THE FEASIBILITY STUDY
ON
THE LOSS REDUCTION PROJECT
OF
DISTRIBUTION NETWORK
IN
THE HASHEMITE KINGDOM OF JORDAN

FINAL REPORT

DECEMBER 2000

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO ELECTRIC POWER CO., INC.
TOKYO ELECTRIC POWER SERVICES CO., LTD.

Preface

In response to a request from the Government of the Hashemite Kingdom of Jordan, the Government of Japan decided to conduct and entrusted the Feasibility Study on Electric Power Loss Reduction of Distribution Network in the Hashemite Kingdom of Jordan to Japan International Cooperation Agency (JICA).

JICA sent a study team led by Mr. Takahashi of Tokyo Electric Power Company, Inc. and organized by Tokyo Electric Power Company Inc. and Tokyo Electric Power Service Company Ltd. to the Hashemite Kingdom four times from September 1999 to October 2000.

The study team held discussions with the officials concerned of the Government of Hashemite Kingdom of Jordan and conducted related field surveys. After returning to Japan, the study team carried out further studies and compiled the final results in this report.

I hope this report will contribute to the rehabilitation of distribution network for power loss reduction and to the promotion of amity between our two countries.

I also express my sincere appreciation to the officials concerned of the Government of Hashemite Kindom of Jordan for their close cooperation throughout the study.

December 2000

Kunihiko SAITO
President
Japan International Cooperation Agency

December 2000

Mr. Kunihiko Saito
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit you the report of Feasibility Study on Electric Power Loss Reduction of Distribution Network in the Hashemite Kingdom of Jordan.

This study was conducted by the joint venture of Tokyo Electric Power Company Inc. and Tokyo Electric Power Service Company Ltd., under a contract to JICA, during the period of from September 6, 1999 to December 21, 2000. The major contents of the report are the technically and economically feasible rehabilitation plans of target distribution networks for power loss reduction in the Hashemite Kingdom of Jordan.

We trust that realization of the study will much contribute to enhance the power losses in the distribution network and to improve system efficiency. In view of urgency to enhance electric system efficiency by power loss reduction, we recommend that the Government of Hashemite Kingdom of Jordan take this study as a highest priority.

We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, Ministry of Foreign Affairs and Ministry of International Trade and Industry. We would also like to express our gratitude to the officials concerned of Ministry of Planning, Ministry of Energy and Mineral Resources, NEPCO, JICA Jordan Office and Embassy of Japan in the Hashemite Kingdom of Jordan for their cooperation and assistance throughout our field survey.

December 21, 2000

Akira Takahashi

Akira TAKAHASHI
Leader of Feasibility Study on the Loss Reduction Project of Distribution Network in the Hashemite Kingdom of Jordan

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Final Report

CONTENTS

CHAPTER 1 Introduction

1.1 Background of the Study ---------- I -1
1.2 Contents of the Study---------- I -2
1.2.1 Objectives of the Study ---------- I -2
1.2.2 Items of the Study ---------- I -2
1.3 Activities of Study Team and Relevant Personnel in Jordan ---------- I -3
1.3.1 Activities of Study Team in Jordan ---------- I -3
1.3.2 Lists of Participants---------- I -5
1.4 Equipment and Materials ---------- I -6
1.5 Preparation of Software---------- I -6
1.6 Training of the Counterparts ---------- I -6
1.7 Seminars ---------- I -6
1.7.1 The First Seminar ---------- I -6
1.7.2 The Second Seminar ---------- I -6

CHAPTER 2 Profile of Jordan

2.1 General---------- II -1
2.1.1 Geographical Features ---------- II -1
2.1.2 Governmental Organization and Administration ---------- II -1
2.1.3 Fiscal Year---------- II -2
2.2 Population and Labor Force ---------- II -2
2.2.1 Population---------- II -2
2.2.2 Labor Force---------- II –3

2.3 General Economic Features ---------- II -3
2.3.1 Gross Regional Domestic Products ---------- II -3
2.3.2 Government Finance ---------- II -4
2.3.3 External Trade and International Balance of Payment ---------- II -4
2.4 Industrial Perspective ---------- II -5
2.4.1 Economic and Social Features ---------- II -5
2.4.2 Industrial Production ---------- II -6
2.4.3 Agricultural Production ---------- II -6
2.4.4 General Industrial Aspects ---------- II -7
2.4.5 Infrastructure in Jordan ---------- II -8
2.5 Development Policies and Target ---------- II -8
2.6 Family Economy ---------- II-10
2.7 Price ---------- II-13
2.7.1 Consumer Price ---------- II-13
2.7.2 Exchange Rate ---------- II-14

Appendix 2.1 Organization of the Government of Jordan ---------- II-15
Appendix 2.2 Area and Population in the Nation by Census ---------- II-16
Appendix 2.3 Population Projection of the Whole Nation since 1980 ---------- II-17
Appendix 2.4 Labor Force Estimates in Jordan ---------- II-18
Appendix 2.5 Gross Domestic Product (GDP) in Jordan ---------- II-19
Appendix 2.6 Summary of Central Government Budget During 1990 – 1994 ---------- II-20
Appendix 2.7 External Trade Situation Since 1967 ---------- II-21
Appendix 2.8 International Balance of Payment in Cash Basis ---------- II-22
Appendix 2.9 Commodities of Exports and Imports in Jordan ---------- II-23
Appendix 2.10 Industrial Production of Principal Industries in Jordan ---------- II-24
Appendix 2.11 Principal Agricultural Production in Jordan ---------- II-25
Appendix 2.12 Situation of Economic Activities by Industrial Origin ---------- II-26
Appendix 2.13 Infrastructure in Jordan (1) ---------- II-27
Appendix 2.13 Infrastructure in Jordan (2) ---------- II-28
Appendix 2.13 Infrastructure in Jordan (3) ---------- II-29
Appendix 2.14 Average Annual Current Income per Household by Economic Activity and Source of Income ---------- II-30
Appendix 2.15 Average Annual Expenditure by Governorate and Expenditure Item ---------- II-31
Appendix 2.16 Cost of Living Index and Exchange Rate ---------- II-32

CHAPTER 3 Current Situation of Power Sector

3.1 Organization and Functions of the Power Sector ---------- III -1

3.1.1 Function and Relationships among Electricity Enterprises in Jordan ---------- III -1

3.1.2 Finance of Energy Enterprises ---------- III -3

3.1.3 Electricity Tariff ---------- III -4

3.2 Power Plant, Transmission Lines, Substations and Distribution Lines ---------- III -4

3.2.1 Generating Power Plant ---------- III -5

3.2.2 Transmission Facilities ---------- III -6

3.2.3 Substation Facilities ---------- III -6

3.2.4 Distribution Facilities ---------- III -6

3.3 Electric Power System ---------- III -7

3.3.1 Present Situations of the Power Systems ---------- III -7

3.3.2 Power Dispatching and T&D System Control ---------- III -7

3.3.3 Duration of Power Outage ---------- III -8

3.3.4 Operation and Maintenance ---------- III -8

3.4 Load Management System ---------- III -9

3.5 Transmission and Distribution Losses ---------- III -10

3.5.1 Trends in Interconnected System Network Losses ---------- III -10

3.5.2 Voltage Reduction and Power Factor of Distribution System ---------- III -10

Appendix 3.1 Situation of Electricity Sales in Jordan ---------- III-12

Appendix 3.2 Statement of Income and Expenses of Electricity Enterprises ---------- III-13

Appendix 3.3 Balance Sheet of Electricity Enterprises ---------- III-14

Appendix 3.4 Jordanian Network Year 2000 ---------- III-15

CHAPTER 4 Demand Forecast and Demand-Supply Balance

4.1 Demand Forecast ---------- IV -1

4.1.1 Demand Forecast of Jordan ---------- IV -1

4.2 Development Plan of Generation and Transmission Facilities ---------- IV -4

4.2.1 Generation and Transmission Facilities ---------- IV -4

4.3 Balance of Demand and Supply ---------- IV -6

CHAPTER 5 The Present Situation of Distribution Systems on the Investigation Target Areas

5.1 Existing Distribution Systems---------- V -1
5.1.1 Distribution Network of EDCO ---------- V -1
5.1.2 Distribution Network of JEPCO---------- V -1
5.1.3 Distribution Network of IDECO ---------- V -2
5.2 Existing Transmission and Substation Facilities---------- V -2
5.2.1 132/33kV Substation Facilities---------- V -2
5.2.2 132kV Transmission Lines ---------- V -2
5.3 Distribution Facilities in the Study Area ---------- V -3
5.3.1 Standards for Facilities ---------- V -3
5.3.2 MV Feeders ---------- V -6
5.3.3 33/11kV Substations ---------- V -7
5.3.4 Distribution Transformers ---------- V -7
5.3.5 LV Feeders ---------- V -8
5.3.6 Service Drops etc. ---------- V -9
5.4 Facility Operation ---------- V -10
5.4.1 Standard for Operation and System Reliability---------- V -10
5.4.2 Operation and Maintenance of Distribution Facilities ---------- V -10
5.5 Selection of Target Areas/Feeders ---------- V -11
5.5.1 Progress Situation of Loss Reduction after M/P---------- V -11
5.5.2 MV Target Feeder---------- V -11
5.5.3 LV Target Feeder---------- V -12

CHAPTER 6 System Improvement Plan in the Study Area

6.1 Community Development and Industrialization Plan ---------- VI -1
6.2 Plan for Power System Development ---------- VI -1
6.2.1 Plan for New 132/33kV Substation Construction---------- VI -1
6.2.2 Plan for 132/33kV Substation Reinforcement---------- VI -2
6.2.3 Plan for Distribution (33kV and below) Network---------- VI –2

CHAPTER 7 Basic Policy on Loss Reduction in Distribution System

7.1 Methodology for loss reduction in distribution system ---------- VII-1

7.1.1 Measures for Loss Reduction---------- VII-1

7.1.2 Target Feeders ---------- VII-2

7.1.3 Measures for Loss Reduction in MV and LV System ---------- VII-3

7.2 Software for Study---------- VII-4

7.2.1 Software for Power Flow and Loss Analysis ---------- VII-4

7.2.2 Optimization Software---------- VII-5

7.3 Conditions for Study of Optimization of Loss Reduction ---------- VII-7

7.3.1 Facilities---------- VII-7

7.3.2 Criteria for Evaluating Losses ---------- VII-8

7.4 Principles of selection of Measures ----------VII-11

7.4.1 Combinations of the Measures----------VII-11

7.4.2 Coefficient of Investment Efficiency----------VII-12

CHAPTER 8 Study on Optimization of Power Loss Reduction

8.1 Overview of Optimization Study on Loss Reduction---------- VIII-1

8.1.1 Loss Reduction by Power Factor Correction----------VIII -1

8.1.2 Policy of Capacitor Installation on Distribution Network ----------VIII -1

8.1.3 Loss Reduction by Installing Capacitor on LV Target Feeders----------VIII -2

8.1.4 Loss Reduction by Installing Capacitor on MV Target Feeders----------VIII -3

8.2 Loss Reduction of LV Feeders ----------VIII -3

8.2.1 Preliminary Study----------VIII -3

8.2.2 Policy of Improvement of LV Target Feeder ----------VIII -6

8.2.3 Study Result on LV Target Feeders----------VIII -7

8.2.4 Study on Application of LAL150 (aluminum bare wire with cross section of 150mm^2) ----- VIII -14

8.2.5 Study on Application of BA120 (aluminum overhead cable with cross section of 120mm^2)VIII-15

8.3 Loss Reduction on MV Systems---------- VIII -17

8.3.1 Preliminary Study---------- VIII -17

8.3.2 Fundamental Policy of Loss Reduction on MV System---------- VIII -19

8.3.3 Method for Improvement of MV Target Feeders---------- VIII -20

8.3.4 Results of Study on MV Target Feeders ---------- VIII -20

8.4 Summary of the Study and Annual Allocation of Construction Cost ---------- VIII -48
8.4.1 Summary of the Study ---------- VIII -48
8.4.2 Annual Allocation of Construction Cost ---------- VIII -48
8.4.2 Annual Trend of Power Loss Reduction ---------- VIII -50

Appendix 8.1 LV Feeder List ---------- VIII -52
Appendix 8.2 Countermeasures on the LV Feeders ---------- VIII -60
Appendix 8.3 Analysis of the Result of Study ---------- VIII -68
Appendix 8.4 Single Line Diagrams and Countermeasures of LV Feeders ---------- VIII -73
Appendix 8.5 Comparison of Voltage Profile of WASP and Bundled Conductor ---------- VIII -114

CHAPTER 9 Effect on Environment of Power Loss Reduction

9.1 Power Loss Reduction due to Improvement of Distribution System ---------- IX-1
9.2 Reduction in Emission of Gases per kWh ---------- IX-1
9.3 Environmental Effect of Power Loss Reduction ---------- IX-1
9.3.1 Reduction of Gases of Target Feeders ---------- IX-2
9.3.2 Effect of the First Stage Power Loss Reduction on Environment ---------- IX-2

Chapter 10 Economic and Financial Analysis

10.1 Methodology of Economic Evaluation ---------- X-1
10.1.1 Outline ---------- X-1
10.1.2 Identification of Economic Benefits of Electricity Loss Reduction Project ---------- X-2
10.1.3 Identification of Economic Cost ---------- X-2
10.1.4 Evaluation Criteria ---------- X-3
10.2 Methodology of Financial Evaluation ---------- X-4
10.2.1 Outline ---------- X-4
10.2.2 Financial Cost and Benefit ---------- X-4
10.2.3 Evaluation Criteria ---------- X-4
10.3 Results of Economic and Financial Evaluation ---------- X-4
10.3.1 Economic and Financial Cost of Project ---------- X-5
10.3.2 Economic Benefit ---------- X-7
10.3.3 Economic Evaluation of Project ---------- X-11
10.3.4 Financial Benefit ---------- X-12

10.3.5 Financial Evaluation of Project ---------- X-13
10.4 Sensitivity Analyses ---------- X-14
10.4.1 Fluctuation in Cost and Benefit ---------- X-14
10.4.2 Economic Sensitivity Test ---------- X-15
10.4.3 Financial Sensitivity Test ---------- X-16
10.5 Overview of Project Evaluation ---------- X-18
10.6 Repayability Analysis ---------- X-18
10.6.1 Financing Resources ---------- X-18
10.6.2 Financing Resources to be Applied for Repayability Analysis ---------- X-20
10.6.3 Repayability of Loan Amount in Case of Arab Fund ---------- X-20
10.6.4 Repayability of Loan Amount in Case of International Commercial Loan of Public Financing Institution ---------- X-22
10.6.5 Repayability of Loan Amount in Case of International Private Commercial Loan ---------- X-23
10.6.6 Overview of Repayability Analyses of Loan Amount ---------- X-24

Appendix 10.1 Estimation of Standard Conversion Factor ---------- X-27
Appendix 10.2 Whole Sales Price Index and Salaries and Wages ---------- X-28
Appendix 10.3-1 Annual Disbursement of Construction Cost with Capacitor ---------- X-29
Appendix 10.3-2 Annual Disbursement of Construction Cost without Capacitor ---------- X-30
Appendix 10.4-1 Calculation of Electricity Loss To Be Reduced with Capacitor ---------- X-31
Appendix 10.4-2 Calculation of Electricity Loss To Be Reduced without Capacitor ---------- X-32
Appendix 10.5-1 Calculation of Economic Internal Rate of Return for Whole Project ---------- X-33
Appendix 10.5-2 Calculation of Economic Internal Rate of Return for EDCO's Service Area -------- X-34
Appendix 10.5-3 Calculation of Economic Internal Rate of Return for JEPCO's Service Area ------- X-35
Appendix 10.5-4 Calculation of Economic Internal Rate of Return for IDECO's Service Area ------- X-36
Appendix 10.6-1 Calculation of Financial Internal Rate of Return for Whole Project ---------- X-37
Appendix 10.6-2 Calculation of Financial Internal Rate of Return for EDCO's Service Area ---------- X-38
Appendix 10.6-3 Calculation of Financial Internal Rate of Return for JEPCO's Service Area -------- X-39
Appendix 10.6-4 Calculation of Financial Internal Rate of Return for IDECO's Service Area --------- X-40
Appendix 10.7-1 Fund Repayability Analysis for the Whole Project without Capacitors in Case of Using the Arab Fund Loan ---------- X-41
Appendix 10.7-2 Fund Repayability Analysis for EDCO's Works without Capacitors in Case of Using the Arab Fund Loan ---------- X-42
Appendix 10.7-3 Fund Repayability Analysis for JEPCO's Works without Capacitors in Case of Using the Arab Fund Loan ---------- X-43
Appendix 10.7-4 Fund Repayability Analysis for IDECO's Works without Capacitors in Case of Using the Arab Fund Loan ---------- X-44

Appendix 10.8-1 Fund Repayability Analysis for the Whole Project without Capacitors in Case of Using the International Commercial Loan of Public Financing Institution -------- X-45
Appendix 10.8-2 Fund Repayability Analysis for EDCO's Works without Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-46
Appendix 10.8-3 Fund Repayability Analysis for JEPCO's Works without Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-47
Appendix 10.8-4 Fund Repayability Analysis for IDECO's Works without Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-48
Appendix 10.9-1 Fund Repayability Analysis for the Whole Project without Capacitors in Case of Using the International Private Commercial Loan ---------- X-49
Appendix 10.9-2 Fund Repayability Analysis for EDCO's Works without Capacitors in Case of Using the International Private Commercial Loan ---------- X-50
Appendix 10.9-3 Fund Repayability Analysis for JEPCO's Works without Capacitors in Case of Using the International Private Commercial Loan---------- X-51
Appendix 10.9-4 Fund Repayability Analysis for IDECO's Works without Capacitors in Case of Using the International Private Commercial Loan ---------- X-52
Appendix 10.10-1 Fund Repayability Analysis for the Whole Project with Capacitors in Case of Using the Arab Fund Loan ---------- X-53
Appendix 10.10-2 Fund Repayability Analysis for EDCO's Works with Capacitors in Case of Using the Arab Fund Loan ---------- X-54
Appendix 10.10-3 Fund Repayability Analysis for JEPCO's Works with Capacitors in Case of Using the Arab Fund Loan ---------- X-55
Appendix 10.10-4 Fund Repayability Analysis for IDECO's Works with Capacitors in Case of Using the Arab Fund Loan ---------- X-56
Appendix 10.11-1 Fund Repayability Analysis for the Whole Project with Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-57
Appendix 10.11-2 Fund Repayability Analysis for EDCO's Works with Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-58
Appendix 10.11-3 Fund Repayability Analysis for JEPCO's Works with Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-59
Appendix 10.11-4 Fund Repayability Analysis for IDECO's Works with Capacitors in Case of Using the International Commercial Loan of Public Financing Institution ---------- X-60
Appendix 10.12-1 Fund Repayability Analysis for the Whole Project with Capacitors in Case of Using the International Private Commercial Loan ---------- X-61
Appendix 10.12-2 Fund Repayability Analysis for EDCO's Works with Capacitors in Case of Using the International Private Commercial Loan ---------- X-62

Appendix 10.12-3 Fund Repayability Analysis for JEPCO's Works with Capacitors in Case of Using the International Private Commercial Loan ---------- X-63
Appendix 10.12-4 Fund Repayability Analysis for IDECO's Works with Capacitors in Case of Using the International Private Commercial Loan ---------- X-64

Chapter 11 Recommendation

11.1 Summary of the Study ---------- XI-1
11.2 Recommendation---------- XI-5

List of Tables

Table 2.2-1 Area and Population by Governorate ..... II – 2
Table 2.3-1 Summary of GDP ..... II – 3
Table 2.3-2 Government Finance ..... II – 4
Table 2.3-3 International Balance of Payment in Cash Basis ..... II – 4
Table 2.3-4 Exports and Imports in Jordan ..... II – 5
Table 2.4-1 Industrial Situation in Jordan ..... II – 7
Table 2.6-1 Average Annual Household Expenditure and Its Share Rate by Item ..... II – 12
Table 2.6-2 Expenditure of Electricity, Gas and Water per Year per Household ..... II – 13
Table 2.7-1 Cost of Living Index in Jordan ..... II – 13
Table 2.7-2 Exchange Rate ..... II – 14

Table 3.1-1 Number of Consumers by Type of Consumption in 1998 ..... III – 3
Table 3.1-2 Summary Statements of Income and Expenses of Enterprises in 1998 ..... III – 3
Table 3.1-3 Summary of Balance Sheet of Electricity Enterprises ..... III – 4
Table 3.1-4 Electricity Tariff ..... III – 4
Table 3.2-1 Generating Facilities in Jordan as of End of 1998 ..... III – 5
Table 3.2-2 Transmission Facilities ..... III – 6
Table 3.2-3 Transmission Substation Capacity ..... III – 6
Table 3.2-4 Distribution Line ..... III – 7
Table 3.2-5 Distribution Substation ..... III – 7
Table 3.3-1 Installed Capacity of Capacitors ..... III – 9
Table 3.5-1 Trend in Losses and System Loss Rate ..... III –10
Table 3.5-2 Trends in Loss Rate ..... III –10
Table 3.5-3 Power Factor of the MV and LV distribution system ..... III－11

Table 4.1-1 Major Hypotheses of Long Term Load Forecast ..... IV – 1
Table 4.1-2 Demand and Energy Forecast for Whole Country ..... IV – 3
Table 4.1-3 Peak Load Forecast for Whole Country ..... IV – 3
Table 4.1-4 Energy Sales Forecast for Whole Country ..... IV – 4
Table 4.2-1 Generation Expansion Plan ..... IV – 5
Table 4.2-2 Expansion of 132kV Transmission Facilities in 1998 ..... IV – 5
Table 4.3-1 Balance of Demand and Supply ..... IV – 6

Table 5.2-1 Transmission Substation Capacity in 1998 ..... V – 2
Table 5.2-2 Transmission Line Length of NEPCO in 1998 ..... V – 3
Table 5.3-1 System Particulars ..... V – 3
Table 5.3-2 Site Design Conditions ..... V – 4
Table 5.3-3 Site Design Parameters for MV ..... V – 4
Table 5.3-4 Site Design Parameters for LV ..... V – 6
Table 5.5-1 Loss Rate of MV System by District of EDCO in 1998 ..... V – 11
Table 5.5-2 Number of Target Feeders by Distribution Company ..... V – 12
Table 5.5-3 Selection Criteria of LV Target Feeders by Company ..... V – 13

Table 7.1-1 MV Target feeders ..... Ⅶ– 2
Table 7.1-2 Current, Lengths and Power Factors of LV Target Feeders ..... Ⅶ– 3

Table 7.1-3 Conductors and Cables ..... Ⅶ– 4
Table 7.1-4 Transformers ..... Ⅶ– 4
Table 7.3-1 Core Loss and Reactance of Transformers ..... Ⅶ– 7
Table 7.3-2 Construction Costs ..... Ⅶ– 8
Table 7.3-3 Unit Capacity Cost of Capacitors ..... Ⅶ– 8
Table 7.3-4 Dimensions for Long Run Marginal Cost ..... Ⅶ– 9
Table 7.3-5 Marginal Energy Cost(kWh/JD) ..... Ⅶ– 10
Table 7.3-6 Marginal Capacity Cost（kW/JD/Month） ..... Ⅶ– 10
Table 7.3-7 Monetary Value for Loss Reduction ..... Ⅶ– 11
Table 7.3-8 Demand Growth Ratio from the Former Year ..... Ⅶ– 11
Table 7.4-1 Combinations of Measures for the Studies ..... Ⅶ– 12
Table 7.4-2 Coefficient of Investment Efficiency vs. Term of Recovery ..... Ⅶ– 12

Table 8.1-1 Equivalent Power Factor and Reduced Current Coefficient ..... Ⅷ– 2
Table 8.1-2 Capacitor Installation on All LV Target Feeders ..... Ⅷ– 3
Table 8.2-1 Critical Beneficial Currents of Various Existing Feeders ..... Ⅷ– 5
Table 8.2-2 Critical Beneficial Current of Overhead MV Introduction ..... Ⅷ– 6
Table 8.2-3 Critical Beneficial Current of Underground MV Introduction ..... Ⅷ– 6
Table 8.2-4 Summary of Study Result on LV Target Feeders ..... Ⅷ– 8
Table 8.2-5 Comparison of MV Line Construction Cost ..... Ⅷ– 8
Table 8.2-6 Grouping of Lines by Resistance ..... Ⅷ– 9
Table 8.2-7 Numbers, Investment and Net-benefit of Target Feeders by Investment Recovery Period ..... Ⅷ– 11
Table 8.2-8 Result of LAL150 Case ..... Ⅷ– 14
Table 8.2-9 Comparison between ‘Base Case’ and ‘LAL150 Case’ ..... Ⅷ– 14
Table 8.2-10 Result of BA120 Case ..... Ⅷ– 15
Table 8.2-11 Comparison between ‘Base Case’ and ‘BA120 Case’ ..... Ⅷ– 15
Table 8.3-1 Loss Reduction by MV and LV Capacitors(Total of Eight Target Feeders) ..... Ⅷ– 18
Table 8.3-2 Outline of MV Target Feeders(1999) ..... Ⅷ– 20
Table 8.3-3 Summary of the Study on MV Target Feeders ..... Ⅷ– 21
Table 8.3-4 Summary of Loss Reduction on MV Target Feeders(2001) ..... Ⅷ– 22
Table 8.3-5 Summary of Economy on MV Target Feeders ..... Ⅷ– 22
Table 8.3-6 Results of Wadi Musa Line(Base Case:LV Capacitor) ..... Ⅷ– 25
Table 8.3-7 Results of Wadi Musa Line(MV Capacitor) ..... Ⅷ– 26
Table 8.3-8 Results of Tafila Line(Base Case:LV Capacitor) ..... Ⅷ– 28
Table 8.3-9 Results of Tafila Line(MV Capacitor) ..... Ⅷ– 29
Table 8.3-10 Results of JV2 Line(Base Case:LV Capacitor) ..... Ⅷ– 32
Table 8.3-11 Results of JV2 Line(MV Capacitor) ..... Ⅷ– 33
Table 8.3-12 Results of Duleel Line(Base Case:LV Capacitor) ..... Ⅷ– 36
Table 8.3-13 Results of Duleel Line(MV Capacitor) ..... Ⅷ– 36
Table 8.3-14 Results of Madaba Line(Base Case:LV Capacitor) ..... Ⅷ– 39
Table 8.3-15 Results of Madaba Line(MV Capacitor) ..... Ⅷ– 39
Table 8.3-16 Results of Jerash Line(Base Case:LV Capacitor) ..... Ⅷ– 42
Table 8.3-17 Results of Jerash Line(MV Capacitor) ..... Ⅷ– 42
Table 8.3-18 Emrawa and Samma Lines under New Network(2001) ..... Ⅷ– 45
Table 8.3-19 Results of Emrawa and Samma Lines(Base Case:LV Capacitor) ..... Ⅷ– 46
Table 8.3-20 Results of Emrawa and Samma Lines(MV Capacitor) ..... Ⅷ– 47
Table 8.4-1 Summary of the study ..... Ⅷ– 48
Table 8.4-2 Breakdown of Power Loss Reduction (GWh) ..... Ⅷ– 48

Table 8.4-3 Construction Schedule of the Project ..... Ⅷ– 49
Table 8.4-4 Annual Allocation of Construction Cost (JD) ..... Ⅷ– 50
Table 8.4-5 Power Loss Reduction by Year (Including Effect of Capacitor:MWh) ..... Ⅷ– 51
Table 8.4-6 Power Loss Reduction by Year (Excluding Effect of Capacitor:MWh) ..... Ⅷ– 51

Table 9.2-1 Intensity of Gas Emission ..... Ⅸ– 1
Table 9.3-1 Total Value of Reduction of Gasses ..... Ⅸ– 2
Table 9.3-2 Annual Value of Reduction of Gasses ..... Ⅸ– 2
Table 9.3-3 Volume of Gasses to be Reduced due to Project (ton) (with Capacitor) ..... Ⅸ– 3
Table 9.3-4 Volume of Gasses to be Reduced due to Project (ton) (without Capacitor) ..... Ⅸ– 3

Table 10.3-1 Annual Cost Allocation for Net Construction Works ..... Ⅹ– 5
Table 10.3-2 Annual Cost Allocation with Capacitors ..... Ⅸ– 7
Table 10.3-3 Annual Cost Allocation without Capacitors ..... Ⅸ– 7
Table 10.3-4 LRMC for Capacity and Energy ..... Ⅸ– 8
Table 10.3-5 Annual Electricity Loss Reduction Due to Completion of Project with Capacitor ..... Ⅸ– 8
Table 10.3-6 Annual Electricity Loss Reduction Due to Completion of Project without Capacitor ..... Ⅸ– 9
Table 10.3-7 Amount of Electricity Loss Reduction by Year with Capacitor ..... Ⅸ– 9
Table 10.3-8 Amount of Electricity Loss Reduction by Year without Capacitor ..... Ⅸ– 9
Table 10.3-9 Intensity of Gasses to be Emitted ..... Ⅸ– 10
Table 10.3-10 Unit Costs of Gasses to be Emitted ..... Ⅸ– 10
Table 10.3-11 Volume of Gases to be Controlled due to Project without Capacitor ..... Ⅸ– 10
Table 10.3-12 Amount of External Cost Saving by Year without Capacitor ..... Ⅸ– 11
Table 10.3-13 Result of Economic Evaluation ..... Ⅸ– 11
Table 10.3-14 Unit Operating Expenses by Distribution Companies ..... Ⅸ– 12
Table 10.3-15 Unit Operating Expenses by Distribution Companies ..... Ⅸ– 12
Table 10.3-16 Amount of Probable Revenue by Year (with Capacitor) ..... Ⅸ– 13
Table 10.3-17 Amount of Probable Revenue by Year (without Capacitor) ..... Ⅸ– 13
Table 10.3-18 Result of Financial Evaluation ..... Ⅸ– 14
Table 10.6-1 Several Arabic and International Financing Institutions ..... Ⅸ– 18
Table 10.6-2 Deficits Appearing in Cash Flows of the Project without Capacitor ..... Ⅸ– 25
Table 10.6-3 Deficits Appearing in Cash Flows of the Project with Capacitor ..... Ⅸ– 25

Table 11.1-1 Currents, Lengths and Power factors of LV target feeders (1999yr) ..... XI– 1
Table 11.1-2 MV Target Feeder (1999yr) ..... XI– 1
Table 11.1-3 Summary of Study Result on LV Target Feeders ..... XI– 2
Table 11.1-4 Summary of the Study on MV Target Feeders(JD) ..... XI– 3
Table 11.1-5 Annual Reduction of Power Losses due to Remedies ..... XI– 3
Table 11.1-6 Annual Cost Allocation without Capacitors ..... XI– 4
Table 11.1-7 Amount of Electricity Loss Reduction by Year without Capacitor ..... XI– 4
Table 11.1-8 Amount of Probable Revenue by Year without Capacitor ..... XI– 5
Table 11.1-8 Result of Economic and Financial Evaluation of the Project ..... XI– 5

List of Figures

Figure 2.6-1 Average Income Level by Economic Activity
Figure 2.6-2 Share Rate of Income by Income Source

Figure 3.1-1 Structure of the Power Sector in Jordan

Figure7.7-1 Feeder Current Distribution of LV Target Feeders

Figure8.2-1 Initial Feeder Current Vs. Net Benefit for Ten Years
Figure8.2-2 LV Feeder Model of Preliminary Study on MV Introduction Measure
Figure8.2-3 Resistance of Lines in Main Portion of Trunk Line
Figure8.2-4 Single Line Diagram of E015 Feeder and Reinforcement at Same Voltage
Figure8.2-5 Single Line Diagram of E015 Feeder and MV Introduction
Figure8.3-1 Wadi musa Line
Figure8.3-2 Tafila Line
Figure8.3-3 JV2 Line
Figure8.3-4 Duleel Line
Figure8.3-5 Madaba Line
Figure8.3-6 Jerash Line
Figure8.3-7 Emrawa and Samma Lines

Figure10.4.1 Sensitivity of EIRR for the Project
Figure10.4.2 Sensitivity of FIRR for the Project
Figure10.6.1 Repayability of Loan in Case of Arab Fund
Figure10.6.2 Repayability of Loan in Case of International Commercial Loan of Public Financing Institution
Figure10.6.3 Repayability of Loan in Case of International Private Commercial Loan

ABBREVIATIONS

ACSR	:	Aluminum Conductor Steel Reinforced
b/d	:	barrel per day
boe/d	:	barrel oil equivalent per day
CEGCO	:	Central Electricity Generation Company
CIF	:	Cost-Insurance & Freight
DSM	:	Demand Side Management
ECU	:	Euro Currency Unit
EDCO	:	Electricity Distribution Company
EIRR	:	Economic Internal Rate of Return
EU	:	European Union
FIRR	:	Financial Internal Rate of Return
FOB	:	Free on Board
GDP	:	Gross Domestic Product
GEF	:	Global Environmental Facility
GIS	:	Gas Insulated Switchgear
GWh	:	Giga Watt-hour (10^6 kWh)
HV	:	High Voltage (400 kV, 230 kV, 132kV and 66kV in Jordan)
HAL	:	Hard-drawn Aluminum Conductors
IDECO	:	Irbid District Electricity Company
IEC	:	International Electro-technical Committee
IRR	:	Internal Rate of Return
ISO	:	International Standards Organization
JD	:	Jordan Dinar
JEA	:	Jordan Electricity Authority
JEPCO	:	Jordan Electric Power Company
JICA	:	Japan International Cooperation Agency
LF	:	Load Factor
LOLP	:	Loss of Load Probability
LRAIC	:	Long Run Average Incremental Cost

LRMC	:	Long Run Marginal Cost
LV	:	Low Voltage (415/240 V in Jordan)
MCC	:	Marginal Capacitor Cost
MEC	:	Marginal Energy Cost
MEMR	:	Ministry of Energy and Mineral Resources
mteo	:	million tons of equivalent oil
MV	:	Medium Voltage (33 kV, 11kV and 6.6kV in Jordan)
MVA	:	Mega Volt Ampere
MVar	:	Mega Volt Ampere (Reactive Power)
MW	:	Mega Watt
NEPCO	:	National Electric Power Company
NPV	:	Net Present Value
O & M	:	Operation and Maintenance
PLC	:	Power Line Carrier
PSS/E	:	Power System Simulator for Engineering (published by PTI, USA)
RCC	:	Regional Control Center
RTU	:	Remote Terminal Unit
SCADA	:	Supervisory Control and Data Acquisition
T & D	:	Transmission and Distribution
VHF	:	Very High Frequency

CHAPTER I

INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Background of the Study

The total amount of generation capacity of the Hashemite Kingdom of Jordan (hereinafter referred to as Jordan) in 1995 and 1998 was 1167.3 MW and 1670.4MW respectively. Peak demands were 894MW in 1995 and 1060MW in 1998, growing rapidly at an average annual growth rate of 9.3%. Thermal power is the main source of energy in Jordan with the ratio of generation capacity being close to 100%. As a country heavily dependant on imported fuels, reduction in generation fuel consumption costs as well as conservation of natural resources and prevention of environmental pollution are all urgent issues which need to be addressed.

