chubu Power Electric Power Company and CO₂ emission of above table is calculated based on the coefficient of the Chubu Power Electric Power Company.

CO₂ emission: 0.2 kWh×10.75 hours×0.481 = 1.034 kg/day/light = 66,424kg/year/176 lights

Conversion of combustion of gasoline: 0.45 litter/day/light = 28,908 litter/year/176 lights

Maximum CO₂ emission coefficient in Japan is specified as 0.55kg-CO₂/kWh, this value is regulated by “Environment Degree No.3: Ministry of Economy, Trade and Industry, 2006”.

3-2 Recommendations

This project is for procurement and installation of a Solar Power Street Lighting System on the highway, where no street lighting is currently installed. There will be no expense for electricity; however batteries are essential equipment because the generated electric power must be charged into a battery for use in the night time. Batteries should be changed periodically to maintain the function of the Solar Power Street lighting of the project.

O&M will be implemented by the cooperative authorities of NERC and MoT. All of the equipment will be procured by Japan, and it will be necessary for Japanese engineers to conduct O&M training during installation work. Street lights have a high probability of damage through collision of moving vehicles on the highway, and so the related authorities have to repair them quickly if perchance the Solar Power Street lighting System was destroyed. And also authorities have to provide measures to burglar-proof the equipment.

To ensure the O&M of the procured equipment, implementation of follow-up of the project is required five years after installation of the Solar Power Street Lighting System.

Up to now, there are no similar Solar Power Street Lighting System projects that have been supported by other donor countries, however, linkage with other donors is required for the Solar Power Street Lighting System and also any other related Solar Power energy projects in the future.

Appendix 1: Member List of the Study Team

1. Member List of the Study Team

Name	Assignment	Authority/Firm
Mr. Satoshi UMENAGA	Team Leader	Advisor Economic Infrastructure Department, (JICA)
Mr. Hideo KAIZUKA	Procurement Agent	Director, Second management department, Japan International cooperation System (JICS)
Mr. Nobuo MONOE	Chief Consultant Road Transport Planner/Road Facility Designer	Oriental Consultants
Mr. Masahiro SAKURAI	Equipment Planner (PV)	Oriental Consultants
Mr. Sotaro MORI	Electric Facility Planner	Oriental Consultants
Mr. Hironori HONMA	Cost Estimator/Natural Condition Surveyor/Social & Environmental Consideration Expert	Oriental Consultants

2. Study Schedule

First Site Survey

Time Schedule			Consultant			
			Mr. Umenaga (JICA) Mr. Kaizuka (JICS)	Mr. Monoe	Mr. Honma	Mr. Sakurai
1	18, June	Sat.		Tokyo – Osaka – Dubai		
2	19	Sun.		Dubai – Damascus/meeting with JICA		
3	20	Mon.		NERC•MOT Courtesy call		
4	21	Tue.		Survey		
5	22	Wed.		Site survey with NERC and MOT		Tokyo–Osaka–Dubai
6	23	Tur.		Survey		Dubai – Damascus
7	24	Fri.	Tokyo–Osaka–Dubai	Documentation		Tokyo–Osaka–Dubai
8	25	Sat.	Dubai – Damascus	Site survey		Dubai – Damascus
			Site Survey			Site survey
9	26	Sun.	Meeting with JICA/Courtesy call to MOE•SPC•MOT, Explanation of Inception report			
10	27	Mon.	Discussion with NERC			
11	28	Tue.	Discussion with NERC			
12	29	Wed.	Signing of M/D, Report to JICA			
			Damascus – Dubai	Survey		
13	30	Tur.	Dubai I – Osaka – Tokyo	Survey		
14	31	Fri.	Documentation			
15	1, August	Sat.	Documentation			
16	2	Sun.	Survey			
17	3	Mon.	Report to JICA, Damascus – Dubai			
18	4	Tue.	Dubai – Osaka – Tokyo			

Legend : EoJ (Embassy of Japan), M/D (Minute of Discussion), MoE (Ministry of Electricity), NERC (National Energy Research Center)
: MoT (Ministry of Transport), MoI (Ministry of Investment)

Second Site Survey

Time Schedule			Consultant			
			Mr. Monoe	Mr. Honma	Mr. Mori	Mr. Sakurai
1	October, 2	Fri.	Tokyo – Osaka – Dubai			
2	3	Sat.	Dubai – Damascus			
3	4	Sun.	Meeting with JICA•Courtesy call to NERC and MOT			
4	5	Mon.	Discussion with NERC			
5	6	Tue.	Documentation			
6	7	Wed.	Site Survey			
7	8	Tur.	Survey, Report to JICA			
8	9	Fri.	Documentation			
9	10	Sat.	Documentation			
10	11	Sun.	Joint Survey with local topographic company			
11	12	Mon.	Report to JICA/Discussion with NERC			
12	13	Tue.	Survey of solar street lighting at Homs			
13	14	Wed.	Local pole manufacture survey			
14	15	Tur.	Investigation of local topographic company/survey			
15	16	Fri.	Documentation			
16	17	Sat.	Documentation			
17	18	Sun.	Discussion with NERC			
18	19	Mon.	Survey of solar street lighting at Damascus			
19	20	Tue.	Temporary storage site survey of NERC (Deir Ali Power Plant)			
20	21	Wed.	Survey/Visiting to MOE (solar panel on the top of roof)			
21	22	Tur.	Survey/Report to JICA			
22	23	Fri.	Documentation			
23	24	Sat.	Documentation			
24	25	Sun.	Survey of battery disposal			
25	26	Mon.	Survey of discharging port (Latakia) and transportation route			
26	27	Tue.	Survey			
27	28	Wed.	Survey			
28	29	Tur.	Report to JICA/EoJ			
29	30	Fri.	Damascus – Dubai			
30	31	Sat.	Dubai – Osaka – Tokyo			

Legend : EoJ (Embassy of Japan), M/D (Minute of Discussion), MoE (Ministry of Electricity), NERC (National Energy Research Center)
: MoT (Ministry of Transport), MoI (Ministry of Investment)

Appendix 3: List of Parties Concerned in the Recipient Country

3. List of Parties Concerned in the Recipient Country

(1) Embassy of Japan

Mr. Katsumi MORIYASU: Counselor

Mr. Takayuki BABA: Second Secretary

(2) JICA Office

Ms. Akiko TOMITA: Chief Representative

Mr. Hideki TANABE: Senior Representative

Mr. Yasuhiro SUHARA: Representative

Mr. Ahmad Al Tawan: Senior Program Officer

Mr. Izeldien Oghly: Program Officer

(3) Concerned in the Syrian Government

Name	Position	Authority
Eng. Mohammed Khalil Sheki	General Director	NatiOnal Energy Research Center (NERC)
Mouaffak Alish	Mechanical-Engineer, Maintenance-Operation of Power Plants	NatiOnal Energy Research Center (NERC)
Dr. Eng. Youssef Hammood	General Manager	Public Establishment for Road Communication
Suleiman Hatem	Director of Road and Bridge	Public Establishment for Road Communication
Dr. Eng. Amal Abou Atash	Deputy Director General for technical affairs	Public Establishment for Road Communication
Dr. Eng. Abdul Salem AL Massri	Director of Road Maintenance	Public Establishment for Road Communication
Hala Imad	Director of Co-operation with Asia, America and Africa	State Planning Commission
Eng. Maurice Addad	Plant Manager	Solid Waste Treatment Plant Damascus Governorate

