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Lakhra Coal Mine and Power Generation Feasibility Study

Power Plant Feasibility

Volume II

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LAKHRA COAL MINE AND POWER GENERATION FEASIBILITY STUDY

POWER PLANT FEASIBILITY

VOLUME II

Submitted to

U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT

and

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LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS

		Page
VOLUME I		
	EXECUTIVE SUMMARY	
1.0	INTRODUCTION	1-1
2.0	SCOPE OF STUDY	2-1
3.0	SYSTEM PLANNING AND COST ANALYSIS	3-1
3.1	FIRST SERIES OF GENERATION PLANNING STUDIES	3-1
3.2	SECOND SERIES OF GENERATION PLANNING STUDIES	3-10
3.3	LAKHRA TRANSMISSION SYSTEM STUDIES	3-18
3.4	IMPORTED COAL TRANSMISSION STUDIES	3-28
3.5	COST ANALYSIS FOR 300 MW UNIT SIZE	3-32
3.6	POST-STUDY REVISIONS - GENERATION AND TRANSMISSION PLANNING STUDIES	3-34
	APPENDIX 3.1 - WASP-3 Computer Generated Study Report, First Series of Generation Planning Studies	3-123
	APPENDIX 3.2 - WASP-3 Computer Generated Study Report, Second Series of Generation Planning Studies	3-179
	APPENDIX 3.3 - Load Flow and Transient Stability Plots	3-235
	APPENDIX 3.4 - Transmission System Cost Estimates	3-283
4.0	LAKHRA COAL CHARACTERISTICS	4-1
4.1	FUEL ANALYSES	4-1
4.2	COAL WASHABILITY ANALYSIS	4-9
4.3	FUEL SAMPLE COLLECTION AND SHIPMENT	4-21
4.4	TEST BURN, BASELINE PMDC NO. 2	4-31

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

		Page
4.5	TEST BURN, WASHED PMDC NO. 2	4-39
4.6	TEST BURN, BT-11 TEST SHAFT	4-44
4.7	INVESTIGATION, "SIMILAR" ASH COAL TO LAKHRA ASH COAL	4-47
4.8	BOILER DESIGN PARAMETERS FOR LAKHRA COAL	4-51
5.0	POWER PLANT DESIGN CHARACTERISTICS	5-1
5.1	GENERAL	5-1
5.2	SITE SURVEYS	5-1
5.3	SITE PLANS	5-6
5.4	ENVIRONMENTAL GUIDELINES	5-11
5.5	BASIS OF DESIGN ANALYSIS (BODA)	5-55
5.5.1	Plan Layouts	5-55
5.5.2	Soils/Rock, Water, Climate Characterization	5-73
5.5.3	Fuel, Chemical, Raw Material, Wastewater Requirements	5-80
5.5.4	System Design	5-81
5.5.5	Equipment Specifications	5-84
5.5.6	Analysis of Environmental Control Technologies	5-86
5.5.7	Availability	5-97
5.5.8	Alternative Fuel Capabilities	5-100
5.5.9	Cooling Tower Considerations	5-105
5.6	CONSTRUCTION PHASE AND SCHEDULE CONSIDERATIONS	5-107

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

		Page
VOLUME II		
6.0	INSTITUTIONAL DEVELOPMENT	6-1
6.1	INTRODUCTION	6-1
6.2	COAL POWER PROJECTS DEPARTMENT	6-6
6.3	PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)	6-56
6.4	PROJECT ORGANIZATION (START-UP AND TEST)	6-65
6.5	STATION ORGANIZATION (OPERATION AND MAINTENANCE)	6-71
	APPENDIX 6.1 - Organization Chart	6-79
	APPENDIX 6.2 - Job Descriptions	6-83
	APPENDIX 6.3 - Guidelines for Evaluation of Project Organizations, Major Construction Projects, and Support of Operations and Maintenance Activities	6-187
	APPENDIX 6.4 - G/C CUE	6-269
7.0	TRAINING	7-1
7.1	INTRODUCTION	7-1
7.2	WAPDA TRAINING CAPABILITIES AND ORGANIZATION	7-1
	7.2.1 Approach	7-1
	7.2.2 WAPDA Academy	7-2
	7.2.3 WAPDA Training Institutes	7-3
7.3	TRAINING NEEDS ASSESSMENT	7-6
	7.3.1 Approach	7-6
	7.3.2 Coal Power Projects Department	7-7