As a solution, the Government of Jordan is paying close attention to the power loss reduction project and promoting it's implementation. Considering these factors and in response to the request of the Government of Jordan, the Government of Japan dispatched a study team from the Japan International Cooperation Agency (hereafter referred to as JICA) from 1996 to 1997 to conduct "The Study on Electric Power Loss Reduction of Transmission and Distribution Networks in the Hashemite Kingdom of Jordan : Master Plan (M/S)."

The results of the study indicated that as transmission and substation loss reduction could expect few economic merits, a detailed study on loss reduction in middle and low voltage distribution networks was required with the following three loss reduction plans proposed:

(1) Improvement of 3-phase unbalanced currents
(2) Power factor correction by installing capacitors in low voltage distribution networks
(3) Installation of new feeders based on the aforementioned study

JICA experts were dispatched from 1997 to 1998 to provide the distribution system improvement plans on the following two measures:

(1) Improvement of 3-phase unbalanced currents
(2) Power factor correction by installing capacitors in low voltage distribution networks

Detailed improvement measures were proposed and the technology transfer was performed (these two measures could be implemented at relatively low cost).

Based on the above mentioned, the government of Jordan requested that the government of Japan formulate technically and economically feasible plans for conducting the third remaining power loss reduction measure on first stage feeders for electric power loss reduction. The government of Japan, through JICA, then

determined the implementation of this Project after dispatching a preliminary study team in December 1998; discussing with relevant local authorities it's implementation as well as carrying out field surveys and collection of data and information.

On December 17, 1998, the JICA Preliminary Study Team and NEPCO reached an agreement on the "Scope of Works (S/W) and Minutes of Meeting (M/M) for the Feasibility Study on Electric Power Loss Reduction of Distribution Networks in the Hashemite Kingdom of Jordan" in confirmation of the terms of reference, the scope of work and the schedule of the main study through discussions with the local authorities concerned. The government of Japan then decided, based on the S/W and M/M, to carry out the full-scale implementation of this plan entrusting the study to JICA. The study area covers the whole area of Jordan. The number of target feeders for the first stage is approximately 400. The study also includes the transfer of technical knowledge on the feasibility study methodology in order to execute the study for improvement and reinforcement of the networks in the second and third phases by Jordanian engineers.

1.2 Contents of the Study

1.2.1 Objectives of the Study

As a country heavily dependant on imported fuels, Jordan is focusing on measures for power loss reduction from the viewpoint of reduction of fuel related costs, conservation of energy and prevention of environmental pollution. Jordan views the energy loss reduction plan as important in these terms and from 1996 to 1997 "The Study on Loss Reduction of Transmission and Distribution Networks in the Hashemite Kingdom of Jordan : M/S" was carried out on the nationwide power system.

The objectives of this study were to formulate technically and economically feasible plans to improve and reinforce the distribution network at the first stage for electric power loss reduction based on the recommendations of the M/S. At the same time, the study also serves to transfer technical knowledge intended for succeeding studies and enables Jordanian engineers to achieve independently the improvement and reinforcement of the distribution networks for the second and third phases.

1.2.2 Items of the Study

It was decided to hold two seminars during the field investigation period in Jordan for a wider range of senior executives in order to recognize the methodology of the study and importance of executing the project. Manual compilation on F/S study methodology was also taken up as a significant item of importance for enabling local counterparts to incorporate the method of study.

The study items are as presented below:

(a) Data acquisition for power supply facilities in the study area including 33kV, 11kV, 6.6kV, 415V feeders and 33kV/415V substations (data in 132kV feeders and 132/33kV substations also necessary in view of introduction of higher voltage system.)

(b) Estimation of energy sales in the study area including review of existing data

(c) Establishment of plural plans and their standardization for energy loss reduction

(d) Establishment of fundamental policy and philosophy for distribution network improvement and reinforcement

(e) Establishment of the optimal improvement and reinforcement plans for the target distribution networks

(f) Comprehensive design of facilities concerned

(g) Estimation on feasibility of the optimal plan (economic and financial analysis, estimation on environmental impacts)

(h) Establishment of practical plan (construction and investment plans, etc.)

(i) Manual compilation on F/S study methodology

1.3 Activities of Study Team and Relevant Personnel in Jordan

1.3.1 Activities of Study Team in Jordan

From November 1999 through to November 2000, the JICA Study Team is scheduled to execute the following activities:

(1) The first site investigation: September 17 ~ December 7, 1999

- Explanation of Inception Report and discussion
- First seminar
- Grasp on existing reinforcement and development programs for transmission and distribution networks
- Preliminary selection of the target areas
- Collection and analysis of data related to power supply-demand in the areas
- Investigation of existing equipment
- Investigation of present maintenance system of distribution facilities
- Investigation of present operating and management system for the distribution network
- Review on evaluation of power losses

- Review on standard construction costs
- Preparation of the progress report, explanation and discussion
- Determination of contents and methodology for detailed investigation
- Selecting the target areas
- Determination of the target feeders and facilities
- Collection of data in respect of target feeders and facilities
- Demand forecast in the target areas
- Examination of measures for loss reduction
- Examination to optimize the plan
- Technology transfer such as software and methodology for loss reduction

(2) The second site investigation : January 17 ~ February 26, 2000

- Formulation of basic philosophy for the improvement and reinforcement of distribution systems
- Establishment of the individual plans for improvement and reinforcement of distribution systems
- Investigation and analysis for economical situation and finances of each distribution company

(3) The third site investigation : May 17 ~ June 30, 2000

- Explanation of interim report and discussion
- Evaluation of the effect of loss reduction
- Estimation of investment for the plan
- Establishment of the implementation programs
- Economic and financial evaluation of the plan
- Environmental assessment
- Examination of funding
- Advice on education of personnel

(4) The fourth site investigation : September 29 ~ October 13, 2000

- Explanation of draft final report and discussion
- Second seminar
- Explanation and Submission of FS Manual for technical knowledge transfer

1.3.2 List of Participants

The counterparts of NEPCO, JEPCO, IDECO, EDECO and Ministry of Energy & Mineral Resources and JICA Study Team are as listed below:

(1) Jordanian Counterparts

NEPCO

Mr. ALI. Y. AL-ZUBI	Load Research & Management Section Head/ Project Manager
Mr. FALAH ABABNAH	Electric Planning Engineer
Mr. TURKI ABU KASSAB	Electric Planning Engineer
Mr. MANSOUR AL KOUZ	Electric Planning Engineer

MINISTRY OF ENERGY & MINERAL RESOURCES

Dr. AUDIH AL SAOURY

Dr. MAHMOUD ZAIDAN

EDCO

Mrs. REEM HAMDAN	Distribution Department Electrical Engineer

JEPCO

Mr. ANWAR ELLAYAN	Electric Planning Engineer

IDECO

Mr. JEHAD ROUSAN	Head of Planning Section

(2) JICA Study Team

Mr. AKIRA TAKAHASHI	Team leader/Power System Planning
Mr. MASAHIKO MINEGISHI	Distribution System Planning (Medium Voltage)
Mr. KYO SAKUMA	Distribution System Planning (Low Voltage)
Mr. HIROYUKI MITSUI	Distribution System Planning (Low Voltage)
Mr. MASAHARU YOGO	Optimization Calculation
Mr. YOSHIAKI ISHIZUKA	Economic and Financial Analysis
Mr. MASAHIKO TADA	Coordination and Assistance
Mr. HIDEKI HAYASAKA	Coordination and Assistance

1.4 Equipment and Materials

The Study Team procured the clamp CT's before the first site survey in Jordan, and used these instruments for power measurement on low voltage distribution feeders. During the first site survey, the Study Team purchased personal computers and until the end of the fourth site survey, the team used them effectively for calculation of power losses, technology transfer and other purposes. All the measurement instruments and computers procured was used for the study until the forth field investigation.

1.5 Preparation of Software

The JICA Study Team used power loss calculation software developed by Tokyo Electric Power Services Co., Ltd. (TEPSCO). The JICA Study Team intended to transfer the technology for analysis know-how etc. including software methods.

1.6 Training of the Counterparts

Training of the counterparts was carried out in Japan in order to enable follow-ups on the power loss reduction project during the study period. Participants and duration of the Training in Japan are as follows:

Mr. Falah Ababneh (NEPCO) : from August 25, 2000 to September 12, 2000
Mr. Anwar Ellayan (JEPCO) : from November 13, 2000 to November 28, 2000

1.7 Seminars

The Study Team held two seminars in Jordan for the purpose of promoting technology transfer to the relevant parties during this study period as follows:

1.7.1 The First Seminar (November 21, 1999)

The team held the first seminar to introduce international and Japanese standard technology related to the study to all participants. Not only theory but also concrete examples were introduced to facilitate understanding. The team also explained methodology and actual results of loss reduction in Japan.

1.7.2 The Second Seminar (October 5, 2000)

The team held a second seminar for counterpart personnel and relevant companies intended for the further understanding of the project and promotion of the loss reduction project of the distribution network. The team explained the results of the study on target feeders and notification on the study, contents of the FS manual, the results of the economic and financial analysis on the first stage of loss reduction project.

CHAPTER II

PROFILE OF JORDAN

CHAPTER 2 PROFILE OF JORDAN

2.1 General

2.1.1 Geographical Features

The capital city of Jordan is Amman. The population of the whole nation of Jordan is approximately 4.9 million. The area is 89,342 km^2 of which 80 % is desert and 557 km^2 incorporates the Dead Sea and Jordan Valley's Eastern bank area bounded by the Jordan river. There are two mountainous ranges which reach a height of approximately 600 to 1,000m high running down along the Jordan River. The area between these two mountainous ranges form one of the world's most famous green belts called the Jordan Valley with an elevation range of 200 to 340m below sea level. The Jordan River flows into the Dead Sea which marks the world's lowest point with its surface at 390m below sea level. The Capital Amman is located in eastern hilly land in the undulations ranging from approximately 900 to 1,100m above sea level. Amman has a clearly defined dry and rainy season. The dry season (May～October) falls in the summer and rainy season falls in autumn, winter and spring. In a dry season (summer), the highest temperature often exceeds 40 degrees in Amman, however the humidity is low. On the other hand, it rains in winter. Jordan has only one seaport in Aqaba. Aqaba is the city in the basin surrounded by rocky mountains located in the most southern end of Jordan, 340 km from Amman to the south and is the only point of contact with the sea for Jordan.

2.1.2 Governmental Organization and Administration

Under His Majesty the King with the Vice of King, there lies the Royal Court, the Council for the King, the House of Parliament, and the Cabinet. Several ministries come under the Cabinet which is headed by the Prime Minister. As of the year 2000, there are 26 ministries as shown in Appendix 2.1. The National Electric Power Company (NEPCO), a state owned electric enterprise, belongs to the Ministry of Energy and Mineral Resources.

Jordan is divided into twelve regional governates, or "muhafathat", each of which is divided into smaller administrative sub-regions. Each governate is headed by a governor, who is appointed by the king through the Ministry of the Interior. The district government acts as the executive organ for carrying out cabinet decisions on the local level. These district governments are thus essentially an extension of the central government, and are supervised by the Ministry of the Interior.

In contrast to the appointed district governors, mayors are elected. The only exception to this rule is the mayor of Amman, who is appointed directly by the king. Mayors supervise the day-to-day affairs of towns and cities, and grievances against mayors can be appealed to the Ministry of Municipal and Rural Affairs and Ministry of Environment.

2.1.3 Fiscal Year

The Government of Jordan adopts a fiscal year ending on December 31. Therefore, years indicated in this study are based on a January 1 to December 31 calendar year, unless otherwise stated.

2.2 Population and Labor Force

The social and economic situation in Jordan is described hereunder based on statistical data and financial conditions in power sectors as described in Chapter 3 based on information from the electricity sector represented by NEPCO and other sources.

2.2.1 Population

The total population of Jordan was 4.90 million as of 1999, with an annual average population growth rate of 4.22 % since 1980. The outline regarding the population is shown in Appendix 2.2 and 2.3 and summarized as shown in Table 2.2-1 hereunder.

Table 2.2-1 Area and Population by Governorate

Governorate	Area (km^2)	Population As of 1999 (persons)	Households (HHs) as of 1997		Population Density as of 1999 (persons/km^2)
			No. of HH (households)	HH size (persons/HH)	
Amman	8,231	1,864,450	291,942	6.20	227
Balqa	1,076	321,440	48,392	6.45	299
Zarqa	4,080	770,770	109,054	6.86	189
Madaba	2,008	124,950	17,971	6.75	62
Irbid	1,621	874,160	125,035	6.78	539
Mafraq	26,43	225,890	27,212	8.05	9
Ajlun	412	108,780	17,125	6.16	264
Jarash	402	144,060	21,704	6.44	358
Karak	3,217	196,980	27,691	6.91	61
Tafiela	2,114	74,480	9,862	7.35	35
Ma'an	33,16	95,550	12,361	7.50	3
Aqaba	6,583	98,490	13,564	7.03	15
Total	89,34	4,900,000	721,852	6.59	55

Source : Statistical Year Book 1998 and 1999 (Draft), Department of Statistics.
Household Expenditure and Income Survey 1997, Department of Statistics, March 1999.

Total number of households stands at approximately 722,000 as of 1997 with the average family size at 6.59 persons per household, as shown in the table above.

2.2.2 Labor Force

The labor force as of 1997 amounted to 981,000 persons with approximately 40% of the share rate engaged in social and administration services in terms of economic activities as shown in Appendix 2.4. Among the other share rates in productive activities, the highest was trading activities at 17% to the total labor force, the second was mining and manufacturing at 15%, and third was construction at 10%.

The share of the agricultural activities was as low as 6% to the total labor force, the fifth lowest, which seems to be reflected in the nation's geographical characteristics. Approximately 80% of the nation's land area is made up of desert as mentioned in previous sub-clause, and arable land is only situated in the Jordan valley area.

2.3 General Economic Features

2.3.1 Gross Regional Domestic Products

Appendix 2.5 shows the Gross Domestic Product (GDP) in Jordan and it's summary is shown in Table 2.3-1 hereunder.

Table 2.3-1 Summary of GDP

As of 1998

No.	Economic activity	At current prices			At 1985 constant prices		
		GDP (million JD)	Share Rate (%)	Annual Growth Since 1989 rate(%)	GDP (million JD)	Share rate (%)	Annual growth Since 1989 rate(%)
A	Industry of origin						
1	Agriculture, hunting, forestry and fishery	147.5	2.98%	0.67%	124.9	4.52%	0.05%
2	Mining and quarrying	169.2	3.42%	1.14%	72.5	2.62%	-0.81%
3	Manufacturing	592.1	11.97%	11.12%	323.5	11.70%	5.91%
4	Electricity and water	117.4	2.37%	10.53%	91.2	3.30%	3.47%
5	Construction	222.0	4.49%	10.28%	163.4	5.91%	8.34%
6	Wholesale and retail trade, restaurants and hotels	517.0	10.45%	14.04%	136.1	4.92%	7.36%
7	Transport, storage and communications	659.3	13.33%	7.89%	360.0	13.02%	3.20%
8	Finance, insurance, real estate and business services	778.2	15.73%	8.22%	517.5	18.72%	4.50%
9	Community, social and personal services	155.8	3.15%	16.60%	77.4	2.80%	12.67%
10	Non monetary terms	948.6	19.18%	9.39%	541.8	19.60%	3.47%
	Total	4,307.1	87.09%	8.98%	2,408.3	87.11%	4.26%
-	Less : Imputed bank service charge	-81.0	-1.64%	4.89%	-45.2	-1.63%	0.31%
	GDP at factor cost	4,226.1	85.43%	9.07%	2,363.0	85.48%	4.35%
+	Indirect taxes less subsidies	719.6	14.55%	13.43%	401.5	14.52%	8.50%
	GDP at producers prices	4,945.7	100.0%	9.62%	2,764.5	100.00%	4.87%

Source: Statistical Yearbook 1994, Department of Statistics of the Hashemite Kingdom of Jordan, October 1995.
Statistical Yearbook 1998, Department of Statistics of the Hashemite Kingdom of Jordan, June 1999.

As shown in the above table, as of 1998, the economic activity category of "finance, insurance, real estate

and business services" is the highest contribution factor to the GDP with 15.7% share rate in the current price levels and 18.7% in 1985 constant price levels. While the second contribution factor is the "transport, storage and communication" category at 13.3% in current price levels and 13.0% at the 1985 constant price level. The "manufacturing" category ranks third both in current and constant price levels, with that of "wholesale and retail trade, restaurant and hotels" ranking forth in current price levels and "construction" fourth in the 1985 constant price levels.

2.3.2 Government Finance

Government finances of Jordan amounted in revenue to JD 908 million in 1990, JD 1,422 million in 1994 and JD 1,788 million in 1999 and, in expenditure to JD 1,033 million in 1990, JD 1,524 million in 1994 and JD 2,007 million in 1999 with increase rates of 7.13 % and 7.95 % since 1990 and 4.69 % and 5.66 % per annum since 1994 respectively. Details are shown in Appendix 2.6 and summarized as below:

Table 2.3-2 Government Finance

(Million JD)

Revenue/Expenditure	1990	1994	1999	Average annual growth rate (%)	
				Since 1990	Since 1994
Revenue	908.3	1,421.9	1,788.2	7.13 %	4.69 %
Expenditure	1,032.6	1,524.2	2,007.1	7.95 %	5.66 %
Surplus/deficit	-124.3	-102.3	-218.9	-	

Source : Statistical Year Book 1994, Department of Statistics.
Statistical Year Book 1999 (Draft), Department of Statistics.

2.3.3 External Trade and International Balance of Payments

Trading for Jordan in exports amounted to JD 11 million in 1967 and JD 1,299 million in 1999. Imports amounted to JD 55 million in 1967 and JD 2,635 million in 1999 as shown in Appendix 2.7. These figures indicate that since 1967, there exists continuous trade deficit with imports exceeding exports.

Capital accounts were on the decline during the four years since 1991 when they were at their highest. The overall balance fluctuated between credit and debit during the five years from 1990. A summary of the cash based international balance of payments is demonstrated in Table 2.3-3 and it's detail is shown in Appendix 2.8.

Table 2.3-3 International Balance of Payment in Cash Basis

(Million JD)

Item of Account	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999	
	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit
Net current Acct.		148.2		269.0		520.6		325.0		279.2		179.8		157.4		20.8		15.5		244.2
Net capital Acct.	353.9		733.2		483.7		106.6			37.6		14.2		90.9	173.1			99.6	197.3	
Overall balance	205.7		464.2			36.9		218.4		311.5		194.0		248.3	193.9			84.1	441.5	

Source : Monthly Statistical Bulletin Vol.31 No.12, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.35 No.12, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.36 No.5, Central Bank of Jordan.

Appendix 2.9 shows the total exports and imports by broad economic category and summarized it as shown

in the following Table 2.3-4.

Table 2.3-4 Exports and Imports in Jordan

(Million JD)

Exports and Imports	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Annual average Growth ratio (%)
Export.	706	768	830	864	994	1,245	1,312	1,322	1,339	1,332	7.31 %
Import	1,726	1,712	2,215	2,456	2,364	2,590	3,045	2,907	2,716	2,639	4.83 %
Trade balance	-1,020	-944	-1,385	-1,592	-1,370	-1,345	-1,733	-1,588	-1,377	-1,307	-

Source : Monthly Statistical Bulletin. Vol.31 No.12, Central Bank of Jordan, December 1995.
Monthly Statistical Bulletin. Vol.36No.5, Central Bank of Jordan, May 2000.
Statistical Year Book 1999 (Draft), Department of Statistics.

Among exports, chemicals ranked highest at over 23 % in share rates in1999, and the second highest with the exception of fuels, were non-edible crude materials at approximately 21 % in the same year as shown in Appendix 2.9. Ranking third was food and live animals at around 10% in the same year. The main export commodities were phosphates, potash belonging to the crude materials and medicaments and fertilizers belonging to the chemicals which indicated a share of around 19 % and 13 % respectively in 1999.

On the other hand, machinery and transport equipment were highest imports at 27 % or more to the total imports as of 1999. Ranking second was food and live animals with the share at around 18 % in 1999. Furthermore, ranking third were manufactured goods classified by materials at 15% or more as the share rate to the total import amount in 1999. The main import commodities were electrical and non-electrical machinery, transport equipment and spare-parts belonging to the machinery and transport equipment that indicated shares of around 13% and 14% respectively to total imports as of 1999.

2.4 Industrial Perspective

2.4.1 Economic and Social Features

As stated in the aforementioned clauses, 40% or more of people were employed in social and administration services in Jordan. Jordan has a GDP with high share rates of finance and insurance, real estate and business services with 19%, transport, storage and communications, 13%, and manufacturing, 12 %, in terms of industry of origin as of 1998 at 1985 constant price.

From the viewpoint of international trading, chemicals representing medicaments and fertilizers were the highest exports at 23% or more, with crude materials representing phosphates and potash ranking second at 21%. These two industrial categories have shared nearly half the total export amounts.

On the other hand, the two industrial categories of machinery and transport equipment and manufactured goods have shared around 40% or more of total imports. During the 31 years since 1967, imports exceed exports with no exception.

Furthermore, the only arable area in Jordan is in the Jordan Valley. Considering this situation, most of the Jordan population depend on mining, quarrying and manufacturing industries for their economic activities at present.

2.4.2 Industrial Production

According to the statistical data shown in Appendix 2.10, phosphate and potash belonging to mining and quarrying were produced at 4,983 thousand tons and 1,780 thousand tons respectively in 1995, and 6,014 thousand tons and 1,800 thousand tons in 1999.

As for construction materials, cement has decreased its production from 3,415 thousand tons in 1995 to 2,687 thousand tons in 1999 with annual growth rate of –0.30 % since 1991. Fertilizers indicated high growth from 602 thousand tons in 1991 to 814 thousand tons in 1999 with annual growth rate of 3.8 %.

2.4.3 Agricultural Production

As mentioned in the previous clause, the only arable area in Jordan is the Jordan Valley where several kinds of plants such as field crops, vegetables, and fruits are cultivated. During the past six years, however, their productions have drastically decreased, especially field crops including wheat, as is the main staple food.

In 1988, production volume of wheat was 78.8 thousand tons, with barley at 44.9 thousand tons, tobacco at 3.7 thousand tons and lentils at 6.5 thousand tons. In 1998, production volume of wheat was 36.0 thousand tons, with barley at 27.4 thousand tons, tobacco at 2.3 thousand tons and lentils at 1.6 thousand tons. The decrease in production rate for wheat over the decade was -8.34%, with barley at -5.34%, tobacco at -5.15 % and lentils at -14.42%. However, they cultivate corn and clover since 1993, and these production volume were increased from 5.3 tons and 6.8 tons in 1993 to 12.3 tons and 27.4 tons in 1998 respectively as shown in Appendix 2.11.

In the vegetable category, tomato production increased from 218.7 thousand tons in 1988 to 299.9 thousand tons in 1998, cucumber increased from 68.0 thousand tons to 93.3 thousand tons, cauliflower increased from 33.6 thousand tons to 62.6 thousand tons and cabbages increased from 87.0 thousand tons to 106.8 thousand tons in 1998 with annual growth rates of 3.57%, 3.58%, 7.16% and 2.30% respectively. However, eggplant production decreased from 72.9 thousand tons in 1988 to 52.9 thousand tons in 1998.

On the other hand, among the four fruit trees, bananas kept up production levels from 24.7 thousand tons in 1994 to 24.5 thousand tons in 1998. Olive production stood at 70.8 thousand tons in 1988 and 137.5 thousand tons in 1998 with grapes at 21.5 thousand tons in 1988 and 17.9 thousand tons in 1998. Their annual growth rates are 7.7 % and -2.0 % respectively since 1988.

2.4.4 General Industrial Aspects

The industrial category consists of 25 kinds of economic activities such as mining/quarrying, food manufacturing, beverage industries, tobacco manufacturing, manufacture of textiles, manufacture of wearing apparel except footwear, manufacture of leather/leather products, manufacture of footwear except vulcanized or molded rubber or plastic footwear, furniture/wood products, paper/paper products, printing/publishing/allied industries, chemical/chemical products, petroleum refineries, manufacture of rubber products, manufacture of plastic products, manufacture of non-metallic mineral products, basic metal products, manufacture of fabricated metal products except machinery/equipment, machinery other than electrical, manufacture of electrical machinery apparatus/appliances/supplies, manufacture of transport equipment, manufacture of professional scientific, measuring/controlling equipment not NEC, other manufacturing industries, electricity, and industrial services. Appendix 2.12 shows the industrial situation in Jordan and it is summarized as below:

Table 2.4-1 Industrial Situation in Jordan

As of 1997

Number of employees Total (persons)	Number of Enterprises (firms)	Gross value added (1,000 JD)	Intermediate Consumption (1,000 JD)	Gross Output (1,000 JD)	Net indirect Taxes (1,000 JD)	Depreciation (1,000 JD)	Total fixed Capital formation (1,000 JD)	Compensation for Employees (1,000 JD)
119,990	14,614	1,055,183	2,199,084	3,254,263	230,768	204,146	254,033	309,594

Source: Statistical Year Book 1998, Department of Statistics.

Within the industrial field, the categories with a number of enterprises were; food and beverages manufacture (2,112 firms), manufacture of wearing apparel except footwear (1,599 firms), manufacture of wood and wood products (1,303 firms), manufacture of non-metallic mineral products (2,125 firms), manufacture of fabricated metal products except machinery and equipment (3,118 firms), and manufacture of furniture (2,476 firms).

However, enterprise figures do not necessarily reflect economic capability. From the viewpoint of gross output, assuming this as a factor of economic capability, the enterprises whose gross output were over JD 100 million were mining and quarrying (144 firms, JD.328 million), food manufacturing (2,112 firms, JD.551 million), manufacture of tobacco products (8 firms, JD.132 million), manufacture of coke, refined petroleum products and nuclear (1 firm, JD.469 million), chemical and chemical products (228 firms, JD.538 million), manufacture of non-metallic mineral products (2,125 firms, JD.246 million), manufacture of basic metal (36 firms, JD.107 million) and electricity (3 firms, 213 million).

The GDP as mentioned in the previous clause clearly reflects these economic activities, partiularly mining, quarrying and manufacturing which are the major industries in Jordan. In the field of petroleum refineries, the firm which produced the second highest gross output was the state enterprise.

Three firms of electricity as mentioned previously consist of the National Electric Power Company (NEPCO)[1], the Irbid District Electricity Company Ltd. (IDECO) and the Jordanian Electric Power Co. Ltd. (JEPCO). They also produced a significant high gross output as mentioned. Details of their activities are described in the next clause.

2.4.5 Infrastructure in Jordan

As shown in Table A of Appendix 2.13 (1), there are 7,200 km of road in total consisting of highway: 2,911 km, secondary road: 2,028 km and village road: 2,261 km in 1999 in Jordan.

Jordan has only one seaport in Aqaba. Table B of the said Appendix shows that the total handled goods and number of vessels were 12,854 thousand tons and 2,351 ships respectively as of 1999.

Jordan has one international airport in Amman, and two local airports in Aqaba and Amman. According to Jordanian Airlines, the number of passengers for fiscal 1999 was 1,252,000 while volume of freight was 56,050 tons as shown in Table A of Appendix 2.13 (2).

Number of facilities for postage and telephone services was 624 in total for the whole area of Jordan as of 1999 consisting of 69 postal agencies, 16 post office counters, 44 rural post offices, 465 post offices and 30 subscribers offices as shown in Table B of Appendix 2.13 (2).

Hotels in Jordan are classified into two categories; as classified hotels and non-classified hotels. Classified hotels amounted to 247 as of 1999 with a total of 26,295 beds while non-classified amounted to 175 with a total of 5,470 beds as shown in Appendix 2.13 (3). Almost all of these hotels were concentrated in the capital of Amman, but some hotels were located in other cities.

2.5 Development Policies and Target

Based on the Economic and Social Development Plan from 1993-1997, the various policies and projects in this plan have aimed at achieving the following economic and social objectives :

- Creating conditions conductive to sustainable growth;
- Ensuring fiscal and monetary stability, eliminating production and price distortions, mobilizing and increasing domestic savings, and securing an appropriate climate for private sector investment;
- Attaining a high level of self-sufficiency and self-reliance by narrowing the gaps in the economy, particularly in the general budget and balance of payments;

[1] It was divided into three companies, NEPCO, CEGCO and EDCO since 1999.

- Expanding and diversifying the income and employment-generating production base and developing a highly competitive export sector
- Reducing disparities among social groups and geographical regions, ensuring equality of opportunity, combating poverty, and providing all citizens with basic services;
- Enhancing the capabilities of all citizens and instilling in them a spirit of initiative and work ethnic through updating educational and training systems and expanding technical and vocational education;
- Creating the right conditions that would encourage citizens to invest in projects based on individual initiative and self-employment;
- Conserving the environment and preventing the deterioration of its component elements through regulating economic and human activities in such a way to secure a healthy environment for people as well as for faun and flora, to ensure the non-depletion of exhaustible resources and to check soil erosion, desertification and pollution;
- Ensuring wider participation and accountability in decision-making.