(4) Local Company

Name	Position	Company
Dr. Eng. Abdul Rahman A. Osman	General Manager	Osman Technical Engineering Consulting
Eng. Mahamoud Warde	Professor in Damascus University	United Engineers & Architects
Hani Al-Hosary	Commercial Department Director	Hamsho for Trade and Construction
Jawad Baidon	Financial Department Director	Hamsho for Trade and Construction
Eng. Akill Ismail	Company Director	Gezairi Transport
M. Jihad Al Saidi	Project Manager	Gezairi Transport
Georges Tambe		Intertransport

Appendix 3: List of Parties Concerned in the Recipient Country

Prof. Dr. Eng. Sinan Massud Al-Ghanem	General Manager	Syrianet
Eng. Maher Shaherli	Technical Consultant of General Director	Syrianet
Yosef Skaf	Vice President	Syrian Engineering Company for Solar Power
Wail Al Ali	Business Developer	Syrian Engineering Company for Solar Power
Hosam Akkad	General Manager	Solar Solution Future Systems

(5) Other Relevant Firm

Name	Position	Firm
Hicham Al Sabbagh	Faculty of Business Administration	Arab International University
Prof. Dr. Abdul majeed A. Al-sa'adoon	University President	Syrian International University for Science and Technology

**Minutes of Discussions
on the Preparatory Survey
on the Project for Solar Street Lighting System**

The Government of Japan (hereinafter referred to as "GoJ") has established Cool Earth Partnership as a new financial mechanism. Through this Partnership, GoJ is cooperating actively with developing countries' efforts to reduce greenhouse gasses emissions, such as efforts to promote clean energy. A new scheme of grant aid, "Program Grant Aid for Environment and Climate Change", was also created by GoJ as a component of this financial mechanism. According to the initiative of Cool Earth Partnership, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), in consultation with GoJ, decided to conduct a Preparatory Survey (hereinafter referred to as "the Survey") on the Project for Solar Street Lighting System in Syria (hereinafter referred to as "the Project").

JICA sent to the Syrian Arab Republic (hereinafter referred to as "Syria") the Preparatory Survey Team (hereinafter referred to as "the Team"), headed by Mr. Satoshi Umenaga, Advisor, Economic Infrastructure Department, JICA and is scheduled to stay in the country from July 19, 2009 to August 3, 2009 as the 1st phase of the Preparatory Survey.

The Team held discussions with the concerned officials of the Government of Syria and conducted a field survey.

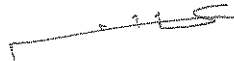
In the course of discussions and field survey, both sides confirmed the main items described in the attached sheets.

Damascus, July 29, 2009

梅永 哲


Eng. Satoshi UMENAGA
Leader
Preparatory Survey Team
Japan International
Cooperation Agency

Dr. Eng. Abdul Salam Al Massri
Director of Roads Maintenance
Ministry of Transport



Eng. Mohamed Khalil Sheki
General Director,
National Energy Research
Center
Ministry of Electricity



Hala Imad 

Representative of State Planning
Commission

(Witness)

Dr. Eng. Ahmad Kussay Kayyali
Minister of Electricity

ATTACHMENT

0. Current Situation

The suggested highway that Damascus Jordan Boarder Highway is the most important arterial highway that connects Syria and southern countries such as Jordan and Gulf countries, and the southern gate of Syria. Millions passengers and freights pass through the highway.

At the moment, there is no street lighting system on the almost all the section of the highway, which causes traffic accident in night time traffic and installation of street lighting system will save a lot of lives of road users. In the development the street lighting, utilizing of solar power which is the ecology friendly way is aiming to achieve both emissions reductions and economic growth and working to contribute to climate stability. This is consistent with the policy of the Government of Syria as well as the global environmental issue.

1. Objective of the Project

The objective of the Project is to introduce solar street lighting system, thus to contribute promotion of clean energy utilization, reductions of greenhouse gas emissions as well as improvement of safety on national highway.

2. Project Site

The Project site is shown in Annex-1

3. Responsible Organization and Implementing Agency

The responsible and implementing organization is National Energy Research Center (hereinafter referred as "NERC"), Ministry of Electricity. (The organization chart is shown in Annex-2, 3.)

4. Items Requested by the Government of Syria


4-1. After discussions with the Team, the procurement of the street lighting system consisted of photovoltaic module, lamp, battery, electric controller and pole was requested by the Syrian side.

The project sites on the Damascus Jordan Border Highway as follows in priority order;

- (1) Jbab section (Universities located section) and Hirjalla interchange
- (2) Deir Ali section(University located section)

4-2. The Team will assess the appropriateness of the request and will report the findings to the Government of Japan.

4-3. The Syrian side has understood that the system components, Project roads and etc. are subject to further assessment in 1st and 2nd Phase of the Survey and the technical analysis.



5. Japan's Program Grant Aid for Environment and Climate Change

The Syrian side understood the Japan's Program Grant Aid for Environment and Climate Change scheme explained by the Team, (as described in Annex-4, 5 and 6) .

6. Schedule of the Study

6-1. The Team will proceed to further survey in Syria until August 3, 2009 as the 1st phase of the Preparatory Survey.

6-1. After the completion of the 1st phase of the Preparatory Survey, the Team will report the results to JICA Headquarters and the Ministry of Foreign Affairs of Japan.

6-2. If the Cabinet will approve the Project based on the results of the 1st phase of the Preparatory Survey, JICA will conduct the Detailed Design Study as the 2nd phase of the Survey.

7. Other Relevant Issues

7-1. Civil and installation works

The Syrian side requested that the civil and installation works will be covered by the Japanese side. The team accepted the request under the consideration of the smooth implementation. However, in case utilities under the ground will be found, the removal work should be implemented by the Syrian side.

7-2. Coordination with Other Organizations

NERC shall coordinate with other concerned organizations such as Ministry of Transport, Traffic department of Ministry of Interior, Governorate of Damascus and Governorate of Daraa, etc.

7-3. Social and Environmental Consideration

The Syrian side explained Environmental Impact Assessment (hereinafter referred as "EIA") is not necessary for the implementation of the Project. On the other hand, the Team emphasized that the disposal of the replaced batteries in future is the most important issue for the environment protection. The Syrian side fully understands the adequate disposal.

7-4. Procurement of Equipment and Materials

The Team explained that, in accordance with the policy of GoJ, products of Japan shall be procured for major equipment in the Project. The Syrian side agreed with the policy of GoJ.

7-5. Operation and Maintenance

The team pointed out the importance of the operation and appropriate maintenance by the Syrian side and the operation and maintenance manual and instruction will be provided under the Project.

The main components of the maintenance work are as follows,

- Periodical inspection
- Replacement of the consumable parts (lamp, battery, etc.)

The Syrian side mentioned that Ministry of Electricity and Ministry of Transport shall have responsibility of the operation and maintenance. The Syrian side explained to the Team that it will

take the necessary measures for securing the budget for “Operation and Maintenance of the System”. The Syrian side shall inform such measures to the Team at the commencement of the 2nd Phase of the Survey.

