Chapter 6

Substation and Transmission Line Facilities

Chapter 6 Substation and Transmission Line Facilities

6.1 Design of Substation

6.1.1 Design Concept

(1) Topographical and Meteorological Site Conditions
Topographical and Meteorological Site Conditions are shown in following Table 6.1.1;

Table 6.1.1 Topographical and Meteorological Site Conditions

	Descriptions	Data
1	Altitude above sea level-maximum	1000 m
2	Air pressure yearly average	1010.8 mill bars
3	Air Temperatures	
3a	-Maximum Peak (Design maximum ambient temperature)	50°C
3b	-Highest maximum for 6 hours a day	55°C
3c	-Maximum daily average	40°C
3d	-Maximum yearly average	30 °C
3e	-Minimum	- 10°C
3f	Highest one day variation	25 °C
4	Sun temperature in direct sunlight	80°C
5	Maximum ground temp at depth of 100mm	35°C
6	Humidity	
6a	-Maximum relative humidity at 40 degrees	92%
6b	-Minimum relative humidity	12%
6c	-Yearly average	38/44%
7	Pollution level	Heavy airborne Contamination
8	Dust Storms	21.5 days/annum
9	Isoceraunic level all equipment)	15 days/annum
10	Maximum wind velocity(for design purposes)	40.2 m/sec
11	Ice loading, radial thickness	NIL mm
12a	Total rainfall Maximum	500 mm
12b	Minimum	50 mm
12c	Maximum in one day	72 mm
12d	Average per year	150.8 mm
13	Seismic loading	Uniform Building Code Zone3

Source: RMEK Specification

(2) Electrical Design Criteria;

The Electrical Design Criteria is shown in following Table 6.1.2:

Table 6.1.2 Electrical Design Criteria

	Descriptions	400kV	132kV (in a 400kV Substation)	11kV Tertiary
(a)	Rated System Voltage	420 kV	145 kV	12 kV
(b)	Nominal System Voltage	400 kV	132 kV	11 kV
(c)	System Earthing	Effective	Effective	Impedance
(d)	System Frequency	50 Hz	50 Hz	50 Hz
(e)	Lightning Impulse Withstand Voltage	1425kV	650kV	75kV
(f)	Power Frequency Withstand Voltage	650kV	275kV	28kV
(e)	Estimated X/R ratio	100	—	—
(f)	System Short Circuit Level	28000 MVA	11500 MVA	950 MVA
(g)	System Short Circuit Level/Sec.	40 kA/1S	50 kA*(*1)*/1S	50 kA/1S
(h)	Busbar Rated Current	4000 A	3150 A	4000 A
(i)	Sound level (NEMATR-1)	88 dB	88 B	

Source: RMEK Specification

*Note1: (*1) System Short Circuit Level of 50kA; Presently, 40kA is applied. RMEK is upgrading the short circuit level to 50kA, which to be reconfirmed to RMEK during Tender stage.*

Note2: All other detailed design criteria(data), such as withstand voltage between across isolating distance of switchgears, withstand voltage of transformer winding/neutral and control/protection scheme such as auto reclose, breaker failure protection etc. will be discussed with RMEK during Tender Stage.

(3) Main Equipment Requirement;

a) Basic Standard of Electrical equipment ; IEC

b) Applicable Specification; IRAQ POWER RECONSTRUCTION, IRAQ SUPERGRID PROJECTS 400/132kV SUBSTATION TECHNICAL SPECIFICATION VOLUME 1, VOLUME 2 and VOLUME 3 (ISSUE 2 – MARCH 2005)
The detailed descriptions/technical data in the Specification will be reviewed & discussed during Tender Stage.

c) Switchgear

c1) Type of switchgear

400kV; Gas Insulated Switchgear (GIS)*(*2)*
132kV; Gas Insulated Switchgear (GIS)*(*2)*
11kV ; Metal clad Switchgear

*Note: (*2) GIS: GIS is new technology comparing with AIS conventional switchgear and RMEK preferred the application of GIS.*

c2) Type of Busbar

400kV; One and a half circuit breaker system
132kV; Double Busbar
11kV ; Single Busbar

d) Power Transformer

d1) Winding arrangement (Separate or Auto) ; Auto Transformer
d2) Single phase or three phase type ; Single phase type

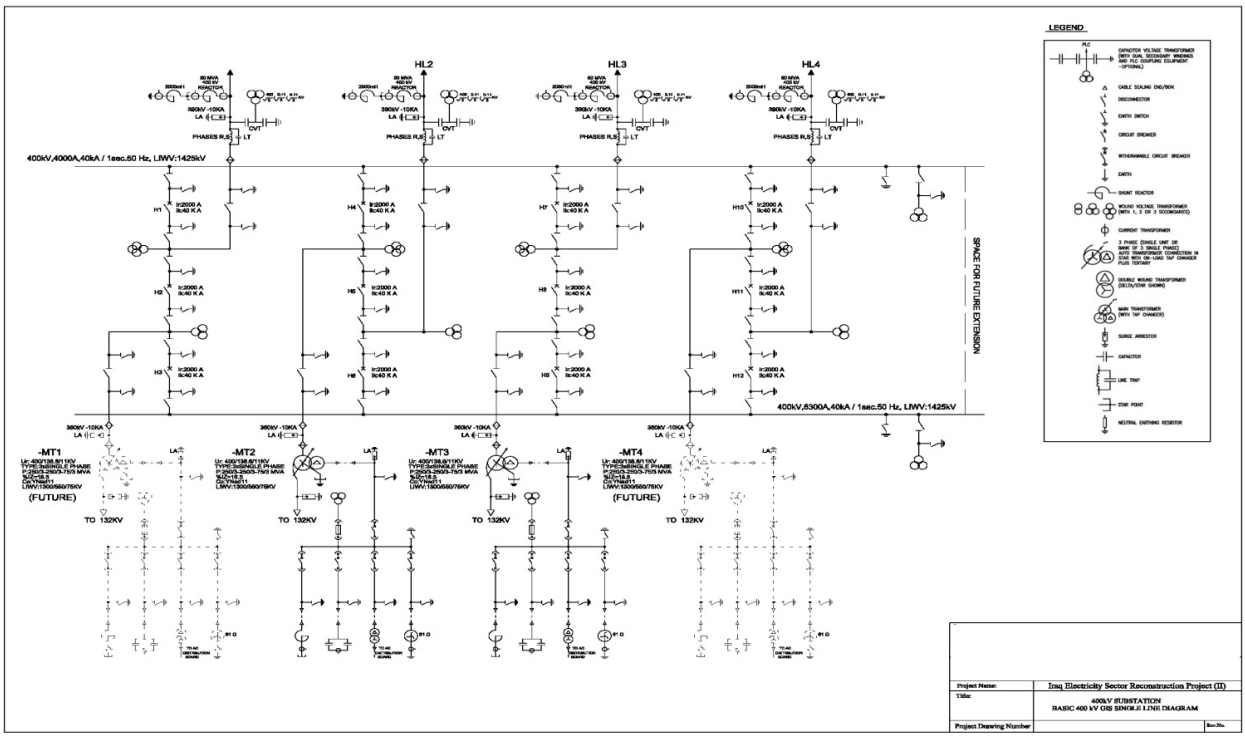
e) Control system; Substation Control System (SCS)

f) Type of Protection relays; Numerical type

Note: Main protection relay will be Distance relay, High impedance relay or Low impedance relay etc., which details shall be discussed with RMEK during the Tender Stage.

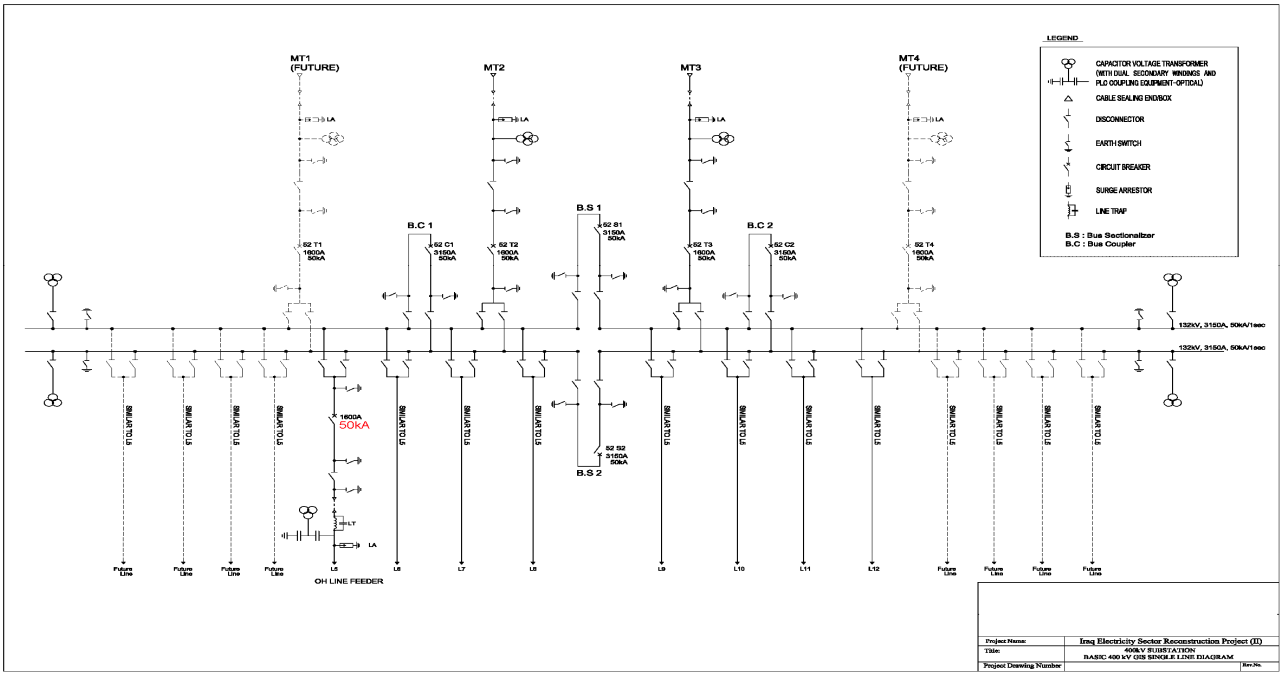
6.1.2 Detailed Design for Gomaspan Substation and Arbat Substation

(1) Single line Diagrams of 400kV and 132kV system;



Source: JICA Survey Team (RMEK Specification & Discussion)

Figure 6.1.1 Single line Diagram of 400kV System



Source: JICA Survey Team (RMEK Specification & Discussion)

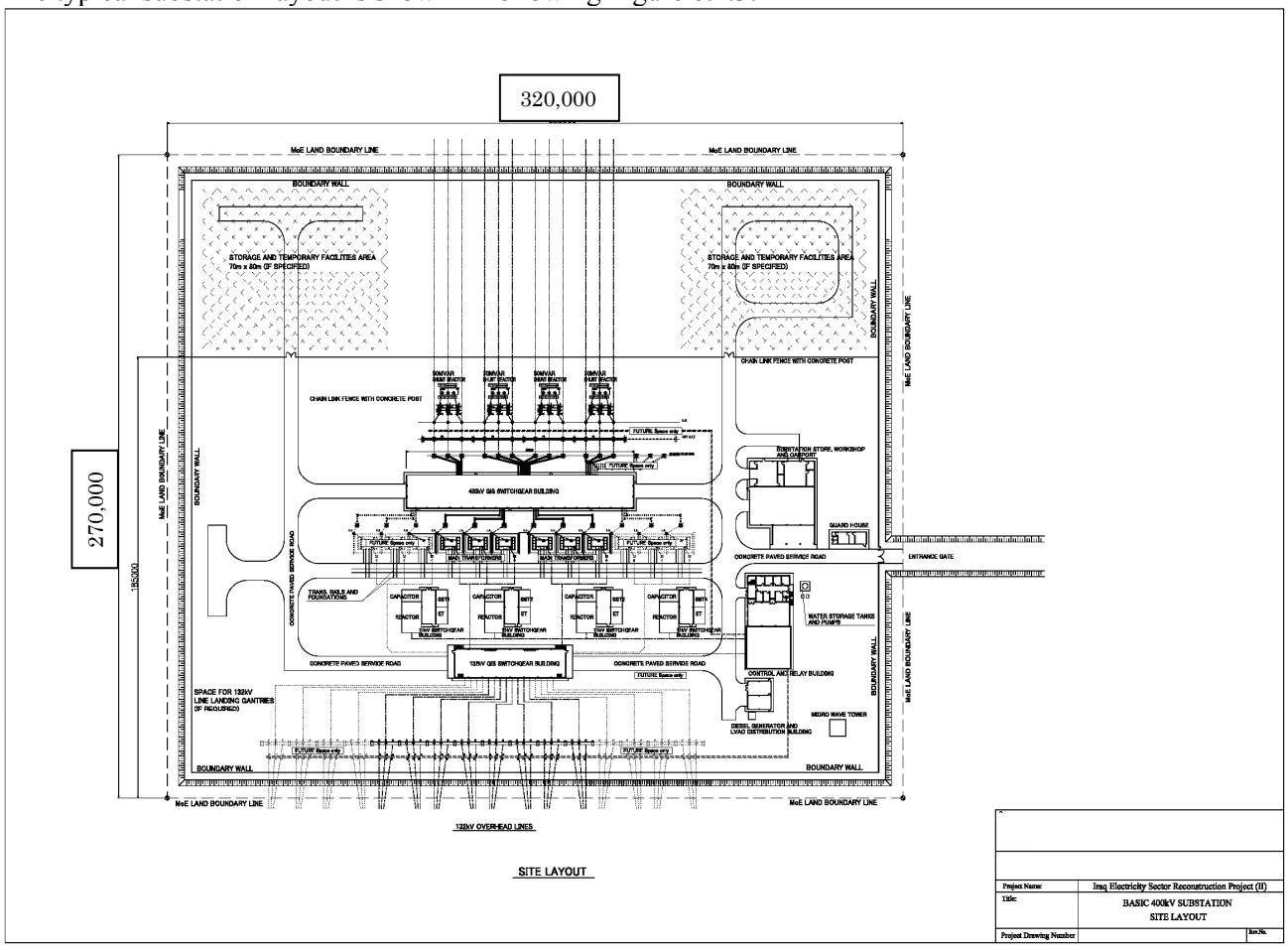
Figure 6.1.2 Single Line Diagram of 132kV System