To achieve the above mentioned objectives, the plan set the following framework:

- From the viewpoint of realization of sustainable growth in excess of population growth rate, the plan aims at realizing a GDP growth rate of 6% per annum at 1991 constant price. This would raise real per capita of GDP by approximately 3%.
- From the viewpoint of correcting structural imbalances and achieving fiscal and monetary stability;
    - Gradual reduction in the budget deficit to GDP ratio, excluding grants, to no more than 3% by 1997.
    - Elimination of the balance of payments current account deficit by 1997.
    - Reduction of the external debt to GDP ratio to a level not exceeding 100% by 1997.
    - Reduction of the external debt service as a percentage of exports of goods and services to a level not exceeding 25% by 1997.
    - Reduction of the ratio of consumption to GDP to a level not exceeding 89% by the end of the planned period.
    - Maintenance of the annual rate of inflation at 4% to 5%.
- From the viewpoint of realization of balanced social development[1];
    - Lowering the unemployment rate to 9.6% by realizing sustainable growth rates that would create 224,100 new job opportunities.
    - Concentrating the public sector investment program in the field of social services, and

[1] The social dimension is vital for the success of economic development, the Plan said that, hence the importance attached to solving the problems of poverty and unemployment, improving the quality and raising the standard of social services, and reducing disparities between the regions.

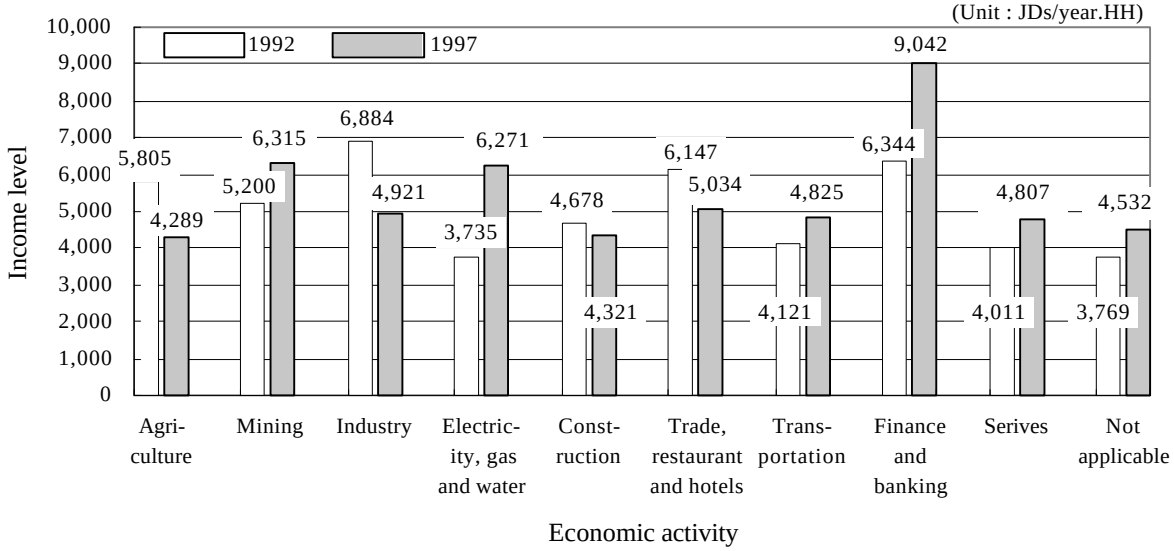
securing the delivery of these services to the various regions in a way that would ensure balanced geographical distribution and access by low income groups.

- Raising the level of educational, health, housing, and other social services during the planned period through appropriate fiscal and monetary policies aimed at providing incentives for private sector investment in these vital areas.[2]
- Reducing poverty in the short run through the adoption of policies designed to promote the establishment of income-generating small projects for low income groups, particularly in the less developed regions, and raising per capita consumption at 1991 constant prices to JD.787 in 1997.
- Training and rehabilitating 72,800 trainees to help them acquire the skills needed for the jobs created by economic growth and to reduce dependence on non-Jordanian labor, and increasing vocational education enrollment to 40 % of total secondary school enrollment by 1997.

2.6 Family Economy

Situation of household income by economic activities as of 1992 and 1997, based on the Household Expenditure and Income Survey of 1992 and 1997 and carried out by the Department of Statistics is shown in Appendix 2.14 and illustrated as Fig 2.6-1 hereunder.

Fig. 2.6-1 Average Income Level by Economic Activity



As shown in the above figure, as of 1992, the highest income level was for households engaging in industrial

[2] The overall objective would be to raise life expectancy from 67 to 69 years, lower infant mortality rates to 25 per 1,000, and infant mortality under 5 years to 30 per 1,000, and raise the percentage of population with access to electricity and drinking water from 98 % to 100 % by 1997 and to sanitation facilities from 55 % to 65 % during the same period.

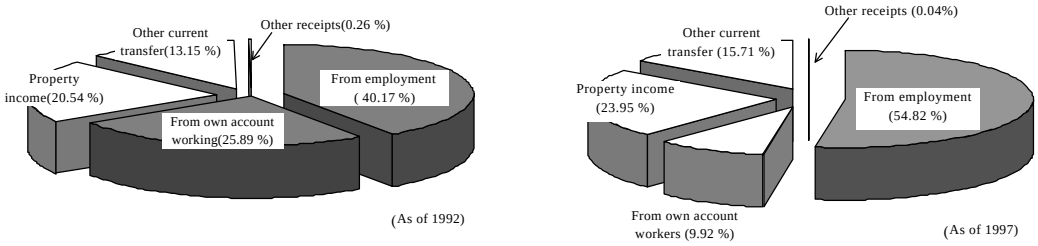
activity at JD 6,884, per year per household with the second in finance and banking at JD 6,344 and the third in trade, restaurant and hotels at JD 6,147. However, this order changed in 1997 in that the highest income level became the households engaging in finance and banking at JD 9,042, the second: in mining at JD 6,315, the third: in electricity, gas and water at JD 6,271. It seems that the said income situation reflects the nation's economy and industrial conditions as mentioned in the previous clause. The average annual income per household may be calculated at an amount of JD 4,607 in 1992 and JD 4,812 in 1997.

According to the said survey, the income mentioned above consists of

- income from employment,
- own account working income,
- property income,
- other current transfer, and
- other receipts.

The income from employment also consists of income in cash and other forms such as food, housing allowance, clothes and so on. For the average income of JD 4,607 in 1992 and JD 4,812 in 1997, the share rates of those components may be illustrated as following Fig.2.6-2.

Fig. 2.6-2 Share Rate of Income by Income Source



Among the income from employment, cash income was JD 1,828 (98.8%) in 1992 and JD 2,486 (98.4%) in 1997. Remaining income was in food, housing allowance, clothes and others.

In looking at the rural and urban average annual household incomes for 1992, the said average was JD 4,607 consisting of the rural average at JD 3,532 and the urban average at JD 4,898. For individual governorates, the average was JD 5,795 in Amman, JD 3,966 in Irbid, JD 4,003 in Zarqa, JD 4,203 in Balqa, JD 2,997 in Mafrak, JD 2,648 in Karak, JD 4,355 in Ma'an, and JD 2,899 in Tafila.

In 1997, the said average income was of JD 4,812 consisting of the rural average at JD 4,044 and the urban average at JD 4,998. By governorate, it consisted of JD 5,489 in Amman, JD 4,286 in Irbid, JD 4,254 in Zarqa, JD 4,753 in Balqa, JD 4,179 in Mafrak, JD 4,805 in Karak, JD 3,991 in Ma'an, JD 3,901 in Tafila, JD 4,789 in Madaba, JD 3,994 in Jarash, JD 3,818 in Ajlun, and JD 5,053 in Aqaba.

During the period from 1992 to 1997, the income level in Amman somewhat decreased. Instead, the governorates with low-income levels in 1992 gained higher income levels during the same period. Therefore, the income level among the governorates became almost equal during the period.

The survey for household expenditure was made by itemization in 16 kinds of food, beverage and tobacco products such as cereal products, meats and poultry, fish and sea products, dairy products and eggs, oils and fats, fruits, vegetables, dry and canned legumes, spices, nuts, sugar and confectioneries, tea/coffee and cacao, beverages, alcohol, and tobacco and cigarettes. Appendix 2.15 shows it's result.

The expenditure for the other commodities and services are also itemized in 17 kinds of expenditure items as ready made men's clothes, ready made women's clothes, children's clothes, clothing and tailoring expense, footwear, housing and related expenses, fuels/electricity/water, house furnishings, household appliances, utensils, cleaning materials, transportation, education, medical care, personal care, recreation, and other expenses. Table 2.6-1 shows a summary of annual household expenditure.

Table 2.6-1 Average Annual Household Expenditure and Its Share Rate by Item

	Food, beverage & tobacco	Clothing	Housing & its related expenses	Fuel, Electricity & Water	Furni-s hings	Trans-portation	Edu-Cation	Medical care	Miscella-neous	Total
In 1992										
Amount of expenditure (JD)	1,856	373	721	229	278	510	160	102	342	4,571
Share rate in percentage (%)	40.60	8.16	15.77	5.01	6.08	11.16	3.50	2.23	7.48	100
In 1997										
Amount of expenditure (JD)	2,150	303	930	206	231	399	220	120	292	4,851
Share rate in percentage (%)	44.32	6.25	19.17	4.25	4.76	8.23	4.54	2.47	6.02	100

Source : Household Expenditure and Income Survey 1992, Department of Statistics.
Household Expenditure and Income Survey 1997, Department of Statistics.
Note 1 : The item of food, beverage and tobacco includes all 16 expenditure items.
2 : The item of clothing includes all items of clothing and footwear.
3 : The item of furnishing includes house furnishings, household appliances, utensils and cleaning materials.
4 : The item of miscellaneous includes personal care, recreation and other expenses.

In 1992, the difference between amounts of income (JD.4,607) and expenditure (JD.4,571) came to a saving of JD. 36. However, the 1997 figure was negative at -JD.39 which seemed to be caused by increasing costs imposed on food, beverages and tobacco, housing and related expenses, education and medical care reflecting the price increase in these items. As shown in Table 2.6-1, the share rate of expenditure for foods was 41% or more in 1992 and 44% or more in 1997. Considering the standard share rate (the "Engel's coefficient") of approximately 30% in developed countries, these figures are quite high.

Energy and water are essential commodities. Table 2.6-2 below shows a breakdown of electricity, gas and water based on the said survey in 1992 and 1997.

Table 2.6-2 Expenditure of Electricity, Gas and Water per Year per Household

(Unit : JD)

	Electricity	gas	Solar	Kerosene	Coal	Charcoal	Batteries	Other fuels	Matches	Water
In 1992										
Whole Jordan	81	41	25	52	0	0	0	0	3	27
Rural	63	54	10	62	0	1	0	0	4	23
Urban	84	38	28	50	0	0	0	0	2	28
In 1997										
Whole Jordan	102	49	20	33	0	0	0	0	1	35
Rural	86	63	6	47	0	0	0	0	1	41
Urban	105	47	23	31	0	0	0	0	1	34

With reference to the cost for electricity in particular, it was 1.77% to the total amount of expenditure in 1992 increasing to 2.10% in 1997. In short, the expenditure for electricity in 1992 was calculated at JD 80.907 and JD 101.871 per year per household in 1997.

2.7 Price

2.7.1 Consumer Price

Costs of living index in Jordan since 1994 is shown in Table A of Appendix 2.16 and summarized in Table 2.7-1 hereunder.

According to the table, on the calculation for the cost of living increase rates from 1994 to 1998, the average increase was 3.72% (and 3.67% for that calculated from 1991). In comparison to that of the other items, with the exception food and clothing/footwear, there were no outstanding changes.

Table 2.7-1 Cost of Living Index in Jordan

1992 = 100

Year	Average	Food	Clothing/ Footwear	Housing	Other goods/services
1991	96.2	96.2	96.2	96.2	96.2
1992	100.0	100.0	100.0	100.0	100.0
1993	103.3	103.3	103.3	103.3	103.3
1994	107.0	107.0	107.0	107.0	107.0
1995	109.5	109.5	109.5	109.5	109.5
1996	116.6	117.1	120.5	115.2	116.0
1997	120.1	124.9	116.2	116.1	118.1
1998	123.8	129.9	120.7	118.2	121.2
1999	124.5	128.7	127.1	119.1	123.7
Average annual growth rate (%)	3.28 %	3.71 %	3.54 %	2.71 %	3.19 %

Source : Monthly Statistical Bulletin Vol.32 No.6, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.35 No.12, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.36 No.5, Central Bank of Jordan.

The Government of Jordan controls prices of bread and over the past ten years, bread produced from Jordanian wheat is priced at Fils.85 per kg, while that from a mixture of Jordanian and imported wheat is Fils.120 per kg and that from wholly imported wheat is Fils.150 per kg. On August 13, 1996, the Government announced increases in prices of bread produced from Jordanian wheat at Fils.180 per kg, from a mixture of Jordanian and imported wheat at Fils.220 per kg. and that from wholly imported wheat at Fils.250 per kg. The increase rate in bread prices is approximately 2 times that of the average. The grain

mainly used in Jordan is wheat, with bread being the staple food. The government has subsidized expenditure for bread but even if the people receive such subsidy from the government, the increase of prices for bread will influence the prices for the other commodities.

2.7.2 Exchange Rate

The fluctuation of exchange rates with US Dollars and Japanese Yen during the period from 1991 to 1998 is shown in Table B of the said Appendix 2.16 and summarized in Table 2.7-2 hereunder.

Table 2.7-2 Exchange Rates

Mid-rate (Unit : Fils)

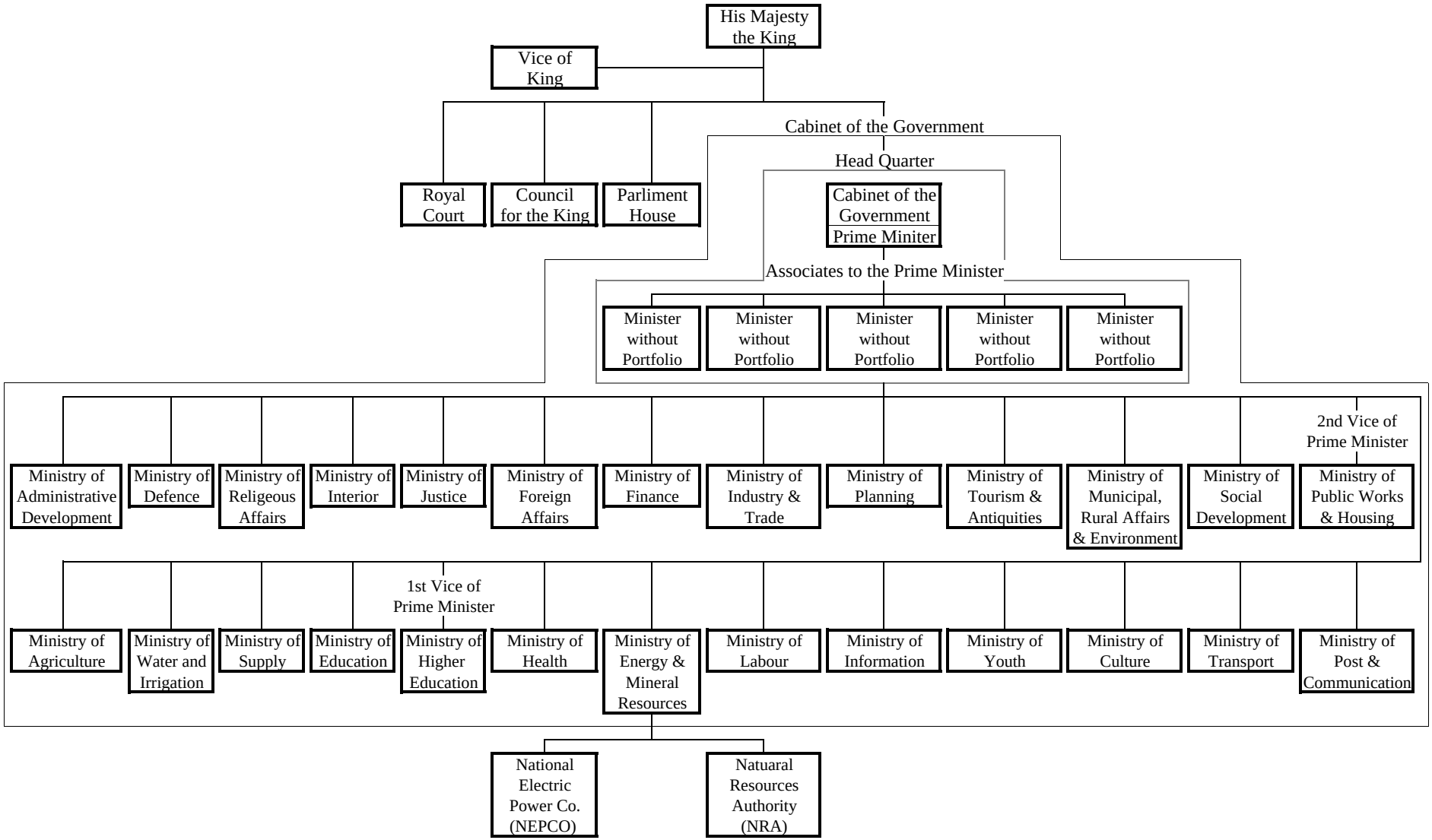
Currency	1991	1992	1993	1994	1995	1996	1997	1998	1999	Annual average decrease (%)
US Dollars (US$1)	680.9	679.8	679.8	698.8	700.8	709.2	709.2	709.2	709.2	0.51%
J. Yen (Yen100)	506.4	537.4	625.0	684.5	749.1	651.9	586.9	542.2	623.1	2.63%

Source : Monthly Statistical Bulletin Vol.32 No.6, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.35 No.12, Central Bank of Jordan.
Monthly Statistical Bulletin Vol.36 No.5, Central Bank of Jordan.

(Note) Mid-rate of the year.

The exchange rate of Jordan Dinar against US Dollars has been constantly decreased from 1991 to 1995. However, since 1996 it has been static as a rate of Fils709.2 per US$1.00 until 1999. Its annual average decease rate was 0.51 % since 1991 until 1999. While the its exchange rate against Japanese Yen has been fluctuated during these 9 years reflecting the fluctuation of Japanese Yen against US Dollars. However, from the viewpoint of annual average, Jordan Dinar has been annually decreased with the rate of 2.63 % against Japanese Yen.

Appendix 2.1 Organization of the Government of Jordan



Source : Statistical Year Book 1994, Department of Statistics.

Appendix 2.2 Area and Population in the Nation by Census

Governorate/Sub-District	Area	Population as of 1994[1)]	Population as of 1999[2)]	Growth ratio per/yr	Number of households					Population density	
					As of 1994	As of 1997*	Annual increase	Estimated at 1998	Family size per HH	as of 1994[1]	as of 1999[2]
	(km^2)	(persons)	(persons)	(%)	(HHs)	(HHs)	(%)	(HHs)	as of 1999	(persons/ $k m^2$)	(persons/ $k m^2$)
Amman Governorate	8,231	1,574,809	1,864,450	3.43%	271,604	286,719	1.82%	291,942	6.39	191	227
Amman City		713,993	842,730	3.37%							
Marqa		263,474	320,690	4.01%							
Quaismeh		140,709	162,200	2.88%							
Al-Jami'ah		189,376	225,600	3.56%							
Wadi Essier		132,195	152,890	2.95%							
Sahab		46,692	55,930	3.68%							
Muaqqar		18,963	22,370	3.36%							
Jizah		32,446	39,160	3.83%							
Na'oor		36,961	42,880	3.02%							
Balqa Governorate	1,076	280,537	321,440	2.76%	43,575	47,140	2.66%	48,392	6.64	261	299
Sult Qasabah		105,096	120,540	2.78%							
Dair Alla		43,993	50,150	2.65%							
Shoonah Janoobiyah		33,598	38,570	2.80%							
Ain Albasha		97,850	112,180	2.77%							
Zarqa Governorate	4,080	640,094	770,770	3.79%	101,847	107,206	1.72%	109,054	7.07	157	189
Zarqa		424,765	511,790	3.80%							
Russeifa		215,329	258,980	3.76%							
Madaba Governorate	2,008	103,183	124,950	3.90%	16,375	17,558	2.35%	17,971	6.95	51	62
Madaba Qasabah		79,686	96,460	3.89%							
Dieban		23,497	28,490	3.93%							
Irbid Governorate	1,621	747,179	874,160	3.19%	117,507	123,109	1.56%	125,035	6.99	461	539
Irbid		324,980	380,260	3.19%							
Bani Obeid		75,763	88,290	3.11%							
Mazzar Shamali		35,651	41,960	3.31%							
Koorah		71,513	83,920	3.25%							
Bani Kenanah		62,221	72,560	3.12%							
Ramtha		79,304	92,660	3.16%							
Aghwar Shamaliyah		73,900	86,540	3.21%							
Taybeh		23,847	27,970	3.24%							
Mafraq Governorate	26,435	178,856	225,890	4.78%	26,055	26,918	1.09%	27,212	8.30	7	9
Mafraq		131,020	165,350	4.76%							
Badia Shamaliyah		47,836	60,540	4.82%							
Ajloun governorate	412	94,548	108,780	2.84%	14,776	16,505	3.76%	17,125	6.35	229	264
Ajloun		94,548	108,780	2.84%							
Jarash Governorate	402	123,190	144,060	3.18%	18,792	20,936	3.67%	21,704	6.64	306	358
Jarash		123,190	144,060	3.18%							
Karak Governorate	3,217	169,770	196,980	3.02%	26,330	27,344	1.27%	27,691	7.11	53	61
Karak		69,674	68,160	-0.44%							
Aghwar Janoobiyah		28,030	32,500	3.00%							
Mazar Janoobiyyah**		44,964									
Ayy Qasabah**			12,600	7.58%							
Mazar Qasabah**			52,200								
Qasr		27,102	31,520	3.07%							
Tafiela Governorate	2,114	62,783	74,480	3.48%	9,830	9,854	0.08%	9,862	7.55	30	35
Tafiela		62,783	74,480	3.48%							
Ma'an Governorate	33,163	79,670	95,550	3.70%	12,025	12,276	0.69%	12,361	7.73	2	3
Ma'an		51,676	62,010	3.71%							
Shobak		10,062	12,040	3.65%							
Wadi Moosa Qasabah		17,932	21,500	3.70%							
Aqaba Governorate	6,583	79,839	98,490	4.29%	13,756	13,612	-0.35%	13,564	7.26	12	15
Aqaba		67,103	82,730	4.28%							
Quairah		12,736	15,760	4.35%							
Total	89,342	4,134,458	4,900,000	3.46%	672,472	709,177	1.79%	721,852	6.79	46	55

Source :
1) Statistical Year Book 1994, Department of Statistics, October 1995.
2) Statistical Year Book 1999, Department of Statistics, July 2000 (Draft).
3) Summary Results for Localities in Jordan, the Housing and Population Census 1994, Department of Statistics, May 1998.
(Note)
* : Household Expenditure and Income Survey 1997, Department of Statistics, March 1999.
** : Mazar Janoobiyah District was divided into two districts as Ayy Qasabah and Mazar Qasabah since 1994.

Appendix 2.3 Population Projection of the Whole Nation since 1980

(1,000 persons)

Year	Male	Female	Total	Growrh R against previous year (%)
1980	1,164.0	1,069.0	2,233.0	4.69%
1981	1,209.0	1,110.0	2,319.0	3.85%
1982	1,256.0	1,153.0	2,409.0	3.88%
1983	1,304.0	1,198.0	2,502.0	3.86%
1984	1,355.0	1,244.0	2,599.0	3.88%
1985	1,408.0	1,292.0	2,700.0	3.89%
1986	1,463.0	1,342.0	2,805.0	3.89%
1987	1,520.0	1,394.0	2,914.0	3.89%
1988	1,579.0	1,448.0	3,027.0	3.88%
1989	1,640.0	1,504.0	3,144.0	3.87%
1990	1,809.0	1,659.0	3,468.0	10.31%
1991	1,931.0	1,770.0	3,701.0	6.72%
1992	2,006.0	1,838.0	3,844.0	3.86%
1993	2,084.0	1,909.0	3,993.0	3.88%
1994	2,160.7	1,978.7	4,139.4	3.67%
1995	2,240.0	2,051.0	4,291.0	3.66%
1996	2,319.8	2,124.2	4,444.0	3.57%
1997	2,404.4	2,195.6	4,600.0	3.51%
1998	2,485.8	2,269.9	4,755.7	3.38%
1999	2,562.2	2,337.8	4,900.0	3.03%
Annual average population growth of the nation since 1980:			4.22%	

Source:

Statistical Year Book, 1998, Department of Statistics of the Hashemite Kingdom of Jordan, June 1999.

Appendix 2.4 Labour Force Estimates in Jordan

A. By Major Economic Activities

Major economic activities	As of 1993 (persons)		As of 1997 (persons)	
	Labour force	Share rate (%)	Labour force	Share rate (%)
Agriculture	54,995	6.4%	59,558	6.1%
Mining and Manufacturing	91,086	10.6%	150,666	15.4%
Electricity and water	6,015	0.7%	14,803	1.5%
Construction	60,151	7.0%	95,035	9.7%
Trade	129,754	15.1%	170,011	17.3%
Transport and communication	57,573	6.7%	85,416	8.7%
Financial and insurance services	24,920	2.9%	16,142	1.6%
Social and administration service	434,806	50.6%	389,495	39.7%
Total	859,300	100.0%	981,126	100.0%

Source : Statistical Year Book 1994, and Household Expenditure and Income Survey 1997, Dep. of Statistics.

B. By Occupation Groups

Major economic activities	As of 1993 (persons)		As of 1997 (persons)	
	Labour force	Share rate (%)	Labour force	Share rate (%)
Specialists and technicians	158,970	18.5%	214,679	21.9%
Administrators	20,623	2.4%	24,320	2.5%
Clerks	66,176	7.7%	69,396	7.1%
Salesmen	76,478	8.9%		
Services	41,246	4.8%	125,975	12.8%
Agricultures	48,121	5.6%	54,988	5.6%
Productive workers and others	447,686	52.1%	491,769	50.1%
Total	859,300	100.0%	981,127	100.0%

Source : Statistical Year Book 1994, and Household Expenditure and Income Survey 1997, Dep. of Statistics.

Appendix 2.5 Gross Domestic Product (GDP) in Jordan

(Million Jds.)

No	Economic activity	At current prices: Gross Domestic Product (GDP) at current prices										Share rate as of 1998	Annual growth	At constant prices: Gross Domestic Product (GDP) at 1985 constant prices										Share rate as of 1997	Annual growth
		1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	(%)	rate(%)	1989	1990	1991	1992	1993	1994	1995	1996	19997	1998	(%)	rate(%)
A	Industry of origin																								
1	Agriculture, hunting, forestry and fishery	139.8	187.8	213.5	246.9	193.3	193.2	171.8	160.7	147.5	141.7	2.74%	0.15%	124.4	163.1	178.7	209.6	154.3	140.0	138.0	146.9	124.9	135.4	4.82%	0.95%
2	Mining and quarrying	154.5	148.8	124.9	130.5	106.9	102.4	157.7	166.0	169.2	169.7	3.28%	1.05%	77.4	63.6	54.1	53.5	47.4	47.6	68.2	68.8	72.5	68.2	2.43%	-1.40%
3	Manufacturing	254.7	345.3	343.7	406.3	427.3	561.4	579.7	528.6	592.1	609.8	11.77%	10.19%	204.4	224.0	220.7	263.7	261.9	336.8	340.3	309.7	323.5	332.6	11.83%	5.56%
4	Electricity and water	52.7	53.9	62.0	66.6	78.7	84.0	98.1	104.1	117.4	119.9	2.31%	9.56%	69.4	53.3	56.2	58.7	67.1	70.2	82.1	85.1	91.2	91.1	3.24%	3.07%
5	Construction	101.5	105.6	125.7	215.3	283.7	299.4	297.5	252.5	222.0	193.1	3.73%	7.41%	86.1	80.7	89.2	38.6	174.1	194.5	196.0	183.5	163.4	138.0	4.91%	5.38%
6	Wholesale and retail trade, restaurants and hotels	180.7	216.8	254.7	278.7	317.2	377.0	414.6	469.3	517.0	549.5	10.61%	13.15%	77.1	57.7	59.0	65.4	82.4	101.2	108.5	115.9	136.1	113.5	4.04%	4.39%
7	Transport, storage and communications	359.1	362.0	382.7	450.0	487.1	520.1	572.3	630.4	659.3	704.4	13.60%	7.77%	279.9	270.2	255.1	278.5	289.9	301.6	328.0	355.2	360.0	403.2	14.34%	4.14%
8	Finance, insurance, real estate and business services	413.8	407.0	472.2	520.4	622.7	658.9	721.7	754.0	778.2	830.1	16.03%	8.04%	363.8	335.5	369.6	386.2	440.9	471.7	499.0	508.0	517.5	529.1	18.82%	4.25%
9	Community, social and personal services	45.6	51.1	66.2	86.9	88.8	109.6	128.6	147.3	155.8	192.0	3.71%	17.32%	29.8	30.9	40.1	49.6	50.6	60.5	68.4	73.0	77.4	93.3	3.32%	13.52%
	Total	######	######	######	######	######	######	######	######	######	######	67.76%	8.37%	######	1,279.0	######	######	######	######	######	######	######	######	67.74%	4.22%
B	Producers of Government Services	431.3	449.1	474.4	554.7	619.1	666.9	756.4	827.3	890.8	942.7	18.20%	9.08%	388.2	386.1	392.6	415.3	451.6	464.6	481.1	494.5	509.2	512.0	18.21%	3.12%
C	Producers of Private Non-Profit Services to Household	25.2	30.8	34.0	39.2	38.9	47.0	50.4	51.4	52.8	55.7	1.08%	9.21%	20.1	22.0	23.1	25.3	24.4	28.8	29.8	29.8	29.5	30.2	1.07%	4.63%
D	Domestic Services of Households	6.0	6.2	5.3	7.2	7.6	6.0	5.9	5.3	5.2	6.6	0.13%	1.06%	4.0	3.6	3.1	4.2	4.4	3.6	3.6	3.5	3.1	4.0	0.14%	0.00%
	Total of non-monetary terms (B+C+D)	462.5	486.1	513.7	601.1	665.6	719.9	812.7	884.0	948.8	######	19.40%	9.01%	412.3	411.7	418.8	444.8	480.4	497.0	514.5	527.8	541.8	546.2	19.43%	3.17%
	Total (A + B + C + D)	######	######	######	######	######	######	######	######	######	######	87.17%	8.51%	######	1,690.7	######	######	######	######	######	######	######	######	87.16%	3.98%
-	Less : Imputed bank service charge	-55.3	-39.9	-53.7	-41.8	-66.4	-73.9	-75.0	-77.2	-81.0	-107.5	-2.08%	7.67%	-44.1	-28.5	-36.5	-27.0	-41.6	-45.3	-44.4	-44.7	-45.2	-58.3	-2.07%	3.15%
	GDP at factor cost	######	######	######	######	######	######	######	######	######	######	85.09%	8.53%	######	1,662.2	######	######	######	######	######	######	######	######	85.09%	4.00%
+	Indirect taxes less subsidies	262.5	343.8	349.5	532.1	653.8	694.9	681.1	691.8	719.6	772.3	14.91%	12.74%	209.1	245.8	237.8	343.5	409.6	425.7	403.5	400.5	401.5	419.2	14.91%	8.03%
	GDP at producers prices	######	######	######	######	######	######	######	######	######	######	100.00%	9.07%	######	1,908.0	######	######	######	######	######	######	######	######	100.00%	4.51%
+	Net factor income from abroad	-191.4	-239.5	-221.1	-186.2	-149.1	-151.4	-116.8	-112.3	-47.4	-5.8	-	-												
	Gross National Product (GNP) at Market Prices	######	######	######	######	######	######	######	######	######	######														
	Population	3,144.0	3,468.0	3,701.0	3,844.0	3,993.0	4,139.4	4,291.0	4,444.0	4,600.0	4,755.7														
	GNP per Capita at Market Price in Jordan Dinar (JI	693.6	700.3	711.7	860.2	929.0	989.4	######	######	######	######														

Source:

Statistical Yearbook 1994, Department of Statistics of the Hashemite Kingdom of Jordan, October 1995.