7-6. Customs and Tax Exemption

NERC is responsible for the exemption of all customs, tax, levies and duties incurred in Syria for implementation of the Project and also responsible for all expenses or fees related to the custom clearance of the equipment procured under the Project.

7-7 Equipment Stock Yards

The Team pointed out that the Syrian side should have responsibility to secure the place/land that stocks the all equipment at the site.

7-8. Security

The Syrian side shall ensure the security of all concerned Japanese nationals working for the Project, if deemed necessary.

7-9. Counterpart Personnel

The Syrian side shall provide necessary numbers of counterpart personnel to the Team during the period of their studies in Syria.

<List of Annex>

- Annex-1 Project site
- Annex-2 Organization Chart of Ministry of Energy
- Annex-3 Organization Chart of National Energy Research Center
- Annex-4 Program Grant Aid for Environment and Climate Change
- Annex-5 General Flow of Program Grant Aid for Environment and Climate Change
- Annex-6 Flow of Funds for Project Implementation
- Annex-7 Project Implementation System
- Annex-8 Major Undertakings to be taken by Each Government

To DAMASCUS

Annex - I

Hirjalla

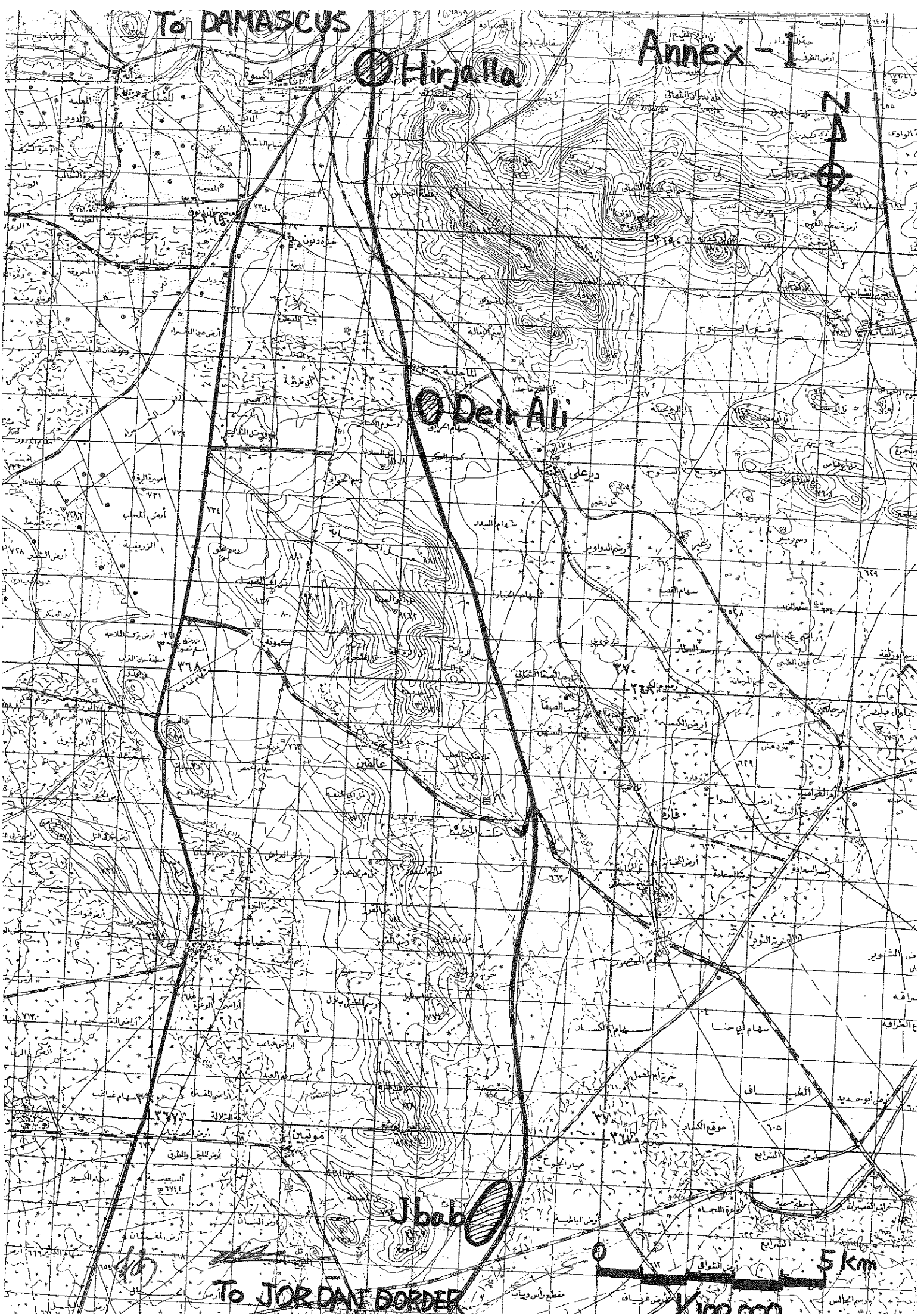
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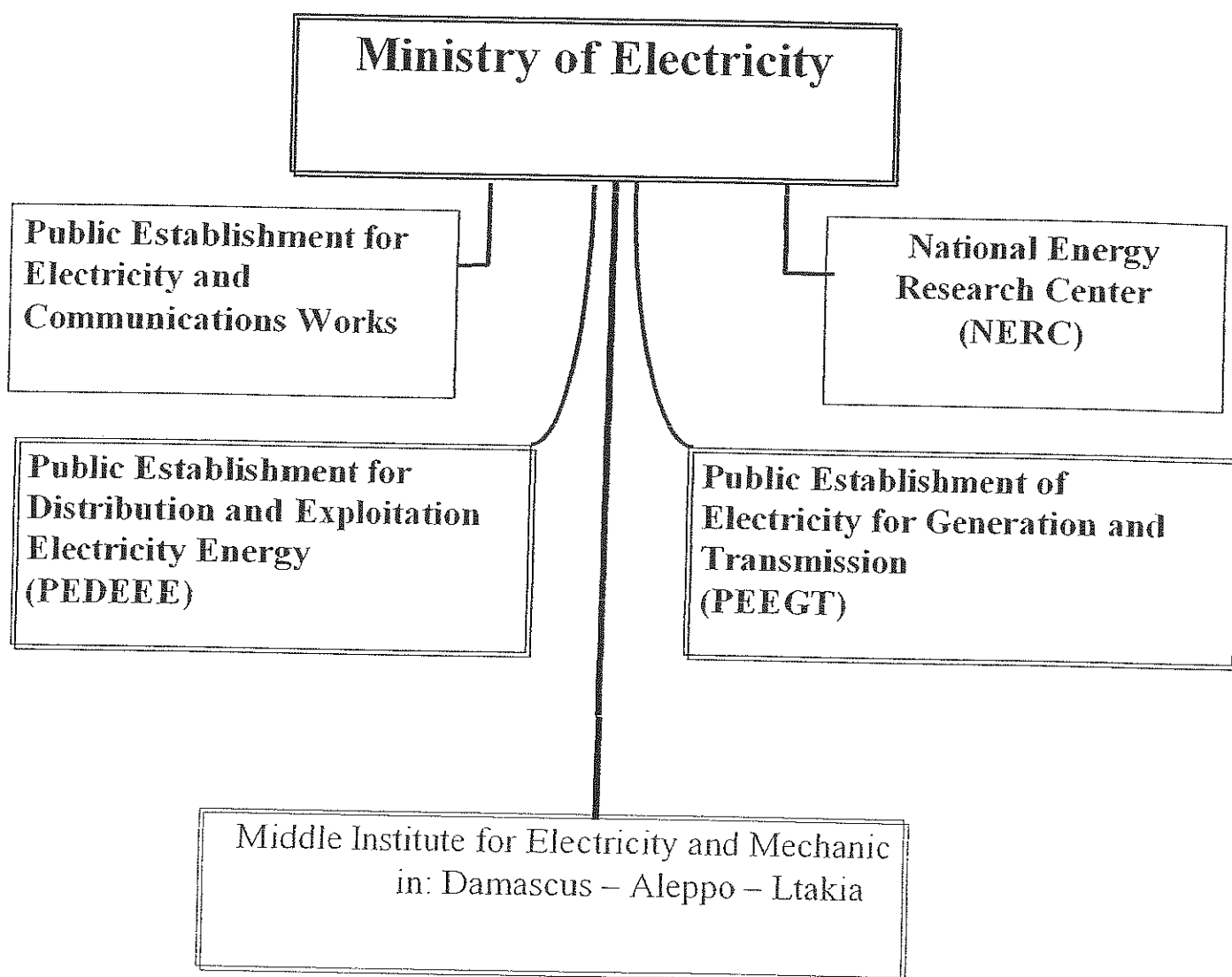
To JORDAN BORDER