As shown in the single line diagrams;

a) The 400kV switchgear consists of four (4) 400kV Line/Transformer diameters plus one future diameter (Space only).
b) Six (6) - single phase of 250/3MVA transformer (2units of complete transformer) shall be installed in the substation and spaces for the future six (6) single phase transformer (2 units of complete transformer) shall be provided.
c) The 132kV switchgears consist of two (2) transformer feeders, eight (8) outgoing feeders, two (2) bus sections and two (2) bus coupler circuits. Additional two (2) transformer feeders and eight (8) outgoing feeders will be provided in future, and then space for the future equipment shall be taking into the design.

(2) Typical substation layout;

The typical substation layout is shown in following Figure 6.1.3:



Source: JICA Survey Team (RMEK Specification & Discussion)

Figure 6.1.3 Typical Substation Layout

a) Both 400kV and 132kV GIS is indoor type.
b) The overall area dimensions of the substation will be considered as 320m x 270m including temporally storage area, site offices etc.
c) The 400kV GIS outgoing feeders are connected to 400kV Over Head Transmission Lines.
d) 400kV GIS and 250MVA/3 transformers are connected by overhead conductors.
e) 132kV side of 250/3MVA transformers is led by 132kV power cable to be connected to 132kV GIS.
f) 132kV GIS outgoing feeders are arranged as; Eight (8) Over Head Transmission Lines to be provided with the Gantry tower inside the substation.

6.2 Design of Transmission Lines

6.2.1 Design Conditions

Basic design conditions are as mentioned below

(1) Atmospheric Temperature
Maximum air temperature: 40 ºC
Minimum air temperature: -15 ºC
Annual mean air temperature: 25 ºC

(2) Wind Velocity
Maximum design gust wind velocity is 40 m/s at 10 m height

(3) Maximum Annual Rainfall
500 mm

(4) Ice Loading, Radial Thickness
10 mm

(5) Other conditions assumed
Maximum humidity: 92 %
Seismic acceleration: 0.2

6.2.2 Conductor and Ground Wire Design

(1) Conductor and ground-wire
The technical characteristics of the conductor are shown in 6.2.1.
OPGW 24F to match ASCR "Dorking" properties is used for ground-wires.

Table 6.2.1 Technical Characteristics of Conductor

Type	ACSR 490 mm^2 (IEC61089)
Component of stranded wires	Al: 54/3.40 mm St: 7/3.4 mm
Total area of aluminum wires	553.8 mm^2
Overall diameter	30.6 mm
Weight	1,852 kg/km
Ultimate tensile strength	152.9 kN
Modulus of elasticity	70,000 N/ mm^2
Coefficient of linear expansion	19.3 x 10^{-6}/ ºC
DC resistance at 20 ºC	0.0590 Ω/km

Source: JICA Survey Team (RMEK Specification)

(2) Standard span length
Standard span length between towers: 450 m.

6.2.3 Insulator Design

(1) Insulator type and size

a) Type:
Insulator unit applied to the transmission lines is a standard disc, fog type insulator with ball and socket.

b) Strength:

Table 6.2.2 Insulator Strength
(*: RUS: Rated Ultimate Strength)

Tower	R.U.S. (*)
Suspension	120 kN
Tension	160 kN

Source: JICA Survey Team (RMEK Specification)

(2) Number of insulator units per String
Suspension tower: 30 units, Tension tower: 24 units

6.2.4 Ground Clearance

(1) Ground Clearance

(2) The most severe state for the ground clearance of the conductors will occur when the conductor's temperature rises to 90 ºC under still air condition. The minimum height of the conductor above ground at 400 kV level is determined as below.

Table 6.2.3 Minimum Height of Conductor above Ground

Classification	Height
Crossing point of main road	10.0 m
Normal ground	8.5 m

Source: JICA Survey Team (RMEK Specification)

6.2.5 Determination of Tower Configuration

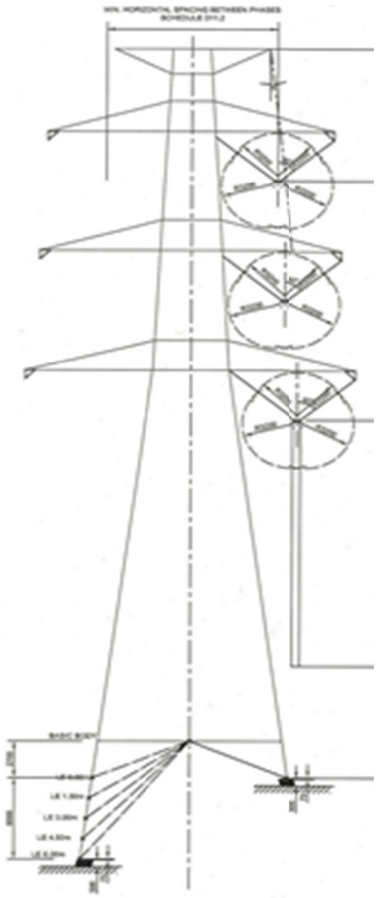
(1) Number of ground-wires
Number: 2

(2) Tower Configurations
The typical 400 kV tower configurations are as follows.

Table 6.2.4 Tower Types and the Applied Conditions

Type (Double Circuit)	Position of Use	Angle of Deviation or Entry	Type of Insulator
YA (Figure 6.2.1)	Straight Line	0 – 2	V-Suspension
YC (Figure 6.2.2)	Angle	0 – 30	Tension

Source: JICA Survey Team (RMEK Specification)



Source: JICA Survey Team (RMEK Specification)

Figure 6.2.1 Type "YA" Tower
(V-Suspension, Horizontal angle; 0-2 degree)

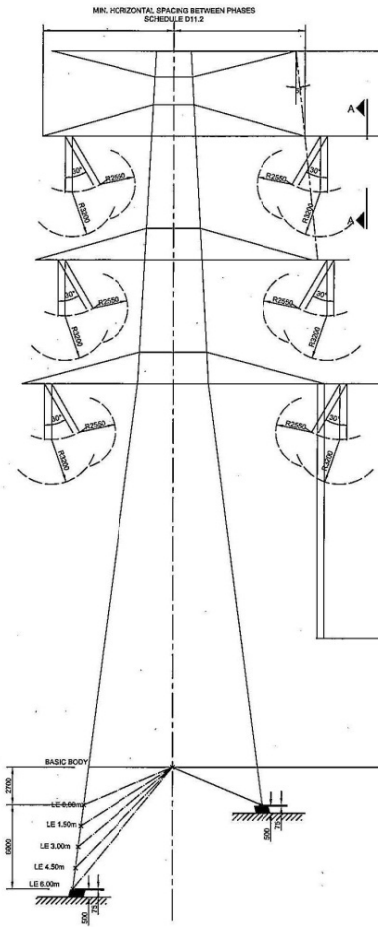


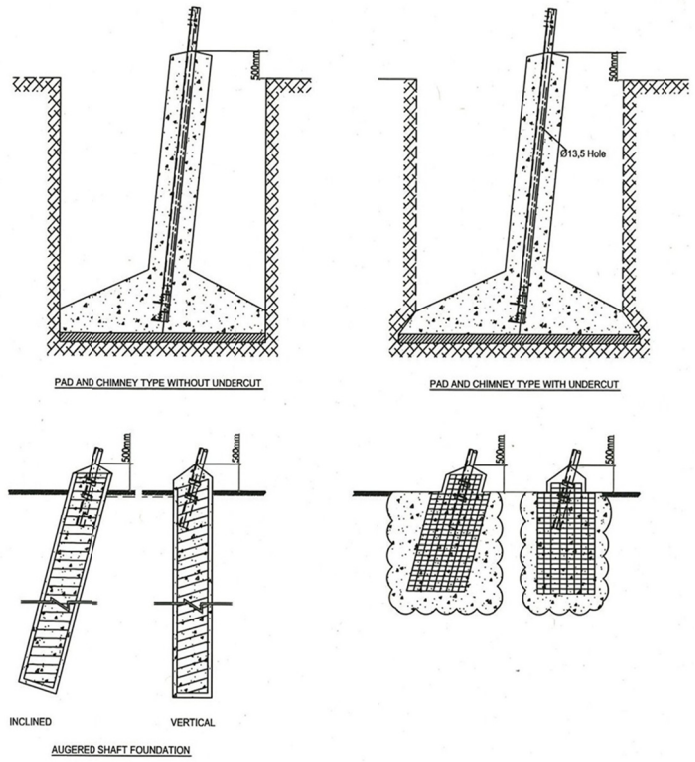
Figure 6.2.2 Type "YC" Tower
(Tension, Horizontal angle; 0-30 degree)

6.2.6 Foundation Configuration

The typical foundation configurations are as follows.

Pad and chimney type
(Moderate mountain area)

Pier type
(Steep mountain area)



Source: JICA Survey Team (RMEK Specification)

Figure 6.2.3 Typical Foundation Configurations

6.3 Quantities of Substation Facilities

The scope of works for the project includes design, manufacturing, factory testing, delivery, civil works, installation and testing & commissioning of the following substation equipment / facilities:
Quantities of facilities/equipment for 400kV Gomaspan Substation and Arbat Substation facilities are shown in the following table 6.3.1 for each substation;

Table 6.3.1 Quantities of Facilities of each Substation

No.	Descriptions	Q'ty
1	Indoor type 400kV GIS - 40kA	4 Diameters (12CB)
2	Indoor type 132kV GIS - 50kA	14 CB Bays
3	Single phase 250/3MVA Auto transformer, 400/√3/138.6/√3/11/√3kV	6 (2 three phase units)
4	400kV 50MVA Shunt Reactor	4 Units
5	11kV Metal Clad Switchgear For auxiliary circuits	Lot
6	400kV Outdoor Equipment and Gantry	4ccts
7	132kV Outdoor Equipment and Gantry	8ccts
8	SCS (Substation Control System)	Lot
9	Protection system	Lot
10	AC/DC System	Lot
11	Tele-communication system	Lot
12	132kV, 11kV, LV & control cables	Lot
13	11kV E-Tr, NGR, 11kV capacitor bank, 11kV Shunt reactor	Lot
14	Buildings and building services equipment	Lot

Source: JICA Survey Team

6.4 Quantities of Transmission Line Materials

Standard quantities of 400 kV transmission lines were estimated based on the similar projects in RMEK.

(1) Assumed number of towers

Number of towers is estimated for a typical terrain of mountainous areas on the assumed line length 10 km.

Table 6.4.1 Tower Type and Tower Number per 10 km Long

	Suspension	Tension	Total	Assumption
Mountainous area	18 units	5 units	23 units	- Length: 10km - 80% suspension tower and 20% tension tower - Average span length: 450m

Source: JICA Survey Team

(2) Average quantities of line materials

Quantities of a 400 kV transmission line per 10 km were estimated in Table 6.9.

