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Republic of South Sudan

Analysis of Juba Distribution Network and Capacity Building Needs in the Electricity Sector

Advisory Services Document – Consultant's Summary Report

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The World Bank

CURRENCY EQUIVALENTS
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Currency Unit	=	South Sudanese Pound (SSP)
SSP 3.1	=	1 United States Dollar (US$)
US$ 1.54	=	1 Special Drawing Rights (SDR)

FISCAL YEAR
South Sudan Electric Corporation (SSEC)
April 1 – March 31

ABBREVIATIONS AND ACRONYMS

EPC	Engineering Procurement and Construction
ESSN	Electricity Sector Strategy Note
ESAMI	Eastern and Southern African Management Institute
GRSS	Government of the Republic of South Sudan
GWh	Gigawatt Hour
IDA	International Development Association
KAPECO	Kapoeta Electric Company Limited
kV	Kilovolt
kWh	Kilo Watt Hour
LTCT	Load Tap Changing Transformer
MECO	Maridi Electric Company Limited
MoEDIWR	Ministry of Electricity, Dams, Irrigation and Water Resources
MoFCIEP	Ministry of Finance, Commerce, Industry and Economic Planning
MHLPU	Ministry of Housing, Lands and Public Utilities
MVA	Mega Volt Ampere
MW	Megawatt
NESP	National Electric Sector Policy
PMU	Project Management Unit
PSU	Public Sector Undertaking
RSS	Republic of South Sudan
SSDP	South Sudan Development Plan
SSEC	South Sudan Electricity Corporation
TOT	Training of Trainers
TQM	Total Quality Management
UMI	Uganda Management Institute
VAT	Value Added Tax

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Executive Summary

1. The objective of this report, financed by the World Bank's Energy Sector Management Assistance Program (ESMAP), is to provide a deep analysis of two key areas of the electricity sector in order to support the overall development of the sector and its institutions in the post-independent Republic of South Sudan (RSS). The focus areas are:

(i) An analysis of the *distribution network* in Juba in support for possible support under a distribution network rehabilitation investment project, and

(ii) An investigation of the *capacity building* needs for sector institutions, including identification of short and long term training programs and associated activities.

2. The two focus areas are described in separate sections of the report below. This report is complimentary to the South Sudan Electricity Sector Strategy Note (ESSN, Report Number ACS3585, April 2013), which describes the overall sector, the key challenges it faces, and recommends measures to support sector development. As such, the scope of this report is limited to description of the two areas, as above. These issues will be further investigated and support for their development will be designed under the proposed Energy Sector Technical Assistance Project (ESTAP).

Background

3. As South Sudan embarks on a process of rebuilding its economy to foster growth and development, the challenges it faces are enormous. Most of the development related indices in the country are amongst the lowest in Sub-Saharan Africa (SSA) and the core infrastructure is in its infancy. South Sudan's estimated gross domestic product (GDP) is about US$10 billion with a population of 8.3 million. A large country of 647,095 sq. km, South Sudan possesses considerable natural resources (oil and gas, hydropower, etc.). However, despite abundant resources, at present, demand for electricity vastly outpaces supply (electricity access rate is estimated to be around about 2 percent).

4. Most of the electricity generation is based on thermal resources (diesel, heavy fuel oil), which is very expensive (average generation cost is about US$0.70/kWh). Due to the low access rate, most of the population relies on burning biomass as their primary energy source for cooking, lighting, etc. Those who do have access to electricity experience unreliable quality of service (outages and disruptions) and yet, end up paying some of the highest average electricity tariff rates on the continent (average tariff is US$0.25/kWh) which is still below cost recovery level. To promote growth and prosperity through efficient use of resources, the Government of Republic of South Sudan (GRSS) announced the South Sudan Development Plan (SSDP), including plans for key sector investments.

Key Findings for Distribution Network in Juba

5. Presently, South Sudan has an installed capacity of 22MW in three isolated distribution networks (in major commercial centers) totaling 15km in length which experiences high system losses (around 35-40 percent). In FY2013, 22,000 customers consumed about 70GWh of energy (per capita consumption of about 10kWh). The current demand including a substantial amount of suppressed demand and the projected future demand cannot be met through the existing power generation and distribution system in Juba. The near term supply prospect for power supply in the Juba distribution area is based on the 40MW hydropower plant at Fula Rapids. As an emergency measure to rehabilitate the existing network and to absorb the possible supply from the Fula Rapids power, immediate investment is required. This report provides a recommendation of the technical equipment and the size and scale of the infrastructure needed to boost the Juba distribution network. Further analysis will be covered under a country wide power sector least cost investment plan study, proposed under ESTAP.

6. Based on the analysis conducted and discussions with stakeholder on the requirements, it has been found that the main technical investment required would be: two 33/11kV substations of capacity 2x10/14 MVA each. It is also necessary to take immediate action to replace faulty equipment along with the installation of source lines, feeder lines, distribution transformers, capacitor banks, service cables, meters etc. This should be supplemented by operation and maintenance contracts, as well as training on system administration for SSEC and MoEDIWR staff. There is also an urgent need to support further technical and commercial loss reduction and efficiency improvement in the system, including new ecosystem of pre-paid meters.

Key Findings for Capacity Building

7. The Ministry of Energy and Mining (MoEM), established in 2009, had the responsibility of policy development and sector planning for the petroleum, energy and minerals sector. However, in the post-independence era, the MoEM was changed to the Ministry of Electricity and Dams (MoED) and was later merged with another ministry to form the Ministry of Electricity, Dams, Irrigation, and Water Resources (MoEDIWR). The main sector utility is the South Sudan Electricity Corporation (SSEC). An Electricity Bill was drafted; however, it is yet to be updated and ratified in light of the new ministries and other institutional changes. The clarity of roles and responsibilities of the institutions has not been achieved. Overall, the capacity of all of the sector institutions is severely lacking.

8. In order to investigate the specific capacity building requirements, a survey was conducted of the main sector stakeholders that included both quantitative and qualitative responses. The survey captured an understanding of the current operations and the need for addressing training of the staff and officials. Based on the findings of the survey, high priority areas were identified as: generation/transmission and sector planning, along with regulation, distribution management, and human resource development. A large percentage of the respondents gave the highest priority on establishment and implementation of modern transmission systems followed by other areas such as operation and maintenance of generation facilities, expansion of transmission and planning process of regional interconnections, and establishment of grid network.

Detailed description of the Juba distribution network analysis (Section 1) and capacity building needs assessment (Section 2) are provided below. The findings will also be used to inform the design and preparation of the proposed ESTAP.

Section I: Analysis of Distribution Network in Juba

Introduction

9. This section of the report aims to provide an analysis and propose specific technical plans for investment in the Juba distribution network to carry out emergency upgrades (as a short term measure) and to enable it to absorb possible power that is foreseen to be delivered from possible increase in supply (such as, through the Fula Rapids HPP). The report firstly explains the current Juba grid status, followed by the approach undertaken by the study. Then, it presents the result of gap analysis, concluding with the distribution investment plan and its necessary measures to achieve the target. It is to be noted that in the medium term, a detailed least cost investment plan (LCIP) for the country (planned under ESTAP) will be developed which would provide comprehensive methodology as well as an assessment of appropriate technical standards to be incorporated in development of the South Sudan electrical grid network.

Current Status of the Juba Grid

10. Juba is the capital of South Sudan as well as the nation's center of economic activity. It is situated on the banks of the Nile River with a population of 0.37 million.[1] Juba's existing electrical distribution system consists of 11kV overhead lines of about 15km and has connected around 10,000 consumers through generally outdated post-paid electromechanical meters and a limited number of pre-paid digital meters. At present, it has electric supply system is based on 13 fossil fuels (mainly diesel or HFO) based generators with rated capacity 17MW.

11. Due to lack of spare parts and proper maintenance, many of the generation plants are out of order and the existing infrastructure is unreliable with high system losses (estimated to be 35-40 percent). As a result of this, the available generation capacity of SSEC is very limited (estimated to be around 12MW). In addition, the distribution network's coverage and capacity is also inadequate. The meagre infrastructure of power distribution system, its operation and schedule maintenance, and irregular supply of fuel are compelling the Juba's electricity users to rely on self-generation (using standby generators). This results in in high cost of electricity and environmental pollution. In addition, the technical expertise required for installing, operating, and maintenance of a proper electric distribution system is not sufficient.

Technical Assessment Approach

12. To assess the present status and future need to improve power distribution system of SSEC, an energy expert mission visited Juba twice, from April 26 to May 10, 2010 and from July 14 to July 20, 2013. During these visits, the mission met with key officials in the relevant government agencies – the Ministry of Finance, Commerce, Industry, and Economic Planning (MoFCIEP), MoEDIWR, SSEC, as well as stakeholders from the private sector, the University of Juba, and development partners. Specified questionnaires were prepared for all the relevant stakeholders of electricity and systematic research on the findings from the visits were carried out.

[1] 5th Sudan Population and Housing Census, 2008

Issues and Challenges Related to the Sector

13. A key shortcoming of the sector is that the only legal document for the electricity sector is the Southern Sudan National Electric Sector Policy (NESP), 2007. There is another draft document, namely, Electricity Bill 2013, which has not yet been enacted. There is no formal Electricity Act, economic tariff structure, or power grid code. In the absence of legal and regulatory underpinnings, an electrical distribution entity cannot run smoothly.

14. In Juba, the overall electrical power system is owned by MoEDIWR and is operated by SSEC. MoEDIWR has a total of 336 employees and SSEC has 745 employees.[2] There is a general lack of clarity in roles and responsibilities of the sector institutions.