Statistical Yearbook 1999, Department of Statistics of the Hashemite Kingdom of Jordan, July 2000 (Draft).

Appendix 2.6 Summary of Central Government Budget During 1990 - 1994

(Million JDs)

Items of revenues and expenditures	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Revenues	908.3	1,054.0	1,306.3	1,354.8	1,421.9	1,620.6	1,650.5	1,620.1	1,688.0	1,788.2
Domestic revenue	744.0 *	828.8 *	1,168.9 *	1,191.5 *	1,246.4	1,450.9	1,430.6	1,395.1	1,485.0	1,589.7
Direct tax revenues	176.8	169.3	214.5	231.4	188.4	214.3	237.9	210.0	180.0	215.3
Income and profit taxes	114.0	92.8	109.5	118.8	136.6	152.4	173.0	150.0	140.0	152.8
Other taxes	62.8	76.5	105.0	112.6	51.8	61.9	64.9	60.0	40.0	62.5
Indirect tax revenues	315.3	361.2	600.2	587.3	628.2	684.5	752.6	753.0	830.2	843.7
Custom duties	116.7	136.1	286.4	237.7	216.9	203.9	219.3	240.0	288.2	274.0
Sales taxes (consumption taxes)	90.4	96.1	138.4	174.3	222.4	263.6	310.0	315.0	350.0	372.5
Licences	36.3	45.6	70.5	62.0	63.4	65.7	72.1	32.0	24.0	24.9
Fees	71.9	83.4	104.9	113.3	125.5	151.3	151.2	166.0	168.0	172.3
Non-tax revenues	251.9	298.3	354.2	372.8	429.8	552.1	440.1	432.1	474.8	530.7
Post, teregrams and telecommunications	75.0	86.9	120.3	135.9	154.3	158.3	6.4	6.0	5.0	6.2
Interest and profits	86.4	69.0	67.1	64.5	43.0	38.7	30.0	19.0	9.0	197.4
Other revenues	90.5	142.4	166.8	172.4	232.5	355.1	403.7	407.1	460.8	327.1
External aid	164.3	225.2	137.4	163.3	175.5	169.7	219.9	225.0	203.0	198.5
Expenditures	1,032.6	1,099.6	1,177.7	1,336.6	1,524.2	1,697.5	1,799.0	1,773.0	2,055.1	2,007.1
Current	841.4	904.0	929.5	1,044.3	1,251.5	1,369.1	1,449.2	1,487.0	1,644.6	1,642.8
Civil	586.7	634.3	656.7	744.8	903.3	973.8	1,018.2	1,042.0	1,198.6	1,196.1
Military	254.7	269.7	272.8	299.5	348.2	389.9	417.2	444.0	491.0	512.0
Capital	191.2	195.6	248.2	292.3	272.7	333.8	363.6	287.0	365.5	299.0
Pre-financing deficit/surplus	-124.3	-45.6	128.6	18.2	-102.3	-76.9	-148.5	-152.9	-367.1	-218.9
Sources of financing										
External financing										
External loans	197.9	336.7	328.4	130.3	308.3	-	-	-	-	-
Repayments	68.2	125.3	119.8	263.5	348.0	-	-	-	-	-
Net external financing	129.7	211.4	208.6	-133.2	16.6	186.1	168.6	-2.6	-46.0	123.8
Domestic financing										
Domestic loans	33.6	2.3	0.0	0.0	0.0	-	-	-	-	-
Repayments	19.2	9.4	51.2	47.7	15.5	-	-	-	-	-
Net domestic financing	14.4	-7.1	-51.2	-47.7	-55.2	-34.6	-86.0	60.4	321.0	69.4
Post financing deficit/surplus	19.8	158.7	286.0	-162.7	-140.9	74.6	-65.9	-95.1	-92.1	-25.7

Source : Statistical Year Book 1994, Department of Statistics.
Statistical Year Book 1999, Department of Statistics (Draft).

(Note) * : Excerpts from Monthly Statistical Bulletin Vol.31 No.12, December 1995, Department of Research and Studies, Central Bank of Jordan.
- : Not mentioned clearly in the above data.

Appendix 2.7 External Trade Situation Since 1967

(thousand JDs.)

Year	Export	Import	Trade balance
1967	11,327	55,048	-43,721
1968	14,263	57,492	-43,229
1969	14,749	67,752	-53,003
1970	12,170	65,882	-53,712
1971	11,441	76,627	-65,186
1972	17,006	95,310	-78,304
1973	18,985	108,248	-89,263
1974	49,752	156,607	-106,855
1975	48,938	234,013	-185,075
1976	69,445	339,495	-270,050
1977	82,100	454,518	-372,418
1978	90,911	458,943	-368,032
1979	120,907	585,666	-464,759
1980	171,576	715,977	-544,401
1981	242,633	1,047,505	-804,872
1982	264,528	1,142,493	-877,965
1983	210,575	1,103,310	-892,735
1984	290,657	1,071,340	-780,683
1985	310,888	1,074,445	-763,557
1986	256,028	850,199	-594,171
1987	315,709	915,555	-599,846
1988	381,271	1,021,667	-640,396
1989	632,988	1,230,142	-597,154
1990	706,087	1,725,828	-1,019,741
1991	770,744	1,710,463	-939,719
1992	829,303	2,214,002	-1,384,699
1993	864,662	2,453,625	-1,588,963
1994	995,181	2,362,583	-1,367,402
1995	1,241,133	2,590,250	-1,349,117
1996	1,288,172	3,043,557	-1,755,385
1997	1,301,389	2,908,085	-1,606,696
1998	1,277,899	2,714,374	-1,436,475
1999	1,298,717	2,635,207	-1,336,490

Source : Statistical Year Book 1994, Department of Statistics.
Statistical Year Book 1999, Department of Statistics (Draft).

Appendix 2.8 International Balance of Payment in Cash Basis

(Million JDs)

Items	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999	
	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit	Credit	Debit
A. Current Account	2,457.8	2,606.0	2,415.8	2,684.8	2,749.0	3,269.6	3,022.5	3,347.5	3,127.9	3,407.1	3,619.6	3,799.4	4,060.3	4,217.7	4,176.1	4,155.3	4,086.5	4,071.0	4,257.9	4,013.7
1) Goods and Services	2,043.3	2,600.9	2,075.7	2,681.8	2,463.2	3,262.8	2,744.8	3,341.0	2,900.3	3,407.1	3,391.3	3,786.4	3,771.2	4,203.3	3,882.3	4,142.5	3,827.1	4,071.0	3,863.7	4,013.7
Goods	706.1	1,714.7	770.7	1,764.8	829.3	2,291.0	864.7	2,449.9	995.2	2,357.6	1,241.1	2,588.2	1,288.2	3,041.6	1,301.4	2,906.5	1,277.9	2,712.4	1,263.9	2,630.6
Services	1,337.2	886.2	1,305.0	917.0	1,633.9	971.8	1,880.1	891.1	1,905.1	1,049.5	2,150.2	1,198.2	2,483.0	1,161.7	2,580.9	1,236.0	2,549.2	1,358.6	2,599.8	1,383.1
Trade Balance		1,008.6		994.1		1,461.7		1,585.2		1,362.4		1,347.1		1,753.4		1,605.1		1,434.5		1,366.7
Services Balance	451.0		388.0		662.1		989.0		855.6		952.0		1,321.3		1,344.9		1,190.6		1,216.7	
Trade and Services Balance		557.6		606.1		799.6		596.2		506.8		395.1		432.1		260.2		243.9		
2) Unrequited Transfers	414.5	5.1	340.1	3.0	285.8	6.8	277.7	6.5	227.6	0.0	228.3	13.0	289.1	14.4	293.8	12.8	259.4	0.0	394.2	0.0
Private	24.0	5.1	17.6	3.0	22.9	6.8	30.8	6.5	1.3 *			13.0 *		14.4 *		12.8 *	13.2 *		117.8 *	
Government	390.5	0.0	322.5	0.0	262.9	0.0	246.9	0.0	226.3 *		228.3 *		289.1 *		293.8 *		246.2 *		276.4 *	
Net Unrequited transfers	409.4		337.1		279.0		271.2		227.6		215.3		274.7		281.0		259.4		394.2	
Net Current Account		148.2		269.0		520.6		325.0		279.2		179.8		157.4	20.8		15.5		244.2	
B. Capital Account	533.1	179.2	962.4	229.2	844.1	360.4	493.7	387.1	350.6	382.9	523.9	538.1	481.2	572.1	540.3	367.2	498.5	598.1	492.1	294.8
1) Public Sector	412.8	179.1	413.2	211.6	305.7	343.7	120.6	360.5	169.2	382.9	357.4	372.7	327.7	387.6	168.3	328.4	227.7	293.2	259.2	294.8
Assets	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-	-	-	-	-	-	-	-	-	-	-	-
Liabilities	412.8	179.1	413.2	211.6	305.7	343.7	120.6	360.3	-	-	-	-	-	-	-	-	-	-	-	-
2) Private Long-term Investment	0.0	0.1	0.0	9.5	0.0	5.0	0.0	0.2												
Assets	0.0	0.1	0.0	9.5	0.0	5.0	0.0	0.2	(All private sectors were compounded since											
Liabilities	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0												
3) Private Short-term Investment	45.8	0.0	0.2	8.1	47.1	11.7	40.5	26.4	176.1 *		166.5 *		153.5 *		372.0 *		270.8 *		168.9 *	
Assets	20.9	0.0	0.2	0.0	7.3	0.0	37.4	0.2												
Liabilities	24.9	0.0	0.0	8.1	39.8	11.7	3.1	26.2												
4) Transfers of Worker's Savings	74.5	0.0	549.0	0.0	491.3	0.0	332.6	0.0												
5) Omissions and errors									5.3			165.4		184.5		38.8		304.9	64.0	
Net Capital Account	353.9		733.2		483.7		106.6			32.3		14.2		90.9	173.1			99.6	197.3	
Overall Balance (A + B)	205.7		464.2			36.9		218.4		311.5		194.0		248.3	193.9			84.1	441.5	
C. Reserves	8.2	276.9	807.5	1,541.6	337.9	371.1	213.9	179.8												
1) Central Bank	0.0	40.7	0.0	578.3	0.4	52.0	46.5	0.0	(1) 39.5		74.3		68.7		78.7		15.8		27.6	
Assets	0.0	40.7	0.0	578.3	0.0	52.0	46.0	0.0	(2) 9.2		10.3		3.8		19.3		6.9			10.2
Liabilities	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.0	(3) 296.5		305.5		263.3		207.2		188.9		197.7	
2) Commercial Banks	0.0	232.6	800.6	961.3	336.1	317.8	163.1	178.6												
Assets	0.0	187.5	0.0	961.3	0.0	317.8	163.1	0.0	(Changed the format since 1994)											
Liabilities	0.0	45.1	800.6	0.0	336.1	0.0	0.0	178.6												
3) Financial Institutions	8.2	3.6	6.9	2.0	1.4	1.3	4.3	1.2												
Assets	8.2	0.0	6.9	0.0	1.4	0.0	4.3	0.0												
Liabilities	0.0	3.6	0.0	2.0	0.0	1.3	0.0	1.2												
Net Reserves		268.7		734.1		33.2	34.1			33.7		196.1		87.5	499.1			127.5	656.6	

Source :

Monthly Statistical Bulletin, Vol.31 No.12, December 1995, Department of Research and Studies, Central Bank of Jordan.

Monthly Statistical Bulletin, Vol.36 No.5, May 2000, Department of Research and Studies, Central Bank of Jordan.

(Note) * : Net.

(1) IMF (net).

(2) AMF (net).

(3) Exceptional financing.

Appendix 2.9 Commodities of Exports and Imports in Jordan

(Million JDs)

Commodities	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Share rate as of 1999 (%)	Growth rate (%)
Exports	706	768	830	864	994	1,245	1,312	1,322	1,339	1,332	100.00%	7.31%
Domestic Exports	612	597	634	691	793	1,008	1,064	1,088	1,107	1,085	81.43%	6.57%
Food and Live Animals	60	86	92	140	91	100	160	181	164	127	9.54%	8.70%
Live animals	1	9	15	18	13	15	63	72	34	24	1.82%	
Dairy products and eggs	10	7	15	38	3	3	3	7	10	7	0.53%	
Wheat and flour of wheat	1	0	0	0	0	0	0	1	0	0	0.00%	
Vegitables	37	44	40	48	44	54	65	70	88	66	4.99%	
Fruits and nuts	8	11	10	21	21	14	17	22	18	12	0.88%	
Fodder	0	5	6	5	2	1	1	1	5	8	0.59%	
Beverages and Tobacco	4	7	5	4	4	5	4	4	6	3	0.23%	-3.10%
Cigarettes	2	4	3	1	11	0	0	2	5	2	0.14%	
Crude Materials, Inedible, except fuels	235	228	218	193	208	260	285	259	269	282	21.17%	2.05%
Phosphates	139	123	122	98	100	105	127	135	140	133	9.95%	
Potash	89	97	86	86	93	122	126	99	112	126	9.45%	
Mineral Fuels, Lubricants and related Materials	0	0	0	0	0	0	26	38	64	68	5.10%	
Animal and Vegitable Oils and Fats	1	2	2	2	63	147	64	69	60	45	3.38%	52.66%
Olive oils	1	0	0	1	0	0	0	0	0	2	0.15%	
Chemicals	189	177	197	195	262	302	331	335	322	307	23.01%	5.52%
Paints	6	4	3	5	4	8	7	7	8	7	0.56%	
Medicaments	40	35	55	70	91	87	104	132	101	100	7.51%	
Detergents and soup	14	13	35	36	27	33	25	38	39	33	2.48%	
Fertilizers	79	86	72	56	89	113	129	96	104	78	5.86%	
Manufactured Goods Classified by Material	78	63	67	81	86	97	119	110	100	107	8.06%	3.62%
Articles of wood	2	0	0	0	0	0	0	0	0	0	0.01%	
Paper and cardboard	8	8	6	13	12	14	22	26	30	32	2.38%	
Textile yarn, fablics, made-up articles and related products	19	12	15	19	21	23	25	25	23	25	1.88%	
Cemet	22	26	22	17	27	30	41	33	16	17	1.24%	
Machinery and Transport Equipment	14	7	12	24	39	49	24	35	44	69	5.15%	19.33%
Misceloneous Manufactured Articles	31	27	41	52	40	48	51	57	78	77	5.78%	10.63%
Clothes	7	9	9	13	13	17	24	26	33	35	2.61%	
Plastic products	4	6	10	15	11	7	5	6	6	10	0.75%	
Commodities and Transactions not Classified Elsewhere	0	0	0	0	0	0	0	0	0	0	0.01%	
Re-Export	94	171	196	173	201	237	248	234	232	247	18.57%	11.35%
Consumer Goods	15	60	62	38	43	-	-	-	-	-	-	
Current consumer goods	8	48	44	26	26	-	-	-	-	-	-	
Durable consumer goods	7	12	18	12	17	-	-	-	-	-	-	
Crude Materials and Intermediate Goods	12	58	73	57	47	-	-	-	-	-	-	
Construction materials	1	1	1	1	1	-	-	-	-	-	-	
Other Intermediate goods	11	57	72	56	46	-	-	-	-	-	-	
Parts and accesories	23	23	32	43	64	-	-	-	-	-	-	
Capital Goods	20	30	23	35	44	-	-	-	-	-	-	
Other Goods not Classified Elsewhere	24	0	6	0	3	-	-	-	-	-	-	
Import	1,726	1,712	2,215	2,456	2,364	2,590	3,045	2,907	2,716	2,639	100.00%	4.83%
Food and Live Animals	404	418	416	435	410	419	686	540	528	483	18.30%	2.01%
Live animals	21	37	26	28	31	30	27	26	13	24	0.92%	
Meat	35	56	50	58	43	29	38	39	36	30	1.13%	
Dairy products and eggs	28	34	35	41	31	39	60	43	51	41	1.55%	
Wheat and flour of wheat	74	62	54	76	52	41	112	76	86	42	1.57%	
Rice	28	27	21	20	16	22	31	32	25	34	1.28%	
Sugar	54	46	29	33	56	30	60	41	36	30	1.15%	
Fruits, vegitables and nuts	27	33	42	26	28	43	80	69	56	58	2.21%	
Coffee, tea, cocoa and spices	13	14	14	11	15	19	18	23	24	24	0.91%	
Beverages and Tobacco	10	10	9	10	14	10	12	16	23	23	0.87%	9.73%
Crude tobacco	5	5	4	2	5	1	1	2	4	4	0.14%	
Cigarettes	2	3	3	5	7	7	10	12	16	16	0.61%	
Crude Materials, Inedible, Except Fuels	43	59	46	56	72	91	93	84	89	84	3.20%	7.79%
Wood, lumber aznd cork	0	1	2	2	17	19	20	14	16	14	0.54%	
Textile, fablics and their waste	10	11	11	14	14	17	20	20	22	16	0.60%	
Oil seeds, oil nuts and oil kernels	10	8	7	7	6	10	10	11	12	12	0.44%	
Mineral Fuels, Lubricants and Related Materials	312	247	303	315	301	336	373	384	257	331	12.53%	0.65%
Crude oil	236	194	229	237	32	249	260	291	183	232	8.77%	
Animal and Vegitable Oil and Fats	22	24	38	43	83	95	74	97	58	45	1.69%	8.20%
Chemicals	190	219	246	249	280	318	329	338	346	336	12.73%	6.54%
Medical and pharmacu, products	37	39	57	67	67	88	84	92	98	102	3.86%	
Essential oils and perfume materials, polishing and cleaning preps	10	10	17	20	15	17	16	23	23	22	0.82%	
Fertilizers	5	7	12	8	7	8	9	9	11	13	0.48%	
Plastic materials	52	50	61	62	56	56	66	63	62	52	1.98%	
Manufactured Goods Classified by Materials	300	328	445	507	432	504	513	443	436	391	14.81%	2.98%
Rubber products	21	24	31	31	31	31	35	33	29	27	1.02%	
Paper and cardboard	38	43	49	55	47	73	67	59	61	53	2.01%	
Textile yarn, fablics, made-up articles and related products	71	77	94	95	88	89	92	82	90	80	3.04%	
Cement	0	0	0	1	0	0	0	0	0	0	0.00%	
Iron and steel	70	85	134	158	131	147	159	113	108	98	3.72%	
Machinery and Transport Equipment	327	299	544	661	600	635	790	814	776	721	27.32%	9.18%
Electrical and non-electrical machinery	151	149	274	375	361	363	457	464	402	355	13.46%	
Transport equipments and spareparts	177	150	270	285	239	272	333	350	374	366	13.86%	
Misceloneous Manufactured Articles	92	94	151	151	152	147	156	148	175	180	6.83%	7.77%
Furniture	6	2	3	4	6	5	6	6	10	18	0.66%	
Clothing and footwear	21	25	42	42	36	44	42	42	50	53	2.01%	
Scientific instruments, photographic equipments etc.	19	21	40	38	41	36	46	38	48	45	1.70%	
Commodities and Transactions not Classified Elsewhere	26	14	17	29	20	35	19	43	28	45	1.71%	6.31%
Trade balance	-1,020	-944	-1,385	-1,592	-1,370	-1,345	-1,733	-1,585	-1,377	-1,307		

Source :

Monthly Statistical Bulletin. Vol.31 No.12, Central Bank of Jordan, December 1995.

Statistical Year Book 1999, Department of Statistics (Draft).

Appendix 2.10 Industrial Production of Principal Industries in Jordan

Industrial Sector	Unit	1991	1992	1993	1994	1995	1996	1997	1998	1999	Annual avaerage growth rate (%)
Mining and Quarrying											
Phosphate	1,000 tons	4,461	4,296	4,215	4,216	4,983	5,355	5,895	5,925	6,014	3.80%
Potash	1,000 tons	1,364	1,346	1,370	1,550	1,780	1,765	1,416	1,527	1,800	3.53%
Manufacturing											
Tanning and leather											
Upper leather	1,000 ft2	2,264	2,640	2,605	2,156	2,979	1,879	1,993	2,017	-	-1.64% *
Sole leather and wool	tons	34	49	60	52	53	54	47	34	-	0.00% *
Chemicals											
Fertilizers	1,000 tons	602	554	470	750	729	671	711	850	814	3.84%
Chemical acid	1,000 tons	-	-	-	-	1,338	1,262	1,369	1,712	1,689	6.00% **
Construction Materials											
Cement	1,000 tons	2,752	2,746	3,437	3,392	3,415	3,512	3,250	2,650	2,687	-0.30%
Clinker	1,000 tons	-	-	-	-	3,152	2,983	3,055	2,442	2,445	-6.15% **
Petroleum Products	1,000 tons	-	-	-	-	3,101	3,154	3,257	3,237	3,266	1.30% **

Source : Monthly Statistical Bulletin. Vol.31 No.12, Central Bank of Jordan, December 1995.
Statistical Year Book 1998, Department of Statistics.

(Note) *: Since 1991 to 1998.
**: Since 1995 to 1999.
-: Lack of data.

Appendix 2.11 Principal Agricultural Production in Jordan

(1,000 tons)

Kind of production	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	Growth rate (%)
1. Plant Production												
A. Field crops												
Wheat	78.8	54.5	82.9	61.8	75.4	57.1	46.9	58.5	42.7	41.8	36.0	-8.34%
Barley	44.9	20.6	42.4	39.9	68.9	31.8	27.4	31.7	29.2	29.4	27.4	-5.34%
Tobacco	3.7	2.9	2.9	1.3	3.2	3.4	1.5	4.8	1.1	2.7	2.3	-5.15%
Lentils	6.5	1.6	4.1	1.2	2.8	4.8	1.4	2.1	2.0	2.1	1.6	-14.42%
Corn	-	-	-	-	-	5.3	9.4	8.6	9.8	11.0	12.3	
Clover	-	-	-	-	-	6.8	17.5	27.4	48.1	27.3	27.4	
B. Vegetables												
Tomatoes	218.7	250.4	376.9	275.5	490.3	331.5	438.7	439.7	291.3	324.0	299.9	3.57%
Eggplant	72.9	43.8	59.5	61.1	49.4	33.6	37.9	73.4	43.1	39.7	52.9	-3.50%
Cucumbers	68.0	53.1	54.3	56.2	34.2	46.0	35.1	66.4	74.2	62.2	93.3	3.58%
Cauliflower and cabbages	33.6	23.7	44.3	40.9	30.7	27.6	51.8	55.4	42.0	41.0	62.6	7.16%
Melons	87.0	66.7	80.5	94.3	90.3	64.3	145.2	117.8	106.4	124.0	106.8	2.30%
Potatoes	-	-	-	-	-	78.8	48.5	97.5	95.2	94.7	88.1	
Zucchini	-	-	-	-	-	15.5	28.4	36.4	28.3	28.8	37.3	
C. Fruit trees												
Olives	70.8	25.7	63.7	40.6	81.8	31.8	94.1	63.2	88.6	57.1	137.5	7.65%
Grapes	21.5	21.8	45.7	39.1	50.2	35.2	26.4	24.3	21.9	18.3	17.9	-2.02%
Citrus fruits	101.3	166.7	154.1	151.9	160.3	106.8	150.7	105.5	133.1	168.9	161.3	5.30%
Bananas	33.3	13.4	18.9	26.3	11.5	30.3	24.7	29.3	29.1	18.2	24.5	-3.35%
Apple	-	-	-	-	-	17.5	27.8	41.9	32.9	31.0	38.5	
Peech	-	-	-	-	-	5.6	17.2	8.8	7.5	3.8	7.0	
2. Livestock Production												
Red meat	8.3	9.4	10.1	16.8	16.8	18.9	16.1	14.5	16.0	15.5	22.1	18.01%
Poultry meat	68.0	43.0	50.0	60.0	70.0	83.4	94.0	107.0	100.0	98.0	93.1	8.43%
Milk	66.4	69.4	96.4	156.7	156.7	166.6	151.4	147.0	165.1	170.0	170.8	22.88%
Eggs (mill. egg)	380.0	350.0	530.0	710.0	775.0	862.2	871.0	715.0	726.0	954.0	948.1	23.04%

Source : Monthly Statistical Bulletin. Vol.31 No.12, Central Bank of Jordan, December 1995.
Monthly Statistical Bulletin. Vol.35 No.12, Central Bank of Jordan, December 1999.

Appendix 2.12 Situation of Economic Activities by Industrial Origin

As of 1997

Industrial origin	Number of employees (Persons)	Number of enterprises (Firms)	Gross value added (Domestic production) (1,000 JDs)	Inter-mediate consum-ption (1,000 JDs)	Gross output (1,000 JDs)	Net indirect taxes (1,000 JDs)	Depre-ciation (1,000 JDs)	Total fixed capital formation (1,000 JDs)	Compen-sation of employees (1,000 JDs)
Extraction of crude petroleum and natural gas, service activities	74	1	10,195	1,873	12,068	131	826	681	1,214
Other mining and quarrying	8,981	144	192,212	135,911	328,123	33,028	35,745	33,014	54,244
Manufacturing of food products and beverages	20,167	2,112	114,787	435,781	550,568	30,356	28,167	32,776	34,814
Manufacturing of tobacco products	1,052	8	96,380	35,522	131,901	86,990	2,792	6,557	2,669
Manufacturing of textiles	3,487	365	17,061	37,060	54,122	2,924	4,130	1,243	6,123
Manufacturing of wearing apparel dressing and dyeing of fur	6,709	1,599	16,311	22,903	39,213	1,096	1,622	491	6,771
Tanning and dressing of leather manufacturing of luggage	2,419	271	9,463	20,626	30,088	721	1,442	763	3,870
Manufacturing of wood and of products of wood and coke	3,542	1,303	8,243	11,610	19,853	179	1,070	321	3,277
Manufacturing of paper and paper products	3,504	77	21,041	68,821	89,863	5,002	4,597	4,642	9,880
Publishing, printing and recorded media	3,450	226	22,960	32,305	55,265	2,621	5,116	4,173	11,121
Manufacturing of coke, refined petroleum products and nuclear	3,533	1	60,028	408,912	468,940	5,445	4,935	4,286	21,735
Manufacturing of chemicals and chemical products	10,230	228	130,277	407,455	537,732	7,924	24,074	69,356	41,112
Manufacturing of rubber and plastic products	4,750	207	27,268	70,109	97,377	5,246	7,878	2,881	9,178
Manufacturing of other non-metalic mineral products	13,932	2,125	116,086	130,247	246,333	25,911	22,216	14,366	30,099
Manufacturing of basic metals	1,839	36	27,634	79,412	107,045	12,288	3,588	2,941	6,942
Manufacturing of fabricated metal products	11,060	3,118	27,991	58,504	86,495	3,022	5,676	691	12,765
Manufacturing of machinery and equipment N.E.C.	2,895	175	17,197	27,644	44,841	2,142	2,471	442	6,652
Manufacturing of electrical machinery and apparatus N.E.C.	903	28	6,940	24,854	31,793	2,119	1,975	361	2,675
Manufacturing of radio, television and communication	414	3	4,408	22,426	26,834	1,771	1,334	115	508
Manufacturing of medical, precision and optical instruments	524	75	2,018	3,197	5,214	50	635	869	943
Manufacturing of motor vehicles, trailers and semi-trailers	821	33	5,755	10,883	16,638	222	629	103	1,930
Manufacturing of furniture, manufacturing N.E.C.	9,661	2,476	24,050	36,410	60,460	1,201	2,986	248	9,977
Electricity, gas steam and hot water supply	6,043	3	96,878	116,619	213,497	379	40,242	72,713	31,095
Total	119,990	14,614	########	########	########	230,768	204,146	254,033	309,594

Source : Statistical Year Book 1998, Department of Statistics.

Appendix 2.13 Infrastructure in Jordan (1)

(A) Length of Road as of 1994 (km)

Governorat	Highway		Secondary roads		Village roads		Total	
	1994	1999	1994	1999	1994	1999	1994	1999
Amman	314	300	238	216	447	326	999	842
Zarqa	278	292	109	132	175	138	562	562
Balqa	153	165	168	167	286	359	607	691
Irbid	381	231	489	297	421	338	1,291	866
Ma'an	705	531	292	246	217	80	1,214	857
Karak	334	285	214	171	257	216	805	672
Mafrak	484	440	285	274	247	355	1,016	1,069
Tafielah	167	163	104	86	80	129	351	378
Madaba	0	49	0	92	0	125	0	266
Jarash	0	85	0	117	0	113	0	315
Ajilun	0	75	0	153	7	38	7	266
Aqaba	4	295	0	77	0	44	4	416
Total	2,820	2,911	1,899	2,028	2,137	2,261	6,856	7,200

Source : Statistical Year Book 1994 and 1999 (Draft), Dep. of Statistics.

(B) Shipping Activity in Aqaba Port

Year	Loaded goods (tons)	Unloaded goods (tons)	Total handled goods (tons)	Number of vessels (ships)
1979	2,709	2,301	5,010	1,238
1980	3,574	3,024	6,599	1,466
1981	3,530	5,805	9,335	1,744
1982	3,835	7,837	11,673	2,599
1983	5,059	6,099	11,158	2,454
1984	7,158	6,448	13,606	2,329
1985	8,178	6,370	14,548	2,671
1986	9,697	7,153	16,851	2,677
1987	11,272	8,744	20,015	2,555
1988	10,953	9,143	20,096	2,583
1989	9,986	8,695	18,681	2,446
1990	8,872	6,147	15,018	2,222
1991	7,677	5,548	13,225	2,075
1992	7,362	6,022	13,384	2,433
1993	6,381	5,253	11,634	2,490
1994	6,648	3,924	10,572	2,486
1995	6,679	5,077	11,756	2,382
1996	7,396	4,612	12,008	2,735
1997	7,535	4,778	12,313	2,996
1998	7,310	5,334	12,644	2,608
1999	7,480	5,374	12,854	2,351

Source : Statistical Year Book 1994, and Statistical Year Book 1999 (Draft), Dep. of Statistics.

Appendix 2.13 Infrastructure in Jordan (2)

(A) Passengers and Freight Carried by Royal Jordanian Airlines

Year	Freight (tons)	Passengers (1,000 persons)
1979	27,012	1,014
1980	28,959	1,112
1981	37,386	1,443
1982	39,288	1,666
1983	40,096	1,582
1984	37,879	1,347
1985	43,095	1,290
1986	43,301	1,132
1987	48,562	1,120
1988	49,995	1,226
1989	49,715	1,204
1990	53,162	964
1991	41,637	798
1992	44,452	1,110
1993	54,062	1,186
1994	54,549	1,220
1995	66,828	1,277
1996	73,095	1,299
1997	70,679	1,353
1998	62,304	1,187
1999	56,050	1,252

Source : Statistical Year Book 1994, and Statistical Year Book 1999 (Draft), Dep. of Statistics.

(B) Number of Different Mail Service Centers by Governorate

Governorate		Postal agency	Post office counter	Rural post office	Post office	Subscribers office	Total
Amman	1994	55	1	11	68	6	141
	1999	9	1	12	81	6	109
Zarqa	1994	26	0	4	23	0	53
	1999	4	2	4	25	0	35
Irbid	1994	49	0	5	106	1	161
	1999	13	0	5	108	0	126
Mafrak	1994	39	0	5	35	10	89
	1999	1	0	4	38	10	53
Balqa	1994	45	5	2	32	4	88
	1999	8	7	5	37	0	57
Tafielah	1994	31	0	0	17	0	48
	1999	11	0	0	17	0	28
Ma'an	1994	23	2	0	36	4	65
	1999	2	1	0	36	4	43
Karak	1994	80	1	7	53	5	146
	1999	6	1	7	55	5	74
Aqaba	1994	2	2	0	8	1	13
	1999	0	3	0	11	1	15
Madaba	1994	28	0	2	21	3	54
	1999	3	0	2	19	3	27
Jarash	1994	28	1	5	15	0	49
	1999	1	1	5	20	0	27
Ajilun	1994	11	0	1	16	1	29
	1999	11	0	0	18	1	30
Total	1994	417	12	42	430	35	936
	1999	69	16	44	465	30	624

Source : Statistical Year Book 1994, and Statistical Year Book 1999 (Draft), Dep. of Statistics.