Table 6.4.2 Average Quantities of 400 kV Transmission Lines per 10 km Long

		400 kV*2cct
ACSR490 mm^2 (Mountainous area)	Tower	740 t
	Conductor	240 km
	OPGW	20 km
	Suspension insulator string	108 sets
	Tension insulator string	60 sets
	Foundation (Concrete volume)	1200 m^3

Source: JICA Survey Team

6.5 Construction Schedule

6.5.1 The Whole Construction Schedule for the Project

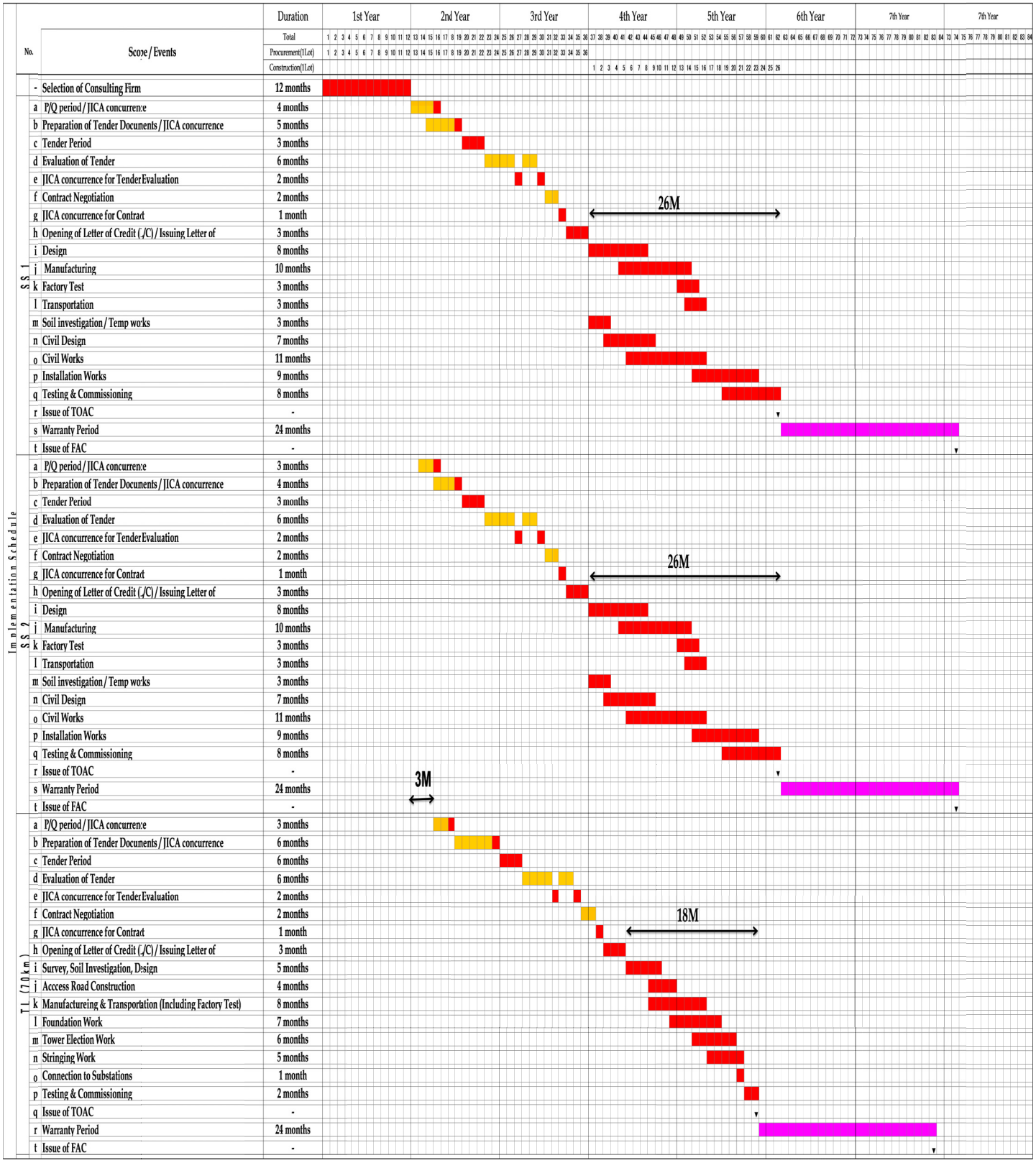
The whole Project Construction schedule starting from Selection of the Consultant is shown in the following Figure 6.5.1;
As shown, the period of the Consultant selection will be 12 months. And, engineering service stage-1, i.e., Prequalification, Tender periods up to the Contract with the Contractor will be 24months. The construction period of the substation is 26months and 18months for the transmission line. Guarantee (Warrantee) period is 24 months from Taking Over the sites to the Owner.

The LOT is separated in three Lots, that is, two substation Lots, i.e., Lot 1(SS1) and Lot 2(SS2), and one Transmission Lot as Lot 3(TL).

The duration of construction period and LOT-separation, such as putting Lot1 and Lot 2 together, will be finalized during the Prequalification/Tender stage.

Note: The number of the tenders can be considered one lot, two lots and three lots. In order to make project implementation period as short as possible, RMEK prefers to start one lot, which means two substation projects and one transmission project shall be started at the same time as one package. The final decision shall be made by RMEK at the implementation.

Expected Implementation Schedule for Construction of 400kV SS in RMEK

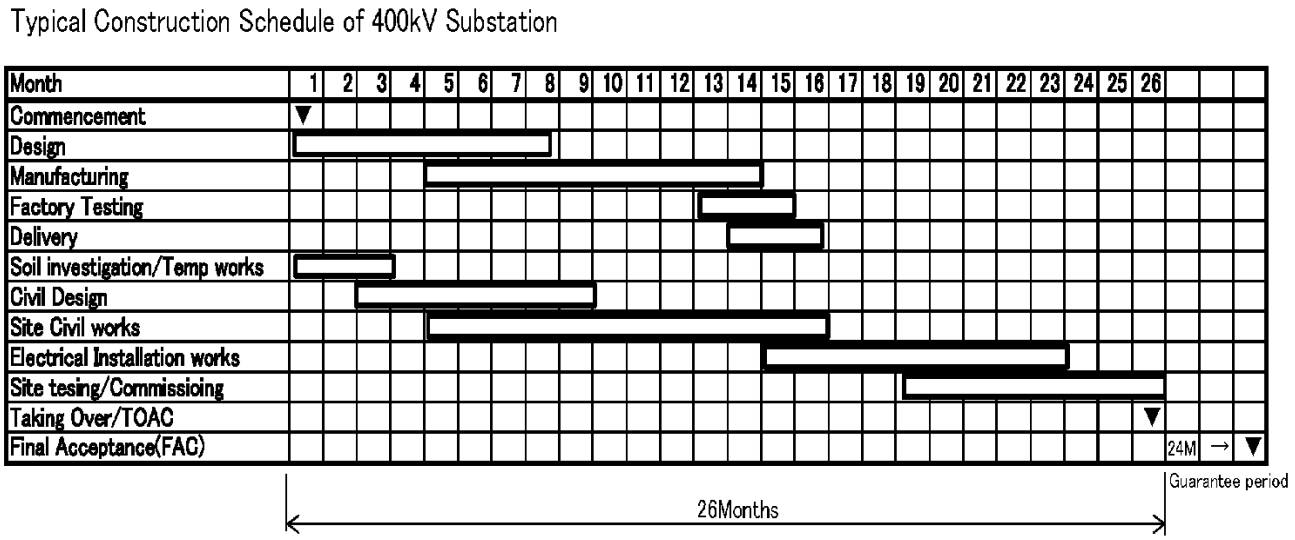


Source: JICA Survey Team

Figure 6.5.1 Whole Construction Schedule of the Project

6.5.2 Construction Schedule of the Substations

The construction periods will be 26months from the commencement date and the guarantee period by the Contractor would be 24months from the taking over (TOAC) as shown in Figure 6.5.2.

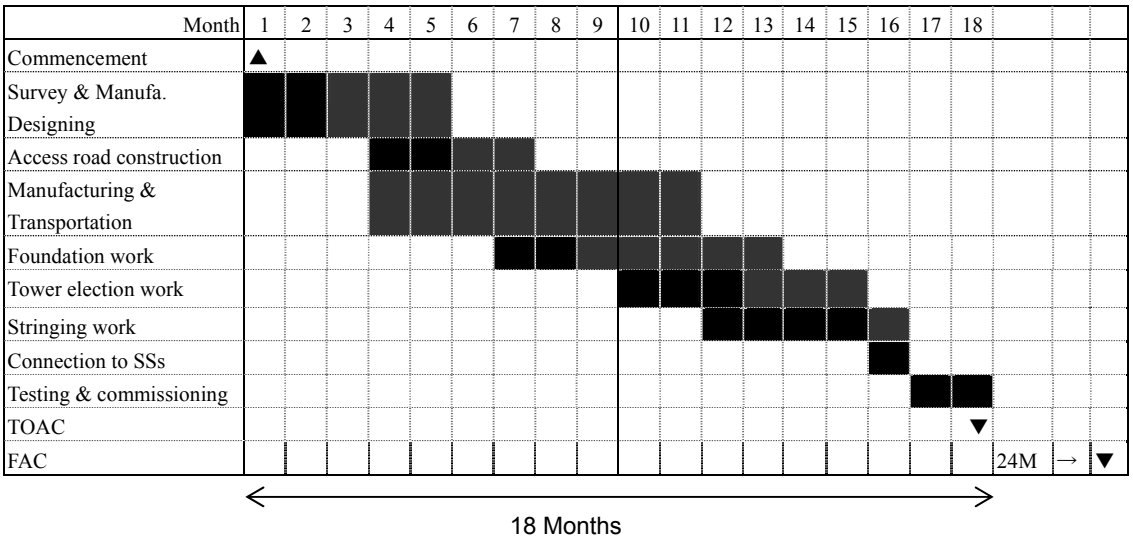


Source: JICA Survey Team

Figure 6.5.2 Construction Schedule of the Substation

6.5.3 Construction Schedule of the Transmission Line

The construction periods will be 18 months from the commencement date and the guarantee period by the Contractor would be 24 months from the taking over (TOAC) as shown in Figure 6.5.3



Source: JICA Survey Team

Figure 6.5.3 Construction Schedule of the Transmission Line

6.6 Project Cost Estimation

6.6.1 Construction Cost of 400 kV Substation

The budgetary construction cost of the proposed 400kV substation (one substation) is 90 million dollars, including contingency, which was converted to this project scope from the recent Tender Price submitted on September 2012 in JICA Electricity Reconstruction Project (MoE).
The estimation cost is shown in the following Table 6.6.1;

Table 6.6.1 Cost Summary Table

	Items / Descriptions	Q'ty	Price (K USD)
Common	1. Supply of Equipment Electrical & Communication Equipment		
	1.1 400kV GIS	4 Diameters	13,000
	1.2 250MVA Transformer	2 Units	5,600
	1.3 400kV Shunt Reactor	4 Units	4,400
	1.4 132kV GIS (*)	14 CB circuits	6,400
	1.5 Control/protection	1 Lot	3,500
	1.6 Others	1 Lot	13,500
	1.7 Insurances and Security for Inland Transportation	1 Lot	6,700
	2. Site Work 2.1 Electrical Site Work & Civil/Building Work	1 Lot	19,000
	2.2 Insurance	1 Lot	1,900
	3. Spare Parts & Maintenance Equipment	1 Lot	2,000
	4. Engineering, Electrical Design, Civil Design, Factory Inspection and Management etc including Training.	1 Lot	5,800
Net Contract Price			81,800
Contingency (10% of Net Contract Price)			8,180
Total Tender / Contract Price			89,980

SAY 90MUSD

Notes; 132kV GIS (*) : Due to 50kA rating of short circuit current, cost of 220kV GIS is applied for.

Source: JICA Survey Team (RMEK discussion)

Note; Foreign currency is generally applied for international contract in Iraq.

6.6.2 Construction Cost of 400 kV Transmission Line

(1) Unit Prices

Table 6-11 shows the unit prices per km applied to the cost estimation of the transmission line. The table has been prepared referring to the recent contract prices of similar 400kV transmission line project in RMEK. Various ICB price data owned by the Team has also been referred to. From the site route survey carried out by our JICA Survey team, it has been investigated that the route is mountain area and steep mountain area. Considering the difficulties of the construction due to mountain and steep mountain area, the estimated cost for the transmission lines in these areas was resulted in around 1.10 and 1.25 times respectively that in normal flat area as shown in Table 6.6.2.

The details of the estimation are shown in Tables 6.6.3.