15. The sector also suffers from the lack of financial / budgetary autonomy for sector investments (both of the entities rely on central budgetary allocations for financial support for capital and operational expenses). SSEC collects the revenue for the electricity consumers and the revenue is then adjusted centrally within the MoFCIEP budget. When any kind of expenditure is required, the fund is collected from MoFCIEP, causing delay in emergency procurement of spare parts and fuel for generating plant, substations, and distribution lines. These delays result in significant damages of plants and lines, cause power outages, and complete dissatisfaction of consumers. To overcome these problems, SSEC must be autonomous and have its own available fund to meet its operational and maintenance expenses.

16. To develop SSEC as a profitable and autonomous electrical distribution entity, the tariff structure needs to be prepared in such a way that it complies with the full cost of delivery. In fact, if quality of electric supply is improved, the potential consumers must take the opportunity to get connection from SSEC, as they are generating their own electricity which costs much higher than that of a larger power plant. Existing electricity tariff is not based on full cost recovery parameters. In addition, its collection ratio of bills falls below 50 percent due to various reasons, such as inappropriate installation and improper maintenance of energy meters, irregular maintenance of the meter readying system, and irregular distribution of bills.

17. Presently, SSEC has only three prepaid card recharge point for the pre-paid meters in operation. In the distribution system of SSEC, about 2,500 electro-mechanical meters have been installed in consumer's premises that generally suffer from poor maintenance standards.[3] For these post-paid meters, the meter reading system is not maintained properly, causing delays in preparation and distribution of bills.

18. Due to lack of regular operational activities, consumers are not paying the bill but no remedial actions are being taken against these consumers. There is a provision for imposing penalty for adopting unfair means but enforcement is very rare. SSEC does not have sufficiently trained human resource based to operate an electrical distribution system smoothly.

[2] Source: South Sudan Electric Corporation and Ministry of Energy and Dam
[3] Source: South Sudan Electric Corporation

Grid Development Plan

19. South Sudan could reach peak demand of nearly 100 MW with energy sales of nearly 200 GWh in the coming years (Table 1 below), based on the GRSS's targets (from Electricity Sector Strategy Note for South Sudan, 2013).

Table 1: South Sudan Electricity Demand Projections, 2013 - 2017

Targets	***2013***	***2014***	***2015***	***2016***	***2017***
Number of Customers (Thousands)	22	31	41	48	55
Growth Rate (%)		30%	23%	15%	15%
Peak Load (MW)	22	27	36	76	96
Energy Sales (GWh)	70	101	136	160	186

Source: The World Bank (Data from SSEC and the South Sudan Development Plan)

20. At present, the demand including a substantial amount of suppressed demand as well as the projected future demand cannot be met through the existing power generation and distribution system in Juba. As such, the near term supply prospect for power supply in the Juba distribution area is based on the 40-MW hydropower plant at Fula Rapids. As an emergency measure to rehabilitate the existing network and to absorb the possible supply from the Fula Rapids power, immediate investment is required. This report provides a recommendation of the technical equipment and the size and scale of the infrastructure needed to boost the Juba distribution network.

21. Based on the analysis conducted and discussions with stakeholder on the requirements, it has been found that the main technical investment required would be: two 33/11 kV substations of capacity 2x10/14 MVA each. It is also necessary to take immediate action to replace faulty equipment along with the installation of source lines, feeder lines, distribution transformers, capacitor banks, service cables, meters etc. This should be supplemented by operation and maintenance contracts, as well as training on system administration for SSEC and MoEDIWR staff. There is also a complementary need for commercial loss reduction and improvements in efficiency of the system, including introduction of a new pre-paid meters with supporting systems and procedures. These elements will be further investigated and designed under an upcoming World Bank funded Energy Sector Technical Assistance Project (ESTAP).

Formulation of Technical Standards and Constitution for Grid Code Development

22. As an electrical utility of a new nation, SSEC, as yet, does not have standards, specification, design and drawing to provide quality electricity to consumers. During installation, the supervisor of SSEC will ensure quality and standard of the materials and equipment. Employees of SSEC should be well trained to do so. Technical standards and specifications of distribution system components are of utmost need for this type of organization.

23. In a power system, the Grid Code is an important document that establishes procedures for operations of facilities that will be used in the power system. It lays down both the information requirements and the procedures governing the relationship between the relevant

entities. It is recommended that the development of a Grid Code be further investigated in the ESTAP.

Key Findings and Recommendation

24. By assessing the requirement of Juba's electrical distribution system, it was found that the establishment of a long-term LCIP (power sector master plan) is critical. In addition, the improvement of the power generation, the development of technical and commercial loss reduction practices, human resource, grid code, training manuals, and operation and maintenance manuals, etc. are the requirements for efficient planning, installation, operation, and maintenance of electricity distribution grid. The capacity development of SSEC as a good distribution entity is very important to meet current market demand and future expansion of distribution system. Following key technical measures in the short term are recommended:

- ➔ Retaining an Engineering, Procurement, and Construction (EPC) contractor of distribution system in Juba for procurement of the 33/11 kV power distribution substation, 33kV source line, 11kV, 11/0.4kV, 0.4kV feeder line and installation of service cable and consumer's meter through EPC contractor. At present, SSEC is not in the position to prepare engineering design, specification, estimate, procurement plan, and construction of such a system.

- ➔ Training and Development of Human Resource: Human Resource development for smooth operation and maintenance of distribution system. Professionalism for the system and commercial operation in SSEC has not been developed yet. As such, in Juba, there is an enormous scarcity of skilled human capital to operate and maintain a quality electrical distribution system. Many generating stations from past projects of SSEC in Juba are now out of order due to lack of maintenance and other issues. Thus, a human resource development plan should be implemented during distribution grid development project. As an electrical utility of a new nation, SSEC, as yet, does not have a technical standard design and specification.

- ➔ Consultancy support to prepare an organogram, grid code, distribution code, tariff rule, etc. for electricity generation, transmission, and distribution is required. Procurement of tools and equipment for power system operation and maintenance and software to project management, GIS and System analysis is also required.

25. To achieve a base electrical distribution system to meet the preliminary demand of Juba's electricity market (Table 2). The total estimated cost of proposed project would be USD50.32 million (detail in Table A1, Annex A).

Table 2: Year-wise breakup of estimated price of the project

[US$]

Item Description		*Year-1*	*Year-2*	*Year-3*
A. Engineering Procurement and Construction				
	Yearly total	4,306,550	19,004,750	23,944,200
Sub- Total				47,255,500
B. Training and Development of Human Resource				
	Yearly total	545,480	1,029,980	1,005,540
Sub- Total				2,581,000
C. Consultancy and Expert Service				
	Yearly total	136,000	184,500	159,500
Sub- Total				480,000
Overall Yearly Total		**4,988,030**	**20,219,230**	**25,109,240**
Grand Total				**50,316,500**

Expected Outcomes

26. Should the recommendations be implemented, the SSEC's distribution capacity will increase to 56MVA which could serve about 25 thousand consumers of Juba with 150km of 11kV, 11/0.4kV, 0.4kV overhead feeder line from 2 units 2x10/14MVA substations with 20 km double circuit 33kV Source line. In addition, under the scope of proposal, SSEC would also procure certain management tools such as, billing software, project management software, GIS software, and system analysis software for efficiency improvement. Training on relevant topics for development of human resources of MoEDIWR and SSEC should also be incorporated. Furthermore, efficient organogram, grid code, distribution code, tariff rule, training module, and operation and maintenance manuals of the power system should be developed.

Section 1 Annex A: Proposed Juba Grid Development Plan

Table A1 shows the detail of a possible approach for an investment project to meet the emergency needs of Juba's distribution network.

Table A1: Year-wise breakup of estimated price of the proposed project

Sl. No	Item description		Unit required	Total cost (in USD)	Year-1		Year-2		Year-3	
					% of Work Completed	Cost (in USD	% of Work Completed	Cost (in USD)	% of Work Completed	Cost (in USD)
A. Engineering Procurement and Construction										
1	Design, Supply & Installation and Commissioning of 02 (Two) no's 33/11KV (New) Sub-Stations on turnkey basis.		2 no's 2x10/14 MVA Sub-station	6,500,000	20	1,300,000	50	3,250,000	30	1,950,000
2	Design, Supply & Installation and Commissioning of 33 kV source line for newly constructed 33/11 kV Substation from 132/33 kV grid Substation		20 KM Overhead	1,500,000	20	300,000	50	750,000	30	450,000
3	Design, Supply & Installation and Commissioning of 11 kV, 11/0.4 kV and 0.4kV feeder lines to evacuate power from 33/11 kV Substations		150 KM Overhead	6,000,000	10	600,000	50	3,000,000	40	2,400,000
4	Construction of office buildings in different location.		LS	3,000,000	20	600,000	30	900,000	50	1,500,000
5	Pole mounted distribution transformers 200 KVA with transformer equipment.		500 Units	6,500,000	0	0	20	1,300,000	80	5,200,000
6	Service Cable and Accessories	Self-Supported Duplex 2x4mmsq	500 km	2,500,000	0	0.00	20	500,000	80	2,000,000
		Self-Supported Duplex 2x6mmsw	200 km	1,500,000	0	0.00	20	300,000	80	1,200,000
		Quadruplex Cable 4x10mmsq	10 km	200,000	0	0.00	20	40,000.00	80	160,000