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Structural chart of Ministry of Electricity



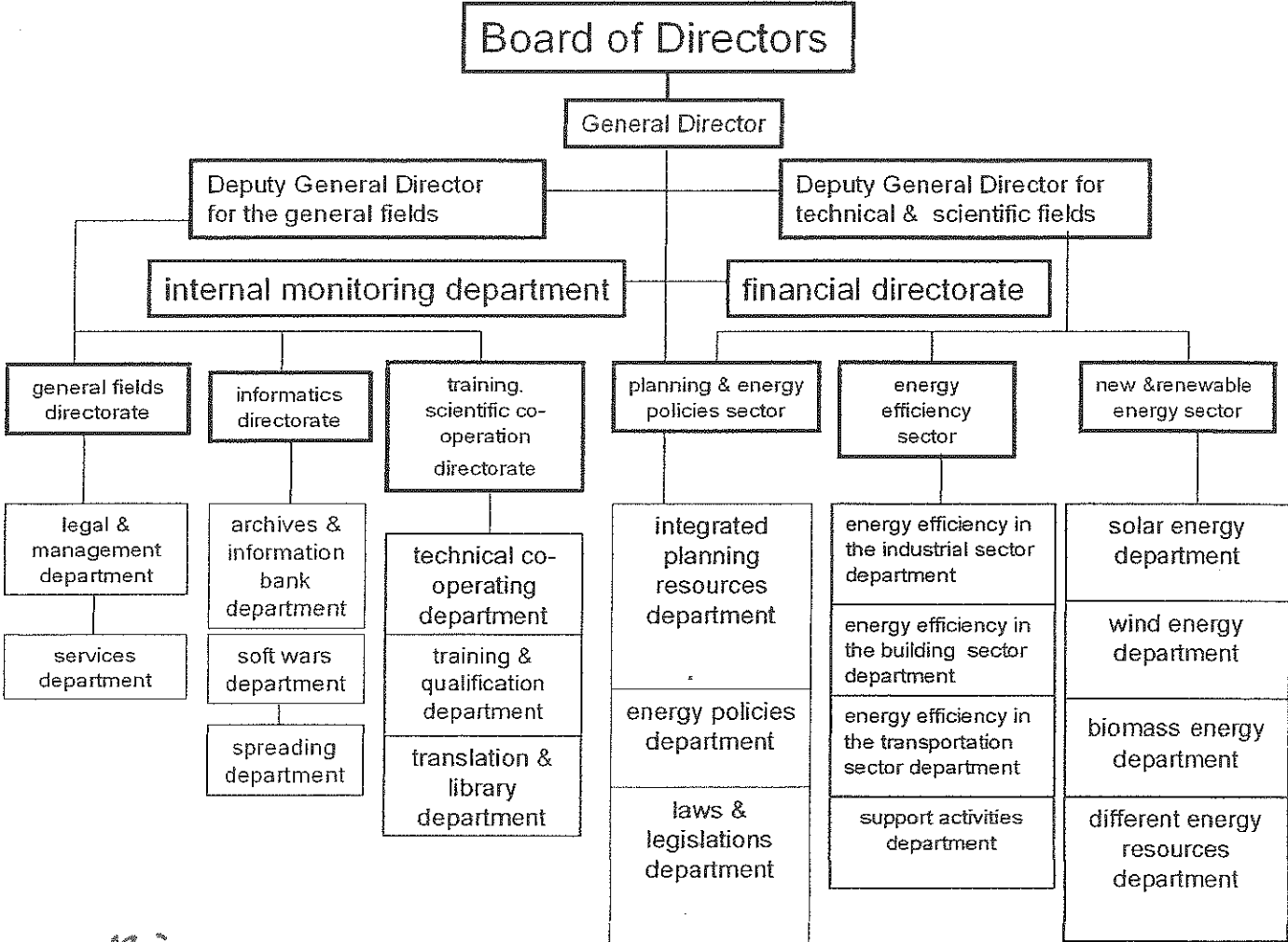
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Structural chart of NERC



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

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

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

1. Procedures for GAEC

GAEC is executed through the following procedures.

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

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

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

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

Fourthly, the project, once approved by the Cabinet, becomes official with the Exchange of Notes (hereafter referred to as "E/N") signed by the Governments of Japan and the recipient country.

Simultaneously, the Grant will be made available by concluding a Grant Agreement (hereinafter referred to as "the G/A") between the Government of the recipient country or its designated authority and JICA

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

2 Preparatory Survey

1) Contents of the Survey

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

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

The contents of the original request by the recipient country are not necessarily approved in their initial form as the contents of the Grant Aid project. The Basic Design of the Project is confirmed considering the guidelines of the Japan's Grant Aid scheme.

JICA requests the Government of the recipient country to take whatever measures are necessary to ensure its self-reliance in the implementation of the Project. Such measures must be guaranteed even though they may fall outside of the jurisdiction of the organization in the recipient country actually implementing the Project. Therefore, the implementation of the Project is confirmed by all relevant organizations of the recipient country through the Minutes of Discussions.

2) Selection of consulting firms

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

In order to maintain technical consistency on the Project's implementation after the E/N and G/A, the consulting firm(s) which conducted the Survey will be employed by the Agent based on the recommendation to the recipient country by JICA.

3. Implementation of GAEC

1) Exchange of Notes (E/N) and Grant Agreement (G/A)

After the Project is approved by the Cabinet of Japan, the E/N will be signed between the Government of Japan and the Government of the recipient country, which is followed by the conclusion of the G/A between JICA and the Government of the recipient country to define the necessary articles to implement the Project, such as payment conditions, responsibilities of the Government of the recipient country, and procurement conditions.