Table 6.6.2 Unit Prices for 400 kV Transmission Lines per km

(Unit; US$)

	400 kV, 2 cct	
	Mountain	Steep Mountain
ACSR490 mm^2 (Double)	626,579	706,904

Source: JICA Survey Team

Table 6.6.3 Assumed Estimation for 400 kV TL Construction Cost

Assumption:
(1) Length: 10km
(2) Ratio of Tenssion Towers for All Towers
: Mountain Area: 80% of Suspenssion Towers (18units), 20% of Tenssion Towers (5units)
(3) Average Span: 450m
(4) Foundation Type: 100% of Pad Type Foundations
(5) Soil Conditions: Normal

Category	No.	Items	400kV, 2cct, (10km), Mountain Area Condutcor : ACSR 490 mm2, Double				400kV, 2cct, (10km), Steep Mountain Area Condutcor : ACSR 490 mm2, Double				Remarks
			Unit	Q'ty	Unit Rate (US$)	Amount (US$)	Unit	Q'ty	Unit Rate (US$)	Amount (US$)	
COST, INSURANCE AND FREIGHT	1	Tower	ton	740	2,100	1,554,000	ton	740	2,100	1,554,000	
	2	Conductor	km	120	5,500	660,000	km	120	5,500	660,000	
	3	OPGW 60mm2	km	20	5,500	110,000	km	20	5,500	110,000	
	5	Suspension Insulator String	set	108	3,200	345,600	set	108	3,200	345,600	
	6	Tension Insulator String	set	60	3,200	192,000	set	60	3,200	192,000	
	7	Accessories	lot	1	10%	286,160	lot	1	10%	286,160	
		Subtotal				3,147,760				3,147,760	
COST OF LABOUR, INLAND TRANSPORTATION AND EXPENSES	1	Survey & S. Investigation	km	10	3,000	30,000	km	10	3,500	35,000	
	2	Access Construction	km	20	2,500	50,000	km	20	3,500	70,000	
	4	Foundation (Volume of Concrete)	m^3	1200	1,000	1,200,000	m^3	1200	1,400	1,680,000	
	5	Tower Erection	ton	1200	800	960,000	ton	1200	1,000	1,200,000	
	6	Stringing	km	10	10,000	100,000	km	10	12,000	120,000	
	7	Inland Transportion			CIF*20%	629,552			CIF*20%	629,552	
	8	Miscellaneous	lot	1	5%	148,478	lot	1	5%	186,728	
		Subtotal				3,118,030				3,921,280	
		Total				6,265,790				7,069,040	

Source: JICA Survey Team

(2) Cost Estimate of Transmission Line

Table 6.6.4 shows the construction cost of transmission lines for the Project.

Table 6.6.4 Construction Cost of Transmission Line

No.	Sections	Items	Total (US$)
1	Moderate Mountain Area between Bazian SS～Arbat SS (61 km)	Materials	19,201,000
		Civil & Erection	19,020,000
		Sub-total	38,221,000
2	Steep Mountain Area = Between Shakh-i Darmana mountain and Shakh-i Kani Bi mountain (8 km)	Materials	2,518,000
		Civil & Erection	3,137,000
		Sub-total	5,655,000
	Summation of Construction Cost (69 km) (No.1 + No. 2)	Materials	21,719,000
		Civil & Erection	22,157,000
		Summation	43,876,000 ($636,000/km)
3	Contingency & Escalation	20% of Summation Cost	8,775,200
Total Cost			**52,651,200**

Source: JICA Survey Team

Note; Foreign currency is generally applied for international contract in Iraq.

Say **53MUS$**

6.6.3 Payment for Land Acquisition of Tower Sites and Substation and Compensation for ROW

In Iraqi Kurdistan, the country owns land, and the relevant ministries and agencies have the right to control the land. In the case of public use, land is provided at no charge.
Due to the use of public land, prior private users have to release control of the land. And the ministries or agencies provide alternative land to compensate the right of prior use.

6.6.4 Environment Monitoring Cost

As environmental monitoring, creating an EIA report is a typical work. Not for identifying the monitoring companies, but environmental consultants have to be authorized by the Ministry of environment. In general, developers for construction receive introduction of professional consultants by Environmental Protection and Improvement Board and delegate the creation of the EIA report.
It is said that the cost of EIA report preparation is, USD5000 for complicated cases, USD2000 ~ 3000 for normal cases, and less than USD1000 for very easy cases.

6.6.5 Consulting Service Cost

Table 6.6.5 shows the TOR Draft for the Consulting Services for the Project.

Table 6.6.5 Terms of Reference (Draft) for the Consulting Services

1. Common	1.1	The Consultants shall draft letter from the Owner to JICA, Contractors and anyone instructed by the Owner.
	1.2	The Consultants shall answer and explain questions and clarifications from the Owner for technical and commercial issues anytime requested.
	1.3	The Consultants shall advise the Owner the guidelines of JCIA anytime requested.
2. PQ Management	2.1	The Consultants shall draft the PQ documents which consists of invitation to applicant, instruction to applicant and templates which applicants shall fill in.
	2.2	The Consultants shall make announcement of the PQ (one English newspaper in Jordan, one Arabic newspaper in Jordan, three Arabic newspapers in Iraq) on behalf of the Owner.
	2.3	The Consultants shall receive PQ applications at the presence of delegates from the Owner.
	2.4	The Consultants shall evaluate PQ applications and submit the report to the Owner.
	2.5	The Consultants shall prepare and explain evaluation criteria and submit evaluation sheet to the Owner.
	2.6	The Consultants shall submit draft of the PQ evaluation report for Owner's review.
	2.7	The Consultants shall submit list of clarifications for applicants to answer if need be.
	2.8	The Consultants shall draft answers to JICA's clarification.
3. Tender Management	3.1	The Consultants shall perform site JICA Survey for each of the project sites.

	3.2	The Consultants shall submit draft of the tender documents: invitation to tenderer, instruction to tenderer, special conditions, and technical specifications.
	3.3	The Consultants shall draft answers to JICA's clarifications to the tender documents.
	3.4	The Consultants shall reproduce the tender documents for tenderers.
	3.5	The Consultants shall distribute the tender documents for tenderers on behalf of the Owner.
	3.6	The Consultants shall receive the tenders at the presence of the Owner on behalf of the Owner.
	3.7	The Consultants shall perform tender opening of Envelop A (technical) in accordance with checklist at the presence of the Owner and JICA on behalf of the Owner.
	3.8	The Consultants shall submit draft of the technical evaluation report to the Owner.
	3.9	The Consultants shall explain evaluation criteria and provide technical evaluation sheet.
	3.10	The Consultants shall submit draft of the technical evaluation report for Owner's review.
	3.11	The Consultants shall submit list of clarifications for applicants to answer if need be.
	3.12	The Consultants shall perform tender opening of Envelop B (financial) in accordance with checklist at the presence of the Owner and JICA on behalf of the Owner.
	3.13	The Consultants shall submit draft of the financial evaluation report to the Owner.
	3.14	The Consultants shall explain evaluation criteria and provide evaluation sheet.
	3.15	The Consultants shall submit draft of the financial evaluation report for Owner's review.
	3.16	The Consultants shall submit list of clarifications for applicants to answer if need be.
	3.17	The Consultants shall assist and support the Owner in negotiating with the first ranked tenderer.
	3.18	The Consultants shall draft the contract documents (commercial and technical).
4. Implementation	4.1	The Consultants shall assist and support the Owner in opening LC in favor of the contractor.
	4.2	The Consultants shall attend the kick off meeting.
	4.3	The Consultants shall attend the progress/coordination meetings.
	4.4	The Consultant shall supervise the progress of the Project Schedule (design, manufacturing, factory tastings, delivery, site installation, site testing and commissioning tests) and comment, if any.
	4.5	The Consultant shall review the Contractor's proposed Project Schedule, Organization Chart, Drawing list etc and

		comment, if any.
	4.6	The Consultant shall assist the Owner and draft the documents if the Amendment of the Contract became necessary with the Contractor.
	4.7	The Consultants shall review the Contractor's "For approval drawings" and make comments on them.
	4.8	The Consultant shall review the Factory Test Reports and comments, if any.
	4.9	The Consultants shall draft (1) Documentation Manual and (2) Site Management Manual for smooth/safety project execution.
	4.10	The Consultants shall assist and support the Owner for the site works, such as Civil works, installation works etc.
	4.11	The Consultants shall assist and support the site testing and commissioning test.
	4.12	The Consultant shall assist and support the Owner to collect O & M Manuals, Site tests reports, Red-marked drawings and As built Drawings".
	4.13	The Consultants shall assist and support the Owner in taking over the site (TOAC).
	4.14	The Consultant shall assist and support the Owner in cooperating with JICA, if any.
5. Warrantee Period	5.1	The Consultants shall assist and support the Owner technically and commercially.
	5.2	The Consultant shall assist and support the Owner to complete the outstanding in Snag list of TOAC.
	5.3	The Consultant shall assist and support the Owner in Final Acceptance Certificate.

Source; JICA Survey Team

Note: Based on the scope of the services as shown in Table 6.1.4, MM allocation has been understood by RMEK. RMEK considers a choice to minimize the cost, making international consultants as visiting basis. Site offices for each lot shall be managed by Kurudistan managers and engineers, however, the responsibility shall belong to the international consultants.

The following Figure 6.6.1 shows Draft Consultant MM Plan and Table 6.6.6 shows Consulting Services cost for the Project.

	No.	Scope / Events	Descriptions	Duration	2014												2015												2016												2017												2018											
					Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Implementation Schedule	LOT1	400kV GIS Substation Construction		26 months	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	LOT2	400kV GIS Substation Construction		26 months	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
	LOT3	400kV OHL Construction		18 months	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
MM for Consultants		Consulting Services		XX months																																																												
		1. Foreign Consultant (JP)		MM																																																												
	F-1	Project Manager	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
	F-2	Senior Electrical Engineer	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
		Senior Civil Engineer	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
		Senior Control & Protection Engineer	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
		Senior Telecom.,Engineer	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
		Senior Commercial Expert	Multiple LOT	46.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			1		1		3
			S-Engnr Sub Total	230.0																																																													
		Total for Foreign Consultants		230.0	0	0	0	0	0	0	0	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0	0	6	0	6	0	18
		2. Local Site Consultant (in Baghdad office)		MM																																																												
	L-1	Senior Engineer / Leader	Multiple LOT	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
	L-2	Senior Electrical Engineer /Leader of the LOT	SS LOT1	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Electrical Engineer /Leader of the LOT	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Electrical Engineer /Leader of the LOT	OHL LOT3	36.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															3
		Senior Civil Engineer	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Civil Engineer	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Civil Engineer	OHL LOT3	36.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															3
		Senior Control & Protection Engineer	SS LOT1	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Control & Protection Engineer	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Telecom.,Engineer	SS LOT1	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Senior Telecom.,Engineer	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
			S-Engnr Sub Total	380.0																																																													
	L-3	Electrical Engineer	SS LOT1	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Electrical Engineer	SS LOT2	44.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							3
		Electrical Engineer	OHL LOT3	36.0													1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															3
			S-Engnr Sub Total	44.0																																																													
		3. Local Site Consultant (in each site)																																																														
	Q-3.1.1	Site Mamager	SS LOT1	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
			SM Sub Total	29.0																																																													
	Q-3.1.2	Senior Electrical Engineer	SS LOT1	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
		Senior Civil Engineer	SS LOT1	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
			S-Engnr Sub Total	58.0																																																													
	Q-3.2.1	Site Mamager	SS LOT2	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
			SM Sub Total	29.0																																																												
	Q-3.2.2	Senior Electrical Engineer	SS LOT2	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
		Senior Civil Engineer	SS LOT2	29.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1							
			S-Engnr Sub Total	58.0																																																													
	Q-3.3.1	Site Mamager	OHL LOT3	21.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															
			SM Sub Total	21.0																																																													
	Q-3.3.2	Senior Electrical Engineer	OHL LOT3	21.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															
		Senior Civil Engineer	OHL LOT3	21.0																									1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1															
			S-Engnr Sub Total	42.0																																																												
		Total for Local Consultants (Item2+3)		237.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Note: Calendar months stipulated in the above is just reference only.