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

		Page
VOLUME II CONT'D		
7.3.3	Thermal Power Station Organization	7-8
7.3.4	Training Institute Organization	7-10
7.4	PRELIMINARY TRAINING PLAN	7-11
7.4.1	Organization	7-11
7.4.2	Plan	7-15
7.4.3	Estimated Cost	7-19
	APPENDIX 7.1 - Training Course Outlines	7-25
	APPENDIX 7.2 - Extract from PC-II Proforma; Training of WAPDA Officers 1985: Foreign Training Requirements of Generation	7-139
	APPENDIX 7.3 - Extract from USAID Participant Training Plans (Lakhra); FY-1985, Coal Power Station Proposed Training Fields	7-143
VOLUME III		
8.0	CAPITAL COSTS OF POWER PLANT	8-1
8.1	ESTIMATE BASIS	8-1
8.2	EXCLUSIONS	8-7
8.3	CAPITAL COST ANALYSIS	8-7
8.4	Coal Washing - Power Plant Cost Differential	8-9
8.5	Flue Gas Desulfurization Options	8-9
8.6	Operation and Maintenance	8-10
	APPENDIX 8.1 - Cost Details for the Khanot Site	8-25
9.0	CONCLUSIONS	9-1
10.0	RECOMMENDATIONS	10-1

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

VOLUME IV

APPENDIX A - SPECIFICATIONS

MATERIAL SPECIFICATIONS

Chemicals
No. 2 Fuel Oil
No. 6 Fuel Oil
Limestone

MECHANICAL SPECIFICATIONS

M-1 Boiler Island
M-2 Turbine Generators and Accessories
M-3 Condenser
M-4A Electrostatic Precipitator
M-4B Wet Flue Gas Desulfurization System

VOLUME V

APPENDIX A - SPECIFICATIONS

MECHANICAL SPECIFICATIONS

M-5 Feedwater Heaters
M-6 Deaerator
M-7 Motor Driven Boiler Feed Pumps
M-8 Condensate Pumps
M-9 Circulating Water Pumps
M-10 Mechanical Draft Cooling Tower
M-11 Cycle Make-up Demineralizer System
M-12A Wastewater Treatment Equipment
M-12B Sanitary Wastewater Treatment System
M-13 High Pressure Power Piping and Hangers
M-14 Fly Ash Handling System (Vacuum Type)
M-15 Closed Circuit Cooling Water Heat Exchangers
M-16A Diesel Engine and Electric Motor Driven Fire Pump and Accessories
M-16B In-Plant and Yard Fire Protection

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

VOLUME VI

APPENDIX A - SPECIFICATIONS

MECHANICAL SPECIFICATIONS

M-17 Low Pressure Piping
M-18 Traveling Water Screens

CIVIL/STRUCTURAL SPECIFICATIONS

S-1A Supply of Concrete
S-1B Concrete Work
S-2 Structural Steel
S-3 Turbine Room Overhead Crane
S-4 Coal Handling System
S-5 Circulating Water Piping
S-6 Reinforced Concrete Chimney with Brick Liners

ELECTRICAL SPECIFICATIONS

E-1 Motors Under 200 KW
E-2 Motors 200 KW and Over
E-3 Medium Voltage Switchgear
E-4 Motor Control Centers
E-5 Diesel Generator
E-6 Auxiliary Power Transformer
E-7 Step-Up Transformer

INSTRUMENTATION AND CONTROL SPECIFICATIONS

I-1 Instrumentation and Control System

VOLUME VII

APPENDIX B - DRAWINGS

SITE ARRANGEMENTS
Figure 5.3-1 Khanot Site, Plant Site General Arrangement
Figure 5.3-2 Khanot Site General Arrangement
Figure 5.3-3 Lakhra Site, Plant Site General Arrangement
Figure 5.3-4 Lakhra Site, General Arrangement