2) Detailed Procedures

Essential points of the detailed procedures on procurement and services under GAEC to be agreed are outlined as follows:

- a) JICA will supervise the implementation of the Project.
- b) Products and services will be procured and provided based on the JICA's "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change."
- c) The Recipient will conclude a contract with the Agent.
- d) The Agent is the representative acting in the name of the Recipient concerning all transfers of funds to the Agent.

3) Focal points of "Procurement Guidelines for the Program Grant Aid for Environment and Climate Change"

a) The Agent

The Agent is the organization, which provides procurement of products and services on behalf of the recipient under the Agent Agreement with the recipient. The Agent is recommended to the recipient by the Government of Japan and agreed between the two Governments in the A/M.

b) Agent Agreement

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

c) Approval of the Agent Agreement

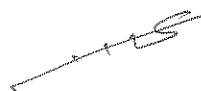
The Agent Agreement is prepared as two identical documents and the copy of the Agent Agreement will be submitted to JICA by the Recipient through the Agent. JICA confirms whether the Agent Agreement is concluded in conformity with the E/N, A/M, and G/A and the Procurement Guidelines for the GAEC then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

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

d) Payment Methods

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

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



e) Products and Services Eligible for Procurement

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

f) Selection of firms

In principle, firms of any nationality could be contracted as long as the firms satisfy the conditions specified in the tender documents.

The same applies for any individual consultants who will be involved in the project and provide services necessary for the training and guidance related to the Project. The consultants that will be employed to engage detailed design and supervise the work for the Project, however, will be Japanese nationals recommended by JICA for the purpose of maintaining technical consistency with the Survey

g) Method of Procurement

In the course of conducting the procurement, sufficient attention will be paid to transparency in selecting the firms and for this purpose, competitive tendering will be employed in principle.

h) Tender Documents

The tender documents should contain all information necessary to enable tenderers to prepare valid offers for the products and services to be procured under GAEC.

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

i) Pre-qualification Examination of Tenderers

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

To achieve this objective, the following points should be taken into consideration:

- (1) Experience and past performance in contracts of similar kind projects
- (2) Financial credibility (including assets such as real estate)
- (3) Existence of offices and other items to be specified in the tender documents.
- (4) Their potentialities to use necessary personnel and facilities.

j) Tender Evaluation

The tender evaluation should be implemented on the basis of the conditions specified in the tender documents.

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

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

k) Additional procurement

If there is any remaining balance after the competitive and/or selective tendering and/or direct

negotiation for a contract, and if the Recipient would like to procure additional items, the Agent is allowed to conduct this additional procurement, following the points mentioned below:

(1) Procurement of same products and services

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

(2) Other procurements

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

l) Conclusion of the Contracts

In order to procure products and services based on the guideline, the Agent will conclude contracts with firms selected by tendering or other methods.

m) Terms of Payment

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

4) Major undertakings to be taken by the Government of the Recipient Country

In the implementation of the Grant Aid Project, the Recipient is required to undertake necessary measures as Annex-8.

5) "Proper use"

The Government of the recipient country is required to operate and maintain the facilities constructed and equipment purchased under the Grant Aid properly and effectively and to assign personnel necessary for this operation and maintenance as well as to bear all the expenses other than those covered by the Grant Aid.

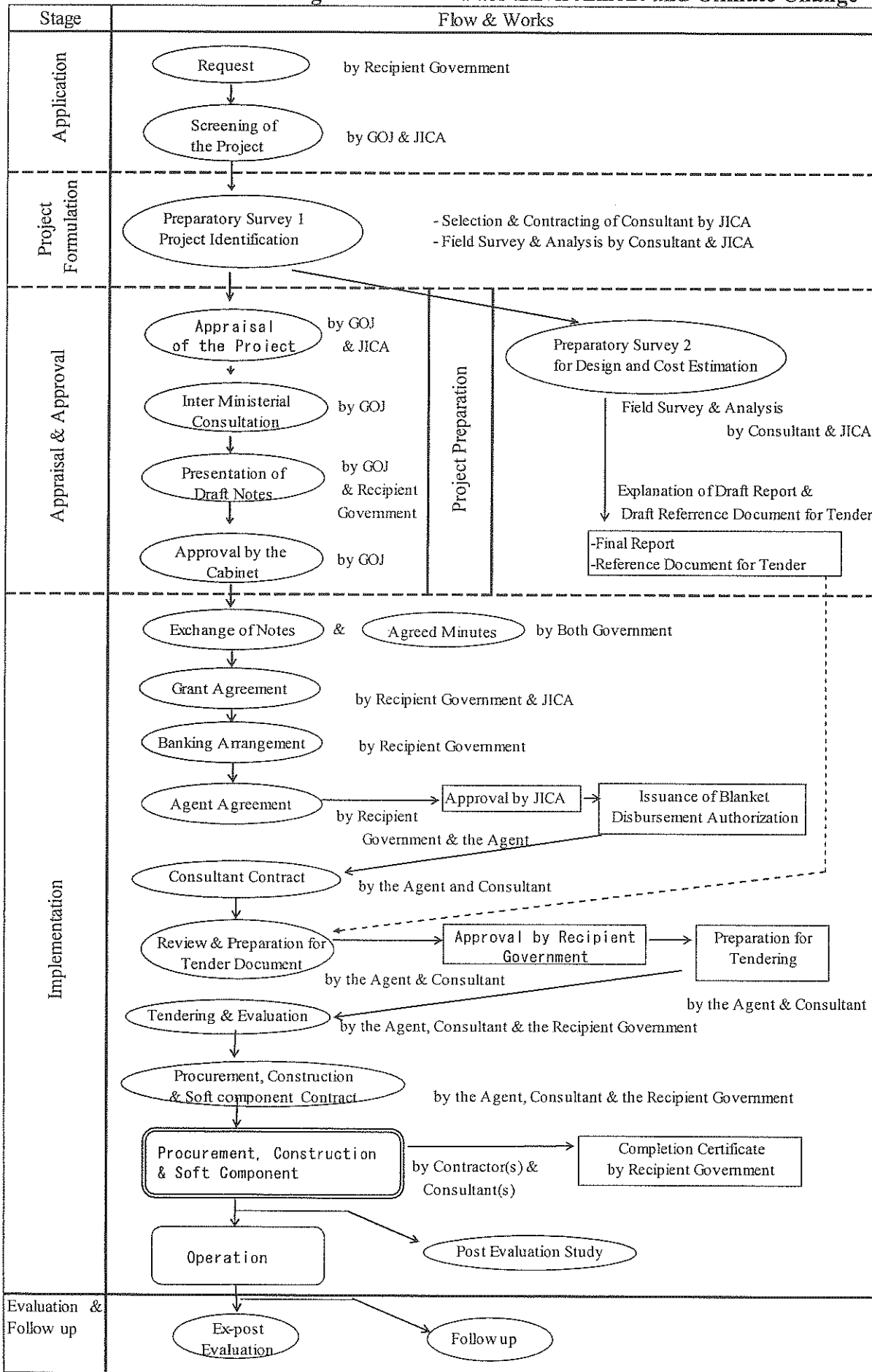
6) "Export and Re-export" of products

The products purchased under the Grant Aid should not be exported or re-exported from the recipient country.

7) Social and Environmental Considerations

The recipient country must ensure the social and environmental considerations for the Project and must follow the environmental regulation of the recipient country and JICA socio-environmental guideline.