Source: JICA Survey Team

Figure 6.6.1 Consultant MM Plan

Table 6.6.6 Consulting Services Cost (Draft)

Consultant Cost Breakdown

1. Engineer Fee

No.	Descriptions	MM, other	Rate(Yen)	Unit	Price (Yen)
1.1	Engineer Fee				
	Foreign Consultant (Japanese)				
	1.1 Project Manger	46	2,500,000	MM	115,000,000
	1.2 Senior Engineer	230	2,500,000	MM	575,000,000
	MM Sub Smm	276			
1.2	Local Site Consultant (Baghdad)				
	(1) Senior Engineer / Leader	44	1,560,000	MM	68,640,000
					0
	(2) Senior Engineer	380	1,020,000	MM	387,600,000
					0
	(3) Engineer	44	1,020,000	MM	44,880,000
1.3.1	Local Site Consultant (Site LOT1)				
	(1) Site Manager	29	1,560,000	MM	45,240,000
	(2) Senior Engineer	58	1,020,000	MM	59,160,000
1.3.2	Local Site Consultant (Site LOT2)				
	(1) Site Manager	29	1,560,000	MM	45,240,000
	(2) Senior Engineer	58	1,020,000	MM	59,160,000
1.3.3	Local Site Consultant (Site LOT3)				
	(1) Site Manager	21	1,560,000	MM	32,760,000
	(2) Senior Engineer	42	1,020,000	MM	42,840,000
	MM Sub Smm (1.1 + 1.2)				
		705			
	(A) Sub Summ (1.1 : 1.3)				1,475,520,000

2. Direct Cost

2.1	Direct Cost (Office rent, Air fee, Accomodation, etc ; (A)*35%)				516,432,000
2.1	Air Fee				
2.1.1	Iraq-Japan for Japanese	72	900,000	trip	64,800,000
	6persons * 3trips / year.for 4years				
2.2	Accommodation				
2.2.1	In Iraq for Japanese	24	10,000,000	Person-years	240,000,000
	Breakdown)				
	PM 46 MM/12 = 4				
	SE 230 MM/12 = 20				
	Total : 24				
2.3	Transpotation				
2.3.1	In Iraq				
	(1) Initial cost	1	3,000,000	cars	3,000,000
	1 car / Site office				
	(2) Running cost	26	500,000	car-months	13,000,000
	1 cars * 26 months				
2.4	Office				
2.4.1	Office Rent for Project Management in Iraq Baghdad	46	2,000,000	months	92,000,000
	Office furniture, IT equipment, the other				
2.4.2	Office Rent for Project Management in Iraq Baghdad	46	80,000	months	3,680,000
	Project coordinator, Secretary, Receptionist, the other				
2.4.3	Office Rent for the project Site in Iraq				
	(1) Initial cost	1	1,000,000	months	1,000,000
	(2) Running cost	29	80,000	months	2,320,000
2.4.4	Office Staff for the Site office in Iraq	29	80,000	months	2,320,000
	Admin, Secretary, Office boy, the other				
2.5	Communication and Document Delivery Cost				
	Telephone bill, fax, mobile, internet access, other	75	336,000	months	25,200,000
2.6	Security cost in Iraq	4	100,000,000	years	400,000,000
	(B) Sub Summ (2.1 : 2.6)				847,320,000
Total Cost					2,322,840,000
					Say 2,300,000,000

Say 23M US$

Source: JICA Survey Team, Note; Foreign currency is generally applied for international contract in Iraq.

6.6.6 Total Project Costs

Table 6.6.7 shows the summary of the total costs for the Project.

Table 6.6.7 Total Project Costs

Items	Total （US$）
Substations Construction Cost (2 SS)	180,000,000
Transmission Line Construction Cost	53,000,000
Sub	
Land Acquisition Cost	0
Environment Monitoring Cost	0
Consulting Service Cost	23,000,000
Ground Total	***256,000,000***

Source: JICA Survey Team

Note: 100Yen/USD

Foreign currency is generally applied for international contract in Iraq.

Chapter 7

Operation, Management and Maintenance System for RMEK

Chapter 7 Operation, Management and Maintenance System for RMEK

7.1 Financial Conditions of RMEK

7.1.1 Financial Structure of RMEK

As the above mentioned, RMEK revenue in 2012 was only 24 % to operating and management cost (O/M cost). The remains with 76 % to the total cost are covered by subsidy from the Government. The details of the subsidy are mainly O/M cost and fuel cost expenses, and capital funds for investment are also supplied by the Government. As RMEK is not independent company and it is one of the ministries in Kurdistan, RMEK does not make their financial statements regarding power business.
When looking at the RMEK data on power business, the average power tariff and unit cost in 2012 was 3.8 ¢ /kWh (44.8 ID/kWh), the subsidy was 11.9 ¢ /kWh (141.4 ID/kWh) and the cost was15.7 ¢ /kWh (186.2 ID/kWh). The above data are calculated by revenue and cost data of RMEK in 2012, other management cost accounts data such as payable interests, repayment of long term loan and profit are not available to collect.

Table 7.1.1 Revenue, subsidy and cost of RMEK (Actual data in 2012)

Sector	Sales &	Revenue		Subsidy		Cost	
	Billed	ID billion	US$ million	ID billion	US$ million	ID billion	US$ million
Domestic	Sales	290	244	1,085	921	1,375	1,164
	Billed	203	170				
Commercial	Sales	41	35	96	80	137	115
	Billed	26	22				
Industry	Sales	66	55	141	117	207	173
	Billed	23	20				
Agriculture	Sales	6	5	33	27	39	33
	Billed	4	4				
Governmenta	Sales	78	65	166	138	243	203
	Billed	67	56				
Total	Sales	482	404	1,521	1,284	2,002	1,687
	Billed	327	274				
Unit / Kwh	Domestic	39.2	3.3	146.3	12.4	185.4	15.7
	Commercial	56.9	4.8	132.6	11.1	189.4	15.9
	Industry	59.9	5.0	127.6	10.6	187.5	15.6
	Agriculture	30.0	2.5	157.5	13.1	187.5	15.6
	Government	60.0	5.0	127.5	10.6	187.5	15.6
	Average	44.8	3.8	141.4	11.9	186.2	15.7

Source: Original data in the table are RMEK

7.1.2 Calculation for Power Tariffs as Power Business of RMEK

Under the current data collected, the average power tariffs are simulated when RMEK becoming an independent company.

(1) Power sales and generation
The following table shows power sales and generation. The sales are the forecasting values of JICA Survey Team, power sales are calculated with “MW × 8,760 hours” and the generation is “Sales + 15% to sales for loss”. And the power sales include social loss and technical loss.

Table 7.1.2 Prediction for Power sale and Generation of RMEK

		2012	2013	2014	2015	2016	2017	2018	2019	2020
Power sales	MW	1,833	2,300	2,880	3,600	4,180	4,850	5,360	5,920	6,540
	GWh	16,057	20,148	25,229	31,536	36,617	42,486	46,954	51,859	57,290
Generation	GWh	18,891	23,704	29,681	37,101	43,079	49,984	55,240	61,011	67,400

Source: JICA Survey Team

(2) Investment and Long term loan repayment plan

The following table shows RMEK investments for transmission and distribution facilities. The investment trends are as the following table. The investments from 2004 to 2012 are actual values, and the investments forecasted after 2013 are calculated with multiplied by GDP growth rates.

Table 7.1.3 Investment and long term loan plan

	Investment	Accumlative	Balance									
	ID million	ID million	ID million	2012	2013	2014	2015	2016	2017	2018	2019	2020
2004	16,635	16,635	15,803	832	832	832	832	832	832	832	832	832
2005	10,326	26,961	25,613	516	516	516	516	516	516	516	516	516
2006	163,846	190,807	181,267	8,192	8,192	8,192	8,192	8,192	8,192	8,192	8,192	8,192
2007	396,733	587,540	558,163	19,837	19,837	19,837	19,837	19,837	19,837	19,837	19,837	19,837
2008	277,061	864,601	821,371	13,853	13,853	13,853	13,853	13,853	13,853	13,853	13,853	13,853
2009	662,377	1,526,978	1,450,629	33,119	33,119	33,119	33,119	33,119	33,119	33,119	33,119	33,119
2010	754,557	2,281,535	2,167,458	37,728	37,728	37,728	37,728	37,728	37,728	37,728	37,728	37,728
2011	643,560	2,925,095	2,778,840	32,178	32,178	32,178	32,178	32,178	32,178	32,178	32,178	32,178
2012	863,246	3,788,341	3,598,924	43,162	43,162	43,162	43,162	43,162	43,162	43,162	43,162	43,162
2013	932,306	4,720,647	4,484,614		46,615	46,615	46,615	46,615	46,615	46,615	46,615	46,615
2014	1,006,890	5,727,537	5,441,160			50,345	50,345	50,345	50,345	50,345	50,345	50,345
2015	1,087,441	6,814,978	6,474,229				54,372	54,372	54,372	54,372	54,372	54,372
2016	1,174,437	7,989,415	7,589,944					58,722	58,722	58,722	58,722	58,722
2017	1,268,392	9,257,806	8,794,916						63,420	63,420	63,420	63,420
2018	1,357,179	10,614,985	10,084,236							67,859	67,859	67,859
2019	1,452,182	12,067,167	11,463,809								72,609	72,609
2020	1,553,834	13,621,001	12,939,951									77,692
			Repayment	189,417	236,032	286,377	340,749	399,471	462,890	530,749	603,358	681,050

Source: Investments during 2004～2012 are RMEK data, and future investments are estimated by JICA Survey Team.

In the analysis, it is assumed that the investment capital funds are applied by long term loan, and the repayment term is 15 year. Therefore, the annual repayment of the long term loan is one fifteenth of the loan. The "Repayment" column in the following table shows repayment of the long term loan every year, and the repayment plan in the table starts from 2004. Although long term loan before 2003 exists in RMEK, the loans are omitted in the analysis.

(3) Factors of power tariff calculation

As the factors required at time of calculating power tariffs, GDP growth rates, investments, long term loan balance, payable interest of loan term loan, required return on asset and power generation efficiency and so on are required. The details are as follow;

a) GDP growth rates are 7 %~8 % per year and it is used for calculating the required investment.
b) The required investments are used for building generation, transmission, distribution and substation facilities.
c) The payable interests are used for repayment of long term loan balance.
d) Return on asset (ROA) is set with 10 % to the total assets. The asset values are applied by the same to long term loan balance.
e) The improvement of power efficiency shows fuel consumption efficiency in company with introducing gas combined cycles. And the average power efficiencies in RMEK are improved with 1 % per year.

f) Fuel and wage costs are increased by the growth rate of "Power generation growth * Power efficiency index". Power efficiency index is accumulation of the power efficiency rate (2012=100).

Table 7.1.4 Factors for calculating power tariff

		2012	2013	2014	2015	2016	2017	2018	2019	2020
GDP growth rate	%	6.7	8.0	8.0	8.0	8.0	8.0	7.0	7.0	7.0
Investment	ID billion	863	932	1,007	1,087	1,174	1,268	1,357	1,452	1,554
LTL Balance	ID billion	3,599	4,485	5,441	6,474	7,590	8,795	10,084	11,464	12,940
Interest rate	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%
ROA	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%
Power efficiency	2012=100	100	99	98	97	96	95	94	93	92

Note: LTL = long term loan Power efficiency means power efficiency index
Source: JICA Survey Team

(4) Cash flow and power tariff

As contents of "Cash in", it is revenue of power sales, the factors as "Cash out" are fuel cost, wages payable interest, repayment of long term loan (cash flow management base) and profit before tax. As the purpose of the analysis is to calculate power tariffs for RMEK to keep suitable profits as independent company, the factor arrangement of the cash flow is defined as the above. The discount rate is given by 10% and it is applied for cash in and cash out.

Under the above definition, if the power tariffs are calculated with taking account of balancing cash in and cash out, the results are as the followings.

a) The power tariff in 2012 is 14.9 ¢ /kWh (175 ID/kWh), and it decreases gradually to 14.1 ¢ /kWh (165 ID/kWh) in 2020.

b) The average power tariff during the calculation period is 14.3 ¢ /kWh (167 ID/kWh). The average fuel and wage costs in the same period is 10.2 ¢ /kWh (119 ID/kWh).

Table 7.1.5 Cash flow and power tariff

			2012	2013	2014	2015	2016	2017	2018	2019	2020
Cash out	Fuel & Wage cost	ID Billion	2002	2,487	3,083	3,814	4,383	5,032	5,503	6,013	6,572
	Interest	ID Billion	252	314	381	453	531	616	706	802	906
	Repayment	ID Billion	189	236	286	341	399	463	531	603	681
	Profit	ID Billion	360	448	544	647	759	879	1,008	1,146	1,294
	Total	ID Billion	2,803	3,485	4,294	5,255	6,073	6,990	7,748	8,565	9,452
Chash in	Tariff	ID /kWh	175	173	170	167	166	165	165	165	165
	Tariff	c /kWh	14.9	14.8	14.5	14.2	14.2	14.1	14.1	14.1	14.1
	Revenue	ID Billion	2,803	3,485	4,294	5,255	6,073	6,990	7,748	8,565	9,452
Present	DCF	10%	100	90.9	82.6	75.1	68.3	62.1	56.4	51.3	46.7
value	Power sales	GWh	16,057	18,316	20,850	23,693	25,010	26,380	26,504	26,612	26,726
	Revenue	ID Billion	2,803	3,169	3,549	3,948	4,148	4,340	4,374	4,395	4,410
	Tariff	ID /kWh	167								
		c/ kWh	14.3								
	Fuel & wage cost	ID Billion	2002	2261	2548	2865	2993	3125	3106	3086	3066
	Cost	ID /kWh	119								
		c/ kWh	10.2								

Source: JICA Survey Team

(5) Financial condition analysis for RMEK

The return on sales is 12.8 % in 2012 under the condition of return on assets with 10 %, after that, it gradually increases to 13.7 % in 2020. As an additional assumption, the profit used for return on sales is "Profit before tax", not "Profit after tax". When using profit after tax for return on sales, it is 11.1 % in 2012 and 11.9 % in 2020.