LAHKRA POWER FEASIBILITY STUDY

TABLE OF CONTENTS
(Continued)

PLANT ARRANGEMENTS

Figure 5.5.1-1	Ground Floor Plan
Figure 5.5.1-2	Mezzanine Floor and Misc. Floor Plans
Figure 5.5.1-3	Operating Floor Plan
Figure 5.5.1-4	Plant Cross Section
Figure 5.5.1-5	Longitudinal Cross Section

FLOW DIAGRAMS

Figure 5.5.3-1	Water Balance Diagram
Figure 5.5.3-2	Material Balance Diagram
Figure 5.5.4I-1	Turbine Heat Balance, SI Units
Figure 5.5.4I-2	Turbine Heat Balance, SI Units
Figure 5.5.4I-3	Turbine Heat Balance, English Units
Figure 5.5.4I-4	Turbine Heat Balance, English Units
Figure 5.5.4IX-1	Water Treatment Diagram
Figure 5.5.4XI-1	Auxiliary Steam Diagram
Figure 5.5.4XII-1	Compressed Air Diagram
Figure 5.5.4XVI-1	Fire Protection System Diagram
Figure 5.5.4XX-1	Coal Flow Diagram
Figure 5.5.4XX-1a	Inplant Coal Flow Diagram

SINGLE LINE DIAGRAMS

Figure 5.5.4XXI-1	Generator and Station Power
Figure 5.5.4XXII-1	Emergency Power System

VOLUME VIII

APPENDIX C - SUPPLEMENTAL REPORTS

Roberts & Schaefer Co. Coal Washablility Analysis

GCII Geotechnical Investigation

WAPDA Ground Water Resistivity Survey at Khanot

APPENDIX D - WORK PLAN

VOLUME IX

COMBUSTION ENGINEERING TEST REPORTS

LIST OF TABLES

Number		Page
4.1-1	Fuel Analyses	4-71
4.1-2	Composite Drill Core Analyses, Unwashed Coal (Boiler Specification Basis)	4-73
4.1-3	Composite Drill Core Analyses, Washed Coal (Boiler Specification Basis)	4-74
4.2-1	Effects of Total Cleaning on Ash/Sulfur Removal and Btu Recovery (Seam Only)	4-75
4.2-2	Effects of Total Cleaning on Ash/Sulfur Removal and Btu Recovery (Seam + 10% Dilution)	4-76
4.2-3	Effects of Partial Cleaning on Ash/Sulfur Removal and Btu Recovery (Seam Only - 4" x 1/2" Cleaned, 1/2" x 0 Raw)	4-77
4.2-4	Effects of Air Drying on Ash/Sulfur Removal and Btu Recovery	4-78
4.2-5	Effects of Size Reduction on Ash/Sulfur Removal and Btu Recovery	4-79
4.2-6	Summary of Whole Coal Analyses	4-80
4.2-7	Raw Vs. Clean Indices	4-81
4.2-8	Sample Summary	4-82
4.2-9	Distribution Curve Determination	4-83
4.2-10	Summary of Whole Coal Analyses (Plant Run)	4-84
4.2-11	Raw Vs. Clean Indices (Plant Run)	4-85
4.2-12	Mass Balance Measurements and Determination	4-86
4.4-1	Test Fuel Analyses	4-87
4.4-2	Preliminary FPTF Results - Pulverized Characteristics	4-88
4.4-3	Lakhra Baseline Coal Evaluation Test Matrix	4-89
4.4-4	Preliminary FPTF Results	4-90