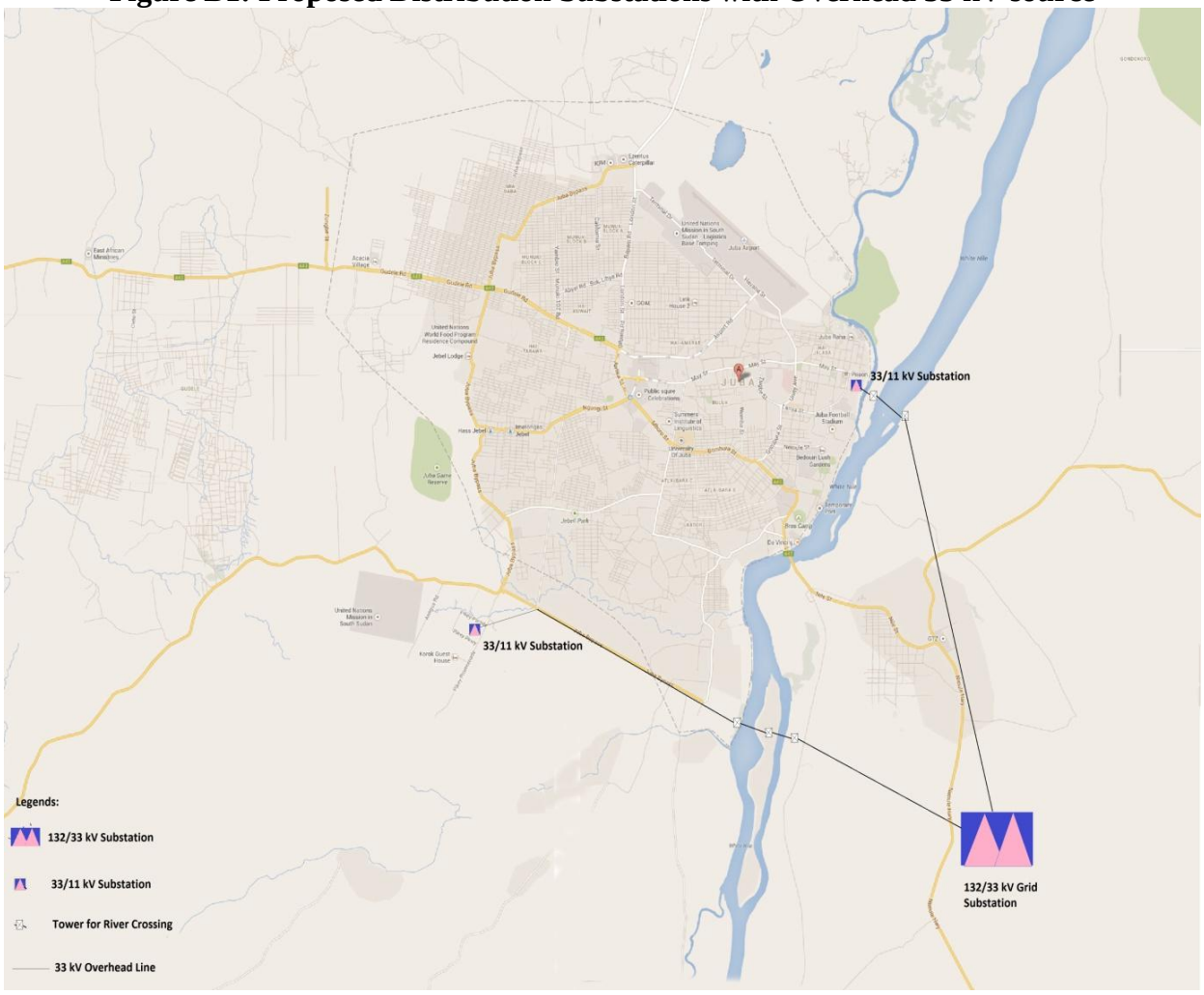
		Quardruplex Cable 4x16mmsq	5 km	125,000	0	0.00	20	25,000	80	100,000
		Quardruplex Cables 4x25mmsq	3 km	120,000	0	0.00	20	24,000	80	96,000
	Prepaid Energy Meters	1-Phase Whole Current	25,000 Units	2,400,000	0	0.00	20	480,000	80	1,920,000
		3- phase whole current	300 Units	45,000	0	0.00	20	9,000	80	36,000
		3- phase LTCT	100 Units	20,000	0	0.00	20	4,000	80	16,000
7	Tools and Equipment for Substations, line and equipment		1 Lot	125,000	10	12,500	50	62,500	40	50,000
8	Appointment of distribution line maintenance Gang for maintenance activity of 11/0.4/0.23 line.		1 Lot	500,000	0	0.00	50	250,000	50	250,000
9	Appointment of 33/11KV Substation maintenance Gang for maintenance activity of 33/11KV Sub stations		1 Lot	500,000	0	0.00	50	250,000	50	250,000
10	Appointment of distribution line trouble shooting Gang for emergency solution of consumer complains.		1 Lot	1,000,000	0	0.00	50	500,000	50	500,000
11	Preparation of Operation manuals for various works perform for quality electricity supply		1 Lot	55,000	50	27,500	50	27,500	0	0.00
12	Other Cost For Transportation, Human Resource, Vehicle, Office, Furniture, and VAT, CD etc.		45% of Total Cost	14,665,500	10	1,466,550	50	7,332,750	40	5,866,200
				Yearly total		4,306,550		19,004,750		23,944,200
	Sub- Total									**47,255,500**

B. Training and Development of Human Resource									
13	Development of Organogram	1 Lot	40,000	100	40,000	0	0.00	0	0.00
14	Development of training modules	25 Topics	10,000	40	4,000	30	3,000	30	3,000
15	Training	150 Man- Months	2,250,000	20	450,000	40	900,000	40	900,000
16	Procurement of software and supportive staff (Project management, GIS and system analysis)	3 Lots	150,000	33	49,500	0	0.00	67	100,500
17	Development of dynamic website and billing software including required hardware	1 Lot	125,000	0	0.00	100	125,000	0	0.00
18	Relevant services	As required	6,000	33	1,980	33	1,980	34	2,040
			Yearly total		545,480		1,029,980		1,005,540
	Sub- Total								**2,581,000**
C. Consultancy and Expert Service									
19	Distribution System Expert	36 man months	170,000	33	56,100	33	56,100	34	57,800
20	Engineer (Electrical/ Mechanical)	48 man months	130,000	25	32,500	50	65,000	25	32,500
21	CAD operator	18 Man-months	20,000	25	5,000	25	5,000	50	10,000
22	Vehicle	60 vehicle-months	80,000	20	16,000	40	32,000	40	32,000
23	Support	As required	80,000	33	26,400	33	26,400.00	34	27,200
			Yearly total		136,000		184,500		159,500
	Sub- Total								**480,000**
	Overall Yearly Total				**4,988,030**		**20,219,230**		**25,109,240**
	Grand Total								**50,316,500**

Section 1 Annex B: Location of Juba Distribution Substations

27. Figure below shows a map of the proposed two distribution substations with overhead 33kV source. The 33kV sub-transmission line for the source of 33/11kV substations need to cross the White Nile river twice, which may be problematic. A river crossed sub-transmission line has been proposed. It needs to be further investigated during engineering part of the EPC by using tower mounted overhead lines.

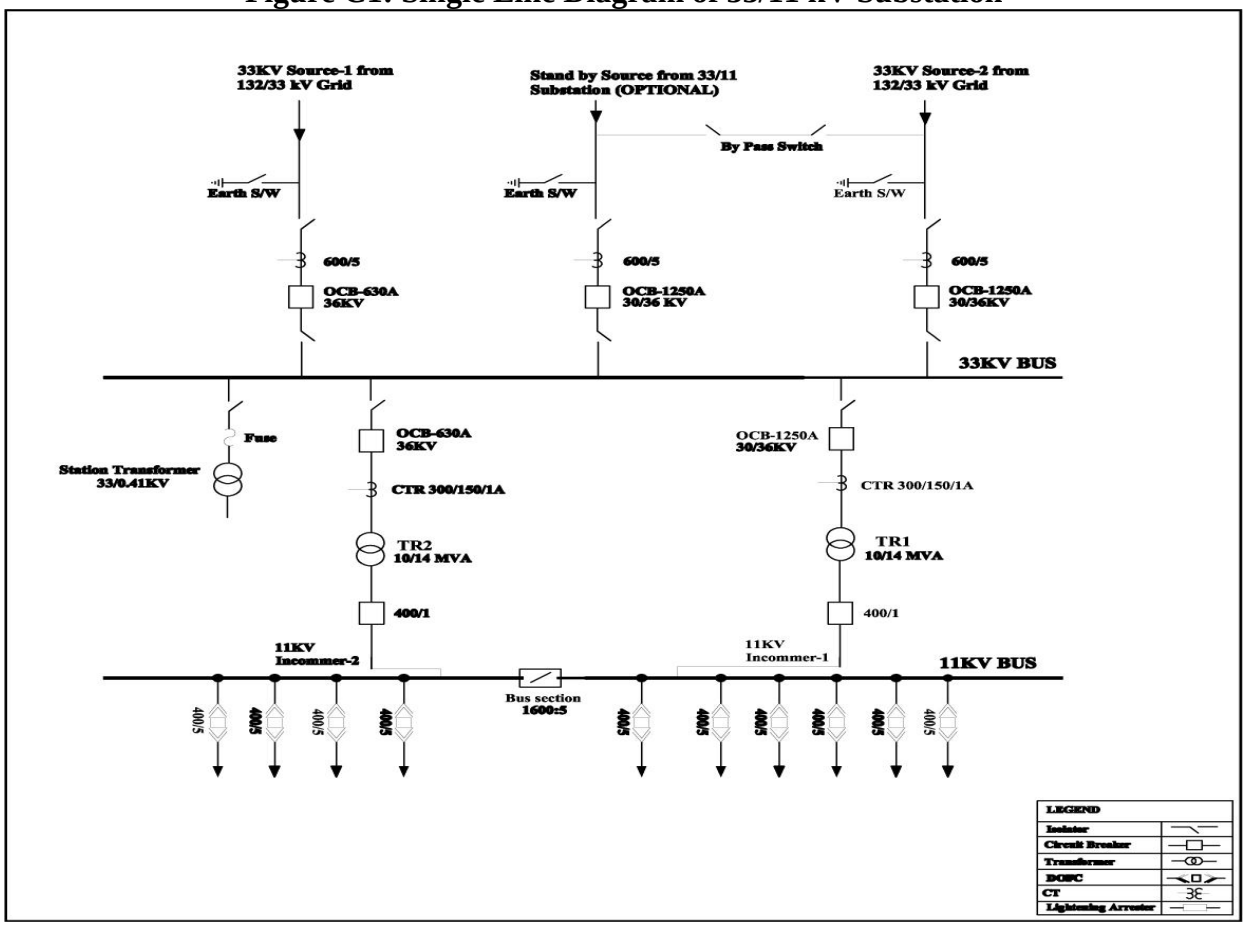
Figure B1: Proposed Distribution Substations with Overhead 33 kV source