Table 7.1.6 Profit analysis of RMEK

	Unit	2012	2013	2014	2015	2016	2017	2018	2019	2020
Profit on sales	%	12.8	12.9	12.7	12.3	12.5	12.6	13.0	13.4	13.7
Variable profit ratio	%	28.6	28.6	28.2	27.4	27.8	28.0	29.0	29.8	30.5
Investment per Added Value	%	71.8	62.3	55.1	49.3	45.8	42.8	40.6	38.7	37.0
Profit per kWh	ID / kWh	22.4	22.3	21.6	20.5	20.7	20.7	21.5	22.1	22.6
Profit per kWh	c / kWh	1.9	1.9	1.8	1.7	1.7	1.7	1.8	1.8	1.9

Source: JICA Survey Team

The marginal profit ratio defined by "(Sales – Variable cost) / Sales " in 2012 is 28.6 % and it is 30.5 % in 2020. At the same time, the investment per value added ratio (Investment / Value added (= "Sales – Variable costs") is 71.8 % in 2012, after that, it becomes 37.0 % in 2020. Therefore, as the results it cannot say that RMEK can make more investment than the current assumption. (Generally, it is said that the maximum investment per value added ratio is 40 %.)
The profit before tax per kWh is 1.9 ¢ /kWh (22.4 ID/kWh), and it is 1.9 ¢ /kWh (22.6 ID/kWh). The profits before tax per kWh do not change during the calculation period.

As the above mentioned, the power tariffs have to be set as the following table for RMEK to implement business activities as independent company.
When looking at the power tariff system as resulting the analysis, it is required that the average power tariff is 14.3 ¢ /kWh (167 ID/kWh) . For keeping the average tariff , the power tariff in 2012 has to be improved to 14.9 ¢ /kWh (175 ID/kWh) and it is gradually decreased to 14.1 ¢ /kWh (166 ID/kWh) in 2020. However, as the current average power tariff is around 4 ¢ /kWh (48 ID/kWh) , the average power tariff in the analysis is around 3.5 times to the current average power tariff.

Table 7.1.7 Future power tariffs of RMEK as independent company

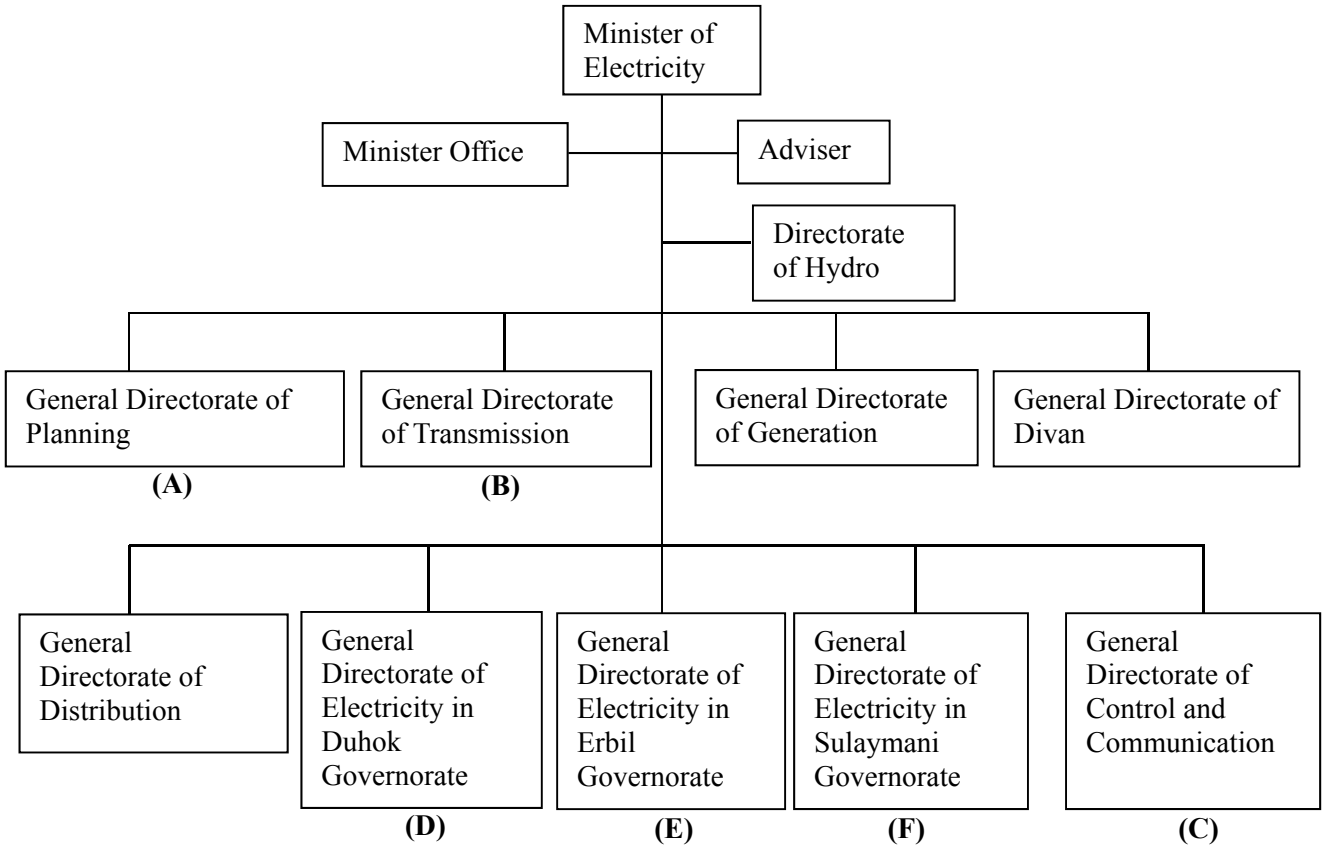
	2012	2013	2014	2015	2016	2017	2018	2019	2020
ID /kWh	175	173	170	167	166	165	165	165	165
c /kWh	14.9	14.8	14.5	14.2	14.2	14.1	14.1	14.1	14.1

Source: JICA Survey Team

7.2 Operation and Maintenance Management System

7.2.1 Organization of RMEK;

The following Figure 7.2.1 shows organization chart of RMEK;



Source: JICA Survey Team

Figure 7.2.1 Organization Chart of RMEK

7.2.2 Directorate to be involved in the Project;

The following Table 7.2.1 shows Directorates which involve in this project for each stage;

Table 7.2.1 Directorate to be involved

Stage	Involved Directorate	Remarks
PQ and Tender stage	General Directorate of Planning and General Directorate of Transmission ((A) & (B))	Up to the signing of Contract
Project Implementation	General Directorate of Transmission (B)	After signing of Contract
Operation and maintenance	General Directorate of Transmission (B)	After Completion of the Construction (Taking Over)

The General Directorate of Control and Communication (C) will supervise the communication system in

all KRG area.

General Directorates of Electricity in Duhok Governorate (D), Erbil Governorate (E) and Sulaymani (F) are responsible for the system voltage up to 33kV. These Directorates will support Land/Route issues of each Governorate upon the request of General Directorate of Transmission.

Two Committees are involved during evaluation stages;

a) Opening Committee; This committee mostly works during Prequalification (PQ) stage and the member is selected by Minister. Almost every 6 months, the members will be changed. General Director or Minister Adviser chairs this committee.
b) Evaluation Committee; The Evaluation Committee supervises both technical and commercial evaluation. The technical evaluation committee will be established during Tender Stage. General Director or Minister Adviser chairs this committee.

Chapter 8

Project Evaluation

Chapter 8 Project Evaluation

8.1 Financial Analysis

8.1.1 Principles of Financial Appraisal

(1) Project appraisal

a) Project criteria are generally conducted as financial analysis based on "Direct accounting principles". In particular, when project feasibility is expressed in a manner that is dependent on fund procurement, rather than estimating the inherent profitability of the project, sometimes the project feasibility is determined by the quality of fund procurement. However, project feasibility is essentially independent of fund procurement, and the project feasibility to be independent of fund procurement should be used to determine the profitability of a project. As achieving the purposes, the internal rate of return method that is based on the present value has been prepared and is used widely today.

b) However, when concerning projects for infrastructure construction or energy development to have an extremely strong publicity, the internal rate of return is often low, and such projects cannot be realized without support from governments and international development agencies. The phenomenon is particularly true of projects in newly emerging nations, middle and developing countries.

c) For a long time, the FIRR criterion was set at more than 15 % throughout the world. In this case, assuming an interest rate of 7 % on a loan with 70 % of total investment. Such an investment return was previously standard practice for private sector enterprises, however, the situation has undergone major change after the Lehman shock, global recession, fiscal worsening of the EU, worldwide deflation and low interest policies, etc. In other words, the profitability can still be secured even when the FIRR is low due to the low interest rates applied to fund procurement now.

d) Considering the current conditions of investors and financing institutions in Middle and Developing countries, the interest rate of ODA projects is in the range of 1~3 %, the FIRR in state-owned or public project operators is deemed to be in the range of 2~6 %.

Table 8.1.1 Expected FIRR (Interest rate =7%) at private sector

Minimum FIRR	=1.0*Interest ＋ (Interest* 1/2)	10.5%
Standard FIRR	=1.5* Interest + (Interest *1/2)	14.0%
Maximum FIRR	=2.0 *Interest + (Interest *1/2)	17.5%

(2) Effective interest rate

a) Borrowing rates in middle developed and developing countries are generally higher than in developed countries. For example, when inflation percentage of a country is 5 % and interest rate is 12 %, the interest rate is determined in a manner that includes the inflation rate. This is referred to as the nominal interest rate, however, inflation factors are generally excluded in financial analysis, the effective interest rate (7 % = 12% - 5%) that doesn't include inflation should be used.

b) Until now the effective interest rate in middle developed and developing countries has usually been around 7 %, while in developed countries with smaller demand for funds, it has been around 5 %. However, the present effective interest rate in middle developed and developing countries is between 7~10 %.

8.1.2 Preconditions of Financial Analysis

(1) Discount rate

Discount rate is one of measures to convert the future values to present values. The discount rate becomes higher in proportion with project risk and interest rate in the targeted country. When deciding the discount rate, usually loan and deposit interest rates are referred in the targeted country. Iraq and Kurdish effective interest rate has been 11.5 % from 2007 to 2012. However, the effective interest rates from 2010 to 2012 are around 10 %. In middle income countries, Iraqi and Kurdish effective lending rate with 10 % is almost equivalent to other middle income countries. Therefore, Iraqi and Kurdish discount rate is set with **10 %** though including project risk. The following table shows loan and deposit interest rates in Iraq and Kurdistan.

Table 8.1.2 Deposit and lending rates in Iraq and Kurdistan

	2007	2008	2009	2010	2011	2012	Average
Discount rate	20.00	16.75	8.83	6.25	6.00	6.00	10.7
Deposit rate	10.43	10.54	7.82	6.06	5.91	6.88	7.6
Lending rate	18.78	19.22	16.16	14.35	14.13	13.59	15.8
Inflation rate	14.7	27.1	-15.4	2.1	6.2	5.8	4.3
Effective deposit rate	6.1	6.2	3.5	1.8	1.6	2.6	0.1
Effective lending rate	14.5	14.9	10.1	10.1	9.8	9.3	11.5

Note: Effective deposit Effective lending rate is defined by "Nominal rate – inflation rate"

Source: International Financial Statistics

Table 8.1.3 Discount rates of International development institutes

Institutes	Values
International Development Bank rate + Risk (Interest/2)	10.5 % (7.0%+3.5%)
Commercial bank interest rate + Risk (Interest /2)	12.7 % (8.45%+4.22%)
Overseas Development Administration announces	10.0 %

Note: Double of interest rates are set for hedging risk for each indicator.

(2) Depreciation conditions

Depreciation conditions for the project such as calculation period, depreciation period, residual value rate and depreciation method are as the following table.

Table 8.1.4 Calculation and Depreciation conditions

Items	Equipment	Values
Calculation period	Transmission line Substation	30 years after operation 30 years after operation
Depreciation period	Transmission line Substation	25 years after operation 20 years after operation
Residual value rate	Substation and Transmission line	5% of investment
Depreciation method	Substation and Transmission line	Straight line method

Source: JICA Survey Team

(3) Long term loan

When financed by JICA, the following loan term loan conditions are applied.

Table 8.1.5 Conditions of long term loan (JICA loan)

Items	Tentative values
Classification of income	Middle income country class (1,916USD~3,975USD)
Loan condition	Standard interest rate

Interest rate	1.4 %
Repayment period	25 years
Grace period	7 years
Procurement condition	Un-tight

Source: JICA HP

(4) Short term loan (STL)

There is time delay between power generating time and collecting power sale money. The implementation entities like RMEK has to borrow short term loan for filling the capital shortage due to the time difference. It is called "Working capital" in accounting aspect and the implementation entities have to pay the interest of the short term loan, if borrow the short term loan from local banks. Regarding transmission and substation projects, the interest cost of the short term loan has to be owned as well as power generation sector and power distribution sector.