LIST OF TABLES

Number		Page
4.4-5	Preliminary FPTF Results	4-91
4.4-6	Lakhra Baseline Coal Furnace Slagging Results	4-92
4.4-7	Preliminary FPTF Results - Convective Pass Fouling Characteristics	4-93
4.4-8	Preliminary FPTF Results - In-Site Fly Ash Resistivity Measurement	4-94
4.4-9	Preliminary FPTF Results - Ash Loading, Gas Velocity, Erosion Rate	4-95
4.4-10	Lahkra Coal Corrosion Probe Results	4-96
4.5-1	Test Fuel Analysis for Lakhra Washed and Baseline Coal	4-97
4.5-2	Preliminary FPTF Pulverization Results	4-98
4.5-3	Lakhra Washed Test Matrix	4-99
4.5-4	Preliminary FPTF Results - Relative Combustion Characteristics	4-100
4.5-5	Preliminary FPTF Results - Furnace Slagging Characteristics	4-101
4.5-6	Lakhra Washed Coal Characterization, FPTF Slagging Results	4-102
4.5-7	Preliminary FPTF Results - Convective Pass Fouling Characteristics	4-103
4.5-8	Preliminary FPTF Results - In-Site Fly Ash Resistivity Measurement	4-104
4.6-1	Lakhra Coal Performance Characteristics	4-105
4.6-2	Lakhra Coal Sample Analyses	4-106
4.7-1	Similar Ash Coal Comparison	4-107
5.4-1	World Bank SO_2 Emissions Criteria	5-43
5.4-2	Threshold Limit Values (TLV) for Dusts	5-44
5.4-3	Summary of Major Power Plant Wastewater Discharges	5-46

LIST OF TABLES (Continued)

Number		Page
5.4-4	Selected Pollutants Often Associated with Power Plant Waste Streams	5-47
5.4-5	Effluent Guidelines for Power Plant Wastewater Discharge to Surface Waters	5-49
5.4-6	Guidelines for Drinking Water Quality (World Health Organization - 1984)	5-51
5.5.2-1	Ground Water Quality	5-76
5.5.2-2	Water Quality of Indus River	5-77
5.5.2-3	Discharge Characteristics of Indus River at Sehwan for the Years 1972-75 and 1979	5-78
5.5.2-4	Meteorological Summary Data from Hyderabad (1931-1960)	5-79
7.2.3	Training Courses Administered at Guddu Training Center	7-5
7.4.1	System Design Descriptions	7-14
7.4.3 (a)	Estimated Cost of Module 1000 Training Courses	7-20
7.4.3 (b)	Estimated Cost of Module 2000 Training Courses	7-21
7.4.3 (c)	Estimated Cost of Module 3000 Training Courses	7-22
7.4.3.(d)	Estimated Cost of Module 4000 Training Courses	7-23
8.1	Cost Summary for Lakhra Units 1 & 2 in U.S. Dollars	8-11
8.2	Cost Summary for Lakhra Units 1 & 2 in Rupees	8-12
8.3	Account Summary for Lakhra Unit 1 & 2 in U.S. Dollars	8-13
8.4	Account Summary for Lakhra Unit 1 & 2 in U.S. Dollars	8-16
8.5	Cash Flow for Lakhra Unit 1	8-18
8.6	Cost Summary for Khanot in U.S. Dollars	8-19
8.7	Cost Summary for Khanot in Rupees	8-20

LIST OF TABLES (Continued)

Number		Page
8.8	Account Summary for Khanot Unit 1 in U.S. Dollars	8-21
8.9	Account Summary for Khanot Unit 2 in U.S. Dollars	8-24
8.10	Cash Flow for Khanot Unit 1	8-26
8.11	SO_2 Emission, Option 2 - Washed Coal	8-27
8.12	SO_2 Emission, Option 3 - 1,000 TPD Site Emission Limit	8-28
8.13	SO_2 Emission, Option 4 - 750 TPD Site Emission Limit	8-29
8.14	SO_2 Emission, Option 5 -500 TPD Site Emission Limit	8-30
8.15	Comparison of Lakhra SO_2 Emission Options	8-31
8.16	Comparsion of Khanot SO_2 Emission Options	8-32
8.17	Lakhra Staffing Plan and Operation and Maintenance Annual Costs	8-33
8.18	Khanot Staffing Plan and Operation and Maintenance Annual Costs	8-36
8.19	Vendors Solicited for Budgetary Quotes	8-39
8.20	Prefabricated Process Piping International Pricing Comparison	8-40
4.2.1	PMDC Mine No. 2 Seam Cross Section	4-109
4.2.2	Characteristic Washability Curve 4" x 100M Size Fraction, Lakhra Field-PMDC Mine No. 2	4-110
4.2.3	Characteristic Washability Curve, 4" x 1-1/2" Size Fraction, Lakhra Field-PMDC Mine No. 2	4-111
4.2.4	Characteristic Washability Curve, 1-1/2" x 3/4" Size Fraction, Lakhra Field-PMDC Mine No. 2	4-112