Section 1 Annex C: Single Line Diagram of Juba Substation

28. To distribute electricity to the consumers of Juba, 33kV will require to be stepped down to a distribution voltage level of 11kV. At the same time, an 11kV feeder needs to be constructed around the city. The proposed 33/11kV substation may be designed as shown with the single line diagram in Figure below.

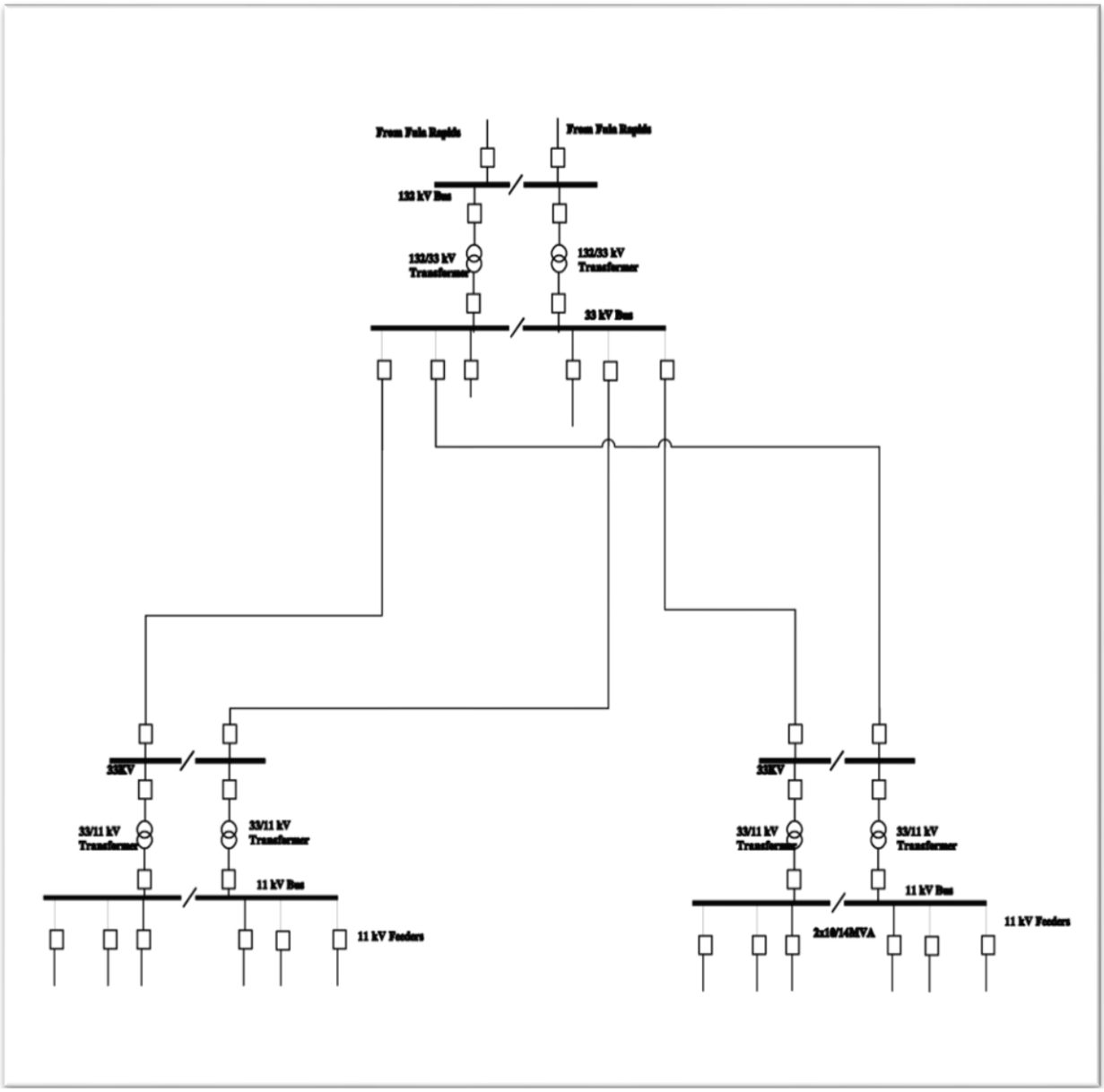
Figure C1: Single Line Diagram of 33/11 kV Substation



Section 1 Annex D: Single Line Diagram of Juba Network

Figure D1 shows a single line diagram of proposed distribution network from 132kV to 11kV.

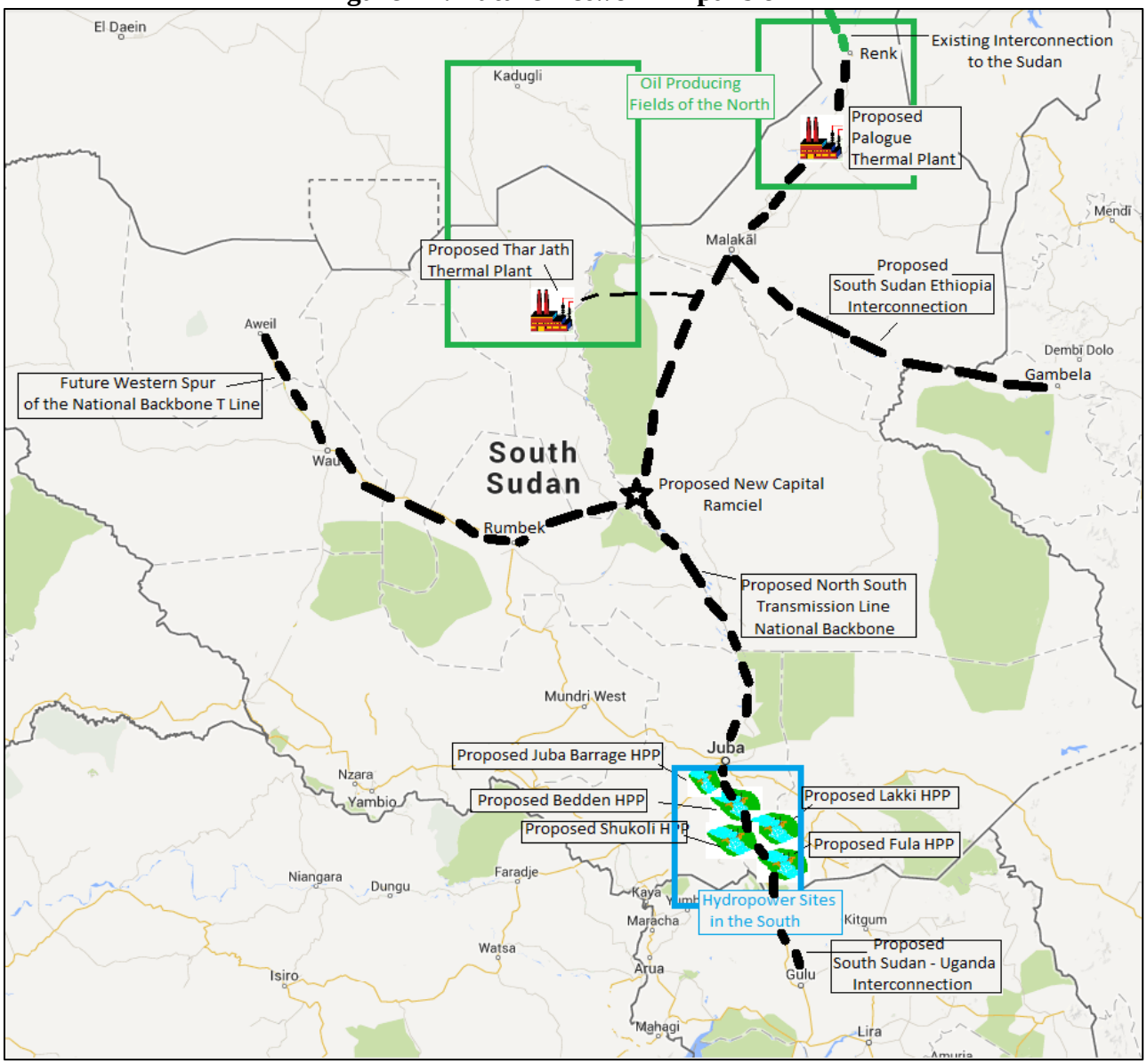
Figure D1: Single Line Diagram of Network



Section 1 Annex E: Possible Future Expansion of National Grid Network

Figure E1 shows the possible extensions and interconnections of South Sudan's network.