Table 8.1.6 Short term loan for working capital

Items	Calculation methods	Values
Required W/C	Calculate receivable additional SS&TL costs	One month sight
STL	Make STL for W/C and business deficits	
Interest rate of STL	Effective lending rate of private banks	10.0%

Note: STL: Short term loan W/C: Working capital

8.1.3 Tax system of Iraq and Kurdistan

Japan External Trade Organization (JETRO) who is Japanese governmental organizations and Deloitte who is a certified public accountant firm have surveyed Iraq tax system in recent year. The main contents are as follows;

(1) JETRO survey

According to " Iraq Accounting Finance & Tax Overview" surveyed by JETRO in March 2011, the tax system is as follows;

a) The system requires that a payer of payable interest to foreign companies should make withholding tax with 15%.
b) It is required that public and private companies make withholding tax with maximum 10% to employee's salaries. (Final tax rates are fixed by their incomes)
c) Import tax is levied to all kinds of imported goods as Iraq recovery tax. (Permanent import tax is defined at the time of lifting recovery tax.)
d) In the agreement between Japan and Iraq governments, Japanese companies for Iraq power sector can obtain preferential tax system. (the details are not clear)
e) The tax system of Iraq is compliant with Iraqi tax system.

(2) Deloitte survey

According to " Middle East Tax Handbook 2011" published by Deloitte in April 2011, Iraqi tax system is as follows;

a) Corporate tax is 15%（Capital gains is proceeded in net profit of a corporate.）
b) Losses can be carried over next 5 years. However, the losses can be applied up to the maximum half of the incomes in the years that corporate tax is levied.
c) Receiver of dividend is not levied.
d) No Surtax
e) Regarding payable interest abroad, a payer has to make withholding tax with 15% to the interest.
f) No tax to intelligence property.
g) As withholding tax of social security, employees expense 5 % from their salaries, and the corporates expense 12% to the employees' salaries.
h) Exist fixed asset tax

i) Stamp tax for the contract is 1% to the contract amounts.
j) Land transfer tax paid by transmitter is 0-6% to the transfer amounts.
k) No added value tax

(3) Tax methods and tax rate
After referring the above surveys, the tax calculation methods and tax rates are as the following table.

Table 8.1.7 Tax methods and tax rate of Iraq & Kurdistan

Items	Tax Rates	Target values
Payable interest abroad	15%	Payable interest
Import tax	5%	Import value
Corporate tax	15%	Profit before tax
Fixed asset tax	Small	Booked value of Fixed assets
Stamp tax to private	1 %	Contract price
Stamp tax to Government	0.2 %	Contract price
Land transfer tax	0- 6 %	Transfer price
Added value tax	None	
Local tax	1 – 2 %	Imported goods
Interest rate of STL	10 %	Effective lending rate
JICA loan rate	1.4%	JICA loan

Source: JICA Survey Team after referring Deloitte & JETRO surveys

In case of RMEK, the all taxes to new investments from Japan are exempted. however, the import tax is levied to the imported parts in the purpose of maintenance.

8.1.4 Methodologies for Financial Analysis

(1) Substation and Transmission line (SS&TL) tariff and cost calculation
The methodology for calculating SS&TL tariff and cost is as the following table. By comparing SS&TL tariff and cost when power consumers use SS&TL system, Financial Internal Rate of Return (FIRR) for the project is calculated.

Table 8.1.8 Substation and Transmission line tariff and cost calculation

Items	Values
• SS&TL tariff is calculated by the estimated power tariff	SS tariff = Power tariff *15% /2 TL tariff=Power tariff * 15% / 2
• SS&TL yearly cost are calculated with Wages, depreciation, O/M cost, interest and administration cost • SS&TL unit cost are calculated from the SS&TL yearly cost divided by the transmitted power	
• FIRR are calculated under the SS&TL tariff and costs.	Calculation period: 30 years

FIRR: Financial Internal Rate of Return

(2) Income statements
The cost calculation and income statements are described as the account items in following table.
a) Sales amount is defined by “Transmission volume * Usage charge”
b) The total costs include direct costs for transmissions and substations (maintenance and labor costs), management cost (Depreciation, Interest, Fixed asset tax and Administration costs).

Table 8.1.9 Income statements

Items	Accounts	Expressions	Values
Sales	a) Usage charge	Power tariff * SS&TL share %	SS=15%/2, TL=15%/2
	b) SS loads	From 30% to 70%	
	c) Sale amounts	SS access * Usage charge	
SS&TL costs	d) Maintenance costs	Estimate by the team	
	e) Labor costs	Estimate by the team	
	f) Depreciation	Straight line depreciation after the start	
	g) Administration costs	(e)*α%	α%=20%
	h) Interest of LTL	Calculated by loan conditions	
	i) Interest of STL	Sale /12 * interest rate	Interest rate = 10%
	j) Cost total	d+e+f+g+h+i	
Profit	k) Profit before tax	Sales (c) - Cost total (j)	
	l) Corporate tax	Profit before tax(k) * Corporate tax rate	Corporate tax= 0%
	m) Profit after tax	Profit before tax (k)– Corporate tax(l)	

(3) FIRR sheet

The FIRR table for calculating Benefits, Capex (total of capital investment), Opex costs (total of maintenance cost), Net benefits and FIRR is as follows;

Table 8.1.10 FIRR calculation table

Items	Contents
Benefits	Sales
Capex	Investment
Opex	Wages + O/M expenses + Import tax + Administration cost
Net Benefits	Benefits- Capex - Opex
FIRR	f(Net Benefits)

Note: Capex is the total of capital investment, Opex is the total of maintenance cost

(4) EIRR

The EIRR table for calculating Benefits, Capex, Opex costs, Net benefits and EIRR is as follows;

Table 8.1.11 EIRR calculation table

Items	Contents
Benefits	Reduction of small diesel power generation
	GDP increase due to national labor productivity up
Capex	Investment – Tax and duties
Opex	Wage total – Unskilled labor wages O/M expenses Administration cost
Net Benefits	Benefits – Capex – Opex
EIRR	F (Net Benefits)

8.2 Results of Economic & Financial Analysis

8.2.1 Project contents and evaluation

The substations and transmission lines in the project are separated in the following three LOTs. The substations and transmission lines are located in Erbil and Sulaymani.

Table 8.2.1 Project contents and LOT

	Governorates	Contents
LOT1	Erbil	Gomaspan 400kV GIS Substation Construction Project (250MW*2)
LOT2	Sulaymani	Arbat 400kV GIS substation Construction Project (250MW*2)
LOT3	Sulaymani	400kV Transmission Line between Sulaymani and Arbat substations

The economic and financial analysis is studied for the above LOTs and the two combinations of the LOTs. The evaluation classifications for economic and financial analysis are as follows;

Table 8.2.2 Evaluation classification for economic and financial analysis

Classification	Comments
LOT1 (Gomaspan SS)	As LOT1 configuration is the same as LOT2, the economic financial analysis of LOT1 and LOT2 are the same values.
LOT2 (Arbat SS)	
LOT3 (Transmission Line)	The length of the transmission line is 70 km. As the line is built for transmitting power from Sulaymani to Arbat, it can consider that LOT2 and LOT3 are unified as a project.
LOT2+LOT3	It is the economic and financial analysis when LOT2 and LOT3 are combined as a project.
LOT1+LOT2+LOT3	It is the economic and financial analysis when LOT1, LOT2 and LOT3 are totaled.

8.2.2 Results of Financial Analysis

(1) Investments

The investments of LOT1 and LT2 are as the following table. The investment values between the two are same. The main investment items are substation equipment, tax and duties (Japanese companies are exempted), cost escalation (include pre-operation interest) and consultant service cost

Table 8.2.3 Investments for LOT1 and LOT2

Items	Value	First year	Second year
a. Substation	75,000	37,500	37,500
b. Contingency	7,500	3,750	3,750
c. Cost escalation	7,500	3,750	3,750
d. Environmental monitoring	0	0	0
e. Land compensation	0	0	0
f. Construction cost total	90,000	45,000	45,000
g. Consultant service	9,500	4,750	4,750
h. Investment total	99,500	49,750	49,750

Note: Construction period is 18 months, first year includes 9 months and second year also 9 months

Note: Substation includes Insurance for transport, Site work cost, Insurance for site work. Contingency and Cost escalation are 10 % to substation.

The investment of LOT3fot transmission line is as follows;

Table 8.2.4 Investment for LOT3

Items	Value	First year	Second year
a. Substation	44,167	22,084	22,084
b. Contingency	4,416	2,208	2,208
c. Cost escalation	4,416	2,208	2,208
d. Environmental monitoring	0	0	0
e. Land compensation	0	0	0
f. Construction cost total	53,000	26,500	26,500
g. Consultant service	4,000	2,000	2,000
h. Investment total	57,000	28,500	28,500

Note: Transmission line includes Insurance for transport, Site work cost, Insurance for site work. Escalation factor and Contingency are 10 % to Transmission line cost.

(2) Partial tariff

The power tariff consists of generation cost, transmission cost, distribution cost and profit. Furthermore, transmission cost is separated to substations and transmission lines. In the analysis, substation tariff and transmission tariff are required for calculating sales income and cost. The substation tariff and transmission tariffs are estimated by the shares of the investments in power sector. The tariffs are called "Partial tariff". The partial tariffs for the substation and transmission line are calculated with based on the average power tariff (15.7 cent / kWh, include subsidy) of RMEK in 2012.

According to "Greater Mekong Sub-region Northern Power Transmission Project by ADB" and "System Grid Master Plan of Lao by JICA", when dividing power tariff to generation cost, transmission cost and distribution cost, the power tariff of Iraq and Kurdistan mainly supplied by fired power generators are separated as the following table, even though the contributions of the power tariff are little bit difference in countries.

Table 8.2.5 Partial tariffs of Generation, Transmission and Distribution

	Contribution	ID / kWh (Actual in 2012)	¢ / kWh (Actual in 2012)
Power tariff	100%	186.2	15.7
Generation	70%	130.3	11.0
Transmission	15%	27.9	2.35
Distribution	15%	27.9	2.35

Furthermore the transmission cost is divided to substation cost and transmission line cost. The contribution is given by the ratio between the investments of the two. In case of Kurdistan, the contribution of Substation : Transmission line is 1 : 1. The substation cost and transmission cost estimated for the current Kurdish transmission network are as follows;

Table 8.2.6 Substation and Transmission line cost in the whole of Kurdistan

Cost items	Length & Number	Expression	Construction cost
Transmission line	Line length: 3,130km (132kV OHL length)	$0.6 million/4/km*3,130km	$469 million
Substation	33 stations	$15 million * 33	$495 million

Note: "$0.6 million/4/km" is the expression for converting $0.6 million of 400kV OHL to 132 kV.
"$15 million / equipment" is a average substation cost in Kurdistan

Source: PSS data at 2013

Under the above conditions, the partial tariffs for LOTs are as the following table. Those are calculated based on the average power tariff (15.7 cent / kWh) in 2012 of RMEK.

Table 8.2.7 Partial tariffs by LOT

LOT	Partial tariff	Expressions
LOT1	1.18 cent/kWh	SS=15.7cent/kWh * 15% /2
LOT2	1.18 cent/kWh	SS=15.7cent/kWh *15% /2
LOT3	0.64 cent/kWh	TL=15.7cent/kWh*15%/2 *Investment ratio of LOT3/LOT2
LOT2+LOT3	1.82 cent/kWh	SS+TL=1.18 cent/kWh +0.64 cent/kWh
LOT1+LOT2+LOT3	1.50 cent/kWh	Average of LOT1and (LOT2+LOT3) =1.18 cent/kWh /2+(1.18 cent/kWh +0.64 cent/kWh)/2

(3) Income and cost accounts

The economic and financial accounts for substation and transmission line are as the followings. The sales income is calculated by the partial tariff.

Table 8.2.8 Expressions for calculating sales income and costs

Items	Accounts	Expressions
SS	Sales	Power transmitted * Substation partial tariff Power transmitted is 30 % to capacity in the beginning year and the maximum becomes 70% by increasing 8%~10% per year. Partial tariff : 15.7 cent/kWh * 7.5%（15% / 2）
	Cost	Wages, Repair cost, Depreciation, Long and Short term loan 20% to Wages as Administration cost of Head quarter
	Tax	5% levied to the imported repair parts Asset tax and corporate tax are not levied
TL	Sales	Power transmitted * Substation partial tariff Power energy transmitted in the line is the same volume as the capacity of LOT2. Partial tariff : 15.7 cent/kWh * 7.5%（15% * TL investment / SS investment
	Cost	Wages, Repair cost, Depreciation, Interest of long and short term loan 20% to Wages as administration cost of Head quarter
	Tax	5% levied to the imported repair parts Asset tax and corporate tax are not levied

(4) Escalation factor

The discount rate, exchange rate and escalation factors of wage, oil products price, power tariff and O/M cost are as the following table. The growth rate of wage is half of GDP growth rate, the growth rate of oil products price is the same as crude oil price. The growth rate of power tariff is defined by oil price growth rate * elasticity (0.7). The growth rate of O/M is defined by (Wages*elasticity (0.5) + Oil price * elasticity (0.5))

Table 8.2.9 Escalation Factors

Items	Unit	Values
Wage escalation	%	3.0%
Oil price escalation	%	2.0%
Tariff escalation	% (Labor*0.5)	1.4%
O/M cost escalation	% (Labor *0.5)	2.5%
Discount rate	%	10.0%
Exchange rate ID	ID /USD	1,170ID/USD

(5) Profit and cost calculation

When calculating under the above conditions, the partial tariff, sales, cost and profit of LOT1, LOT2 and LOT3 are the following tables.