General Flow of Program Grant Aid for Environment and Climate Change



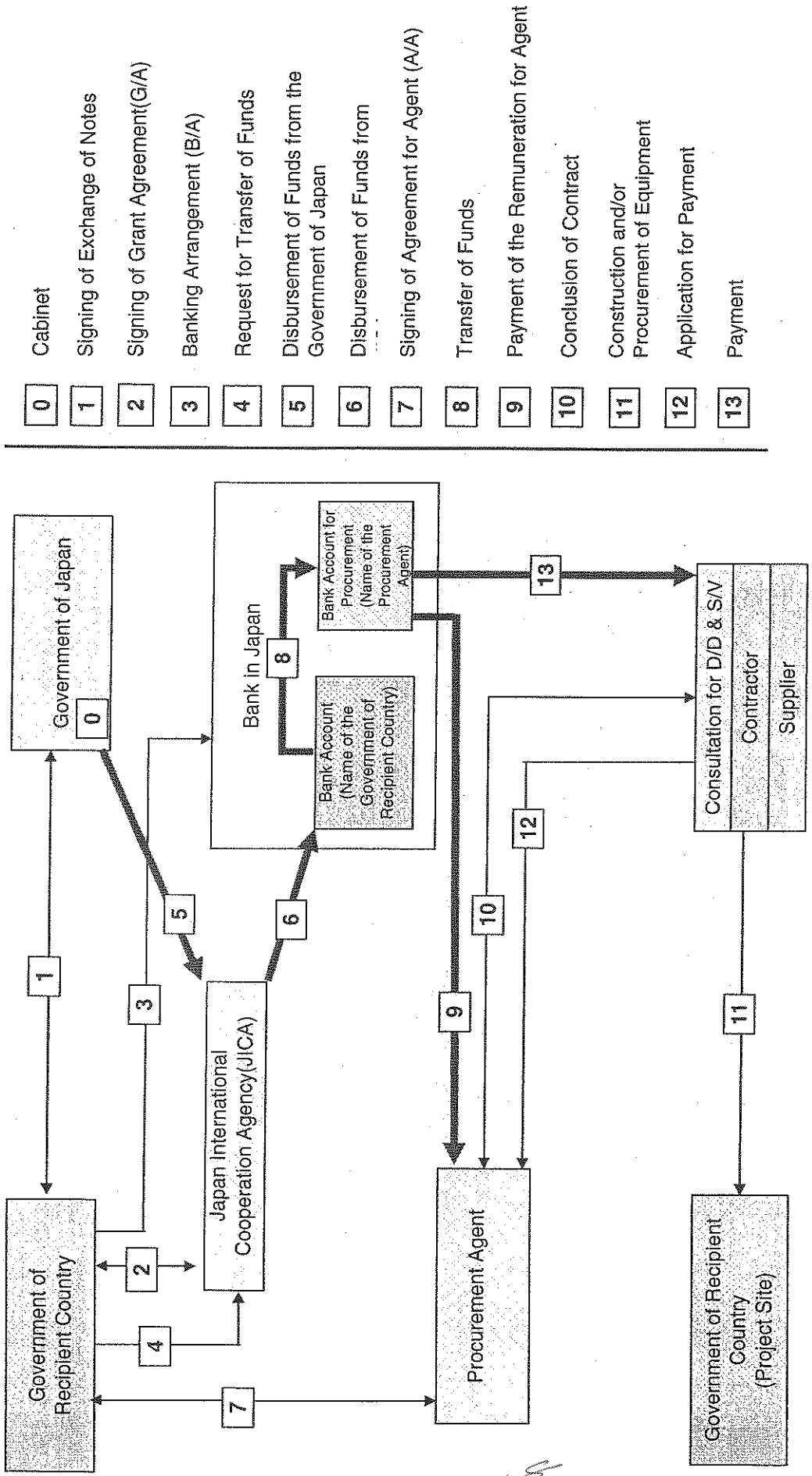
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Flow of Funds for Implementation