Figure E1: Future Network Expansion



Section 2: Capacity Building Needs Assessment

Objective

29. This section of the report aims to provide a gap analysis of energy sector's capacity in South Sudan in order to increase the overall performance of the sector. The World Bank, in collaboration with the GRSS developed an ESSN in April 2013 to provide a broad-level discussion of key issues in energy sector, comprehensive analysis of development challenges, and a structure for strategic interventions for sector-wide growth. The note identified capacity building as a high priority area.

30. The need for capacity-building in the electricity sector is a pre-requisite for efficient addition of generation capacity, development of transmission and distribution networks, and improvements in customer service.

Background

31. The South Sudan Development Plan (SSDP) describes four pillars of the Government's growth agenda; energy sector related targets are outlined in the economic development pillar. The objective of this pillar is to achieve diversified private sector led economic growth. The target calls for an extremely ambitious investment program of US$0.7 billion for the electricity sector as a key driver of growth in South Sudan. None or very little of the ambitious target has been achieved due to lack of funds and lack of capacity to implement the programs.

32. The MoEDIWR and the SSEC have requested funds from developing partners for the following activities: for rehabilitation of existing but outdated power plants, for distribution lines in Juba, for the development of Fula Rapids Hydro Power Project with an installed capacity of 40 MW. In addition, MoEDIWR is also seeking assistance with the Export-Import Bank of China for the extension of power lines from Ethiopia to the eastern region of South Sudan, as well as long-term plans to construct a dam south of Juba. MoEDIWR has also held discussions with partners in India about building a 150-300 MW power plant in Wau.

33. The MoEDIWR is responsible for overall sector policy and strategy and will also be involved at a hands-on level for major projects in transmission (anything above 33kV) and other large hydropower and regional integration projects. SSEC is deemed to be an autonomous national utility acting as a public sector undertaking (PSU) – which is yet to be defined clearly under prevailing law. At the moment, it functions as a unit of the MoEDIWR with all its expenditures and revenues being rolled up into the Ministerial budget. SSEC will be involved in electricity generation, transmission and distribution, and access related projects in South Sudan along with its current role of operations and maintenance.

34. The proposed Electricity Bill identifies and clarifies the roles and responsibilities of the work institutions and will provide guidance on how to regulate the generation, transmission, bulk supply, distribution, supply, export and import of electricity, and system operations within the territory of South Sudan. The current organization of the sector institutions is presented below.

Figure 1: Current Organizational Structure of MOEDIWR

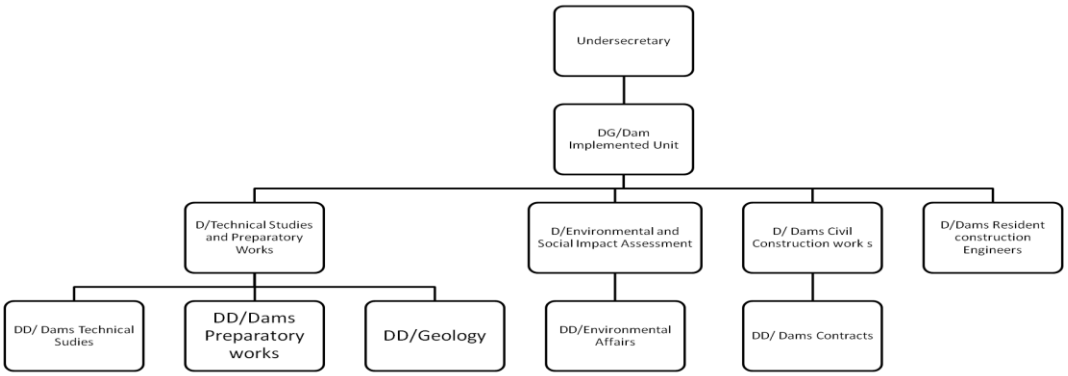
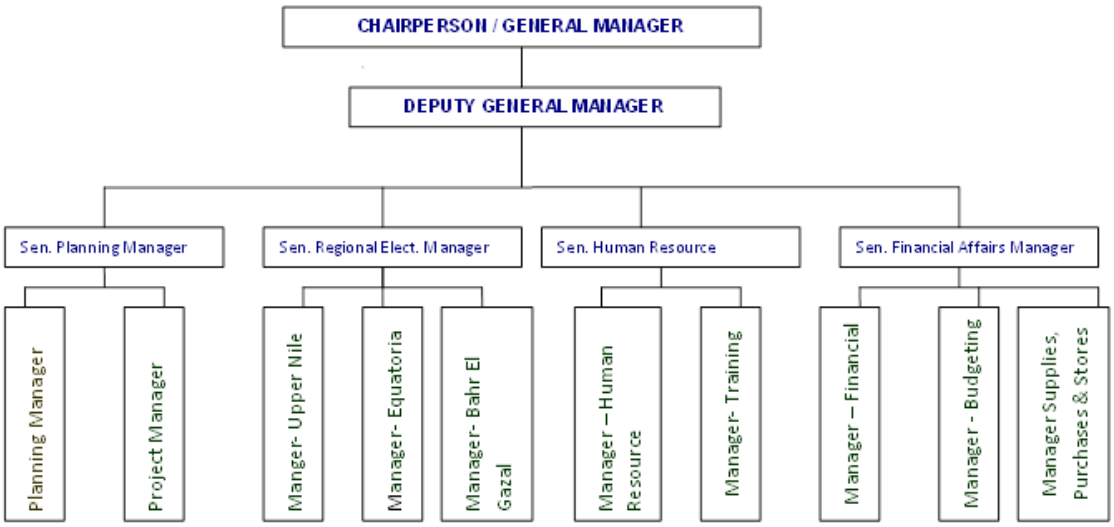


Table 1: 2011 Summary of Organization Structure of MOEDIWR

S/N	Unit	Total
1.	Minister Office	10
2.	D/Minister Office	8
3.	Undersecretary Office	6
4.	Finance & Administration	51
5.	Planning & Projects	75
6.	Engineering & Operation	113
7.	Dams Implementation Unit (DIU)	73
	Grand Total	336

Figure 2: Current Organizational structure of SSEC



Assessment Approach

35. The assessment was carried out over several missions during January and February 2013, to carry out an assessment of capacity-building needs of the South Sudan Electricity Sector. The mission met with key officials in the relevant government agencies – the Ministry of Finance, Commerce, Industry, and Economic Planning (MoFCIEP), MoEDIWR, SSEC as well as stakeholders from the private sector, the University of Juba, and development partners.

36. A survey questionnaire was developed and sent to MoEDIWR, SSEC, and other relevant organizations to assess the needs of capacity building in South Sudan's electricity sector. The questionnaire provided for both quantitative and qualitative responses. The survey included three main groups involved in the sector: (i) MoEDIWR, (ii) SSEC, and (iii) off-grid utilities, such as Kapoeta Electric Company limited (KAPECO) and Maridi Electric Company Ltd. (MECO). In addition, faculty members from the University of Juba were included in the survey considering their likely involvement in providing local training. The questionnaire attempted to capture an understanding of the operation and potential of the human resource management by addressing strategy and organization, training of the staff and officials at home and abroad and availability of training facilities. The questionnaire asks the respondents to identify their priorities and to suggest the resources required.

Identified Priority Areas for Capacity Building

37. Based on the findings of the survey, high priority areas were identified as: improved sector planning (generation and transmission), along with regulatory issues, distribution management, and human resource development. A large percentage of the respondents gave the highest priority on establishment and implementation of modern transmission systems followed by other areas such as operation and maintenance of generation facilities, expansion of transmission and planning process of regional interconnections, and establishment of grid network.