Table 8.2.10 Profit and Cost of LOT1 and LOT2

	Unit	2019	2020	2025	2030	2035	2038
Sales	1000USD	14,936	16,660	26,727	40,610	43,533	45,388
Cost	1000USD	13,454	13,588	16,295	17,517	18,841	19,738
Profit	1000USD	1,483	3,072	10,432	23,093	24,693	25,649
(SS Tariff)	Cent/kWh	1.20	1.21	1.30	1.39	1.49	1.56
(Unit cost)	Cent/kWh	1.08	0.99	0.79	0.60	0.65	0.68

Table 8.2.11 Profit and Cost of LOT3

	Unit	2019	2020	2025	2030	2035	2038
Sales	1000USD	8,101	9,036	14,496	22,026	23,611	24,617
Cost	1000USD	7,222	7,304	9,232	9,972	10,779	11,326
Profit	1000USD	879	1,732	5,264	12,054	12,833	13,291
(SS Tariff)	Cent/kWh	0.65	0.66	0.71	0.76	0.81	0.85
(Unit cost)	Cent/kWh	0.58	0.53	0.45	0.34	0.37	0.39

Table 8.2.12 Profit and Cost of LOT2+LOT3

	Unit	2019	2020	2025	2030	2035	2038
Sales	1000USD	23,037	25,696	41,223	62,636	67,145	70,005
Cost	1000USD	20,675	20,892	25,527	27,489	29,619	31,064
Profit	1000USD	2,362	4,804	15,696	35,147	37,526	38,941
(SS Tariff)	Cent/kWh	1.85	1.87	2.01	2.15	2.31	2.40
(Unit cost)	Cent/kWh	1.66	1.52	1.24	0.94	1.02	1.07

Table 8.2.13 Profit and Cost of LOT1+LOT2+LOT3

	Unit	2019	2020	2025	2030	2035	2038
Sales	1000USD	37,973	42,355	67,950	103,246	110,678	115,392
Cost	1000USD	34,129	34,480	41,822	45,006	48,460	50,802
Profit	1000USD	3,844	7,876	26,127	58,239	62,218	64,590
(SS Tariff)	Cent/kWh	1.52	1.54	1.65	1.77	1.90	1.98
(Unit cost)	Cent/kWh	1.37	1.26	1.02	0.77	0.83	0.87

(6) Results of Financial analysis

The FIRRs by LOT are as the following table. The FIRRs are calculated by the three cases, the first FIRR named by “Likelihood scenario” is calculated by partial tariffs based on the actual power tariff in 2012, the second FIRR named by “10 % less scenario” is calculated by 90% to the partial tariffs (it means 10% less than the actual power tariff) and the third FIRR named by “20% less scenario” is calculated by 80% to the partial tariffs (it means 20% less than the actual power tariff),

Table 8.2.14 FIRR, Partial tariff and Costs by LOT

		Likelihood scenario	10% less scenario	20% less Scenario
LOT1	Partial tariff	1.18c ¢ /kWh	1.06 ¢ /kWh	0.94 ¢ /kWh
	Cost	0.81 ¢ /kWh	0.81 ¢ /kWh	0.81 ¢ /kWh
	FIRR	**16.2%**	**14.3%**	**12.2%**
LOT2	Partial tariff	1.18 ¢ /kWh	1.06 ¢ /kWh	0.94 ¢ /kWh
	Cost	0.81 ¢ /kWh	0.81 ¢ /kWh	0.81 ¢ /kWh
	FIRR	**16.2%**	**14.3%**	**12.2%**
LOT3	Partial tariff	0.64 ¢ /kWh	0.58 ¢ /kWh	0.51 ¢ /kWh
	Cost	0.45 ¢ /kWh	0.45 ¢ /kWh	0.45 ¢ /kWh
	FIRR	**14.9%**	**13.1%**	**10.9%**
LOT1+LOT2	Partial tariff	1.18c ¢ /kWh	1.06 ¢ /kWh	0.94 ¢ /kWh
	Cost	0.81 ¢ /kWh	0.81 ¢ /kWh	0.81 ¢ /kWh
	FIRR	**16.2%**	**14.3%**	**12.2%**
LOT2+LOT3	Partial tariff	1.82 ¢ /kWh	1.64 ¢ /kWh	1.45 ¢ /kWh
	Cost	1.26 ¢ /kWh	1.26 ¢ /kWh	1.26 ¢ /kWh
	FIRR	**15.7%**	**13.9%**	**11.7%**
LOT1+LOT2+LOT3	Partial tariff	1.50 ¢ /kWh	1.35 ¢ /kWh	1.20 ¢ /kWh
	Cost	1.03 ¢ /kWh	1.03 ¢ /kWh	1.03 ¢ /kWh
	FIRR	**15.9%**	**14.0%**	**12.0%**

Note: The Cost of "LOT2+LOT3" is the summation of LOT2 cost and LOT3 cost. And the cost of "LOT1+LOT2+LOT3" is the average between "LOT1" and "LOT2+LOT3".

<Evaluation of FIRR>
The FIRRs by LOT are 16 % in likelihood scenario, 14% in 10% less scenario and 12 % in 20 % less scenario. As the interest rate for the project loan even though including local fund procurement is less than 2 % per year. When the FIRR might be 4 %, it is feasible as infrastructure project under such low interest rate. According to the above financial analysis, all kinds of FIRRs exceed the expected target to be over 10 %. Therefore, the profitability of financial analysis is no problem.
It can be considered that future Kurdish power tariff (including subsidy) is decided by the increase of fuel prices and power efficiencies. It can be expected that power efficiencies are increased by introduction of Independent Power Producers (IPP) and Gas Combined Cycle (GCC). Therefore it can consider that fuel costs increase with 2 % per year are absorbed by the improvement of the productivity in the power sector.
When the power tariffs in 2012 are set constantly in all calculation periods, FIRRs are decreased by around 2 % from the current level. If so, as the FIRRs can be kept over 10%, the profitability as infrastructure project is kept.

8.2.3 Results of economic analysis

As benefits of economic analysis, it can be considered that the project substitutes private small diesel generators to be inefficiency due to high diesel oil cost. Until now, some power consumers have had small diesel generators for measuring power shortage in Kurdistan. The main reason of power shortage is power generator capacity and transmission network shortage in Kurdistan. Therefore, introduction of new power generators and new power transmission networks make power shortage decrease, after that, it can make private small diesel generators reduce. The reduction of private small diesel generators makes the imported diesel oil decrease into Kurdistan, which becomes national benefit for Kurdistan.
Other hand, resolution of power shortage makes labor productivity increase, which makes GDP growth rate increase as the results. This is big economic benefits for Kurdistan In the economic analysis, the above two impacts are applied as economic benefit.

(1) Cost calculation of diesel generator

The following table is expressions for estimating diesel generator cost in 2012. The costs are separated to fuel cost and fixed cost.

Table 8.2.15 Estimation of Diesel generation cost

Diesel oil price	50 cent /liter
Power efficiency	30%
Fuel cost	9,000kcal/liter*30%/860kcal/kWh*50cent/liter=16cent/kWh
Fixed cost	$1,000/kW*(Depreciation*10% + Interest*10% + Other cost*10%)=3.4cent/kWh
Generation cost	16 cent/kWh＋3.4 cent/kWh=19.4cent/kWh
Minimum cost	19.4cent/kWh*90%=17.0 cent/kWh

Source: Diesel oil price and Fixed costs are estimated by JICA Survey Team

(2) GDP increase by power shortage reduction

The following table shows calculation procedures of the benefit as GDP increase from the project. At first, labor productivity are calculated by GDP per capita and number of consumers from the project. As the next stage, the labor productivity makes GDP increases.

Table 8.2.16 GDP increase by reduction of power shortage

Number of beneficiary	500MW*1,000*70%*8,760hour/7,000kWh/person=438,000person
Minimum beneficiary	438,000person * 70%=307,000person
GDP per capita	$6,000 per capita in 2012
Power shortage reduction rate	5% in year average (10 labor hours/day*5%=0.5 hour / day)
Labor productivity increase	GDP per capita* Minimum beneficiary*(1+Power shortage reduction rate)
GDP increase from SS & TL	Labor productivity increase *15%

Source: GPD per capita shown in Table 2.1.12 GDP at current price and GDP per capita

(3) The results of economic analysis

Benefits of economic analysis are diesel oil reduction and GDP increase, and the Cost are Investment (none tax), Wages (manager + skilled), O/M expenses (none import Tax) and Administration cost. The following table shows the benefits including diesel reduction (summation in 2019~2048) and GDP increase (summation in 2019~2048) and EIRR.

Table 8.2.17 Results of EIRR

LOT	EIRR	Total Benefits	Diesel reduction Benefit	GDP increase Benefit
LOT1	**22.9%**	1,564 million USD	1,160 million USD	404 million USD
LOT2	**22.9%**	1,564 million USD	1,160 million USD	404 million USD
LOT3	**21.6%**	853 million USD	635 million USD	218 million USD
LOT2+LOT3	**21.9%**	2,374 million USD	1,751 million USD	623 million USD
LOT1＋LOT2＋LOT3	**22.3%**	3,945 million USD	2,918 million USD	1,027 million USD

Note: The benefits are total from 2019 to 2048.

＜Evaluation of EIRR＞
EIRR of "LOT1+LOT2+LOT3" reaches around 22 % and it is higher than FIRR with around 16 %. The benefit of diesel oil reduction is around 3,000 million USD and the benefit of GDP increase is around 1,000 million USD in operating 30 years. The average net benefit per year is 90 million USD ((Benefit:3,945 – Cost :1,254)÷30 years, it is not present value.)
Other hand, the investments for LOT1 and LOT2 are 99.5 million USD respectively and LOT3 is 57 million USD. The total investment is 256 million USD. And Pay Back Period (PBP) based on cash flow (it is present value base) is 8 years after starting operation. It means that the total net benefit from 2019 to 2026 almost equal to the total investment.
The project does not target the whole power business, it is only substation and transmission line. Therefore, the partial tariffs for substation and transmission line are introduced and used in economic financial analysis, which complicates the procedures of the analysis. As the mind position of the analysis, the benefits should be evaluated by rather lower worth, and the cost items in financial analysis are remained as cost item in the economic analysis as much as possible.
As the results of the above procedures, EIRR reaches 22 %. It can be said that the profitability of the project is comparatively kept at higher level than other infrastructure projects.

8.3 Achievement indicators for the project

As achievement indicators for the project after implementation, the following indicators should be selected. Power distribution targets in Erbil and Sulaymani are the forecasted power demand in 2020. As power shortage, even though the Master plan of RMEK has already had the targets of power shortage reduction by 2015, herein, what it is resolved by 2020 is set as the project target.

Table 8.3.1 Project achievement indicators

Items	Indicators & Targets	Situation in 2012
The targeted governorates	Erbil Sulaymani	
Indicator for measuring the project effect	Indicator 1 : Implementation of power supply plan Indicator 2 :Reduction of power shortage	
Distributed power supply as Indicator 1	Erbil :1,900MW(16.6 TWh) in 2020 Sulaymani :2,100MW(18.4 TWh) in 2020	665 MW 755 MW
Targets of Power shortage reduction as Indicator 2	Erbil :Almost zero in 2020 Sulaymani :Almost zero in 2020	20 % shortage 20 % shortage

Note: Targets of power distributions are calculated from RMEK peak demand forecasts in 2020.
The target peak demand in 2020 = Targets of Power distribution in 2020 / 0.7

"Indicator 1" means the power supply plan by RMEK up to 2020. By the plan, RMEK considers that the current power shortage will be resolved in 2020 at the latest. Therefore, the RMEK and JICA Survey Team select RMEK's power supply plan in 2020 as "Indicator 1".

"Indicator 2" means that the power shortage will be resolved by the implementation of RMEK's plan. In the past years, there was power shortage even though implementing RMEK's power supply plan. "Indicator 2" puts emphasis that the power shortage is resolved if the current RMEK's power supply plan will be implemented through this project and so on.