Appendix 2.13 Infrastructure in Jordan (3)

Number of Hotels and Their Facilities
by City or Archaeological Place

	Employees		Beds		Rooms		Hotels	
	1994	1999	1994	1999	1994	1999	1994	1999
Classified Hotels								
Amman	3,482	5,947	9,362	17,296	5,092	9,326	84	167
Aqaba	807	1,037	2,878	3,731	1,421	1,832	26	33
Petra	175	1,159	395	3,182	169	1,614	4	24
Ma'an	0	0	0	0	0	0	0	0
Karak	15	53	39	92	13	48	1	3
Ajilun	27	19	56	70	28	35	2	2
Irbid	97	78	356	448	172	200	4	6
Dibeen	8	0	16	0	8	0	1	0
Al Ruweshed	0	0	0	0	0	0	0	0
Zarqa	15	14	145	129	55	55	2	2
Azraq	25	31	112	88	44	44	2	2
Shuneh Janoobiyye	0	389	0	714	0	366	0	3
Jarash	0	22	0	54	0	28	0	2
Ramtha	0	0	0	0	0	0	0	0
Mafrak	0	0	0	0	0	0	0	0
Hemma	17	4	80	27	37	13	2	1
Ma'in	160	54	280	436	142	206	1	1
Fhais	0	6	0	28	0	14	0	1
Total	4,828	8,813	13,719	26,295	7,181	13,781	129	247
Non-classified Hotels								
Amman	338	361	2,578	3,652	1,058	1,583	91	114
Aqaba	33	29	371	429	147	179	9	9
Petra	19	67	141	519	63	261	6	17
Ma'an	7	8	71	90	27	37	4	4
Karak	9	16	65	134	28	62	3	4
Ajilun	0	0	0	0	0	0	0	0
Irbid	12	13	111	153	41	65	4	5
Dibeen	0	0	0	0	0	0	0	0
Al Ruweshed	3	14	47	59	20	28	2	3
Zarqa	20	18	150	184	60	71	8	8
Azraq	6	6	64	72	25	29	1	2
Shuneh Janoobiyye	3	2	18	18	6	6	0	1
Ramtha	0	0	0	0	0	0	0	0
Mafrak	5	4	34	36	14	12	2	2
Hemma	0	0	0	0	0	0	0	0
Shuneh Shamaliyyeh	7	16	20	48	10	30	1	1
Tafielah	0	2	0	32	0	15	0	2
Madaba	0	9	0	44	0	22	0	3
Total	462	565	3,670	5,470	1,499	2,400	131	175

Source : Statistical Year Book 1994 and 1999 (Draft), Dep. of Statistics.

Appendix 2.14 Average Annual Current Income per Household by Economic Activity and Source of Income

(A) Basic Conditions of Household Expenditure and Income Suvey

Economic activities of household head	Year	Number of samples: Samples (HHs)	Number of samples: Share rate (%)	Persons per HHs	HHs size (persons/ HH)	Persons by economic activities (above 13 year): (persons)	Persons by economic activities (above 13 year): Share(%)
Agriculture	1992	403	7.30%	3,291	8.17	536	5.11%
	1997	39,529	7.47%	270,005	6.83	59,558	6.07%
Mining	1992	93	1.69%	683	7.34	116	1.11%
	1997	7,801	1.47%	56,288	7.22	10,879	1.11%
Industry	1992	577	10.46%	3,898	6.76	1,192	11.37%
	1997	64,773	12.25%	388,348	6.00	139,787	14.25%
Electricity, gas and water	1992	92	1.67%	685	7.45	112	1.07%
	1997	11,660	2.20%	82,984	7.12	14,803	1.51%
Construction	1992	464	8.41%	3,236	6.97	797	7.60%
	1997	48,324	9.14%	302,842	6.27	95,035	9.69%
Trade, restaurant and hotels	1992	972	17.62%	6,843	7.04	1,594	15.21%
	1997	92,576	17.50%	574,096	6.20	170,011	17.33%
Transportation	1992	656	11.89%	4,956	7.55	902	8.60%
	1997	60,158	11.37%	422,873	7.03	85,416	8.71%
Finance and banking	1992	106	1.92%	653	6.16	174	1.66%
	1997	8,969	1.70%	50,966	5.68	16,142	1.65%
Services	1992	2,154	39.04%	13,813	6.41	5,060	48.27%
	1997	195,172	36.90%	1,162,558	5.96	389,495	39.70%
Total	1992	5,517	100.00%	38,058	6.90	10,483	100.00%
	1997	528,962	100.00%	3,310,960	6.26	981,126	100.00%

(B) Income Level by Economic Activity and Source of Income (JD/year/HH)

Economic activities of household head		Income from employment: In cash: Gross income	Income from employment: In cash: Net income	Income from employment: In kind: Food	Housing	Clothes	Others	Total	Total income from employ-ment	Own account workers	Property income	Other current transfer	Other receipts	Grand total of current income
Agriculture	1992	1,286	1,214	6	5	10	5	25	1,310	2,522	1,693	277	2	5,805
	1997	1,502	1,397	12	21	15	4	51	1,553	1,009	1,121	605	0	4,289
Mining	1992	3,609	3,266	24	47	2	28	101	3,710	352	537	601	0	5,200
	1997	4,733	4,265	2	106	2	53	164	4,896	200	826	392	0	6,315
Industry	1992	2,247	2,125	8	20	3	9	39	2,286	3,318	903	346	31	6,884
	1997	2,968	2,743	14	16	2	3	35	3,003	434	956	528	1	4,921
Electricity, gas and water	1992	2,683	2,451	6	0	3	25	34	2,717	140	601	275	2	3,735
	1997	4,583	3,726	3	55	5	35	99	4,681	86	891	612	0	6,271
Construction	1992	1,838	1,793	2	1	2	0	5	1,843	1,676	811	345	3	4,678
	1997	2,465	2,349	7	2	2	18	29	2,493	488	1,041	299	1	4,321
Trade, restaurant and hotels	1992	1,381	1,324	9	1	3	3	15	1,396	3,011	1,175	557	7	6,147
	1997	1,717	1,621	5	1	3	1	10	1,727	1,194	1,655	457	0	5,034
Transportation	1992	1,733	1,643	7	1	5	3	15	1,749	1,410	620	332	10	4,121
	1997	2,681	2,471	3	19	7	17	46	2,726	710	880	503	7	4,825
Finance and banking	1992	4,139	3,665	0	36	9	2	48	4,187	120	796	1,209	33	6,344
	1997	6,527	5,879	0	1	2	32	35	6,563	237	1,842	401	0	9,042
Services	1992	2,470	2,268	3	8	12	9	32	2,502	352	773	365	18	4,011
	1997	3,227	2,920	5	32	21	8	66	3,293	221	826	465	3	4,807
Not applicable	1992	1,179	1,112	4	1	6	2	13	1,192	386	1,058	1,126	7	3,769
	1997	1,590	1,466	3	1	11	2	16	1,606	217	1,270	1,438	1	4,532
Weighted average in Jordan	1992	1,828	1,708	5	6	7	5	23	1,851	1,193	946	606	12	4,607
	1997	2,486	2,276	5	16	11	8	40	2,526	457	1,104	724	2	4,812

Source : Household Expenditure and Income Survey 1992, and House Expenditure and Income Survey 1997, Department of Statistics.

Appendix 2.15 Average Annual Expenditure by Governorate and Expenditure Item

(JD/year.HH)

Expenditure item	Whole Jordan						Governorate																							
	Rural		Urban		Jordan		Amman		Irbid		Zarqa		Balka		Mafrak		Karak		Ma'an		Tafiela		Madaba		Jarash		Ajlon		Aqaba	
	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997	1992	1997
Current income	3,532	4,044	4,898	4,998	4,607	4,812	5,795	5,489	3,966	4,286	4,003	4,254	4,203	4,753	2,997	4,179	2,648	4,805	4,355	3,991	2,899	3,901	-	4,789	-	3,994	-	3,818	-	5,053
Food, beverages and tobacco	1,832	2,161	1,862	2,147	1,856	2,150	2,053	2,099	1,947	1,993	1,590	2,126	1,458	2,185	1,511	2,113	1,544	2,920	1,835	1,885	1,459	2,145	-	2,193	-	2,398	-	2,391	-	2,739
Cereals and products	189	360	146	272	155	289	156	249	164	285	130	285	163	350	171	357	190	436	166	301	121	346	-	278	-	335	-	395	-	341
Meats and poultry	485	581	514	559	507	563	573	550	501	545	443	515	441	595	382	556	434	746	461	518	462	633	-	588	-	691	-	619	-	621
Fish and sea products	28	25	32	37	31	35	35	42	30	24	24	32	21	18	23	25	29	46	59	21	27	24	-	25	-	28	-	39	-	100
Dairy products and eggs	203	179	210	188	209	187	240	191	217	148	156	175	150	129	120	175	204	366	280	167	178	190	-	201	-	191	-	268	-	282
Oils and fats	184	129	162	152	166	147	161	144	246	128	121	173	109	138	79	135	99	155	159	136	127	122	-	144	-	125	-	131	-	314
Fruits	92	117	116	141	111	137	127	133	118	134	99	145	74	138	70	113	69	167	102	108	79	129	-	139	-	163	-	142	-	132
Vegetables	183	223	172	187	174	194	177	161	192	220	169	194	126	238	186	251	121	230	152	177	165	211	-	219	-	234	-	213	-	185
Dry and canned legumes	26	27	19	22	20	23	18	21	28	20	16	22	15	24	15	27	24	45	30	24	16	26	-	20	-	27	-	35	-	47
Spices	17	19	11	16	12	17	12	17	14	12	7	19	14	17	17	25	11	29	16	13	8	11	-	12	-	15	-	19	-	22
Nuts	10	8	18	21	16	19	24	26	12	9	10	16	9	24	5	4	8	9	16	6	5	8	-	11	-	26	-	15	-	25
Sugar and confectioneries	129	134	104	111	109	115	120	102	106	104	88	120	92	127	144	145	120	199	109	119	90	143	-	108	-	129	-	143	-	136
Tea, coffee and cacao	70	92	46	74	51	78	51	72	61	76	30	57	63	128	74	114	69	123	52	40	35	58	-	63	-	74	-	106	-	84
Other food items	80	82	116	142	108	131	126	157	104	107	119	141	45	75	64	58	60	127	113	72	53	86	-	125	-	133	-	103	-	179
Beverages	25	37	37	55	34	52	43	53	30	48	32	59	24	32	22	26	22	65	29	53	21	44	-	59	-	63	-	43	-	79
Alcohol	2	1	3	3	3	3	5	5	2	0	0	1	4	2	2	0	6	0	0	0	0	0	-	6	-	0	-	2	-	5
Tobacco and cigarettes	112	147	158	165	148	162	185	176	122	135	146	172	110	151	138	104	81	179	92	131	74	117	-	198	-	166	-	120	-	188
Other commodities/services	1,884	1,867	2,935	2,902	2,713	2,700	3,520	3,328	2,249	2,330	2,617	2,570	1,654	2,176	1,540	1,750	1,378	2,153	2,106	1,899	1,865	1,908	-	2,940	-	2,253	-	1,875	-	2,581
Ready made men's cloths	77	61	95	77	92	74	107	80	94	65	83	73	65	66	52	53	49	78	83	49	78	68	-	98	-	79	-	64	-	90
Ready made women's cloths	93	65	109	88	106	83	124	88	102	69	100	91	63	71	91	67	55	83	105	70	95	91	-	109	-	92	-	74	-	95
Children's cloths	85	73	86	74	86	74	93	72	82	71	93	75	60	88	84	65	48	67	83	69	87	83	-	82	-	79	-	79	-	101
Clothing and tailoring expenses	18	11	21	12	20	12	21	8	22	171	24	10	8	11	19	11	10	19	22	8	12	4	-	20	-	18	-	10	-	15
Footwear	61	51	71	62	69	60	77	66	68	51	70	54	49	59	50	49	37	58	61	52	60	53	-	64	-	66	-	57	-	74
Housing and related expenses	444	573	795	1,016	721	930	978	1,292	529	673	673	755	540	712	391	621	427	656	524	526	372	472	-	795	-	610	-	403	-	755
Fuels, electricity and water	177	169	243	215	229	206	297	250	190	167	200	183	164	199	183	170	155	184	164	154	136	163	-	195	-	164	-	184	-	153
House furnishings	100	91	137	90	129	90	134	68	136	117	158	101	57	78	92	81	58	125	92	78	153	99	-	122	-	111	-	105	-	127
Household appliances	53	46	61	44	60	45	59	35	70	57	65	48	25	40	42	36	24	54	68	38	71	45	-	77	-	52	-	55	-	72
Utensils	15	16	18	18	18	17	15	13	21	22	24	20	7	16	12	12	6	16	18	12	16	15	-	25	-	26	-	19	-	27
Cleaning materials	65	73	72	81	71	79	81	84	77	77	61	72	42	98	35	57	52	67	66	56	67	82	-	66	-	77	-	102	-	77
Transportation	337	269	556	430	510	399	743	495	339	264	466	434	284	276	199	246	226	266	385	444	333	313	-	541	-	314	-	353	-	355
Education	69	94	184	251	160	220	226	332	134	163	143	147	79	136	49	70	62	138	78	82	71	115	-	235	-	151	-	101	-	152
Medical care	50	66	116	133	102	120	148	142	58	84	118	170	50	102	50	56	31	80	64	60	43	38	-	89	-	107	-	51	-	137
Personal care	124	113	163	163	155	153	161	154	177	161	166	180	80	88	116	86	71	144	126	106	138	126	-	208	-	195	-	142	-	177
Recreation	50	48	105	80	93	74	121	83	83	57	94	82	37	44	41	37	30	91	85	40	61	74	-	95	-	78	-	53	-	127
Other expenses (N.E.C)	68	48	101	69	94	65	134	66	70	61	81	75	46	93	35	34	39	29	86	57	71	66	-	121	-	36	-	25	-	47
Total	3,716	4,028	4,797	5,049	4,569	4,850	5,573	5,427	4,196	4,324	4,207	4,696	3,112	4,361	3,051	3,863	2,922	5,073	3,941	3,784	3,324	4,053	-	5,133	-	4,651	-	4,266	-	5,320

Source : Household Expenditure and Income Survey 1992, and Household Expenditure and Income Survey 1997, Department of Statistics.

Appendix 2.16 Cost of Living Index and Exchange Rate

(A) Cost of Living Index

Year	Living index														
	General			Food items			Clothing & footwear			Housing			Other goods and services		
	Vol.32/6	Vol.35/12	Linkage	Vol.32/6	Vol.35/12	Linkage	Vol.32/6	Vol.35/12	Linkage	Vol.32/6	Vol.35/12	Linkage	Vol.32/6	Vol.35/12	Linkage
1991	96.2		96.2	97.1		96.2	92.1		96.2	96.2		96.2	96.7		96.2
1992	100.0		100.0	100.0		100.0	100.0		100.0	100.0		100.0	100.0		100.0
1993	103.3		103.3	101.9		103.3	105.8		103.3	106.3		103.3	101.5		103.3
1994	107.0	89.1	107.0	107.9	85.7	107.0	109.9	87.8	107.0	108.6	92.0	107.0	102.6	92.4	107.0
1995	109.5	91.2	109.5	110.4	87.7	109.5	117.9	94.2	109.5	111.4	94.3	109.5	102.9	92.7	109.5
1996		97.1	116.6		93.8	117.1		103.7	120.5		99.2	115.2		98.2	116.0
1997		100.0	120.1		100.0	124.9		100.0	116.2		100.0	116.1		100.0	118.1
1998		103.1	123.8		104.0	129.9		103.8	120.7		101.8	118.2		102.6	121.2
1999		103.7	124.5		103.1	128.7		109.3	127.1		102.6	119.1		104.7	123.7
Annuak average growth ratio(%)			3.28%			3.71%			3.54%			2.71%			3.19%
2000 January		104.3	125.2		102.2	127.6		109.9	127.8		104.0	120.8		107.4	126.9
February		104.5	125.5		102.8	128.4		109.7	127.5		103.9	120.6		107.6	127.1
March		105.4	126.5		104.6	130.6		102.6	119.3		103.9	120.6		107.5	127.0
Average monthly growth ratio(%) since Jan. 1999			0.53%			1.17%			-3.38%			-0.05%			0.05%
Equivalent %/annum since 1991			3.09%			3.46%			2.42%			2.55%			3.13%

(B) Exchange Rate (Unit : fils)

	US Dollar			Japanese Yen (\100)		
	Selling	Buying	Average	Selling	Buying	Average
1991	682.2	679.5	680.9	507.7	505.1	506.4
1992	680.8	678.8	679.8	538.7	536.0	537.4
1993	693.9	691.9	692.9	626.5	623.4	625.0
1994	699.8	697.8	698.8	686.3	682.6	684.5
1995	701.8	699.8	700.8	750.8	747.4	749.1
1996	710.2	708.2	709.2	653.6	650.2	651.9
1997	710.2	708.2	709.2	588.2	585.5	586.9
1998	710.2	708.2	709.2	543.5	540.8	542.2
1999	710.2	708.2	709.2	624.6	621.5	623.1
Annual average decreasing ratio(%)	0.50%	0.52%	0.51%	2.62%	2.63%	2.63%
2000 January	710.2	708.2	709.2	678.0	674.8	676.4
February	710.2	708.2	709.2	650.2	647.2	648.7
March	710.2	708.2	709.2	665.3	661.8	663.6
April	708.2	708.2	708.2	675.2	672.0	673.6
Average annual decreasing ratio(%) since January 2000	-0.10%	0.00%	-0.05%	-0.14%	-0.14%	-0.14%
Equivalent %/annum since 1991	0.42%	0.46%	0.44%	3.22%	3.22%	3.22%

Source : Monthly Statistical Bulletin Vol.32 No.6, Central Bank of Jordan, June 1996.
Monthly Statistical Bulletin Vol.35 No.12, Central Bank of Jordan, December 1999.

CHAPTER III

CURRENT SITUATION OF POWER SECTOR

Chapter 3 Current Situation of Power Sector

3.1 Organization and Functions of the Power Sector

The government has continued to adopt several measures which have lead to the improvement of economic performance by implementing privatization programs for principal infrastructure projects in order to improve performance and increase efficiency and production levels.

There used to be three electricity enterprises operating in Jordan, one of them being the National Electric Power Co. (NEPCO) and the other two being private enterprises, the Jordanian Electric Power Co. (JEPCO) in Amman and the Irbid District Electricity Co. (IDECO) in northern Jordan. In January 1999, NEPCO was divided into three companies, that is; NEPCO as a transmission company, CEGCO as a generation company and EDCO, as a distribution company. The function and relationships of each are described hereunder.

CEGCO and IDECO have generation facilities while JEPCO is a distributing firm responsible for the distribution of electric power in Amman, Zarqa and Balqa regions. EDCO distributes electricity to the previous NEPCO concession area. These three distribution companies purchase electricity from NEPCO.

Other than those five enterprises, the Jordan Potash Co., Ltd. and the Jordan Cement Factories Co., Ltd. etc. are also producing electric power mostly for their own use.

3.1.1 Function and Relationships among Electricity Enterprises in Jordan

The Ministry of Energy and Mineral Resources (MEMR) is one of the ministries in Jordan. NEPCO, CEGCO and EDCO still belong to this ministry. The structure of power sectors in Jordan, along with their functions and relationships are illustrated in Fig. 3.1-1.

CEGCO is a large scale power generation enterprise in Jordan. It owns the 11 main power stations; Hussein Thermal Power Station, Aqaba Thermal Power Station, Risha Power Station, Marka Power Station, Karak Power station, Aqaba Central Power Station, Amman South Gas Turbine Power Station, Rehab Power Station, King Tolal Dam and Wind Energy Generation Station. Energy production of CEGCO (NEPCO) in 1998 was 6,300 GWh with an annual growth rate of 6.7% (1998/1997). The average annual growth rate of the five years from 1993 was 7.4%.

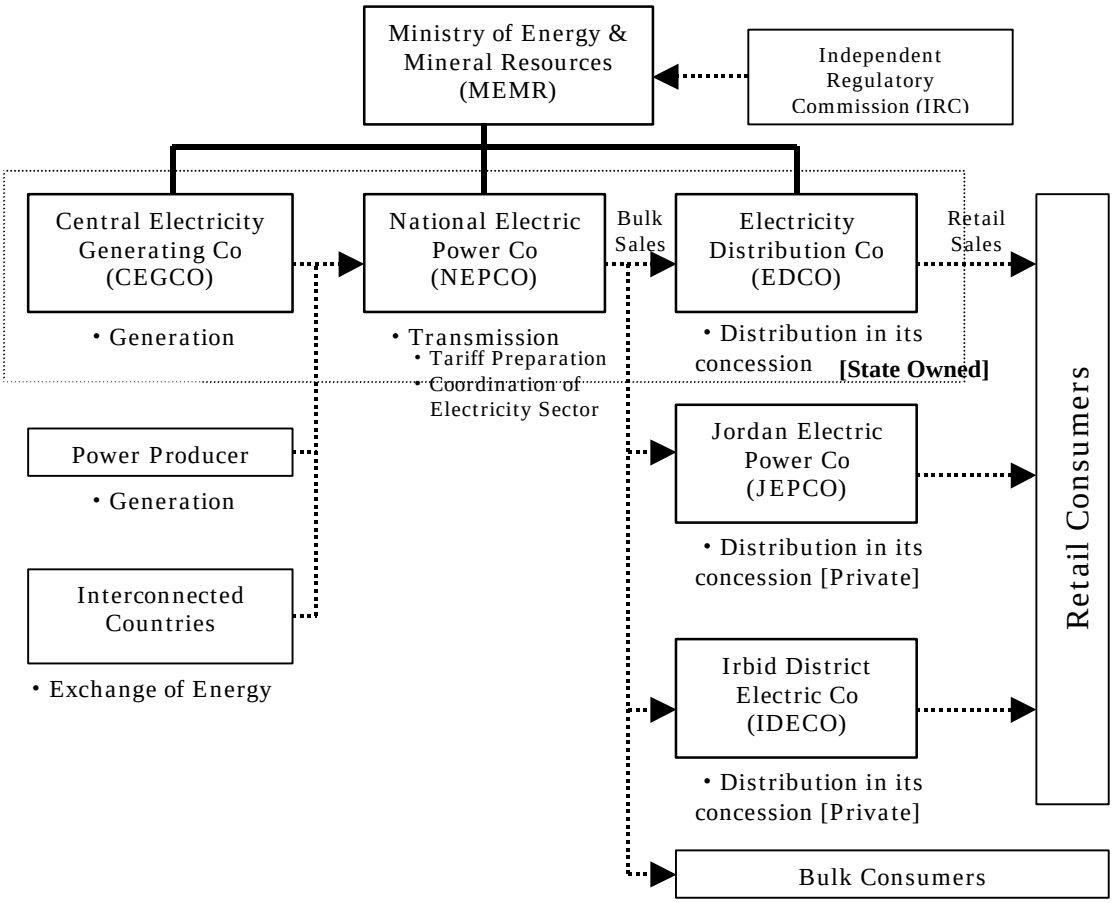


Fig 3.1-1 Structure of the Power Sector in Jordan

NEPCO sells electricity to distribution companies and large consumers. The electricity generated by CEGCO is sold to EDCO, JEPCO, IDECO and other large-scale industries such as refinery companies, cement factories etc. in bulk, using NEPCO's power transmission lines. NEPCO's interconnecting system network covers the whole area of Jordan. As of 1999, EDCO covers NEPCO's distribution concession area, the areas of Aqaba, Ma'an, Shoubak, Karak, Tafila, Jordan Valley, the eastern area and a part of the Amman area for retail sales. In 1998, the total energy consumption for the whole area of Jordan was 5,634 GWh. The energy sold by NEPCO to JEPCO and IDECO amounted to 3,262 GWh and 857 GWh, respectively. However, the retail sales of NEPCO were 540GWh, less than that compared with sales to the two private enterprises.

The number of total consumers in Jordan as of 1998 was approximately 793,000 as shown in Appendix 3.1. This demonstrates an annual average growth rate of 5.41% since 1990. JEPCO covers the areas of a large part of Amman Governorate and Balqa Governorate including the cities of Amman, Al-Zarqa, Al-Salt, Madaba and Al-Baq'ah, and IDECO covers the area of Irbid Governorate including the cities of Irbid, Al-Ramtha, Al-Mafrak, Ajlun and Jerash by their network.

The number of consumers or subscribers of the three enterprises in 1998 was 792,714 in total and is summarized by type of consumption as shown in the following Table 3.1-1.

Table 3.1-1 Number of Consumers by Type of Consumption in 1998

	NEPCO	JEPCO	IDECO	Others	Total
Domestic	86,379	406,727	150,383	220	643,709
Industrial	1,097	8,120	2,836	0	12,053
Commercial	11,957	79,328	19,514	10	110,809
Water pumping	968	660	892	0	2,520
Governmental	2,502	6,227	3,638	0	12,367
Others	2,115	8,998	143	0	13,406
Total	105,018	510,060	177,406	230	792,714

Source : Annual Report 1998.National Electric Power Company.

According to the Annual Report of NEPCO, as of 1998, the number of customers receiving energy supply was 4.745 million at an electrification ratio of 99.8% to the total population.

NEPCO, JEPCO and IDECO have carried out rural electrification schemes since 1984 and in 1992 the Ministry of Energy and Mineral Resources started to manage the rural electrification of the whole Kingdom. In 1998, 120 villages were electrified and the remaining 142 villages were to be electrified in 1999.

3.1.2 Finance of Energy Enterprises

All three electricity enterprises have made balance sheets and statements of their incomes and expenses as of the end of each fiscal year, along with formulation of annual account reports. The available annual account reports were from NEPCO, JEPCO and IDECO for the 1998 fiscal year.

Appendix 3.2 and 3.3 show the situation of income and expenses in 1998 for NEPCO, JEPCO and IDECO and summarized as shown in the following Table 3.1-2 and 3.1-3.

Table 3.1-2 Summary Statements of Income and Expenses of Enterprises in 1998

(Unit : JDs)

	NEPCO	JEPCO	IDECO
REVENUE	192,438,971	132,050,654	33,281,982
Electricity sales	189,294,354	129,738,793	27,020,277
Other income	3,144,617	2,311,861	6,261,705
GROSS EXPENDITURE	169,391,430	122,731,672	32,083,849
Operation/purchase	117,386,986	104,995,111	30,659,496
Other expenditure	52,004,444	17,736,561	1,424,353
NET PROFIT	23,047,541	9,318,982	1,198,133

Source : Annual Account Reports from NEPCO, JEPCO and IDECO

Note: The item of purchase means the electricity purchase of JEPCO/IDECO from NEPCO.

Table 3.1-3 Summary of Balance Sheet of Electricity Enterprises

For 1998 Fiscal Year (Unit: JDs.)

Credit	NEPCO	JEPCO	IDECO	Debit	NEPCO	JEPCO	IDECO
Current assets	133,926,291	42,972,162	22,811,852	Current liabilities	108,838,519	69,629,003	30,334,842
Fixed assets	946,093,372	140,966,421	40,165,924	Equity	577,179,339	115,565,253	4,979,439
Others	4,869,246	1,255,673	1,727,040	Others	398,871,051	0	29,390,535
Total	1,084,888,909	185,194,256	64,704,816	Total	1,084,888,909	185,194,256	64,704,816

Source: Annual Account Reports of NEPCO, JEPCO and IDECO.

3.1.3 Electricity Tariff

The electricity tariff is set by NEPCO. The existing tariff system valid from May 1996 (Jordan Electricity Authority) is listed in Table 3.1-4.

Table 3.1-4 Electricity Tariff

	Electricity Tariff		
Bulk Supply Tariff			
Electricity enterprises	Peak load	2.4	(JDs/kW/Month)
	Day energy	29	(Fils/kWh)
	Night energy	19	(Fils/kWh)
Large industries	Peak load	2.4	(JDs/kW/Month)
	Day energy	47	(Fils/kWh)
	Night energy	32	(Fils/kWh)
Retail Tariff			
Domestic	First block : From 1 - 160 kWh/Month	30	(Fils/kWh)
	Second block : From 161 - 300 kWh/Month	52	(Fils/kWh)
	Third block : From 301 - 500 kWh/Month	60	(Fils/kWh)
	Fourth block : More than 501 kWh/Month	75	(Fils/kWh)
	Flat rate tariff for TV and broadcasting	60	(Fils/kWh)
Commercial		60	(Fils/kWh)
Medium industries	Peak load	3.05	(JDs/kW/Month)
	Day energy	33	(Fils/kWh)
	Night energy	21	(Fils/kWh)
Small industries		36	(Fils/kWh)
Water pumping		34	(Fils/kWh)
Hotels		60	(Fils/kWh)
Agriculture		23	(Fils/kWh)
Street lighting		*20	(Fils/kWh)

(Note) Monthly minimum charge for all consumers all over the kingdom is:

a. for domestic consumers is fixed at JD1.0/month

b. for all other consumers is fixed at JD1.250/month

3.2 Power Plant, Transmission Lines, Substations and Distribution Lines

In principle, most of the power plants owned by CEGCO (NEPCO) are interconnected to the 400kV or 132kV transmission system. Electricity is distributed to low-voltage consumers by 415 V 3- phase 4-wire system after stepping down from 33, 11 and 6.6 kV in main substations and to 415/240 V in distribution substations in the respective load areas. Further details are provided in the following section.

3.2.1 Generating Power Plant

In 1998, three units of 130MW steam turbine generating units were installed in Aqaba Thermal Power Station in the south area in the Kingdom. As of the end of 1998, the total installed capacity was 1,670MW. Among these, 120MW generating capacity came from the natural gas fired power plant, which is built in the gas field in northeastern area in the Kingdom. Most of the generating power plants are connected to the interconnected network throughout the country. Generating power plants in Jordan as of the end of 1998 are listed in Table 3.2-1.

The fuel used in both the Aqaba and Hussein Thermal Power Stations is heavy oil. Although Aqaba Thermal Power Station faces the Red Sea, all the required heavy oil is transported by tank lorries from the refineries near Amman or from Iraq, as sea-transportation of fuel is impossible due to political circumstances in the Middle East. In case of Hussein Thermal Power Station (HTPS) located in the desert area where cooling water is not available, the condensers are cooled with air fans in HTPS.

Table 3.2-1 Generating Facilities in Jordan as of End of 1998

	Steam	Gas		Diesel	Wind	Hydro	Total
		Diesel	N.Gas				
CEGCO	1013	342	120	56.5	1.425	7	1539.9
Hussein Thermal PS	363	32					395
Aqaba Thermal PS	650	3					653
Aqaba Central P.S.				22			22
Marka Thermal PS		72		30			102
Al-Risha P.S.			120				120
Amman South G.T.		60					60
Karak P.S.		18		4.5			22.5
King Talal Dam						4	4
Wind Energy					0.3		0.3
Hofa Wind Paek					1.125		1.125
Rehab P.S.		160					160
Other Organizations	85			45.5			130.5
IDECO				6			6
Cement Factory				9			9
Refinery Co.	14			2			16
Arab Potash Co.	15			8			23
Fertilizer Co.	44						44
El-Hasa Phosphate Co				12			12
Indo-Jordan Co.	12						12
Municipal & Others				8.5			8.5
Total	1098	342	120	102	1.4	7	1670.4

3.2.2 Transmission Facilities

The transmission system in Jordan is classified into 400, 230, 132 and 66 kV voltage systems.

A 400kV transmission was introduced in accordance with extension of Aqaba Thermal P.S. in 1998. The 400 kV double circuit transmission line between the Aqaba Thermal Power Station and Amman South Substation has been upgraded from the operating voltage of 132kV.