LIST OF FIGURES

Number		Page
4.2.5	Characteristic Washablity Curve, 3/4" x 1/2" Size Fraction, Lakhra Field-PMDC Mine No. 2	4-113
4.2.6	Characteristic Washability Curve, 1/2" x 1/4" Size Fraction, Lakhra Field-PMDC Mine No. 2	4-114
4.2.7	Characteristic Washability Curve, 1/4" x 28M Size Fraction, Lakhra Field-PMDC Mine No. 2	4-115
4.2.8	Characteristic Washability Curve, 28M x 100M Size Fraction, Lakhra Field-PMDC Mine No. 2	4-116
4.2.9	Btu/lb. vs. Ash (4" x 100M - Seam Only)	4-117
4.2.10	Effects of Total Cleaning on Ash/Sulphur Removal and Btu Recovery	4-118
4.2.11	Total vs. Partial Cleaning and the Effect on Ash/Sulphur Removal and Btu Recovery (Seam Only)	4-119
4.2.12	Raw Coal Size Reduction Due to Air Drying	4-120
4.2.13	East Fairfield Coal Company Flowsheet	4-121
4.2.14	Distribution Curve for 2-1/2" x 28M Raw Coal Cleaned in Heavy Medium Cyclones	4-123
4.4-2	Lakhra Baseline Coal Evaluation	4-125
4.4-3	Lakhra Baseline Coal Evaluation	4-126
4.4-4	Lakhra Baseline Coal Evaluation	4-127
4.4-5	Lakhra Baseline Coal Evaluation	4-128
4.4-6	Lakhra Baseline Coal Evaluation	4-129
4.4-7	Lakhra Baseline Coal Evaluation	4-130
4.4-8	Lakhra Baseline Coal Evaluation	4-131
4.5-1	Lakhra Washed Coal Evaluation	4-132
4.5-2	Lakhra Washed Coal Evaluation	4-133

LIST OF FIGURES

Number		Page
4.5-3	Lakhra Washed Coal Evaluation	4-134
4.5-4	Lakhra Washed Coal Evaluation	4-135
4.5-5	Lakhra Washed Coal Evaluation	4-136
4.5-6	Lakhra Washed Coal Evaluation	4-137
4.7-1	Site Elevation B&W Boiler	4-138
4.7-2	Design Information B&W Boiler	4-139
4.7-3	Design Information CE Boiler	4-140
4.7-4	Coal Analysis CE Boiler	4-141
4.7-5	Design Information FW Boiler	4-142
4.7-6	Side Elevation FW Boiler	4-143
4.7-7	Coal Analysis FW Boiler	4-144
4.7-8	Ash Analysis FW Boiler	4-145
5.2.1	Lakhra Area Map	5-2
5.5.1.6-1	Coal Laboratory and Sample Preparation Area	5-64
5.6.2	Master Project Schedule	5-111
5.6.3	Progressive Manufacture of Boilers and Turbines in Pakistan	5-117
5.6.4	Letter in Reference to Progressive Manufacture of Boilers and Turbines in Pakistan	5-126
5.6.5	Letter in Reference to Local Manufacturing of Boilers/Turbine	5-129
5.6.6	Letter in Reference to Progress in Manufacture of Boilers in Pakistan	5-132
5.6.7	Letter in Reference to Progressive Manufacture of Boilers and Turbines in Pakistan	5-134