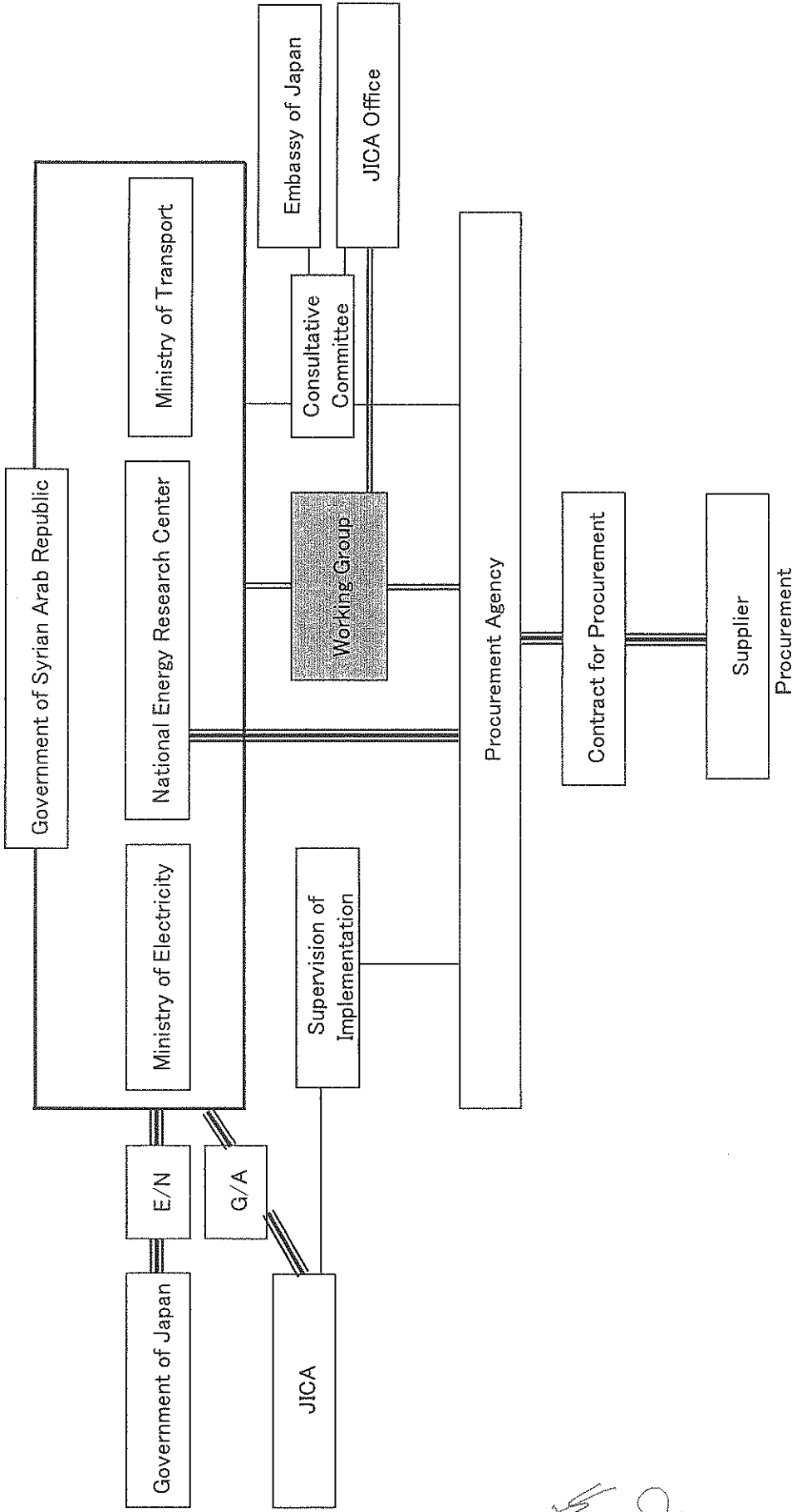


- 0** Cabinet
- 1** Signing of Exchange of Notes
- 2** Signing of Grant Agreement(G/A)
- 3** Banking Arrangement (B/A)
- 4** Request for Transfer of Funds
- 5** Disbursement of Funds from the Government of Japan
- 6** Disbursement of Funds from Bank in Japan
- 7** Signing of Agreement for Agent (A/A)
- 8** Transfer of Funds
- 9** Payment of the Remuneration for Agent
- 10** Conclusion of Contract
- 11** Construction and/or Procurement of Equipment
- 12** Application for Payment
- 13** Payment

Fund →
Implementation Arrangement →

CA

Project Implementation System



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Major undertakings to be taken by each Government

No.	Items	To be covered by Grant Aid	To be covered by Recipient Side
1	To secure land		●
2	To clear, level and reclaim the site when needed		●
3	To construct the facility and install the equipment	●	
4	To bear the following commissions applied by the bank in Japan for banking services based upon the Bank Arrangement (B/A):		
	1) Payment of bank commission		●
5	To ensure prompt unloading and customs clearance at the port of disembarkation in the recipient country		
	1) Marine or air transportation of the products from Japan or third countries to the recipient	●	
	2) Tax exemption and customs clearance of the products at the port of disembarkation		●
	3) Internal transportation from the port of disembarkation to the project site	●	
6	To accord Japanese nationals and / or nationals of third countries, including persons employed by the agent whose services may be required in connection with the Components such facilities as may be necessary for their entry into recipient country and stay therein for the performance of their work.		●
7	To ensure that customs duties, internal taxes and other fiscal levies which may be imposed in the recipient country with respect to the purchase of the Components and to the employment of the Agent will be exempted by the Government of recipient country		●
8	To maintain and use properly and effectively the facilities that are constructed and the equipment that is provided under the Grant.		●
9	To bear all the expenses, other than those covered by the Grant and its accrued interest, necessary for the purchase of the Components as well as for the agent's fees.		●
10	To ensure environmental and social consideration for the Project		●

5. Other Relevant Data

Collected Data

- ① External Call for outside Tenders No. L.S 1/2009 (Tender announce for solar street lighting system by NERC): Photocopy
- ② External Call for Tenders No. L.S 1/2009, Financial and Legal Conditions Book: Photocopy
- ③ Technical Specification 3km Solar Street Lighting System): Photocopy/Softcopy
- ④ Executive Instructions (by law) for Law No. 50 for the year 2002 Modified by the Law No. 17 for the year 2004: Softcopy
- ⑤ Information of Osman Technical Engineering Consulting: Softcopy
- ⑥ Technical Condition Book Related to the Lighting Projects: Photocopy (Ministry of Building & Construction)
- ⑦ Photovoltaic in Scientific Studies & Research Center: Photocopy
- ⑧ (1/100,000) : Photocopy
- ⑨ Topographic Map (Damascus – Dara) (1/2,000) : Photocopy
- ⑩ Plan Drawing of Haijalla Interchange (1/1,000) : Photocopy
- ⑪ Plan Drawing of Deir Ali (1/1,000) : Photocopy
- ⑫ Middle East Contracting Co.: Brochure
- ⑬ Gezairi Transport: Brochure
- ⑭ Arabu International University : Brochure
- ⑮ Syrianet: Brochure
- ⑯ NERC Brochure
- ⑰ Syrian Engineering Company for Solar Power Brochure
- ⑱ Adra Solar Street Lighting Pilot Project General Drawing

The Preparatory Survey on the Project for Solar Street Lighting System
(Second Site Survey)
Technical Memorandum

Regarding the captioned project, the Consultant and NERC/MOT had several discussions during second site survey. Both sides have agreed about following items and the Consultant will proceed for preparing of the draft tender documents based on following conditions.

29 October, 2009

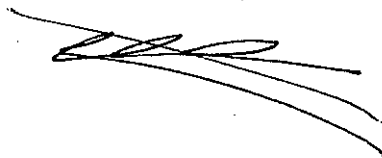
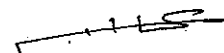
Confirmed by

物江 紳夫

Nobuo Monoe
Chief Consultant of the Project

Eng. Mohammed Khalil Sheki
General Director
National Energy Research Center
Ministry of Electricity

Dr. Abdul Salam Al Massri
Ministry of Transport



1. Specification of Equipment

Life time of bulb is key issue in the specification. Consultant proposed Japanese product bulb that's life time is 9,000 hours. On the other hand, European product is 25,000 hours. Life time of Japanese bulb is too shorter than European. NERC proposed that if Japanese bulb was applied, at least 7 years from initial stage of installation work should be guaranteed as same as European bulb.

Regarding Ingress Protection (IP) also, Japanese standard is lower than the other European-made, so the Consultant will consider for something guarantee on it.

Detail specification is attached.

2. Guard fence to protect lighting system

MOT has responsibility to install the guard fence for protecting the Solar Street Lighting System of the project by their owned cost. Guard fence will be put in continuously front of the lighting system.

3. Location of setting of the Solar Street Lighting System

At first, the Consultant has planed to install the Solar Street Lighting Poles on ramp-way at Interchanges. However, the shoulder width of ramp-way between pavement and embankment slope is too narrow to install the Solar Street Lighting Poles. If Solar Street Lighting Poles will be installed at the place, the collapse of slope will be occurred in anytime soon.

The Consultant proposes the installation location of Solar Street Lighting Poles on the median strip on the main road instead the shoulder of ramp-way.

As of now, number of Solar Street Lighting System and location is as follows, and refer to attached drawings.

Project site	Estimated length	Estimated no. of systems
Hir Jalha IC	600m x 2 directions	62 systems
Der Ali IC	(260m+200m) x 2 directions	50 systems
SIUST frontage road	200m x 2 directions	22 systems
IUST frontage road	200m x 2 directions	22 systems

AIU frontage road	200m x 2 directions	22 systems
SIUST frontage road-2	200m x 2 directions	22 systems
Estimated total poles		200 systems

Based on above mentioned, the total number of Solar Street Lighting Systems to be installed by the Project shall be approximately 200, but this number shall be changed depending on the Project budget.

4. Temporally depository

NERC has made clear the temporally depository of procured equipment. Location of depository is inside Der Ali Power Plant that is located 8km from Der Ali Interchange. Der Ali Power Plant is good for security system, enough to accommodate the all of equipment and close to the project site.

5. Maintenance of the Solar Street Lighting System

Maintenance of the Solar Street Lighting System of the project should be done by MOE and MOT by their own fifty-fifty responsibility.

For this project, the maintenance cost of the Solar Street Lighting System is calculated based on following conditions.