As for international interconnection, the Jordanian-Egyptian interconnection was completed in 1998. A 400kV submarine cable with line length of 13km was laid between Aqaba on the Jordanian side and Taba on the Egyptian side. At the end of 1999, the 400kV Jordanian-Syrian interconnection was expected to be put into synchronized operation. The 400kV single circuit tie line has been completed on the Jordanian side.

The 230 kV single circuit transmission line between the Syrian system, which had been constructed for power transfer to Syria from Irbid Substation, is not currently in operation. A 66 kV tie line was connected between Irbid Substation and Syria; however, the line is used as a regional 33 kV distribution line. The length of the transmission lines of NEPCO as of fiscal 1998 are listed in Table 3.2-2.

Table 3.2-2 Transmission Facilities (Circuit Length, unit :km)

Voltage	66kV	132kV	230kV	400kV	Total
Length	17	2124	17	670	2,828

3.2.3 Substation Facilities

The total installed capacity of the main substations owned by NEPCO as of fiscal 1998 are listed in Table 3.2-3.

Table 3.2-3 Transmission Substation Capacity (unit :MVA)

Substation (kV)	400/132	230/132	132/33	132/6	66/33
Capacity (MVA)	1280	200	1989	75	10

SF6 gas insulated switch-gears are adopted partly for 132 kV class substations. Both manned and unmanned operating control systems are applied for substations in the country.

3.2.4 Distribution Facilities

Distribution facilities in Jordan are those of 33 kV and below. The distribution voltages are classified in Jordan into two categories, one of which is medium distribution voltage (MV) of 33kV, 11kV and 6.6kV, and the other is low distribution voltage (LV) of 415V/240V. In principle, the 11 kV underground cable is used

for the primary distribution lines in urban areas. In rural areas and city outskirts, the 33 and 11 kV overhead distribution lines are used. The 6.6 kV distribution system is observed in partial city areas, though it may tend to be replaced in the future by a 11kV distribution system.

Although the 415 V or lower voltage distribution lines are mainly overhead systems, the underground cable is used in newly developed areas such as Aqaba City. The distribution facilities and installed capacity of the distribution substations of JEPCO, IDECO and EDCO are shown in Tables 3.2-4 and 3.2-5.

Tables 3.2-4 Distribution Line (as of fiscal 1998) (km)

	33kV	11kV	6.6kV	0.4kV
EDCO(NEPCO)				
・Overhead Distribution Line	1699.5	339.8	4.2	2814.7
・Underground Distribution Line	25.3	107.0	3.4	291.7
JEPCO & IDECO				
・Overhead Distribution Line	3622.8	309.7	375.4	14336.9
・Underground Distribution Line	492.1	812.8	867.7	1272.4
Total of Overhead Distribution Line	5321.3	649.5	379.6	4248.3
Total of Underground Distribution Line	517.4	919.8	871.1	1564.1

Tables 3.2-5 Distribution Substation (MVA) (as of fiscal 1998)

	33/11/6.6kV	33/0.4kV	11/6.6/0.4kV
EDCO(NEPCO)	494.4	228.0	7.5
JEPCO & IDECO	1002.4	693.7	1906.5
Total	1496.8	921.7	1913.0

3.3 Electric Power System

3.3.1 Present Situations of the Power Systems

The trunk power systems in Jordan are composed of mutually interconnected 400kV and 132 kV transmission systems. The trunk power system in the year 2000 is illustrated in appendix3.4.

3.3.2 Power Dispatching and T&D System Control

The 400kV and 132 kV transmission lines, power stations, main substations and their circuit breakers on the 33 kV bus-bar including EDCO's and IDECO's MV systems are supervised and controlled by the NEPCO Control Center adjacent to Amman South Substation. Daily and weekly load forecasts are conducted in order to realize stable and economic power supply. Load dispatching services including instruction of

generation commitment for electrical energy production, switching operation and so forth are also carried out from the Control Center.

For the distribution system at JEPCO, the 33kV, 11kV and 6.6kV circuit breakers on the distribution networks are controlled from its own Control Center installed at the head office. For supervisory control from control center, the SCADA system is implemented. Concerning distribution control of the MV system at EDCO and IDECO, their distribution networks are controlled and supervised by NEPCO's control center.

3.3.3 Duration of Power Outage

In Jordan, the duration of power outage per consumer is six hours per year.

3.3.4 Operation and Maintenance

(1) Generation Operation

For realizing economically optimum and highly reliable power supply, economical load dispatching is analyzed. The output of generator units and those to on standby are determined or selected based on the analysis in the Control Center of NEPCO. The results of analysis are sent to the generator operation staff.

(2) Frequency and Voltage Control

(a) Frequency Control

Under normal conditions, system frequency is maintained by Automatic Generation Control (AGC). Under abnormal conditions such as system islanding due to the loss of synchronism, according to the under-frequency relay (UFR) load will be shed. The level of load shedding is classified into nine stages according to the frequency drop. In case of the first step, 4.8% of the total load will be automatically shed when frequency decreases to 49.1 Hz for 0.4 seconds, and in the final step, 56.9% of the total load will be automatically shed when frequency decreases to 48 Hz for 0.7 seconds.

(b) Voltage Control of Transmission System

For system voltage control, reactive power from generating stations is controlled by automatic voltage regulators. In transmission substations, on-load transformer tap-changers are controlled automatically, though the capacitors are switched based on the commands of the Control Center.

The total capacity of installed capacitors in transmission substations as of fiscal 1998 was 235MVA as shown in Table 3.3-1 and 75MVA (30 MVA at Sweima s/s and 45 MVA at Abdoon s/s) is under construction.

Table 3.3-1 Installed Capacity of Capacitors (as of fiscal 1998) (MVA)

Substation	Capacity	Substation	Capacity
Irbid s/s	30	Rashadiya	15
Sahab s/s	30	Tareq s/s	30
Bayader s/s	15	Abdali s/s	45
Qaia s/s	30	Amman South s/s	40

(3) Monitoring and Control of the T&D Network

From the control center of NEPCO, the load conditions of transmission systems are monitored and circuit breakers for 33 kV and above systems (including those of IDECO and EDCO) are remote-controlled.

From the head office of NEPCO, it is also possible to monitor voltages of 33 kV – 400 kV system and load flow on the system (current, active and reactive power). Meanwhile, these data are recorded every 30 minutes and kept for one week.

In case any circuit breakers open automatically due to contingences on the system, circuit breaker information will be sent to the control center two seconds later. In the 400kV and 132 kV systems, the transmission lines will be re-closed automatically after the opening operation of circuit breakers by main protective relay due to contingencies. A single-phase re-closing scheme is adopted for the 400kV-transmission system with re-closing time of two seconds.

At the Control Center of JEPCO, 33/11kV substations are remote-controlled, and the load conditions of MV distribution lines and transformers are monitored by SCADA system.

(4) Maintenance of substation

Visual inspection on the facilities in the substation is conducted. Periodic inspection with opening and closing operation is conducted for switching equipment such as circuit breakers and dis-connectors and detailed visual inspections on the other facilities are carried out once a year. The visual inspection of other equipment including switching equipment is carried out once a month.

3.4 Load Management System

As in Japanese Electric utilities, NEPCO has positively been promoting leveling of the load by shifting from peak load period to light load period. Under this policy, many farming pumps used to be operated in the evening peak period, though it is recommended that they operate during the off-peak time zone in the evening especially during summer. In the electricity tariff system, the off-peak load time zone tariff is set to

be cheaper compared with that for peak period, reflecting the policy.

3.5 Transmission and Distribution Losses

3.5.1 Trends in Interconnected System Network Losses

According to the NEPCO's Annual Report 1998, generation loss-rate has been maintained at approximately 6%, while the transmission and distribution loss-rate has increased year by year. Among these, distribution loss is still high at 12%. Trends in losses and respective system loss-rate are summarized in Table 3.5-1.

Table 3.5-1 Trend in Losses and System Loss Rate

	1993	1994	1995	1996	1997	1998
Generation Loss Rate (%)	6.48	6.08	5.82	5.71	5.40	6.13
Generated Energy (GWh)	4,551	4,837	5,365	5,801	6,042	6,520
Sent out Energy (GWh)	4,256	4,543	5,053	5,470	5,716	6,120
Energy Loss (GWh)	295	294	312	331	326	400
Transmission Loss Rate (%)	1.81	1.62	2.36	2.61	2.46	2.50
Sent out Energy to 132kV (GWh)	3,928	4,141	4,612	5,037	5,293	5,705
Bulk Sales (GWh)	3,857	4,074	4,503	4,906	5,163	5,562
Energy Loss (GWh)	71	67	109	131	130	143
Distribution Loss Rate (%)	11.19	10.59	10.48	10.67	10.86	12.13
Sent out Energy to Dis.Co. (GWh)	3,102	3,448	3,768	4,153	4,363	4,813
Sold Energy (GWh)	2,755	3,083	3,373	3,710	3,889	4,229
Energy Loss (GWh)	347	365	395	443	474	584
Total System Loss Rate (%)	15.79	15.09	15.65	15.95	15.94	16.79
Generated Energy (GWh)	4,551	4,837	5,365	5,801	6,042	6,520
Sold Energy (GWh)	3,832	4,107	4,525	4,876	5,079	5,425
Energy Loss (GWh)	719	730	840	925	963	1,095

The loss rate per generated energy is summarized in Table 3.5-2.

Table 3.5-2 Trends in Loss Rate

	1993	1994	1995	1996	1997	1998
Generation Loss (Rate : %)	6.48	6.08	5.82	5.71	5.40	6.13
Transmission Loss (Rate %)	1.56	1.39	2.03	2.26	2.15	2.19
Distribution Loss (Rate : %)	7.62	7.55	7.36	7.64	7.85	8.96
Total Loss (Rate : %)	15.79	15.09	15.65	15.95	15.94	16.79

3.5.2 Voltage Reduction and Power Factor of Distribution System

Monthly average of power factors of target eight MV distribution feeders in 1998 and 1999 ranges from 0.81 to 0.98 as shown in the table below. The lowest power factor of LV feeders can be envisaged as low as 0.7. Based on the power factor and load current at peak period in 1999, voltage reduction in the distribution system has been examined. The studies conducted on eight MV target feeders and randomly selected forty LV feeders. The voltage reduction of the MV and LV feeders were 12% and 8% on the average, respectively.

Table 3.5-3 Power Factor of the MV and LV distribution system

	EDCO	IDECO	JEPCO
MV distribution line（33kV）	0.81～0.92	0.83～0.86	0.85～0.98
LV distribution line（400V）	0.7～		

Appendix 3.1 Situation of Electrification in Jordan

(A) Electrical Energy Production in Jordan (Interconnected System) (GWh)

Name of power station	1990	1991	1992	1993	1994	1995	1996	1997	1998	Annual growth rate(%)
National Electric Power Co.(NEPCO)	3,258	3,342	4,018	4,389	4,676	5,201	5,645	5,906	6,297	8.58%
Hussein Thermal	1,288	1,483	1,760	2,040	2,377	2,184	2,285	2,452	2,330	7.69%
Aqaba Thermal	1,463	1,352	1,641	1,594	1,235	1,886	2,039	1,820	2,521	7.04%
Risha	433	419	456	539	773	751	731	783	716	6.48%
Marka	32	38	90	108	128	97	83	68	61	8.68%
Karak	0	1	3	5	18	7	9	6	5	100.39%
Remote Village	0	0	0	0	1	0	0	0	2	-
Aqaba Central	29	34	39	45	61	54	54	45	51	7.10%
Amman South Gas Turbine	1	7	12	30	64	99	120	100	129	92.91%
Rehab	0	0	0	0	3	105	301	607	467	-
King Tolal Dam & Fertilizer Co.	11	7	16	27	17	17	22	17	13	1.75%
Wind Energy	1	1	1	1	1	1	1	1	1	-2.42%
Hufa	0	0	0	0	0	0	1	2	1	
Purchased energy	0	0	0	0	0	0	0	3	0	
IDECO	11	9	6	9	11	12	9	2	0	-
Potash Co.	95	94	105	117	110	113	115	101	105	1.26%
Cement Factories Co.	16	40	39	36	40	39	32	36	34	9.88%
Indo-Jordan Chemicals Co.	0	0	0	0	0	0	0	0	81	
Total	3,380	3,485	4,168	4,551	4,837	5,365	5,801	6,045	6,517	8.55%

(B) Electrical Energy Sales by NEPCO (GWh)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	Annual growth rate(%)
Electrical energy consumption in whole Jordan	3,089	3,141	3,674	3,981	4,330	4,778	5,122	5,281	5,634	7.80%
I. Bulk sales	2,641	2,713	3,291	3,606	3,865	4,269	4,608	4,851	5,110	8.60%
JEPCO	1,572	1,664	1,920	2,152	2,397	2,606	2,846	3,007	3,262	9.55%
IDECO	391	419	472	521	585	654	734	783	857	10.30%
Refinery Co.	12	15	19	27	30	24	27	18	14	2.32%
Cement Factories Co.	147	147	161	187	180	187	154	142	131	-1.40%
South Cement Co.	118	105	147	176	174	175	195	190	144	2.46%
Potash Co.	120	118	111	105	149	176	178	186	205	6.86%
El-Hasa Phosphate Co.	99	89	96	92	51	87	90	88	85	-1.89%
Sheidiyah Phosphate Co.	2	5	14	18	20	21	33	52	26	38.42%
Fertilizer Co.	3	0	1	8	19	10	14	44	52	40.76%
Queens Alia Inter'l Airport	40	35	38	40	40	41	42	43	45	1.72%
Water Authority	122	105	235	225	208	277	278	283	272	10.58%
Haraneh	15	11	10	9	15	12	14	13	13	-1.60%
Export	0	0	67	46	0	0	2	3	4	-
II. Retail sales	269	278	313	358	375	415	471	489	541	9.16%
Aqaba area	93	93	106	119	123	136	152	157	168	7.66%
Ma'an and Shoubak areas	33	34	37	44	48	52	59	61	70	9.65%
Karak area	72	76	85	92	96	107	121	123	133	7.92%
Tafila area	10	10	11	15	17	19	20	23	27	13.85%
Jordan Valley area	53	55	61	75	77	86	103	107	127	11.66%
Eastern area	8	10	11	13	14	15	15	17	16	10.19%
Amman	1	1	1	1	1	1	1	1	1	6.59%
Total	2,909	2,991	3,604	3,965	4,240	4,683	5,079	5,340	5,651	8.65%

(C) Number of Consumers in Jordan (thousand)

Energy consumption in Jordan and NEPCO sell to :	1990	1991	1992	1993	1994	1995	1996	1997	1998	Annual growth rate(%)
NEPCO	69	74	77	81	85	90	96	100	105	5.33%
Jordan Valley areas	17	18	18	20	20	21	23	23	25	4.70%
Karak and Tafila areas	31	32	34	35	38	40	42	43	45	4.78%
Ma'an and Shoubak areas	10	11	11	12	12	13	14	14	15	5.11%
Aqaba area	11	11	12	13	13	14	16	16	18	5.86%
Eastern area	0	2	2	2	2	2	2	3	3	-
JEPCO	329	342	360	381	406	430	455	482	510	5.64%
IDECO	122	126	131	139	146	154	161	168	177	4.84%
Others	0	0	0	0	0	0	0	0	0	-8.30%
Total	520	542	568	601	637	674	712	750	793	5.41%

(D) Number of Consumers by Type of Consumption

	Domestic		Industrial		Commercial		Water pumping		Governmental		Others		Total	
	1995	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995	1998	1995	1998
NEPCO	75,381	86,379	895	1,097	9,867	11,957	723	968	2,642	2,502	967	2,115	90,475	105,018
Jordan Valley area	18,001	20,857	103	128	1,783	2,055	486	624	600	80	241	961	21,214	24,705
Karak area	25,548	28,163	287	411	2,606	3,415	87	123	648	900	337	398	29,513	33,410
Tafila area	8,747	9,984	63	94	1,040	1,149	26	41	394	388	133	144	10,403	11,800
Ma'an/Shoubak areas	10,378	12,015	262	283	1,383	1,728	94	118	541	570	174	203	12,832	14,917
Aqaba area	11,215	13,821	165	166	2,497	3,020	19	23	349	416	72	83	14,317	17,529
Eastern area	1,492	1,539	15	15	558	590	11	39	110	148	10	326	2,196	2,657
JEPCO's supply area	348,078	406,727	7,179	8,120	67,282	79,328	487	660	2,124	6,227	4,883	8,998	430,033	510,060
IDECO's supply area	129,816	150,383	2,487	2,836	17,034	19,514	761	892	1,376	3,638	2,279	143	153,753	177,406
Others	212	220	0	0	8	10	0	0	0	0	3	0	223	230
Total	553,487	643,709	10,561	12,053	94,191	110,809	1,971	2,520	6,142	12,367	8,132	11,256	674,484	792,714

Source : Annual Report 1995, Jordan Electricity Authority (JEA), and Annual Report 1998, National Electric Power Company (NEPCO).

Appendix 3.2 Statement of Income and Expenses of Electricity Enterprises

(JDs.)

Debit	NEPCO				JEPCO			IDECO		
	in 1994	in 1995	in 1997	in 1998	in 1994	in 1997	in 1998	in 1994	in 1997	in 1998
Revenue from :	121,489,052	134,541,212	240,386,383	192,438,971	86,821,457	121,751,838	132,050,654	21,252,652	30,745,052	33,281,982
Electricity sales	119,242,838	132,012,477	236,595,895	189,294,354	84,567,035	119,063,391	129,738,793	16,887,571	24,754,787	27,020,277
Production poles	1,404,900	1,477,673	2,353,233	2,063,040	0	0	0	0	0	0
Other operating revenue	841,314	1,051,062	1,437,255	1,081,577	2,254,422	2,688,447	2,311,861	967,081	1,240,265	1,411,705
Government compensation due to equal tariff difference	0	0	0	0	0	0	0	3,398,000	4,750,000	4,850,000
Operating Expenses	97,340,945	108,298,422	210,554,360	169,391,430	77,662,393	112,801,020	122,731,672	19,739,260	29,525,267	32,083,849
Power purchase	0	0	0	0	62,045,644	92,895,412	100,423,713	15,149,683	24,290,249	26,545,977
Operating costs - stations	70,366,464	77,763,510	141,427,086	117,386,986	3,879,554	4,517,482	4,571,398	3,386,830	3,926,003 4)	4,113,519
Depreciation of fixed assets	16,143,723	18,148,413	45,067,596	35,014,514	4,314,007	5,418,688	5,952,395	1,182,747	1,309,015	1,394,353
Production cost - Pole plant	1,042,108	1,193,471	2,141,185	1,545,026	0	0	0	0	0	0
Maintenance expenses	5,038,428	6,013,949	8,961,421	7,648,416	0	0	0	0	0	0
Expenses related to consumers and collection	261,281	309,109	508,692	399,015	0	0	0	0	0	0
Consumers' services	138,703	155,265	256,778	205,920	0	0	0	0	0	0
General and administrative expenses	4,350,238	4,714,705	12,191,602	7,191,553	6,592,994 1)	9,138,814	10,953,344	0	0	0
Currency rate differences depreciation	0	0	0	0	824,672	824,672	824,672	0	0	0
Fees and taxes	0	0	0	0	5,522	5,952	6,150	0	0	0
Reservve for doubtful loans	0	0	0	0	0	0	0	20,000	0	30,000
Balance	0	0								
Operating profit	24,148,107	26,242,790	29,832,023	23,047,541	9,159,064	8,950,818	9,318,982	1,513,392	1,219,785	1,198,133
Investment incomes	0	0	0	0	350,260 2)	28,706	27,822	0	0	0
Interest on loan and bank charges	-11,961,666	-11,220,934	-15,518,354	-13,086,009	-3,787,896	-4,300,781	-4,543,469	-987,078	-654,105 5)	-595,480
Currency expenses losses (incl. provisions for foreign exchanges)	-5,050,078	-6,710,375	11,054,146	-13,307,911	-1,364,507	-893,226	-454,026	0	0	0
Interest income	253,413	350,403	637,562	372,174	0	0	0	0	0	0
Other income and expenses - Net	1,270,288	3,985,803	5,501,801	5,582,829	0	0	0	0	0	0
Allowance for doubtful debts	-114,005	0	0	0	0	0	0	0	0	0
Contributions(donation)	0	0	0	0	-13,445	-9,245	-9,445	0	0	0
Differences in installations of loans	0	0	0	0	1,615,287 3)	0	0	0	0	0
Profit for the year before tax	8,546,059	12,647,687	31,507,178	2,608,624	5,958,763	3,776,272	4,339,864	526,314	565,680	602,653
Prior year's net income (expenses) (less:provision for income tax)	5,426,832	23,595	-1,163,585	11,928,850	-2,337,170	-619,103	-828,297	0	0	0
Postponed profits	0	0	0	0	0	0	0	76,250	95,955	53,025
Transfer from the optional reserve to close up postponed loss of previous years	0	0	0	0	0			161,100	0	0
Net profit (loss) for the year	13,972,891	12,671,282	30,343,593	14,537,474	3,621,593	3,157,169	3,511,567	763,664	661,635	655,678
Amount transfered to statutely reserve	-1,397,289	-1,267,129	-3,316,656	-260,862	-595,876	-755,254	-867,973	-52,631	-56,568	-60,265
Voluntary reserve	0	0	-6,633,313	-521,725	0	0	0	0	-95,955	-22,000
Special reserve	0	0	-6,633,313	-521,725	0	-404,749	-301,798	0	0	0
Provision for university fees	0	0	-331,666	-26,086	-59,588	-37,763	-43,398	-5,263	-5,657	-6,026
Provision for scientific research/vocational training	0	0	-331,666	-26,086	-59,588	-37,763	-43,398	-5,263	-5,657	-6,026
Accumulated losses - beginning of the year	-28,920,718	-16,345,116	0	0	0	0	0	0	0	0
Retained earnings/Accumulated losses at the end of the year	-16,345,116	-4,940,963	13,096,979	13,180,990	2,906,541	1,921,640	2,255,000	700,507	497,798	561,361
Profit Distribution	-	-								
Salary for the Board of Directors	-	-			53,636	54,139	55,000	46,315	42,900	45,265
Closing up board of directors salaries	-	-			0	0	0	19,083	0	0
Profits suggested to be distributed	-	-			1,620,000	1,650,000	2,000,000	0	0	0
Profits to close up losses of previous years	-	-			0	0	0	635,109	0	0
Close up part of the debts from the obligatory reserve	-	-			1,232,905	0	0	0	0	0
Deficit coverage of life insurance fund					0	52,501	0	0	0	0
Distribution tax					0	165,000	200,000	0	33,333	0
Income tax								0	68,540	55,285
Net dividens paid								0	300,000	0
Profit carried to the next year								0	53,025	460,811
Total	-	-			2,906,541	1,921,640	2,255,000	700,507	497,798	561,361

Source : Annual Report 1995 (JEA) (now named as NEPCO), The 57th Annual Report (JEPCO), and The 33rd Annual Report (IDECO).

Note 1. Includes the cost for consumers' services.
2. Includes the other incomes.
3. Russian Loan.
4. Includes administration expenses.
5. Includes currency exchange losses.

Appendix 3.3 Balance Sheet of Electricity Enterprises

(JDs.1,000)

Credit	NEPCO				JEPCO			IDECO		
	1994	1995	1997	1998	1994	1997	1998	1994	1997	1998
Current Assets	81,933	95,991	123,718	133,926	39,082	44,836	42,972	12,451	17,472	22,812
Cash on hand and at bank	4,723	5,813	6,495	9,960	2,262	2,011	2,781	1,770	290	169
Accounts receivable	46,108	53,504	78,158	69,762	24,107	29,539	26,275			
Debtor obligation and other debtor balance								7,305	14,255	19,607
Storehouses by cost								3,138	2,589	2,698
Investment in electrical industries								238	338	338
Spareparts, fuel and materials	27,923	33,845	35,891	50,659	11,906	13,038	13,285			
Interest receivable on Loans	507	602	131	21						
Loan installments due	565	503	456	258						
Current portion of long-term loans receivable	693	552	270	86						
Deposits on documentary credits	1,031	811	1,532	2,290	738	54	465			
Prepaid expenses and other debit balances	382	361	785	889	69	195	167			
Other Assets	5,801	5,297	4,843	4,869	806	1,118	1,256	208	856	1,727
Investments in companies shares	4,021	4,084	4,321	4,434	806	1,118	1,256			
Long-term loans rceivable	1,779	1,213	522	435						
Consultancy Projects in progress	2	0	0	0						
Fixed Assets	285,570	319,892	900,811	946,093	94,916	132,708	140,966	31,157	37,706	40,166
Fixed assets under capital lease	10,885	10,885	0	0						
Fixed assets	391,213	428,309	705,093	712,588	103,898	134,187	147,229	32,480	38,512	41,146
Less : Accumulated depreciation	161,969	179,786	44,393	78,773	45,294	60,528	66,480	14,067	18,313	19,883
Net book value of fixed assets	240,129	259,408	660,700	633,815	58,604	73,659	80,749	18,413	20,199	21,263
Assets contributed by consumers	29,761	31,563	44,877	47,222	23,268	37,966	41,284	11,271	18,250	19,196
Less : Accumulated depreciation	8,239	9,507	2,346	4,223	4,608	8,581	10,232	2,165	3,986	4,735
Net book value of assets contributed by consumers	21,522	22,056	42,531	42,999	18,660	29,386	31,052	9,107	14,264	14,462
Rural fils fund assets	523	523	279	279	1,521	16,202	17,031	2,920	2,977	3,836
Less : Accumuleted depreciation	209	230	15	26	300	1,844	2,525	320	676	812
Net book value of rural fils fund assets	314	293	264	253	1,221	14,359	14,506	2,600	2,301	3,024
Total net book value of total fixed assets	261,965	281,757	703,495	677,067	78,484	117,403	126,307	30,120	36,765	38,748
Assets of loans evaluation differences					20,617	20,617	20,617			
Less : Accumulated depreciation					4,948	7,422	8,247			
Net register value of assets for loans evaluation differences					15,669	13,195	12,370			
Projects under construction and payments to contractors	23,605	38,136	197,317	269,026	763	2,110	2,289	1,037	941	1,418
Total Assets	373,304	421,180	1,029,372	1,084,889	134,804	178,663	185,194	43,816	56,034	64,705

Debit	NEPCO				JEPCO			IDECO		
	1994	1995	1997	1998	1994	1997	1998	1994	1997	1998
Current Liabilities	71,472	98,396	110,589	108,839	54,792	79,186	69,629	14,650	22,719	30,335
Due to banks	11,399	12,020	854	6,627	2,924	814	769			
Notes payable	352	148	126	21	13,450	19,222	21,237 1)			
Accounts payable	21,853	42,755	40,537	22,885	26,893	46,965	38,319 2)	3,064	11,639	16,438
Accured expenses			250	0						
Provision for income tax			2,823	1,801						
Provision for university fees, schientific research and vocational training fees			663	718						
Other creditor balance					3,835	2,404	2,477	2,691	2,767	4,126
Creditor banks					70	5,036	1,527	1,527	742	2,028
Profits to be distributed					249	297	350	58	300	0
Profits suggested to be distributed to shareholders					1,620	1,650	2,000			
Saving, insurance, medical service accounts					927	-383	-531			
Interest payable on loans	3,044	2,998	4,755	5,137				5,442	5,643	5,709 3)
Loan installments payable	1	1	115	229						
Current portion of long(short)-term loans and bonds	24,835	27,065	29,657	28,603	4,824	3,180	3,479	1,868	1,533	1,855
Contractors' retentions payable	7,441	10,679	27,650	29,276						
Previous year's profits									94	179
Advances received on uncompleted projects	2,547	2,731	3,159	13,542						
Long-Term Liabilities and Consumers' Deposits	186,361	192,886	344,704	398,871				25,009	28,826	29,391
Loans and bonds	202,983	209,319	370,364	425,687				5,456	8,369	9,051
Counry-side fils deposits								2,600	2,301	3,024
Loans to finance fixed assets under capital lease	7,045	9,355	0	0						
Less : Current portion of loans and bonds	24,835	27,065	29,657	28,603						
Long-term loans and bonds	185,192	191,609	340,707	397,084				7,846	3,891	2,854
Provision for staff indemnity			2,394	0						
Consumers' deposits	1,169	1,277	1,603	1,787				9,107	14,264	14,462
Equity	115,471	129,898	574,079	577,179	80,011	99,477	115,565	4,156	4,489	4,979
Capital	80,734	81,720	230,000	230,000	15,000	15,000	20,000	3,000	3,000	3,000
Share issuing increase					3,000	0	0			
Statutory reserve/obligatory reserve	4,835	6,102	26,317	26,578	5,469	5,957	5,957	1,150	1,317	1,378
Optional reserve			6,633	7,155	188	1,686	868	6	119	141
Premium on stocks						3,000	0			
Special reserves						885	872			
Retained earnings								0	53	461
Subscribers participations opposite to fixed assets					23,268	37,966	41,284			
Close up of subscribers participations					-4,608	-8,581	-10,232			
Net subscribers participations					18,660	29,386	31,052			
Reserve for expansion programs	17,190	17,310	253,633	254,155						
Rural fils fund	7,222	7,359	13,097	13,181	1,521	16,202	17,031			
Government equity			1,604	2,859						
Accumulated losses	-16,345	-4,941			-300	-1,844	-2,525			
Net equity of the Government of Jordan	93,635	107,549	531,284	533,927	1,221	14,359	14,506			
Consumers' contributions - Net amortization	21,522	22,056	42,531	42,999						
Long-term loans					26,053	23,293	36,805			
Loans evaluation differences					8,426	3,519	2,312			
Provision for retirement compensation					1,994	2,394	3,194			
Rural fils fund - Net amortization	314	293	264	253						
Total of Liability and Equity	373,304	421,180	1,029,372	1,084,889	134,804	178,663	185,194	43,816	56,034	64,705

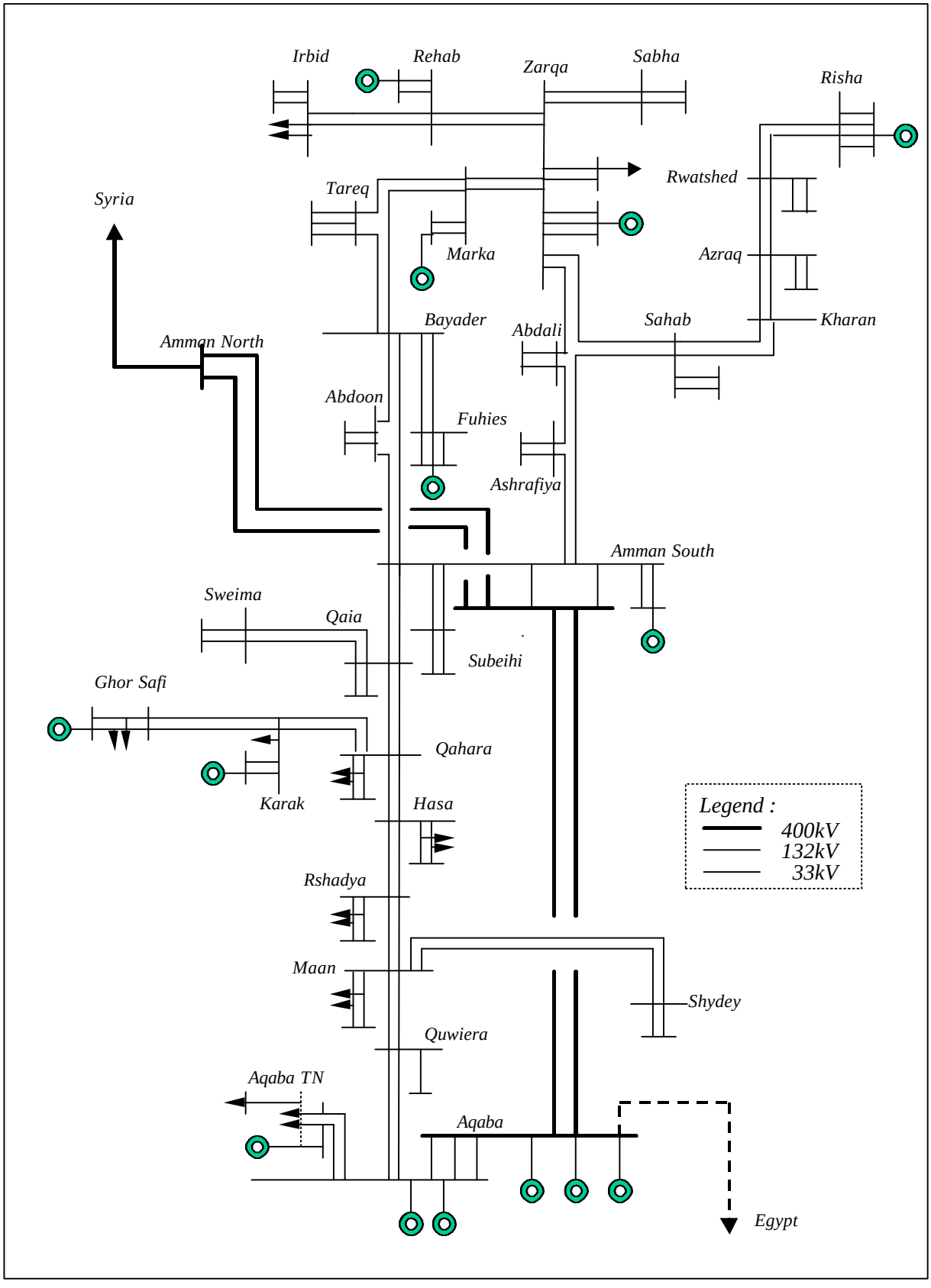
Sources : Annual Report 1995 (JEA (now named as NEPCO), The 57th Annual Report (JEPCO), and The 33rd Annual Report)IDECO).