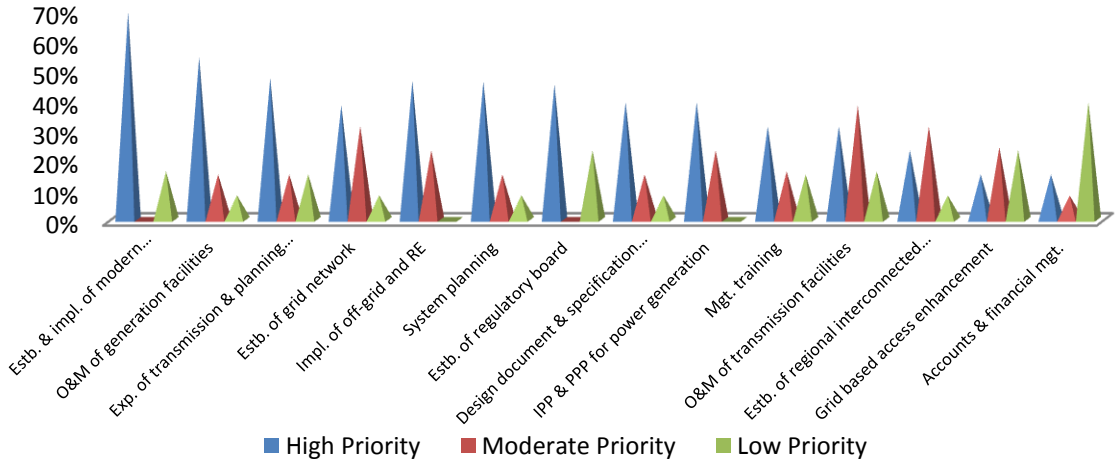
Table 2: Common Priority Areas for Capacity Building

Sl. No.	Future Capacity Building Areas	Percentage of Respondents	High Priority (%)	Moderate Priority (%)	Low Priority (%)	Priority
1	Establishment and implementation of modern transmission system	85	69	0	16	High
2	Operation and maintenance of generation facilities	77	54	15	8	High
3	Expansion of transmission and planning process of regional interconnections	77	47	15	15	High
4	Establishment of grid network	77	38	31	8	High
5	Implementation of off-grid and renewable energy	69	46	23	0	High
6	System planning	69	46	15	8	High
7	Establishment of regulatory board	69	46	0	23	High

8	Design document and specification preparation	62	39	15	8	High
9	IPP and PPP for power generation	62	39	23	0	High
10	Management training	62	31	16	15	High
11	Operation and maintenance of transmission facilities	85	31	38	16	Moderate
12	Establishment of regional interconnected distribution network	62	23	31	8	Moderate
13	Grid based access enhancement	62	15	24	23	Moderate
14	Accounts and financial management	62	15	8	39	Low

Source: Questionnaire Survey from MOEDIWR, SSEC, Off-grid utilities, and University of Juba

Figure 3: Common Priority Areas for Capacity Building



Source: Questionnaire Survey from MOEDIWR, SSEC, Off-grid utilities, and University of Juba

38. Institutional priority areas for future capacity building identified by MoEDIWR, SSEC, off-grid Utilities, and University of Juba are mentioned below (The chart of each institute is shown in Section 2, Annex A). The survey data show that MoEDIWR, SSEC, off-grid utilities, and University of Juba respondents have some similarities in terms of high, moderate and low priority areas for future capacity building, while each places its priority in unique areas.

39. While MoEDIWR perceives overall electricity sector planning, transmission and distribution of electricity, and generation capacity to be the highest priorities for future capacity building, SSEC places highest priority on the operation of generation and transmission facilities and their expansion and modernization according to the findings of the questionnaire. According to the findings of the questionnaire, off-grid utilities place highest priority on establishment and implementation of modern transmission system, along with other areas such as the overall implementation of renewable energy systems and the establishment of procurement design and process, while the University of Juba placed highest priority on electricity sector policy for capacity building plans.

Key Challenges Facing the Sector

40. Along with the above capacity development priority areas, some of the major institutional weaknesses of South Sudan electricity sector were observed through the survey.

41. The Southern Sudan National Electric Sector Policy (NESP) has been developed by the Ministry of Housing, Lands, and Public utilities (MHLPU) and was approved by the Council of Ministers on May 9, 2007, before the independence of the Republic of South Sudan. Its objectives are to define effective electric sector institutional relationships, to establish a new regulatory authority to balance the interests of the consumers and electricity service providers, and to define funding mechanisms to finance electric investments by the Government of Southern Sudan. Although the policy has been passed, it has not realized its objective, waiting for the draft electricity bill to be enacted. There is also a lack of clarity on roles and responsibilities of various agencies in the electricity sector of the country.

42. Currently, there is no electricity sector master plan for South Sudan and the absence of master plan can inhibit long-term, strategic decision-making as well as impede the expansion of least cost power system.

43. The electricity sector suffers from a massive capacity gap like many other sectors. In South Sudan, the MoEDIWR is responsible for overall sector policy and strategy. On the other hand, the SSEC is treated as an autonomous national utility acting as a public sector undertaking (PSU) and reports directly to the minister. However, the overall capacity of all the sector institutions is severely lacking.

44. Since SSEC maintains single-entry bookkeeping system like most of the state owned organizations, they are unable to produce final accounts such as Income Statement, Cash Flow Statement and Balance Sheet. Unlike many other electricity sector companies, SSEC does not report net profit or net loss. Preparation of a comprehensive financial statement and effective financial management is also crucial for the SSEC towards corporatization.

45. There is no particular training center or training school in South Sudan where the electricity sector officials and technicians can be trained regularly on effective and efficient operation and management of the electricity sector facilities. Further, inadequate supply of goods and equipment for the trainees and the trainers hinder the opportunity to create competent pool of electricity sector personnel.

46. Many of the officials of various South Sudan Electricity Sector agencies lack proper theoretical and practical field training, including on-job, and on-site training. The majority of them have not attended any seminars, workshops, or other types of training programs related to electricity generation and operation of facilities such as: online training, simulator training, or management training either in South Sudan or abroad.

Proposed Capacity Building Strategy

47. The following summarizes the capacity building strategies recommended to remedy the weaknesses identified during the assessment of the South Sudan electricity sector, using common as well as institutional priority areas, which were identified by the sector's organizations through the questionnaire survey, as its guiding principle:

48. Consulting services, training, and other capacity building measures together with the necessary tools and equipment should be provided to:

- ➔ To build overall institutional capacity of the electricity sector at government, organization and institutional, service, and individual level.
- ➔ Create effective capacity within government, particularly Ministry of Electricity and Dams (MoEDIWR), to put in place electricity sector policies, electricity sector planning, and regulation strategy needed for the development of South Sudan electricity sector.
- ➔ Strengthen the management of South Sudan Electricity Corporation (SSEC) to manage and to operate the sector efficiently.
- ➔ Strengthen the management of off-grid utilities (as they develop) to manage and to operate the decentralized and off-grid electricity system.
- ➔ Create the competent personnel within the electricity sector related entities.
- ➔ Improve the internal financial controls within the entities of the electricity sector.

49. The following major strategies for electricity sector are recommended:

- ➔ *Better coordination among institutions between MoEDIWR and SSEC:*
  Under the current laws of South Sudan, the roles of these institutions are not clearly defined and there are no coordination mechanisms in place. This issue needs to be more carefully examined, looking at the coordination between institutions involved in policy making and operation. Electricity sectors in neighboring countries such as Sudan, Ethiopia and Uganda should be studied as well.

- ➔ *Establishment of a the Project Management Unit (PMU):*
  Project Implementation Units are dedicated management units designed to support the implementation and administration of investment projects or programs. PMU should be made up of representatives from SSEC and MoEDIWR.

- ➔ *Electricity sector policy:*
  The focus should be on creation of adequate legal framework, preparation of power sector master plan, and other policy related issues.
  (i) Preparation of adequate legal framework: A comprehensive and complete legal framework needs to be prepared focusing on public policy goals, drafting of legislation, contract and legal agreement for projects, increasing generation capacity etc. Enactment of the draft electricity bill through a consultative process involving key stakeholder needs to be accelerated. Additionally, the roles of various agencies in the electricity sector have to be clearly defined.
  (ii) Preparation of electricity LCIP or sector master plan: An electricity sector master plan / least cost investment plan needs to be developed for South Sudan.

➔ *Electricity generation from sustainable sources*
The country has high prospects of generating electricity from renewable and sustainable sources such as solar energy, biomass, wind power, geothermal energy, hydropower, and biogas. The cost of electricity generation as well as transmission will be minimized if sufficient amount of electricity can be produced from these renewable sources.

Human Resource Strengthening

50. Support should be provided to SSEC to improve its overall financial and managerial efficiency. Development of SSEC as a corporate structure should include the following.

- ➔ Prepare documents such as: business models, organizational structure, etc., highlighting the policy, regulatory and company level actions necessary to underpin the successful turnaround of the companies.
- ➔ Develop the actions necessary to revitalize the human resource base. An HR expert can be used to better define such roles of different staff levels.
- ➔ Design specific corporate and management structure and define competencies to improve the efficiency, accountability and customer orientation of the company.
- ➔ Secure the management expertise needed to improve enterprise performance under suitable terms and conditions).
- ➔ Restructure the financial reporting system to improve the internal control and public accountability arrangement.

Training and Other Capacity Building Needs

51. Areas of training should include planning and design of infrastructure projects, project implementation, procurement management, financial management, management tools and systems, and environmental and social impact mitigation, etc. Establishment of training infrastructure should be given the utmost importance.

- ➔ *Training infrastructure:* This facility will require a building, fixtures and fittings, equipment, computers (including software), air-conditioners, photocopiers, projectors and screens, consumables etc.

- ➔ *Training of trainers (TOT)*: Training of trainers should be provided to help the development of necessary training programs, operation manuals, and guidelines. A list of important training centers in the region and the relevant courses offered by these institutions are attached in Annex B. Seminars, workshops or other type of training such as online training, simulator training or management training should be arranged for the trainers. Trainers trained abroad will provide in-house training for utility officials based on the training manuals and materials provided in the TOT courses.

- ➔ *Training of power sector officials and technicians*: Training should be provided to the power sector officials and technicians taking into account other on-going training programs. Seminars, workshops, and other type of training such as online training, simulator training or management training could be arranged.

- ➔ *Distribution network training*: This can be divided into two parts: (i) management level training and (ii) field level training. Arrangement of management level training can be undertaken by both MoEDIWR and SSEC and would deal with topics like Utility management, which should include methods of energy procurement; energy management, such as efficient metering and consumption data; account management etc. The other topics would include reduction of system loss, calculation of account receivable, disconnection procedures, and complaint attendance. Field level training would deal with topics like substation maintenance, which should include how to properly take care of substations to ensure proper functioning and avoid unnecessary deterioration, dealing with faults that might arise, creating inspection schedules, etc. The other topics would include distribution line maintenance, trouble shooting, meter installation and maintenance, meter testing, cable jointing, and fault finding of cables.