- Life time of the Solar Street Lighting System is assumed for 20 years.
- Maintenance cost also is calculated for 20 years according to the life time.
- Equipment cost is applied by the project estimated cost, that is product in Japan.
- Maintenance cost is excluded periodical cleaning and equipment replaces works.

(1) Lighting Bulb

- Beginning of installation, bulb is guaranteed for 7 years.
- After 7 years, a period of bulb replacement is assumed for 2.5 years. (9,000hours / 365days = 2.465years)
- Price of bulb that product Japan is estimated about \$100 per each.
- Number of replacement: 5 times

Total bulb cost is calculated as following.

$$200(\text{systems}) \times \$100 \times 5(\text{times}) = \underline{\$100,000}$$

(2) Battery

- Life time of battery is 5 years.
- 3 times replacement is needed for 20 years exclude initial installation.
- Price of battery that product Japan is estimated \$3,000 per each lighting system. (4 batteries per 1 system) According to the solid waste treatment plant of Damascus

Governorate, cost of battery disposal is SP5,600/m³. Volume of battery is 0.08 m³ per each lighting system.

- Number of disposal time is 4.

Total battery cost is calculated as following.

Replacement: 200(systems) x \$3,000 x 3(times) = \$1,800,000

Disposal: 200(systems) x 0.08(m³) x 4(times) x SP5,600 = SP358,400 = \$8,000

Total maintenance cost for 20 years is estimated as follows.

\$100,000 + \$1,800,000 + \$8,000 = \$1,908,000 (\$95,400 per year)

6. Banner Advertising

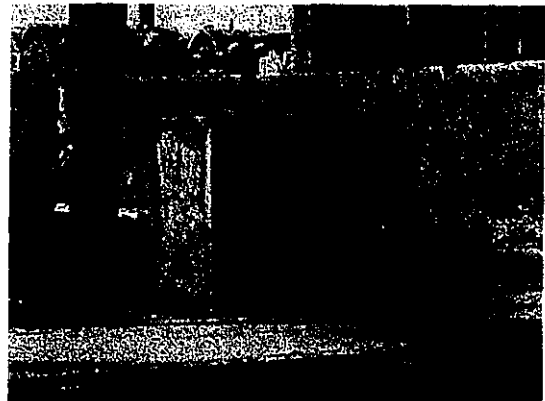
A lot of banner advertising is fit with existing street lighting in Syria; however, NERC explained to us they will not fit the banner advertising on the Solar Street Lighting System of the Project. Japan-side will consider the showcase that the Systems is procured by Japanese environment grant aid include using banner.

7. Battery Disposal Site

Consultant has made certain of battery disposal site that is inside of Solid Waste Treatment Plant organized by Damascus Governorate. This plant is located 45km from center of Damascus city, near the airport, the organization, structure and capacity of the dangerous cabinet is suitable condition and enough space for the battery disposal of the Project.

8. Antitheft Measure of Battery

In the project, battery box will be put on the ground at the behind of lighting pole. Battery is essential for the Solar Street Lighting System and antitheft measure will be needed for example protect by concrete box like as right side picture.



The Consultant requested the antitheft showcase to NERC.

9. Underground Facilities on the Median-strip of the Planed Site

NERC/MOT has explained that there are no underground facilities on the Median-strip of the planed site. If these facilities have been discovered, removal work of the existing underground facilities should be implemented by Syrian side.

**Specification of The Solar Street Lighting System
(Road Lighting Poles with Closed Circuit Solar Power Generation System)**

Description	Tender Requirement
Quantity:	: 200 sets
Model Number:	:
Specifications:	
1. Type of Lighting Poles	:Road Lighting Poles with Stand Alone Solar Power Generation System
2. Specifications of PV panel	
(1) Type	: Mono-Crystalline Silicon
(2) Maximum Power (P _{max})	: 215W or more, x 2 pcs (Total 430 W or more)
(3) Module Efficiency	: 16.0 % or more
(4) Dimension	: L 1,600 mm or less, W 820 mm or less (1pc)
(5) Weight	: Maximum 16 kg
3. Specifications of Lighting Poles	
(1) Height	: 8 m or more (from ground level to center of electric bulb)
(2) Basement anchor bolts	: Depend on structure; The anchor bolt assembly should be folding type, to secure accuracy of the bolts installation.
(3) Material	: Hot Dip Galvanized Steel (t (mm) = depend on structure)
(4) Color	: Manufacturer's original color (brown or gray)
4. Specifications of Lighting Equipment	
(1) Electric Bulb Type	: High pressure sodium (AC220V, 50Hz, Single-Phase)
(2) Power consumption	: 85 W or more (for input power consumption from battery)
(3) Life time	: More than 25,000 hours, or guarantee for 7 years
(4) Reflector type	: Wide intensity distribution type
(5) Ingress Protection (IP)	: More than IP 43, or guarantee for 7 years
(6) Illumination	1) Under the condition to secure for: a) Road width 7.5m, pole spacing 20m: - The illuminance 15 Lx, or more - (at under the center of the electric bulb) - The average illuminance 11.4 L, or more - The uniformity ratio of illuminance 0.4, or more 2) The illuminance intensity drawing on the road surface should be attached to this sheet.
(7) Color temperature (K) and Color rendering index (Ra)	: 1,900K to 2,100K, : 17Ra to 20 Ra
5. Specifications of Controller	
(1) Charging Control Method	: Maximum Power Point Tracking (MPPT)
(2) Running Time	: 10.75 hours lighting time per day
(3) Activation Switch On/Off	: Automatic lighting after sunset and timer
(4) Battery Charging Method	: PWM (Pulse Width Modulation)
6. Specifications of Battery	
(1) Type	: Lead-Acid battery (AGM sealed type)
(2) Expected Lifetime	: 5 years or more

Description	Tender Requirement
(3) Nominal Voltage	: DC 24V (DC 12V x 2)
(4) Nominal Capacity	: 1,440 Wh x 4 pcs / one pole
7. Other Main Requirement	
(1) Allowable Wind Load	: Up to 36 m/s (130km/h)
(2) Autonomy	: 4 days or more (10.75 hours lighting time per day)
(3) Optimal Operating Ambient Air Temperature	: -15 to +35 C degree
(4) Maximum Ambient Air Temperature	: +45 C degree
(5) Maximum Ambient Humidity	: 75%
8. Attachments	
(1) Battery Case	: Fit up with pole on ground, with lock system
	:
9. Accessories	
(1) Standard Tool Kit	: Manufacturer standard tool kit: 20 sets
(2) Operation Manual	: English 20 sets
(3) Maintenance Manual	: English 20 sets
10. Spare Parts	: As per the attached spare parts list (required items and quantities)
11. Document Submission	
(1) Illuminance Intensity Drawing on the Road Surface	
(2) Structure Strength Calculation Sheet	
(3) Battery Generation Calculation Sheet	
(4) Circuit Drawing	
(5) General Drawing	
(6) Test Certificate of Luminance Intensity on the Road Surface after Completion	

Notes:

1. PV panel should be 100% made in Japan. The cell factory information including its address shall be declared in the Certificate of Country of Origin.
2. The following main component factory information including their address in Japan shall be declared in the Certificate of Country of Origin.
 - PV panel cell
 - Lighting pole
 - Inverter/Controller
 - Battery