Note 1. Subscribers insurance.

2. Creditor obligations.

3. Including loan installments.

Appendix 3.4 Jordanian Network Year 2000



CHAPTER IV

DEMAND FORECAST AND DEMAND - SUPPLY BALANCE

CHAPTER 4 Demand Forecast and Demand - Supply Balance

The demand forecast and long-term power generation plan of the Jordanian power system are described in this chapter. All studies for distribution system loss reduction in Jordan has been carried out based on this load forecast.

4.1 Demand Forecast

4.1.1 Demand Forecast of Jordan

(1) General

NEPCO has annually prepared and published long term load forecasts and generating extension plans.

The long term electricity demand forecast is calculated for three scenarios (low, medium, high) to reflect all possible future evolution of electricity load and consumption. The medium scenario represents the continuation of the modest development of the economy and achievements of the country. The low and high scenarios are pessimistic and optimistic variations to the medium scenario.

(2) Hypotheses of Demand Forecast

The long-term load-forecast up to 2015 has been carried out based on the following major hypotheses as shown in Table 4.1-1.

Table 4.1-1 Major Hypotheses of Long Term Load Forecast

Particulars		Scenario-High	Scenario-Medium	Scenario-Low
Population (3.5% at present)		Decline to 2.8% in 2015	Decline to 2.4% in 2015	Decline to 2.0% in 2015
GDP Growth (7.3%/annum past 5 years)	1999-2000	6.5% per annum	5.0% per annum	4.0% per annum
	2001-2005	5.0% per annum	4.0% per annum	3.0% per annum
	2006-2010	4.0% per annum	3.0% per annum	2.0% per annum
	2011-2015	2.8% per annum	2.2% per annum	1.6% per annum

The methodology used are Market Survey, Economic Approach (regression) and Gompertz extrapolation and total demand forecast is the summation of results of aforementioned methodologies. The following are the abstract for respective methods of load forecast.

(a) Market Survey

This method is used to forecast the electricity demand of the bulk supply industries and water pumping facilities. The survey was carried out by personal visits to the industrial companies and water authority.

(b) Economic Approach

Economic models are based on single or multiple regression models. For this approach, past annual energy consumption and economic data will be used as indicators to derive statistical information that demonstrates the relations between electricity demand and other independent variables which influence demand. Multi-econometric models are produced through the study. This approach is applied to the demand forecast of domestic, commercial, services, retail industries and retail pumping sectors.

(c) Gompertz Extrapolation

The Gompertz method is a modification of the simple exponential model which is calculated as a function of time until saturation level. The Gompertz method is formulated as follows;

$$D = \alpha \, EXP(\beta \, EXP(\gamma \, t))$$

Where: D = energy demand in year t

α = stationary or saturation value of D (at $t=\infty$)

β, γ = constants, both < 0

The formula can be rewritten in the following logarithmic form.

$$\ln(-\ln(D/\alpha)) = \ln(-B) + \gamma \, t$$

The Gompetz method is used to forecast the future values such as number of customers in the domestic sector.

(3) Demand Forecast

Table 4.1-2 shows the summary of electricity demand forecast. The following is an overview of the tables;

Net generation required in 2005 is forecasted to be 9,710 GWh at an average annual growth rate of 6.4% from 1995, and that of 2010 is forecasted at 13,667 GWh at an average annual growth rate of 3.5% for the succeeding 10 years. The required generation in 2010 and 2015 is equivalent to about 1.9 and 2.6 times of that in 1995.

Peak Load in 2005 and 2015 are forecasted to be 1,542 MW and 2174 MW with average growth rates of 6.0% and 3.5%, respectively. Morning Peak load is estimated to exceed Evening Peak Load in the year 2005 due to increases in air-conditioning load.

Table 4.1-2 Demand and Energy Forecast for Whole Country (Scenario-Medium) (unit: MW, GWh)

	1995	2000	2005	2010	2015	Ave. Annual Growth (%)
Energy Generated (GWh)	5,201	7,390	9,710	11,999	13,667	6.4 (3.5)
・NEPCO	5,201	7,151	9,487	11,791	13,459	6.2 (3.6)
Peak Load (MW)	862	1,179	1,542	1,901	2,174	6.0 (3.5)
・Morn. Peak	842	1,163	1,553	1,927	2,207	6.3 (3.6)
・Even. Peak	862	1,179	1,531	1,874	2,140	5.9 (3.4)
Load Factor (%)	71.0	71.6	71.9	72.1	71.8	----

Note: Ave. Annual growth (%) …… from 1995 to 2005 (from 2005 to 2015)

Peak Load is the load which is most probable and is estimated as an average of morning and evening peak load.

(4) Electricity Sales Forecast

Table 4.1-3 and Table 4.1-4 show the forecast of the peak load and total electrical energy sold to respective sectors. The total energy sales in 1999 are expected to be 5529GWh with an annual growth rate of 5.9%. In the former and later five years in the first decade in 21st century, annual average growth rate is 4.5 and 2.6%, respectively. In the period from 2011 to 2015, the average annual growth is 2.6%.

Table 4.1-3 Peak Load Forecast for Whole Country (Scenario-Medium) (unit: MW)

	1995	2000	2005	2010	2015	Ave. Annual Growth (%)
Domestic	267	363	465	554	644	5.7 (3.3)
Commercial	86	127	170	294	236	7.1 (3.3)
Retail Industry	61	105	151	194	230	9.5 (4.3)
Retail W-Pumping	109	119	147	173	191	3.0 (2.7)
Services	25	37	47	58	66	6.5 (3.5)
Street Lighting	27	37	45	55	66	5.2 (3.9)
Total	576	788	1016	1232	1427	5.8 (3.5)
Sent Out	682	946	1223	1480	1713	6.0 (3.4)
kW Loss Rate (%)	15.5	16.7	16.9	16.8	16.7	----

note: Ave. Annual growth (%) …… from 1995 to 2005 (from 2005 to 2015)

Table 4.1-4 Energy Sales Forecast for Whole Country (Scenario-Medium) (unit: GWh)

Scenario-Medium	1995	2000	2005	2010	2015	Ave. Annual Growth (%)
Domestic	1265	1757	2263	2701	3140	6.0 (3.3)
Commercial	481	715	960	1152	1339	7.2 (3.4)
Retail Industry	605	1009	1487	1958	2349	9.4 (4.7)
Retail W-Pumping	612	681	838	991	1091	3.2 (2.7)
Services	303	415	538	656	751	5.9 (3.4)
Street Lighting	119	161	197	240	290	5.2 (3.9)
Total	3384	4738	6283	7699	8959	6.4 (3.6)
Sent Out	3883	5471	7222	8850	10298	6.4 (3.6)
Energy Loss	499	733	939	1151	1342	---
Loss Rate (%)	12.9	13.4	13.0	13.0	13.3	---

note: Ave. Annual growth (%) ····· from 1995 to 2005 (from 2005 to 2015)

4.2 Development Program of Generation and Transmission Facilities

MEMR and NEPCO prepared and published expansion programs of generation annually working to secure the electricity required for different economic sectors in the most economic and reliable manner.

4.2.1 Generation and Transmission Facilities

(1) Generating Plants

NEPCO (CEGCO) is now implementing the second stage of Aqaba Thermal Power Station (ATPS) which comprises of three 130MW steam generating units. The reliability run test started in Dec. 1998 and one of the three units has already been put into commercial operation. The remaining two units are expected to be put into operation in Dec. 1999. The total installed capacity in the Kingdom, after the completion of the second stage of ATPS project, will be 1670MW. However, firm available capacity is approximately 1500MW. This capacity will meet the demand for electrical energy with substantial availability until the end of the year 2001.

The privately owned production project in the Kerbet Al-Samra region is succeeding in generation expansion. The implementation capacity of this generating project is 450MW and in the case of selected combined cycle units being adopted by the end of 2002, additional conventional steam units will be adopted in the first quarter of the year 2003.

Table 4.2-1 Generation Expansion Plan

Commissioning	New Construction			
Year	Steam	Combined Cycle	Gas Turbine	Total Capacity
1999	2 units of 130 MW			260 MW
2002			100MW	100MW
2003		1/2 of 300MW	△30MW	120MW
2004		1/2 of 300MW		150MW
2006		300MW		300MW
2007			△15MW	△15MW
2008			100MW	85MW
			△15MW	
2009		300MW	△133MW	167MW
2010			100MW	70MW
			△30MW	
Total	260MW	900MW	77MW	977MW

(2) Transmission Facilities

In accordance with the expansion of Aqaba Thermal Power Station Stage II (130MWx3), the 132kV transmission line between Aqaba and Amman South s/s was upgraded to a design voltage of 400kV in 1998 to ensure stable power transmission from south to middle and northern load centers in the kingdom. The 400kV transmission line length is 364km between Aqaba Thermal p/s and Amman South s/s and two 400/132kV 200MVA transformers are installed on both stations, respectively.

(3) Regional Transmission Facilities

NEPCO has the responsibility for transmission reinforcement to meet demand growth. To reinforce the electricity supply to JEPCO, IDECO and EDCO (NEPCO) distribution networks, 132kV transmission facilities shown in Table 4.2-2 were commissioned in 1998.

Table 4.2-2 Expansion of 132 kV Transmission Facilities in 1998

Facilities	1998	1999	2000	2001
132/33 kV Substation(Number)	1	0	1	1
132kV Transmission Line(km)	0	0	0	50
132kV Switch-gear(Bulk Supply)	0	1	0	1

(Source: NEPCO Annual Report 1998)

(4) Interconnection

(a) Jordan-Egypt Electrical Interconnection

In January 1998, a 400kV submarine cable was laid between Aqaba on the Jordanian side and Taba on the Egyptian side. The 400kV one circuit submarine cable was energized and both systems

were put into synchronized operation in October 1998. The submarine cable laying under Aqaba Gulf is 13km in transmission length and is composed of four pregnant cables including one auxiliary cable, which is being considered to be diverted to DC interconnection in the future. The submarine network is constructed for the future interconnection of all six countries; the Egyptian-Jordan-Syria-Turkish-Iraq and Lebanon international interconnection (EIJST Interconnection).

(b) Jordan-Syria Electrical Interconnection

NEPCO is currently implementing the Jordanian-Syrian 400kV interconnection project as a part of the EIJST Interconnection mentioned above. The 400kV transmission line construction between Amman South s/s and Syrian border through Amman North s/s has already completed. The 400kV transmission line between Amman South s/s and Syrian border is composed of 40.4km double circuit lines (Amman South s/s – Amman North s/s) and 58.4km single circuit line (Amman North s/s – Syrian border). The 400kV-trasmission system between two countries has been expected to be put into synchronized operation by the end of 1999. The 400kV double circuit transmission line is constructed between Amman South s/s and Amman North s/s taking into account as a back bone of Jordanian bulk power transmission system, single circuit transmission line for international interconnection between two nations.

4.3 Balance of Demand and Supply

Table 4.3-1 shows the future balance of demand and supply of peak power and energy over the country. In order to meet the demand growth, new generating plants will be added, while old and inefficient small power plants will be put out of use. The following table illustrates balance of demand and supply up to the year 2010.

Table 4.3-1 Balance of Demand and Supply (up to the year 2010)

	1999	2000	2001	2002	2003	2004
Peak Demand (MW)	1104	1179	1244	1324	1392	1462
Available Capacity (MW)	1490	1490	1490	1590	1729	1880
Margin (%)	35.0	27.0	19.5	20.3	23.5	28.3

	2005	2006	2007	2008	2009	2010
Peak Demand (MW)	1542	1623	1699	1776	1843	1901
Available Capacity (MW)	1880	2190	2160	2260	2370	2470
Margin (%)	21.7	34.0	26.9	27.3	28.7	30.3

CHAPTER V

THE PRESENT SITUATION OF DISTRIBUTION SYSTEMS ON THE INVESTIGATION TARGET AREAS

Chapter 5 The Present Situation of Distribution Systems on the Investigation Target Areas

5.1 Existing Distribution Systems

Existing distribution systems and facilities in Jordan are briefly summarized as follows.

5.1.1 Distribution Network of EDCO

EDCO distributes power to all governorates except the Amman areas covered by JEPCO and the Irbid areas covered by IDECO. There are six districts in the EDCO area, which are; Jordan Valley, Karak, Tafila, Ma'an, Aqaba and the Eastern districts. Approximately 100,000 consumers are supplied energy and in comparison to the other two companies, EDCO covers a wide area with relatively small demand. The peak demand is approximately 150MW corresponding to 14% of the whole Jordan. Power is commonly distributed with 33kV overhead distribution lines supplied from the nine HV/MV (132/33kV) bulk substations. An 11kV underground distribution system is also used for power distribution to the towns within the four districts of Karak, Tafila, Ma'an and Aqaba and 6.6kV distribution lines are usually only applied for supply to water pumps. The 6.6kV lines used for distribution purposes fall under the old system and will be replaced with 11kV lines. The number of MV/LV distribution transformers amount to more than 1,000 using a common 415V LV system of overhead distribution lines, with the exception of the limited area in the new town in Aqaba district where underground cables are used for LV systems. Overhead distribution lines are configured in the radial form and the sectionalizers are installed in the MV systems. The sectionalizer is also installed on the far end of the feeder as a normally open switch, which is closed to interconnect with the adjacent feeder when necessary.

5.1.2 Distribution Network of JEPCO

JEPCO covers the capital city Amman and has the largest demand among three distribution companies. Its customers number half a million, occupying 60% of the whole Jordan area. The peak demand was 540MW in 1998, which was 50% of the peak load of Jordan in 1998. The average demand growth rate of JEPCO is 6～7% in recent years. The service areas cover the Amman, Madaba and Balqa governorates with ten bulk substations (132/33kV) where the power is distributed from. Power supply to the cities is distributed with 11kV underground distribution lines and supply to the suburban areas is distributed with the 33kV overhead distribution lines as with the other two distribution companies. There are 4,000 distribution transformers (MV/LV) and the 415V overhead distribution lines are used as the low voltage distribution systems both in

cities and suburbs which is characterized by the high demand and short length of distribution lines.

5.1.3 Distribution Network of IDECO

IDECO's distribution area covers the four governorates of Irbid, Ajulun, Jarash and Mafrak with 180,000 customers and supply to 20% of the whole Jordan area with a peak demand of 170MW. There are three bulk substations (132/33kV) in the area the power is distributed from. The number of MV/LV distribution transformers amounts to approximately 1,500. The system configuration is the same as those of EDCO and JEPCO where the 33kV overhead distribution lines are common for power distribution to the suburbs, the 11kV underground distribution lines to the cities and 415V overhead lines for low voltage distribution system are common for the distribution system. There are, however, 6.6kV underground distribution lines in Jarash and Mafraq, which are to be replaced with 11kV lines due to limited capacity and aging. Overhead vinyl covered twisted wires are also frequently adopted mainly for security reasons.

5.2 Existing Transmission and Substation Facilities

Existing transmission and substation facilities were investigated and summarized as follows:

5.2.1 132/33kV Substation Facilities

The substation capacities as of 1998 year end are as shown in Table 5.2-1.

Table 5.2-1 Transmission Substation Capacity in 1998

Substation(kV)	400/132	33/11	66/33	132/6	132/33	230/132
Capacity(MVA)	1280	150	10	75	1989	200

Among the above, the distribution systems are supplied through the 132/33kV substations. There are two or three transformers with the capacity of 16 to 63MVA. SF6 gas insulated switchgears are used in some of the 132/33kV substations. They are operated either attended or unattended.

5.2.2 132kV Transmission Lines

There are two voltage classes of 400kV and 132kV in Jordanian transmission systems. Among these, 132kV transmission lines are used to connect between bulk substations (132/33kV) from which the distribution lines are outgoing. A 66kV transmission line between Irbid substation and Syria was constructed, however, now it is used as 33kV distribution lines. Overhead lines (ACSR) which are installed on porcelain or glass insulators supported with the iron towers are common transmission lines applied in Jordan. Length for transmission lines at NEPCO as of end of 1998 are shown in Table 5.5-2.

Table 5.2-2 Length Chart for Transmission Lines at NEPCO in 1998

Transmission line(kV)	66kV	132kV	230kV	400kV
Length(cct-km)	17	2124	17	670

5.3 Distribution Facilities in the Study Area

5.3.1 Standards for Facilities

(1) Distribution Systems

Distribution systems used in Jordan distribution networks are as follows:

- 33kV O.H.L: Mainly applied in rural areas.
- 33kV U.G.C: Mainly applied in JEPCO area.
- 11kV O.H.L: Mainly applied for distribution in towns or limited areas in Karak, Soubak, Tafila.
- 11kV U.G.C: Applied in Aqaba, Ma'an, some part of Karak and Tafila.
- 6.6kV O.H.L: & U.G.C: Existing in some areas (not applied to new construction).
- 0.4kV O.H.L: Generally applied in villages and towns.
- 0.4kV U.G.C: Mainly applied in towns.

Existing system particulars are shown in Table5.3-1.

Table 5.3-1 System Particulars

Nominal Voltage	415V	11kV	33kV
Maximum Voltage	440V	12kV	36kV
No. of Phases	3	3	3
System Frequency	50Hz	50Hz	50Hz
No. of Wires	5	3	3
Short Circuit Capacity	25MVA	330MVA	1,500MVA
Grounding	Solid	Resistance	Resistance
Conductor Arrangement	Vertical	Horizontal	Horizontal (or Triangle)

(2) Design Particulars

(a) Design Conditions

The design conditions are shown in Table 5.3-2.

Table 5.3-2 Design Ambient Conditions

Altitude	-400 ～ +1,365m
Highest Ambient Air Temp.	50℃
Lowest Ambient Air Temp.	-5℃
Average Relative Humidity	40 ～ 90%
Annual Average Rainfall	300mm
Annual Average Thunderstorm	10 days
Average Radial Thickness of Ice On Covering Conductors	10mm
Ground Temperature	3℃(at 1.0m depth)
Soil Thermal Resistance	1.2cm/W
Wind Force	70kPa/m^2

(b) Medium Voltage Networks

Medium voltage networks consist mainly of overhead lines and 3 phase, 3 wire horizontal conductor arrangements (or triangle arrangements in some cases where steel towers are used). Those network configurations are radial. Lines are protected against over currents and earth faults by means of circuit breakers at substations. Most of these breakers are fitted with auto reclose facilities. Auto recloser and auto sectionalisers or section-isolators are installed at some locations in the line.

Secondary windings of 132/33kV transformers are delta connected and earthing transformers are installed at 132/33kV substations. To limit the earth fault current at the 33kV network, a neutral point is earthed through earthing resistance. Every supporting structure in the MV network is earthed by earthing rods. Earthing resistance of structures is limited to not more than 15 Ohms. The design span of structures is around 120 meters and the following main structure arrangements are applied:

- Intermediate arrangement
- Angle/section arrangement
- Terminal arrangement
- Lay pole arrangement
- Long span arrangement

Table 5.3-3 shows the site design parameters for MV.

Table 5.3-3 Site Design Parameters for MV

Areas	Very Cold	Cold	Hot
Wind loading	70kPa/m^2	70kPa/m^2	70kPa/m^2
Ice loading radial	10mm	None	none
Min. Temp.	-5℃	-5℃	0℃
Max. Temp.	65℃	75℃	75℃

(c) Transformers

Distribution transformers in Jordan are classified into three typical types, pole mounted, ground mounted and package transformers. Fences are provided for the ground mounted transformers and the metal section of the fence is connected to the earth transformer. The transformer earthing consists of an earth ring of steel conductors installed at depth of 60cm. The earthing resistance of the transformer should not exceed 2 Ohms. Earthing rods are added (if needed) to ensure this value. The earthing of the pole mounted steel structure and transformer earthing are interconnected.

All transformers are Dyn11 with the low voltage side solidly earthed. Their primary voltage is 33kV or 11kV and secondary voltage is 0.4kV. Some transformers are supplied with bushing while others are with cable box. These are selected in accordance with type of MV network. The standard capacities are 25kVA, 50kVA, 100kVA, 150kVA, 250kVA, 400kVA, 500kVA, 630kVA, 750kVA, 1,000kVA and 1,500kVA. The 250kVA or smaller capacity transformers are pole mounted while the 630kVA or larger capacity transformers are ground mounted.

Lightning arresters are equipped with outdoor ground mounted or pole mounted substations, and not equipped with package transformers. Outdoor ground mounted transformers have load break switches and fuses at the primary side, while pole mounted transformers only have cut-out fuses at the primary side. Package transformers have fuse-switches at the primary side and load break switches at the secondary side.

LV distribution boards installed at the secondary side of the transformers have fuses or circuit breakers at the incoming points of feeders to protect facilities. The standard number of outgoing feeders for up to 250kVA and for 630kVA or lager capacities is four and six, respectively.

(d) Low Voltage Networks

Low voltage networks are mainly composed of overhead lines with six vertically arranged wires. These wires are over-running earth wires, red, yellow and blue phase wires, street lighting switch wires and neutral wires at the top. The LV network is earthed by earthing rods at every five or six poles. The design span of poles is approximately 40 meters. The following main structure arrangements are applied:

- Intermediate or straight line arrangement
- Section arrangement
- Terminal arrangement

Table 5.3-4 shows the site design parameters for LV.

Table 5.3-4 Site Design Parameters for LV

Areas	Very Cold	Cold	Hot
Wind loading	50kPa/m^2	50kPa/m^2	50kPa/m^2
Ice loading radial	10mm	None	None
Min. Temp.	-5℃	-5℃	+5℃
Max. Temp.	70℃	70℃	70℃

5.3.2 MV Feeders

(1) MV Distribution Systems

Medium tension distribution voltages applied in Jordan are 33kV, 11kV and 6.6kV. The 33kV network is mainly composed of overhead systems in rural areas. The 11kV network is mainly applied to both overhead and underground systems in towns. The 6.6kV network used to be applied in limited areas but is planned to be replaced with 11kV system, and will not be expanded. The 11kV cables and transformers with 6.6kV and 11kV primary voltage terminals are installed in the case of replacement of 6.6kV facilities. Long feeders in rural areas are equipped with voltage regulators or capacitors for voltage compensation.

(2) MV Overhead Feeders

The wires for overhead feeders are either aluminum alloy conductors or aluminum conductor steel reinforced bare wires. The standard size of wires is 50mm^2 ,100mm^2 and 150mm^2, and the arrangement of wires of MV system is horizontal.

Pre-stressed spun concrete poles are mainly applied and their standard pole length is from 10 to 15 meters. A bare 35mm^2 copper conductor is cast into each pole. Poles are designed with a minimum ultimate load of 1,800kg at 600mm lower from the top. If required, structures are propped up by stay wires or rods. Stay wires are of hot dip galvanized stranded steel with minimum breaking load of 10 tons, while stay rods are 2.44m long with ultimate strength of not less than 10 tons.

(3) MV Underground Feeders

Cables for MV networks are cross linked polyethylene insulated (XLPE) with three or single core stranded copper conductors with cross sections of from 70mm^2 to 400mm^2. Standard cables of three core cables are armored with galvanized steel wires and their cross sections are 70mm^2(11kV), 120 mm^2(11kV), 150 mm^2(11 and 33kV) and 240mm^2(33kV). Single core cables (if armored) are armed with two layers of helical wound aluminum tape and their cross sections are 70mm^2(11kV), 120 mm^2(11 and 33kV) and 150 mm^2(33kV).

Most of the underground cables are directly buried. Only cables at the roadway crossing and small amount

of sections are laid in cable ducts. The cable indication sheets or blocks are buried above the laid cables. The cable sections from the ground to the overhead wires are protected by steel or ploy-vinyl-chloride pipes.

(4) Protections

Circuit breakers are installed at the outgoing of MV feeder in substations. Some long feeders have recloser(s), and sectionaliser(s) or section-isolator(s) in the middle point of the line.

5.3.3 33/11kV Substations

33/11kV substations are usually used in the cities and reduces voltage from 33kV to 11kV. There are two or three transformers rated at from 10 to 25MVA in one substation.

5.3.4 Distribution Transformers

(1) Installation Type of Transformers

The capacities of existing MV (33kV,11kV,6.6kV)/LV(0.4 kV) transformers are 25kVA, 50kVA, 100kVA, 150kVA, 200kVA, 250 kVA, 400 kVA, 500kVA, 630 kVA, 750kVA, 1000 kVA, 1250kVA and 1500 kVA. The standard capacities of the transformers for new installations are 50kVA, 100 kVA, 250 kVA, 630 kVA, 1000 kVA and 1600 kVA. Those are three phase oil immersed self cooled (ONAN) transformers and are classified into following four types:

- Pole mounted type
- Ground mounted type
- Ground mounted package type
- Indoor type

Transformer capacity of 400kVA or less is applied for mounted poles. There are also cases where more than two ground mounted transformers or indoor type transformers are installed at one place. Some transformers also have capacitors at their secondary side. During site investigations, old aged transformers have been observed, however maintenance work seems to have been carried out properly with no evident malfunctions.

(2) Protections

Disconnectors and cutout fuses are installed at the primary side of the transformers. For transformers connected to the overhead distribution lines, lightning arresters are installed at the dropping wires from the MV lines to the transformers and overcurrent circuit breakers are installed at the secondary side of the transformers.

5.3.5 LV Feeders

(1) Distribution Systems

A three phase four wire 415/240V system is applied for LV distribution and feeders are classified into three types as shown as follows;

- Overhead wire feeder (O.H.L.)
- Overhead cable feeder (O.H.C.)
- Underground cable feeder (U.G.C.)

Most of LV feeders are overhead wire feeders. Both overhead and underground cables are applied in areas such as the center of town. At least the first section of feeders from the transformers are underground cables.

(2) LV Overhead Feeders

Most of existing wires are hard drawn stranded aluminum bare wires with the exception of some old copper conductors. Standard size of conductors are $50mm^2$ and $100mm^2$ ($25mm^2$ conductor is used for street lighting). Standard wire arrangement is a vertical layout with six types of wires; over running earth wires, red phase, yellow phase, blue phase wires, street lighting switch wires and neutral wires running from the top. In case each pole is earthed , the earth wire is exempted.

For the overhead cable feeders, the standard cross section of conductors are $70mm^2$ and $120mm^2$ while existing cross sections are $25mm^2$, $35mm^2$, $50mm^2$, $70mm^2$, $120mm^2$, $170mm^2$.

Standard poles for LV system applied are galvanized steel poles of standard length of 10 and 11 meters. Concrete poles used to be applied for most low voltage networks, however their application has been reduced due to the heavy weight and higher cost. There are two kinds of steel pole, one is named 'L3' applied for the terminal end or angle structure and the another is 'L2' applied for intermediate locations. If required, the stay wires or rods are propped up to the pole. Stay wires are of hot dip galvanized stranded steel with minimum breaking load of 10 tons, stay rods are 2.44m long and their ultimate strength are not less than 10 tons.

(3) LV Underground feeders

There exists underground cables of the cross section from $25mm^2$ to $300mm^2$. The standard cables are four core stranded aluminum conductor polyvinyl chloride (P.V.C.) insulated, steel wire armored cables ($3\times 240mm^2+1\times 120mm^2$, $3\times 185mm^2+1\times 95mm^2$, $3\times 120mm^2+1\times 70mm^2$, $4\times 35mm^2$), and single core stranded copper conductor polyvinyl chloride (P.V.C.) insulated aluminum armored (if armored) $300mm^2$or $185mm^2$ cables.

Most of the underground cables are directly buried. Only the roadway crossing section or certain small portions are laid in cable ducts. The cable indication sheets or blocks are buried above the laid cables. By steel or polyvinyl chloride (P.V.C.) pipes, cable sections between the ground to overhead wires along poles are protected.

(4) Protection

The protection device for the LV feeders are only fuses installed at the LV distribution board at the transformers.

5.3.6 Service Drops etc.

(1) Overhead service drops

Overhead service drop cables are insulated with polyvinyl chloride (P.V.C.) and their copper conductors are suspended by steel wire. Three core 10mm^2 conductor is applied for single phase consumers, while five core 16mm^2 conductor is applied for three phase consumers.

(2) Underground service drops

Underground service drop cables are of copper conductor polyvinyl chloride (P.V.C.) insulated and steel wire armored. Two core 10mm^2 conductor is applied for single phase consumers, while four core 16mm^2 conductor is applied for three phase consumers.

(3) Metering devices

Kwh meters are installed at consumer's service point . The standard meters are induction type, 10 Amps or 20 Amps for single phase, and 15 Amps or 25 Amps for three phase customers.

(4) Protections

At the service point to the consumers (primary side of the kWh meter), miniature circuit breakers are installed. Standard capacities of these are 32 Amps or 50 Amps for the single phase consumers and 50 Amps or 80 Amps for the three phase consumers.

5.4 Facility Operation

5.4.1 Standard for Operation and System Reliability

(1) Operation Standard

For the medium voltage system, an open sectionalizer is normally installed at the far end of distribution lines, which is closed to interconnect feeders during the contingency. The distribution lines, however, are operated within the current capacity of wires. In unlikely event of fault, the sectionalizers are together with an auto-recloser on the source side in order to isolate the fault section and its load side section. The interconnection is not taken into consideration for the low voltage systems.

(2) Standards of System Reliability

There is a standard of voltage drop as a reliability standard. The voltage drop in cities and suburbs is limited within ±6% and ±10% respectively as a design standard. Countermeasures are taken against claims from customers. In addition, as to the low voltage system, feeder length is controlled according to the design standards of less than 300m in Amman city, 500m in other cities and 700m in suburbs.

5.4.2 Operation and Maintenance of Distribution Facilities

(1) Present Situation of Operation

NEPCO's control center supervises and controls the load condition and remotely controls the switchgears of the substations above 33kV, including the substations in the IDECO area. Voltage and load (A, kW, MVA) of 33kV-132kV systems can be supervised from the NEPCO's head office as well. The collected data is recorded every 30 minutes and stored for a week. JEPCO's control center remotely controls 15 substations and supervises the load of MV distribution lines and transformers. Whereas at the distribution substations with voltage below 33kV, the load current of the transformer is measured every two years. Additionally, visual checks and oil inspections are executed periodically. The watt hour meters are also calibrated before customer installation. The errors are controlled within 2% using the standard meter with 0.2% accuracy at the meter inspection room at the distribution office. The calibration results are also checked.