- ➔ *Renewable energy*: The objective of the training on renewable energy/off-grid solution would be to promote a proactive attitude by creating awareness and building capacity among the stakeholders of the electricity sector to understand the importance of renewable energy and other off-grid solutions as a tool to achieve sustainability. The components of the training program should include overview of renewable energy planning and environmental management; project identification and formulation; economic evaluation of projects; environmental impact assessment; project monitoring and evaluation; dissemination strategies; and rural energy policy issues.

- ➔ *Procurement*: The objective of procurement training should be to assist MoEDIWR and SSEC staffs to increase their efficiency and cost-effectiveness in the procurement of work contracts funded by different financing institutions (such as the World Bank). The training should include: procurement and tendering product description; procurement resources; market condition; solicitation planning process of preparing; documents needed to support solicitation such as request for quotation, request for proposal; evaluation criteria; solicitation – the process of obtaining information (bids and proposals); source selection; and contract administration / award / closeout.

- ➔ *Others*: In addition to the above, one of the major problems of implementing a capacity building program is the availability of relevant electricity statistics. Thus, electricity data collection and reporting support/training should be provided to the appropriate staff members to ensure proper recording of data.

- ➔ *Customized training*: Training specifically designed for electricity distribution, renewable energy/off-grid solutions and procurement should be provided to the relevant staff members. The trainings can be provided through consultancy support, on the job training, regional training, study tours, twining arrangements, seminaries etc. depending on the specific requirements and availability of resources.

Resources for Capacity Building Support

52. Capacity building needs assessment indicates need for following types of support:

- ➔ Consultancy support for creating a legal and regulatory framework, prepare an electricity system master plan, corporatization of SSEC covering both human resource and financial management, and a renewable energy and energy efficiency plan;

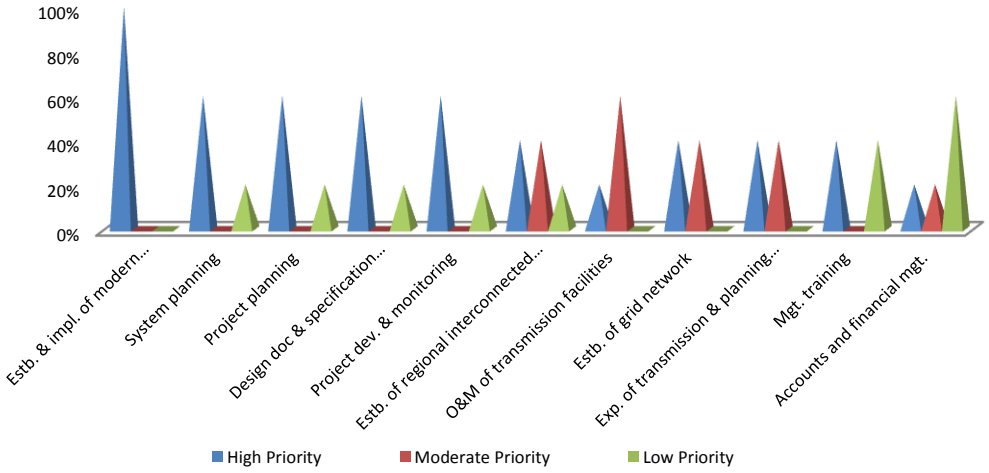
- ➔ Training support for training of trainers, officials and technicians of the electricity sector both at home and regional training centers, study tours, seminars for management level officials; and

- ➔ Tools and related equipment for creating in-house training facilities for MoEDIWR and SSEC. This should also include appropriate resources for management information systems, information and communication technology tools, as necessary.

A sample medium term plan of activities, year wise phasing of budget, and item wise expenditure list have been presented in Section 2, Annex C, D, and E. Annex F presents the suggested training modules based on the needs identified. If the capacity development plan proposed in this report is implemented properly, significant capacity in the electricity sector will be created to achieve the sector goals and objectives.

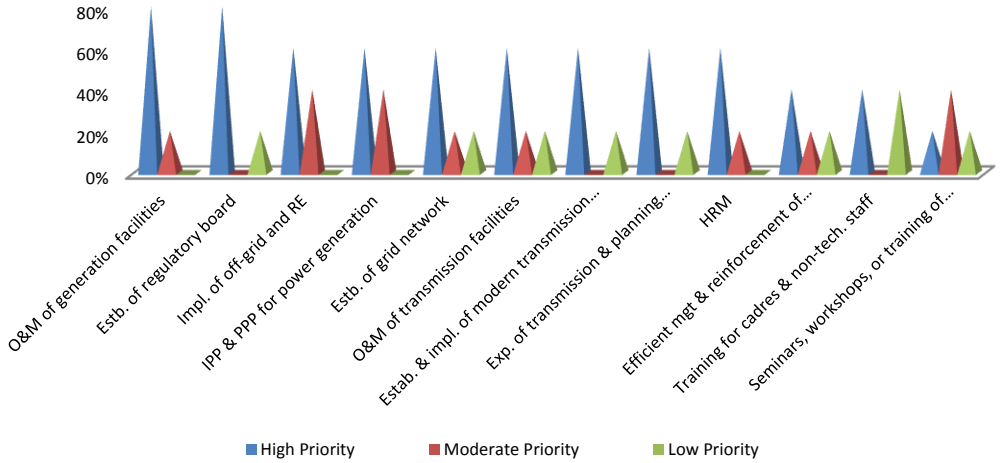
Section 2 Annex A: Priority of Issues by Institute

Figure A1: Priority Chart of MOEDIWR



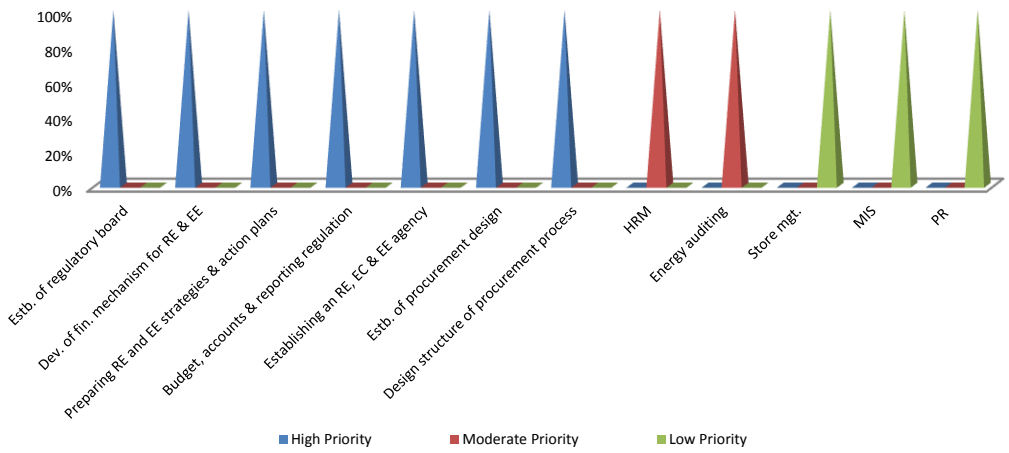
Source: Questionnaire Survey of MOEDIWR

Figure A2: Priority Chart of SSEC



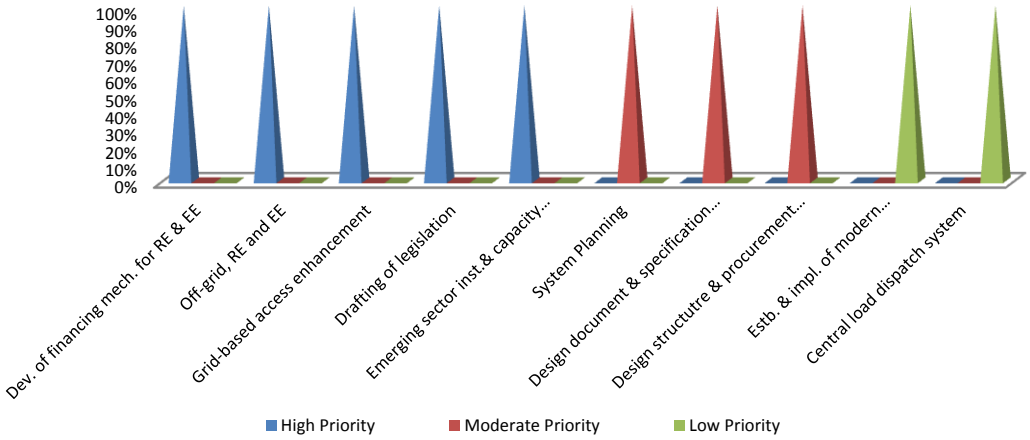
Source: Questionnaire Survey of SSEC

Figure A3: Priority Chart of Off-grid Utilities



Source: Questionnaire Survey of Off-grid utilities

Figure A4: Priority Chart of University of Juba



Source: Questionnaire Survey of Off-grid utilities

Section 2 Annex B: List of Possible Training Institutions and Courses

53. Training can be provided in regional centers, as appropriate. The need for training facilities with necessary equipment and supplies is essential for conducting training programs and is imperative to the capacity building plan. This will help development of necessary frameworks, operation manuals and guidelines. A list of important training centers in the region and of relevant important training courses offered by these institutions is highlighted below.