(2) Present Situation of Maintenance

As to the transmission substations, switchgears are inspected every year and the other equipment is visually checked every month. For the distribution facilities 33kV and below, maintenance teams in each area conduct visual inspection of distribution lines and replacement of mal-functioning equipment. In addition to those, specialized teams of cable jointers carry out jointing works of underground cable connections. The maintenance teams also conduct switching operation of the switchgears on distribution lines.

5.5 Selection of Target Areas/ Feeders

5.5.1 Progress Situation of Loss Reduction after M/P

Following the recommendation of the M/P, the phase current unbalance is being improved. Meanwhile, installation of capacitors have been recently implemented by three distribution companies (EDCO, JEPCO, IDECO). It was required that the study be carried out on the selection of capacity and the effective installation method.

5.5.2 MV Target Feeder

(1) MV Target Feeders of EDCO

(a) Target feeders

- Ma'an district: Ma'an – Wadi Musa line (33kV)
- Jordan Valley district: Subehi – JV2 line (33kV)
- Tafila district: Rashadya – Tafila line (33kV)

(b) Reason and background of selection

EDCO's distribution area is widespread throughout the whole of Jordan and divided into 6 districts of Karak, Tafila, JV, Ma'an, Aqaba and the Eastern Area. These are characterized by longer lines and higher loss rates. The three districts of Tafila, JV and Ma'an are selected as a target area for higher loss rates shown in Table 5.5-1. Among these regions, that of JV district was the highest at 7.6%.

Table 5.5-1 Loss Rate of MV System by District of EDCO in 1998

District	Karak	Tafila	JV	Ma'an	Aqaba	Eastern area
Loss rate	3.3%	7.2%	7.6%	7.3%	5.4%	3.3%

As to the JV district, electricity is distributed by three bulk substations of Irbid, Subehi and Bayader. Two 33kV feeders from Subehi run along the long and narrow Jordan Valley to the north and south respectively at a length of 70km. JV2 lines going north with a voltage drop above 20% were selected as a target feeder for the study since this line has a heavy load (8-9MW) and low power factor of 0.80. JV1 going south has a relatively lower load and higher power factor compared with JV2. According to the planning study, the transmission substations are to be installed along both lines of JV1 and JV2.

Concerning the Ma'an district, there are two bulk substations of Ma'an and Rashadya from which the 33kV distribution lines are outgoing. The Wadi Musa line was selected among them. The line with total length of 60km has heavy hotel loads and ends in Petra.

For the Tafila district, electricity in this area is distributed with two distribution lines from different transmission substations. Among the two distribution lines, the Tafila line from Rashadya substation was selected due to heavier load of 4MW and worse power factor of 0.81. Another line from Hasa substation is longer but has light load.

(2) MV Target Feeders of JEPCO

(a) Target feeders

- Zarqa district: Hussein – Duleel line (33kV)
- Madaba district: QAIA – Madaba (33kV)

(b) Reasoning and background of selection

As in the case of EDCO, target feeders were selected based on high loss rates, high voltage drops and heavy load.

(3) MV Target Feeders of IDECO

(a) Target feeders

- Irbid district: Irbid – Samma line (33kV)
  - Emrawa line (33kV)
- Jarash district: Rehab – Jarash line (33kV)

(b) Reasoning and background of selection

As in the case of EDCO, target feeders were selected based on the reasons of high loss rates, high voltage drops and heavy load.

5.5.3 LV Target feeder

The numbers of target feeders for respective companies were determined based on the Jordanian side request as shown in Table 5.5-2.

Table 5.5-2 Number of Target Feeders by Distribution Company

Distribution Company	EDCO	IDECO	JEPCO	Total
MV feeders	3	3	2	8
LV feeders	150	150	100	400

Target LV feeders were selected under following conditions with the cooperation of counterparts;

- Current on feeder: more than 100amps.
- Line length: more than 700m (EDCO), 500m (IDECO) and 300m (JEPCO)

Conditions for feeder length were taken into account due to the differences in respective features of the distribution area. For example, EDCO has relatively longer feeders due to a wide area with low load density, so target feeders were chosen under the condition of feeder length over 700meters.

Table 5.5-3 Selection Criteria of LV Target Feeders by Company

Distribution Company	EDCO	IDECO	JEPCO
Critical current	100A	100A	100A
Feeder length	700m	500m	300m

CHAPTER VI

SYSTEM IMPROVEMENT PLAN IN THE STUDY AREA

Chapter 6 System Improvement Plan in the Study Area

6.1 Community Development and Industrialization Plan

The development of tourism and industry such as construction of hotels and industrial complexes are under way in the Dead Sea eastern coast and Karak areas. These development plans should be taken into account in the feasibility study.

6.2 Plan for Power System Development

Concrete plans for installation of the 132/33kV substation and 33kV MV feeders in the target area are as follows;

6.2.1 Plan for New 132kV/33kV Substation Construction

To meet growing demand in the respective area, the following transmission substations and lines are planned or under construction;

(1) 132/33kV Abdoon and Seima Substation

In the Amman area, construction of the Abdoon substation is planned in addition to the Tareq substation in 1998. In the Dead Sea eastern area, a 132kV/33kV Seima substation and 132kV double circuit transmission line from QAIA substation are under construction aiming at commercial operations in the first quarter of the year 2000.

(2) 132/33kV Waqas and Shtafina Substation

In the western section of the Irbid area, commissioning of Waqas substation is expected in 2001 to meet growing demands due to area development and increasing pumping demands in the Irbid area. A 132kV double circuit transmission line from Subeihy substation is also planned as a power source of Waqas substation.

MV feeders for target feeders of the Emrawa and Samma lines and the Jordan Valley area are also planned as secondary networks of the Waqas substation. One feeder for the Emrawa line and two feeders for the Samma line are planned. One of the other two feeders for Jordan Valley area is expected to reduce load on the MV target feeder of the JV2 line.

In the southern area of Waqas substation, the 132kV/33kV Shtafina substation is expected to be put into commercial operation in the early stage of 2000s with one feeder for the target feeder for the Samma line.

6.2.2 Plan for 132/33kV Substation Reinforcement

The Ghor Safi, Karak and Ma'an substations will also be reinforced in 2001 and 2002 to meet electricity demand growth of the magnesium factory and industrial complex, respectively.

For reactive power compensation, total capacity of 105MVA capacitors will be installed in Abdoon (45MVA), Seima (30MVA) and Waqas (30MVA).

6.2.3 Plan for Distribution (33kV and below) Network

In accordance with the transmission substation reinforcement plan, 33kV distribution lines are planned with reinforcement. Distribution companies, EDCO, JEPCO and IDECO will carry out the studies for 33kV and below networks reinforcement plan. Respective plans related to this study will be corrected and reviewed in the second site investigation period. Existing 6.6kV distribution systems are planned to be upgraded to 11kV in the future, installing 11kV facilities and cables on existing 6.6kV distribution systems to meet demand growth.

(1) MV feeders from 132/33kV Waqas Substation

MV feeders for target feeders of Emrawa and Samma lines along with the Jordan Valley area are also planned as a secondary network for Waqas substation. One feeder for the Emrawa line and two feeders for the Samma line are planned. One of the other two feeders for Jordan Valley area is expected to reduce load on the MV target feeder of JV2 line.

(2) MV feeders from Shtafina Substation

The 132kV/33kV Shtafina substation is expected to be put into commercial operation in the early stage of 2000s with one feeder for the target feeder for the Samma line.

(3) Reinforcement of MV feeder from Irbid Substation

The underground cable portion of the MV feeder for the Samma line of the target feeder from the existing 132/33kV Irbid substation has been completed to date. This system will be utilized to reduce the load on the Samma line.

Studies on target feeders of Emrawa and Samma lines of IDECO and JV2 lines of EDCO will be carried out based on the afore-mentioned reinforcement plan. Their respective study has been conducted on system configuration reflecting the reinforcement plans.

CHAPTER VII

BASIC POLICY ON LOSS REDUCTION IN DISTRIBUTION SYSTEM

Chapter 7 Basic Policy on Loss Reduction in Distribution System

7.1 Methodology for Loss Reduction in the Distribution System

Low loss reduction levels in the distribution system result in higher distribution efficiency. However, system efficiency improvement must be evaluated in economic terms taking into account the investment required and the benefits. It would be almost impossible to establish just how far loss reduction in the system should be achieved due to the large number of facilities. Studies on system loss reduction in practice are usually carried out only on the respective target heavy load feeders. The optimum plans for loss reduction are established and put into practice to improve efficiency of the networks. In this project, the study on optimization of respective measures for loss reduction should be examined in the same manner as the previous Master Plan Study on Electric Power Loss Reduction of Transmission and Distribution Network in the Hashemite Kingdom of Jordan. Studies have been carried on respective target feeders selected through the study in cooperation with Jordanian counterparts in the first site investigation. The target feeders consist of 8 MV feeders and 400 low voltage feeders. Suitability of the countermeasures on these target feeders should be studied mainly in economic terms. The concrete reinforcement plan for respective target feeders should be established based on the studies on technical standards required and viable measures for loss reduction.

7.1.1 Measures for Loss Reduction

In addition to measures to be studied in this project such as construction of same voltage feeders and the introduction of higher voltage system, power factor correction by installation of capacitors has been taken into account as one of the measures for loss reduction in accordance with the strong request by the Jordanian counterparts. Power factor correction with capacitors is one of most economical and viable measures for low power factor systems due to low cost with superior measures to other facility measures such as reinforcement of the distribution line itself. The study on reinforcement such as construction of same voltage feeders and introduction of higher voltage system has been carried out under given conditions of power factor correction with capacitors. Reduction in loss due to power factor correction does not necessarily result in significant reduction compared with other measures, however it only requires minimal investment. Thus, the power factor correction is deemed to be a superior measure. Re-conductoring with larger size conductors without needing to replace existing poles and structures is also one of the economical measures for loss reduction adopted in the study.

Concrete measures for studies on power loss reduction in this project are summarized as shown below;

- Power factor correction with capacitors
- Re-conduct ring of the existing lines
- Construction of same voltage lines
- Introduction of higher voltage system

For re-conductoring of existing distribution lines, capability of supply during the re-conductoring work period should be sufficient. Feasibility of re-conductoring especially for the regional trunk MV system should be carefully studied in terms of supply capability during re-conductoring work so as not to cause long term interruption of electricity supply due to shortage of capability of the remaining system in cooperation with Jordanian counter parts.

7.1.2 Target Feeders

Target feeders in low (415V) and medium voltage (33kV) systems were selected in cooperation with the Jordanian counterparts based on the conditions described in Chapter 5. Outlines and situation of respective MV and LV target feeders are shown below;

(1) MV Target Feeder

Outlines of respective MV target feeders are shown in Table7.1-1.

Table 7.1-1 MV Target Feeder (1999yr)

Distribution Company	Name of Line	Main Substation	Total Line Length (km)	Capacity (MVA) [A]	Load (A)	Power Factor
EDCO	Wadi Musa	Ma'an	156	15.5 (271)	157	0.84
	Tafila	Rashada	28	15.5 (271)	92	0.82
	JV2	Subeih	125	15.9 (278)	194	0.80
JEPCO	Duleel	Zarka	48	19.4 (340)	167	0.80
	Madaba	QAIA	156	19.4 (340)	283	0.88
IDECO	Jarash	Rihab	155	15.5 (271)	246	0.83
	Emrawa	Irbid	163	20.0 (350)	250	0.82
	Samma	Irbid	182	20.0 (350)	367	0.84

(2) LV Target Feeder

Table 7.1-2 shows currents, lengths and power factors of LV target feeders. Current distribution of LV feeders is shown in Figure 7.1-1.

Table 7.1-2 Currents, Lengths and Power factors of LV target feeders (1999)

	The Number of LV Target Feeders in Peak Current										Current		Line Length		Ave. p.f
	～75 (A)	～100 (A)	～125 (A)	～150 (A)	～175 (A)	～200 (A)	～225 (A)	～250 (A)	Over 250(A)	Total	Total (kA)	Ave. (A)	Total (km)	Ave. (km)	
EDCO	1	5	31	39	32	13	5	11	11	148	24.2	163	262.4	1.77	0.817
JEPCO	3	10	9	18	15	12	9	4	20	100	18.5	185	105.6	1.06	0.820
IDECO	11	16	22	21	37	13	9	13	8	150	23.2	155	313.7	2.09	0.820
Total	15	31	62	78	84	38	23	28	39	398	65.9	166	681.7	1.71	0.819

Line Length : Total of main and branch portion of feeder

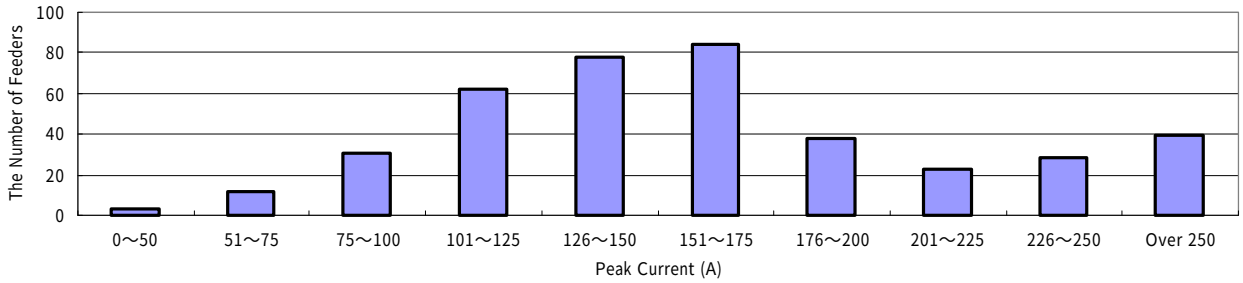


Figure 7.1-1 Feeder Current Distribution of LV Target Feeders

7.1.3 Measures for Loss Reduction in MV and LV System

Facilities such as conductors and transformers for improvement in loss reduction in the distribution system were selected based on the technical standard and wide application in distribution companies in Jordan. The adoption of larger sized conductors should be examined as measures for re-conductioring and new line installation at the same voltage. As the number of feeders from distribution transformers would be confined from the view point of land acquisition and environment, the number of newly installed feeders from existing transformers is limited to one in this study. The main facilities for respective measures of loss reduction are described below;

(1) Conductors and Cables

Conductors and cables for the study on respective measures for loss reduction in MV (33kV) and LV (0.4kV) systems are listed in Table 7.1-3. Among these conductors, the aluminum l50mm2 conductor was added as a measure for re-conductoring or installation of new LV lines, which has not been adopted so far. The Al 150mm2 conductor was examined because economic benefits of introduction of larger conductor would be envisaged. As to bundled conductors, they also were expected to be beneficial in terms of economy and safety, the studies were also conducted on bundled conductors.

Table7.1-3 Conductors and Cables

	MV （33 kV）	MV （11 kV）	LV (415 V)
Overhead Bare Conductors	ACSR 50,100,150,200,240 mm^2 Al 50,100,150 mm^2	ACSR 50,100 mm^2	Al 50,100,(150) mm^2
Overhead Cables	-----	------	(B-Al 70,95,120 mm^2)
Underground Cables	Al 150,300,400 mm^2	Al 120,150,185,240,300, 400 mm^2	------

(2) Transformers

Transformers applied are listed by type and capacity in Table 7.1-4.

Table7.1-4 Transformers

Type of Transformer	33/0.415 kV	11/0.415 kV
In-door Type	-----	250,400,500,630,750,1000,1500, 2000kVA
Package Type	-----	250,400,500,630,750, 1000kVA
Pad-mounted Type	250,400,500,630,1000,1500kVA	250,400,500,630,800,1000,1500kVA
Pole Type	25,50,150,250kVA	50,150,250kVA

7.2 Software for Study

Substantial analysis is essential for investment optimization procedures due to various kinds and numbers of facilities in this project. The software has been improved in order to improve efficiently to carry out such extensive analysis. Combining power flow analysis and optimization software, the results of power flow/loss analysis can be taken into the study on optimization of investment. The main points of improvement in software are described below;

7.2.1 Software for Power Flow and Loss Analysis

PFLOW software has been used for analysis on power flow and losses in the transmission and distribution system. PFLOW has been improved by integration of previous FLOW and VLCALC software which were used in the study for the Master Plan. Power flow analysis in PFLOW can be executed by using load current data in ampere for the LV system and lumped load data in kW/kVA for the MV system and above.

Available load data for the LV system is generally limited within currents. Only current or voltage data is measured with devices of current and/or voltage meters on the LV system. It is impossible to gauge in

detail the distribution of load along low voltage feeders without any special measurements. PFLOW can be executed by using both lumped load on respective nodes and unified distributed load along distribution lines. The unified distributed load model is adopted for LV feeders in this study. For the LV system in Jordan, the three-phase-four conductor system is adopted; analysis can be conducted on unbalanced three-phase-four conductor system with PFLOW.

For the medium-high voltage distribution systems, active and reactive loads are measured and such data is available at respective locations along the system such as substations, generating and switching stations. To analyze power flow and loss reduction of medium-high voltage distribution systems, the PFLOW adopts a method (such as the one used in the PSS/E program run by NEPCO) for solving power equations through analysis techniques by concentrating the load at one of the nodes in the system. The PFLOW program also adopts the Newton-Raphson method which is commonly utilized for convergence calculation.

PFLOW has been improved to conduct analysis on two different types of system models simultaneously. Concretely, convergent calculation is repeated until the voltage and current conditions of the load at the connecting point of low and medium voltage system becomes below tolerance level. Furthermore, PFLOW has been improved so that capacitors in the low voltage systems can be modeled as reactive current sources.

7.2.2 Optimization Software

There are several measures for loss reduction in transmission and distribution systems such as;

- Reduction in resistance by replacing the existing conductors with larger sizes (re-conductoring),
- Improvement of distribution of current by new lines (construction of same voltage lines),
- Reduction in current by introducing higher voltage systems and ;
- Correction of power factors by installing capacitors on the middle of the system

In order to select the optimum measure from above, many studies must be carried out on which section of feeder should be reinforced by re-conductoring or by new feeder installation. The PLOPT has been developed as a solution for many such examinations on transmission and distribution systems for loss reduction. This software also has been improved in such areas as limiting the number of new feeders from the distribution substation for this feasibility study.

Optimization procedure for respective measures is described below;

(1) Re-conductoring of Existing Feeder

Conductors of respective sections are replaced with larger size conductors, one by one along the existing

distribution line. Economic evaluation is carried out step by step comparing the benefits due to loss reduction and the expenses of facilities due to investment. PLOPT outputs sets of results such as conductor size, section to be re-conductored and net benefit due to re-conductoring. Among these sets of results, the most beneficial conductor and length reinforced is selected. With the results on re-conductoring study, expenditure due to investment, benefit due to loss reduction, net benefit and total construction cost are outputted. The required data for economic studies for loss reduction such as conductor resistance and construction costs are tabulated prior to analysis in the PLOPT software. Common data such as respective conductor resistance is used in PFLOW and PLOPT.

(2) Installation of Same Voltage New Lines

Installation of same voltage new lines along with the existing lines are examined in the PLOPT software. The benefits from loss reduction and expenses of facilities are calculated by making changes on the conductor size and length to be reinforced. Sets of results such as conductor and installation length are outputted with their net benefit. Comparing net benefit among sets of results, the most beneficial case is selected. The result comprises of conductor size, newly constructed sections and results of the economic study such as benefits, expenditures and net benefits due to loss reduction.

(3) Introduction of Higher Voltage System

Installation of higher voltage lines along with existing distribution feeder and step-down substation in the neighboring areas are examined in the PLOPT software. Changing the length and conductor size of the higher voltage line, location and capacity of the step-down substation, benefits and expenditures due to loss reduction are analyzed. The most beneficial combination of conductor, length of higher voltage line and step-down transformer is selected by the software.

If the conditions such as geometric relations of existing facilities and limitations by land acquisition were taken into account on the software, an extensive amount of information or data would be required and the software would become extremely oversized and complicated. To avoid such a situation for the optimization analysis, the studies on reinforcement are carried out provided that the lines are constructed along the existing distribution lines. In case of introduction of the higher voltage lines or the construction of medium voltage lines, the result of the software PLOPT cannot be directly put into practice. In reality, route or land acquisition for large electric facilities such as transmission lines and main substations has various limitations. Shorter routes may exist instead of the routes along existing distribution lines. Based on the result of the analysis, further study should be carried out to brush up on the results of analysis with utmost use of knowledge.

In studies of power factor correction, the model of unified distributed load cannot be directly applied for LV system due to changes in distribution of reactive currents and annual demand growth so the equivalent power

factor which represents power factor of distribution feeder with lumped capacitor on the middle of distribution feeders is studied.

7.3 Conditions for Study of Optimization of Loss Reduction

7.3.1 Facilities

(1) Transformer Core Loss and Reactance

In order to reflect transformer core losses that are affected by operating voltages, transformer core loss is modeled in such a manner that a resistor represented core loss is placed on the transformer primary terminal. The averaged value of reactance obtained by fitting existing data to the regression formula has been used for the reactance of various types of transformers. (Refer to Table 7.3-1)

Table7.3-1 Core Loss and Reactance of Transformers

Capacity (kVA)	Core loss, Copper loss and Reactance （1MVA Base）		
	Core loss (%) (W)	Copper loss (%) (W)	Reactance (%)
50	0.032 (322)	26.693 (667)	68.548
100	0.037 (369)	10.626 (1063)	35.124
200	0.046 (463)	4.633 (1853)	18.412
250	0.051 (510)	3.597 (2248)	15.070
300	0.056 (557)	2.937 (2644)	12.841
315	0.057 (571)	2.784 (2762)	12.311
400	0.065 (651)	2.146 (3434)	10.056
500	0.074 (745)	1.690 (4225)	8.385
630	0.087 (867)	1.323 (5252)	7.005
800	0.103 (1026)	1.031 (6596)	5.878
1000	0.121 (1214)	0.818 (8177)	5.042
1250	0.145 (1449)	0.650 (10153)	4.374
1500	0.168 (1683)	0.539 (12129)	3.928
1600	0.178 (1777)	0.505 (12920)	3.789

(2) Construction Cost

Based on previous data in the Master Plan on construction cost, the construction costs composed of material and construction labor costs has also been revised to reflect actual costs. Costs of capacitors for low and medium voltage distribution system have also been re-evaluated by adding construction labor costs to the procurement price. Construction cost is summarized in the following table as shown in Table 7.3-2. One third of these prices are applied for the construction cost of re-conductoring.

Table 7.3-2 Construction Cost

Voltage (kV)	Facilities	Capacity (MW, MVA)	Construction Cost (JD)
132kV Overhead Distribution Lines	132kV x 240 mm^2, 400 mm^2, 2ckt	102MW 174MW	84,000/km
132/33kV Outdoor Type Substations	132/33kV 2x40MVA 132/33kV 2x63MVA	80MVA 126MVA	2,500,000 3,900,000
33kV Overhead Distribution Lines	ACSR 50～240 mm^2 Al 50～150 mm^2	600 A 68 MVA/ckt	11,000-15,500/km
33kV Underground Distribution Lines	Al 150～400 mm^2 Cu 150～300 mm^2		35,000-60,000/km
33/0.4kV Transformer	Pad Mounted	250～1500kVA	12,125-23,325
	Pole Mounted	25～250kVA	6,060-9,835
11kV Distribution Lines	Underground Lines Al 150～400 mm2		24,500-48,000/km
11/0.4kV Transformer	Indoor Type	250～2000kVA	17,360-39,763
	Package Type	250～1000kVA	16,690-22,290
	Pad Mounted	250～1500kVA	9,780-20,925
	Pole Mounted	50,150,250kVA	6,918-8,518
0.4kV Overhaed Distribution Lines	Bare Conductor Lines Al 50,100,(150) mm^2		9,750-12,750
	Bundled Conductor Al 70,95,120 mm^2		10,500-15,000

Table 7.3-3 Unit Capacity Cost of Capacitors

MV	33kV S/S	Including Circuit Breakers and Control Panels	12JD/kVA
	33kV MV	Only capacitor	5JD/kVA
	11kV MV	Only capacitor	4JD/kVA
LV	0.4kV LV	Only capacitor	4JD/kVA

7.3.2 Criteria for Evaluating Losses

The benefit brought by loss reduction can be attained by saving fuel consumption through energy loss reduction and reduction in expenses by reducing development capacity of power plant and transmission and distribution facilities. The net benefit due to loss reduction can be obtained as the deference between benefits mentioned above and expenditures due to investment on distribution/transmission system for loss reduction. The Study Team calculated the benefits based on the Long-Run Marginal Cost prepared by NEPCO (Re JEA) in March 1999. These values were used as the criteria for evaluating the power loss reduction measures.

(1) Strict Long Run Marginal Cost

In Jordan, the cost of generation, transmission and distribution system classified by system voltage is evaluated every year by NEPCO as a Long-Run Marginal Cost. Among Long Run Marginal Costs, the Marginal Energy Cost (MEC) corresponding to the kWh value of loss reduction is calculated for peak, mid-peak and off peak period of time. MEC calculates energy costs at ; a) power stations b) transmission ends c) medium voltage distribution and; d) low voltage distribution systems. The MEC of the respective systems correspond to fuel and O&M costs per kWh according to energy loss reduction. In addition, Marginal Capacity Cost (MCC) corresponds to the cost of facilities per kW, based on the investment of generation units (gas turbine generation units), and transmission and distribution systems covering the peak demand. MCC includes construction costs and losses and is classified into respective voltage levels. The MCC for the respective systems is utilized for the evaluation of the kW value of loss reduction. Dimensions for NEPCO's Long Run Marginal Cost as of 1999 are shown in Table 7.3-4 – 7.3-6.

Table 7.3-4 Dimensions for Long Run Marginal Cost

Year for study	1999			
Last year for study	2008			
Reserve ratio of power supply	20.0%			
Discount rate	8.0%			
Conversion Coefficient				
Foreign currency	1.0			
Standard (SCF)	1.00			
Exchange Rate(JD/US$)	0.71			
Investment for facilities				
	Peak Generation Gas Turbine	Transmission and Distribution system		
		Transmission	MV Distribution	LV Distribution
Life Time(Year)	20	40	25	25
O&M etc (%)	3.00	2.00	2.50	2.50
Delays in Construction	--	2	1	1
Year when generation is required	2002			
Rate of Capital (%)				
Imported	95	80	80	80
Domestic	5	20	20	20
Labor Cost	0	0	0	0
Marginal Cost				
	Peak	Meddle Loads	Off Peak	
Type of Generation	Gas Turbine	Steam+NG	Steam(Aqaba)+NG	
Heat efficiency	0.296	0.296	0.258	
Fuel	Diesel Oil	Heavy Oil	Heavy Oil	
Fuel Cost(US$/ton)	174.3	109.2	108.5	
Calorific Value(kCal/ton)	10,200	9,700	9,700	
Variable Cost of Operation	3%	6%	6%	

Table 7.3-5 Marginal Energy Cost (JD/kWh)

	Peak (3)	Meddle peak (13)	Off peak (8)	Average(Weighted)
Generation	0.038	0.023	0.020	0.0238750
Transmission system(HV)	0.039	0.024	0.021	0.0248750
Distribution system (MV)	0.041	0.025	0.021	0.0256667
Distribution system (LV)	0.044	0.027	0.023	0.0277917

Table 7.3-6 Marginal Capacity Cost (JD/kW/Month)

	Generation	Transmission and Distribution System				Total
		Transmission system	Distribution System (MV)	Distribution System(LV)	Total	
Transmission system(HV)	2.457	1.190715			1.190715	3.648
Distribution system (MV)	2.557	1.23877	1.097777		2.336547	4.893
Distribution system(LV)	2.772	1.342965	1.190112	1.548107	4.081182	6.853

(2) The Economic Evaluation for Power Loss Reduction

The measures for power loss reduction can be evaluated comparing the benefits due to reducing power losses with the costs due to investment on distribution facilities. This benefit can be evaluated in terms of economic values of reduction in kWh and kW.

The monetary value of kWh for a specific period can be calculated by evaluating the total energy reduction in that specific period. Whereas, the monetary value of kW can be calculated by evaluating the total capacity curtailment due to reduction in power demand at peak period. The study on the evaluation of the monetary value of loss reduction per unit kW for target 10 year period (economic evaluation for power loss reduction) has been carried out.

Reduction in loss (kWh, kW) attained in the first year by countermeasures will increase in proportion to the square of load/current according to demand growth. Total amount of loss reduction per unit kW in the initial year of the target ten years has been calculated. To be concrete, based on the demand forecast during the target period of ten years and using NEPCO's Long Run Marginal Cost, the monetary value has been calculated as the value of the economic benefit due to loss reduction per kW in the first year. The monetary value for loss reduction and its dimensions for calculation are shown in Table 7.3-7. The demand growth ratio in each year against the previous year is shown in Table 7.3-8.

Table 7.3-7 Monetary Value for Loss Reduction

	Transmission System(HV)	Distribution System (MV)	Distribution System(LV)	Notice
Monetary Value for Loss Reduction (10years)	1693JD	1887JD	2237JD	
Discount Rate	8%			
Life time	40years	25years	25years	
O&M	2%	2.5%	2.5%	
Salvage Value	0	0	0	
kW cost (JD)	43.77	58.71	82.24	
kWh cost (JD)	0.02488	0.02567	0.02779	
Loss factor	0.5463			

Table 7.3-8 Demand Growth Ratio from the Former Year

	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Demand growing ratio from the former year(%)	6.43	5.14	5.03	5.47	5.25	4.68	4.53	3.77	3.15

7.4 Principles of Selection of Measures

Power factor correction by installing capacities and adoption of higher voltage system etc. are measures to reduce losses in the network. Generally speaking, the measures with larger investment bring about greater benefit but take more time to recover investment costs. On the other hand, the measures with smaller investment bring less benefits but swiftly recover the investment. Power factor correction by capacitors is such that countermeasures and can be applied to the distribution system introduced as the most superior in economic efficiency. The aim of the study of loss reduction is to select measures with maximum net benefit among respective measures and their combinations. And further, it will be necessary to study other aspects such as total amount and efficiency of investment to realize the project. The study on selection of measures will be conducted in such manner as described in the following.

7.4.1 Combinations of the Measures

Power factor correction by installing capacitors is the most effective measure economically for medium and low voltage target feeders. Thus, the studies on power factor correction with capacitors have been firstly examined to evaluate effects on loss and voltage reduction. Other measures in combination with power factor correction have been studied.

Combinations of measures for the studies are listed in Table 7.4-1.

Table 7.4-1 Combinations of Measures for the Studies

	Measures
1	Power factor correction by installation of capacities
Combinations of options of measures	
2	Power factor correction by installation of capacities and Re-conductoring
3	Power factor correction by installation of capacities and construction of the same voltage lines
4	Power factor correction by installation of capacities and Introduction of higher voltage lines

7.4.2 Coefficient of Investment Efficiency

The term of recovery of initial investment on facilities for loss reduction has been studied. Using the coefficient of investment efficiency that is the ratio of the net benefit to the construction cost (investment for facilities), the term (recovering duration) has been estimated when the net benefit due to loss reduction exceeds the construction cost (initial investment for facilities). Relation between coefficient of investment efficiency and term of recovery of initial investment is summarized in Table 7.4-2.

Table 7.4-2 Coefficient of Investment Efficiency vs. Term of Recovery

Term of Recovery of Initial Investment	Coefficient of Investment Efficiency (IE Factor)
The first year	10.43
2nd year	4.68
3rd year	2.80
4th year	1.86
5th year	1.30
6th year	0.93
7th year	0.66
8th year	0.47
9th year	0.32
10th year	0.20

・Coefficient of Investment Efficiency = Net Benefit during the 10 years/ Investment on Facilities

The above table shows that as coefficient of investment efficiency becomes larger, the term of recovery of initial investment becomes smaller. Using the coefficient of investment efficiency, measures for loss reduction can be ranked by respective feeders according to the value of investment efficiency. Further coefficients of investment efficiency can be used for determining the amount of investment and the selection of respective measures based on the order and/or term of recovery.

As mentioned in chapter 8, measures for respective target feeders have been evaluated calculating the coefficient of investment efficiency. It is called 'IE Factor' hereinafter. Studies on total amount of investment have been also carried out based on the term of recovery of initial investment.