Eastern and Southern African Management Institute (ESAMI)

Public/Private Sector Partnership in Infrastructure Projects
Goods and Equipment Procurement Program
Government Contracting
Advanced Works Procurement and Selection of Consultants
Rural Energy Planning
Environmental Impact Assessment of Projects

Uganda Management Institute (UMI)

Managing the Tendering Process
Public Procurement and Contract Management

Talent Training and Consultancy, Egypt

Process Troubleshooting & Problem Solving and Effective Decision Making
Troubleshooting Of Electrical Equipment and Control Systems
Power Plant Start-Up, Commissioning and Troubleshooting
Electrical Maintenance, Testing, Inspection and Risk Assessment
Power Generation Operation and Control
LV/MV/HV Circuit Breakers (Switchgear): Inspection, Maintenance, Design, Repair and Troubleshooting and Power Distribution
Power Plant Troubleshooting and Engineering Problem-Solving
Power Generation: Gas Turbines, Steam power plants, co-generation and combined cycle plants - Selection, Applications, Operation, Maintenance, And Troubleshooting
Electrical Generators: Selection, Applications, Operation, Protective Systems, Diagnostic Testing and Maintenance
Motors and Variable Speed Drives: Selection, Applications, Operation, Diagnostic Testing, Protection, Control, Troubleshooting &Maintenance
Maintaining and Troubleshooting Electrical Equipment
Reactive Power Management and Power Factor Correction
Troubleshooting, Maintenance and Protection of AC Electrical Motors And Drives
Practical Variable Speed Drives (VSD's) For Instrumentation and Control Systems
Electrical Drawing and Interlocking Circuit
Power Optimization of Energy Management System In Modern Power Generation Industry
Advanced Lighting Design and Application
National Electrical Codes (NEC)
Electrical Equipment (Basic Electricity): Transformers. Inverters, rectifiers, uninterruptable power systems, generators, circuit breakers and fuses: Selection, Applications, Operation, Diagnostic Testing, Troubleshooting, & Maintenance
Basic Electrical and Instrumentation
Electrical Engineering for Non- Electrical Engineers
Oil and Gas Management Courses

Section 2 Annex C: Sample Timeframe of Activities

Activities	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5
Consultancy					
Prepare an electricity sector master plan					
Corporatization of SSEC					
Development of a RE and EE plan					
Development of HR plan					
Accounting firm/software					
PMU consultant					
Training activities					
Seminars, workshops, training of officials abroad					
Seminars, workshops, training of officials in the country					
Establishment of training center					
Staffing of training center					
Goods and equipment for training center					
Training for cadres and non-technical staff					
Study tours and staff exchanges					
Goods and equipment					
Computers and associated hardware					
Training equipment					
Furniture and fixtures					
Consumables					
Transport for PMU					

Section 2 Annex D: Yearly Phasing of Budget

	Project Component	Total (US$ M)	Phasing (US$ M)					% of Total
			Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	
A.	**Technical Assistance**							
A.1	**MOEDIWR**							
1	Electricity Sector Master Plan	**1.2**	0.3	0.9	0	0	0	24.5 %
2	Organizational Restructuring	**0.3**	0.3	0	0	0	0	6.1%
3	Training and Other Capacity Building Measures	**0.5**	0.1	0.1	0.1	0.1	0.1	10.2 %
A.2	**SSEC**							
1	Improvements in Financial Reporting (including software and hardware)	**0.9**	0.5	0.2	0.2	0	0	18.4 %
2	Organizational Restructuring	**0.6**	0.4	0.2	0	0	0	12.2 %
3	Development of RE and EE plan	**0.3**	0.15	0.15	0	0	0	6.1%
4	Training and Other Capacity Building Measures	**1.1**	0.2	0.3	0.3	0.2	0.1	22.5 %
B.	**Total Project Cost**	**4.9**	**1.95**	**1.85**	**0.60**	**0.30**	**0.20**	**100%**

Section 2 Annex E: Item Wise Expenditure (Estimated Costs)

	Expenditure Category	Total cost (USD million)
1	**Consultants' Remuneration**	
1.1	Organizational restructuring (including HR expert's remuneration)	0.9
1.2	Electricity Sector Master Plan	1.2
1.3	Improvement in financial reporting (including account expert's remuneration)	0.9
1.4	Development of RE and EE plans	0.3
	Sub total	**3.3**
2	**Training Expense**	
2.1	IDA Procurement Procedure (abroad)	0.3
2.2	Non-renewable/off-grid solutions (abroad)	0.3
2.3	Electricity data collection and reporting (abroad)	0.3
2.4	Management level distribution training (abroad)	0.5
2.5	Field level distribution training (local)	0.2
	Sub total	**1.6**
	Total	**4.9**

Section 2 Annex F: List of Suggested Training for MOEDIWR and SSEC Officials

The following courses and modules have been identified:

Table A1: Target Group: Top Level Management

Item No.	Course Modules
1	Corporate Risk Management
2	Result/Performance Based Management
3	Conflict Management/Dispute Resolution Method/ Negotiation Process
4	Decision Making Process
5	e-Management and e-Governance
6	Corporate Culture
7	Overview of Human Resource Management
8	Strategic Human Resource Management
9	Performance Appraisal Procedures & Techniques

Table A2: Target Group: Mid-level Management

Item No.	Course Modules
1	Total Quality Management (TQM)
2	Time & Stress Management
3	Change Management & Managing the Change
4	Effective Communication Skill
5	Labor Management Relationship
6	Leadership & Influencing Skills
7	Interpersonal Relations & Personality
8	Overview of Human Resource Management
9	Strategic Human Resource Management
10	Performance Appraisal Procedure & Techniques
11	English Language Course
12	Anti-Corruption, Honesty & Integrity
13	Power Distribution Code
14	Basic Computer skills like MS-Office, web-browsing, e-mail, networking, etc.
15	Delegation of Financial Power
16	Procurement Policy
17	Internal & External Auditor Relationship for Various Activities
18	Internal Audit Report Writing Procedure

Table A3: Target Group: Lower-Level Management

Item No.	Course Modules
1	Total Quality Management
2	Effective Communication Skills
3	English Language
4	Leadership & Influencing Skills
5	Modern Office Management
6	Supply Chain Management
7	Customer Relationship Management
8	MIS & e-governance
9	Basic Computer skills like MS-Office, web-browsing, e-mail, networking, etc.
10	Meter Test Result Interpretation & Supplementary Bill Issue Procedure
11	Distribution Line Design, Inspection & Maintenance
12	Distribution X-former Inspection, Diagnosis & Maintenance
13	Operation & Maintenance of S/S
14	Electrical Safety Guidelines
15	Electricity Networks (HV/MV/LV)
16	Project Planning Development & Management
17	Delegation of Financial Power
18	Procurement Policy
19	Corporate & Financial Management
20	Accounts & Financial Management
21	Fixed Assets Management & Inventory Control System
22	Effective Budget & Cost Control
23	Internal Audit Report Writing Procedure

Table A4: Target Group: Field level Management

Item No.	Course Modules
1	Effective Communication Skills
2	Store Management & Inventory Control
3	English Language Course
4	Customer Care Excellence and Understanding Customer Behavior
5	Effective One Point Service
6	Office & File Management
7	Front Desk Effective Behavior
8	Distribution Line, Inspection & Maintenance
9	Renewable Solar Energy & Its Application
10	Energy Meter Installation, Testing & Inspection
11	Energy Meter & Loss Reduction in Electrical Power System
12	Reliable & Quality Power Supply
13	Cable Faults Analysis, Diagnosis & Maintenance
14	Occupational Health, Safety & First Aid
15	Fire Fighting & Safety Procedure
16	Operation & Maintenance of Circuit Breaker /Isolator/ /Switchgear
17	MIS & e-governance
18	Basic Computer skills like MS-Office, web-browsing, e-mail, networking, etc.
19	Internal Audit Report Writing Procedure

Table A5: Target Group: Asst. Line Man/Line Man/Assistant Foreman / Field Assistant/ Senior OA/ Machine Operator / Electrician/Meter Tester

Item No.	Course Modules
1	Disaster Management
2	Customer Care Excellence
3	Front Desk Executive Behavior
4	Discipline & Office Management
5	Distribution Line Inspection & Maintenance
6	Distribution X-former Inspection & Maintenance
7	Electrical Safety Guideline
8	Energy Meter Installation & Meter Reading Collection
9	Energy Meter & Loss Reduction in Electrical Power System
10	Occupational Health, Safety, Environment & First Aid
11	Fire Fighting & First Aid
12	Grounding System Analysis
13	Prepaid Metering System & Automatic Meter Reading System
14	Basic Accounting
15	MIS & e-governance
16	Basic Computer skills like MS-Office, web-browsing, e-mail, networking, etc.
17	Basic Computer Hardware & Trouble Shooting

Table A6: Target Group: Complaint Attendants/Substation Attendants/Vending Operators

Item No.	Course Modules
1	Disaster & Crisis Management
2	Understanding Consumer Behavior
3	File Management & Record Keeping
4	Front Desk Executive Behavior
5	Effective communication skills and English language
6	Operation & Maintenance of S/S (Basic)
7	Electrical Safety Guideline
8	Occupational Health, Safety & First Aid
9	Fire Fighting & First Aid
10	Operation & Maintenance of CB/SWS/Isolator
11	Grounding System Analysis
12	Relay & Power System Protection (Basic)
13	On-the-Job Training
14	Basic Computer skills like MS-Office, web-browsing, e-mail, networking, etc.