LIST OF FIGURES (Continued)

Number		Page
6.2.1	CPPD Responsibilities Throughout Project Phases	6-32
6.2.2	Recommended CPPD Head Office Staff Activities	6-33
6.2.3	Recommended Coal Power Projects Department Organization	6-51
6.2.4	Coal Power Projects Department; WAPDA Staffing Plan for Key Personnel	6-54
6.2.5	Summary of Base Salary Costs (Rupees)	6-55
6.3.2(a)	Lakhra Project Organization (Design and Construction)	6-57
6.3.2(b)	Lakhra Construction Management Organization	6-58
6.3.3	Construction Management Manual; Table of Contents	6-63
6.3.4	Project Organization (Design and Construction); WAPDA Staffing Plan for Key Personnel	6-64
6.4.2	Lakhra Project Organization (Start-up and Test)	6-66
6.4.3	Start-up Manual; Table of Contents	6-68
6.4.4	Project Organization (Start-up and Test); WAPDA Staffing Plan for Key Personnel	6-70
7.4.2(a)	Coal Power Projects Department; Preliminary Training Plan	7-16
7.4.2(b)	Project Organization (Design and Construction); Preliminary Training Plan	7-17
7.4.2(c)	Project Organization (Start-up and Test); Preliminary Training Plan	7-18

LIST OF EXHIBITS

No.		Page
3.1	Pakistan Planning Commission 1986-2005 Load Forecast Used in Generation Planning Studies	3-47
3.2	Fuel Cost Data Used in Generation Planning Studies	3-48
3.3	Fixed System Thermal Units	3-49
3.4	Fixed System Hydro Units	3-51
3.5	Earliest In-Service Dates for Various Types of Thermal Units Considered in the Generation Planning Studies	3-52
3.6	Variable System Thermal Additions	3-53
3.7	Variable System Hydro Additions	3-54
3.8	Summary of Capital Costs in Dollars/kW for Alternate Thermal Power Plant Additions	3-55
3.9	Summary of Capital Costs in Dollars/kW for Variable System Hydro Additions	3-56
3.10	First Series of WASP-3 Computer Studies, Optimum Generation Expansion Program for the WAPDA System	3-57
3.11	First Series of WASP-3 Computer Studies, Capacity Factors in Percent for Various Periods for the First Domestic Coal Unit	3-60
3.12	First Series of WASP-3 Computer Studies, Capacity Factors in Percent for Various Periods for Three Domestic Coal Units (300 MW Each) and Two Imported Coal Units (600 MW Each)	3-61
3.13	First Series of WASP-3 Computer Studies, Coal Consumption for the First Year of Operation for One 300 MW Domestic Coal Unit	3-62
3.14	Data for Alternate 300 MW Unit Additions	3-63
3.15	Summary of Capital Costs in Dollars/kW for Alternate 300 MW Unit Additions	3-64
3.16	First Series of WASP-3 Computer Studies, Comparison of Alternate Generation Expansion Plans	3-65

LIST OF EXHIBITS
(Continued)

No.		Page
3.17	First Series of WASP-3 Computer Studies, Cumulative Present Worth Through the Year 2005 vs. Coal Cost	3-67
3.18	Power Cost as a Function of Capacity Factor	3-68
3.19	Second Series of WASP-3 Computer Studies, Optimum Generator Expansion Program for the WAPDA System	3-69
3.20	Second Series of WASP-3 Computer Studies, Capacity Factors in Percent for Various Periods for the First Domestic Coal Unit (300 MW) (1990-1991)	3-71
3.21	Second Series of WASP-3 Computer Studies, Capacity Factors in Percent for Various Periods for Three Domestic Coal Units (300 MW Each) and Three Imported Coal Units (600 MW Each) (1999-2000)	3-72
3.22	Second Series of WASP-3 Computer Studies Comparison of Alternate Generation Expansion Plans	3-73
3.23	Second Series of WASP-3 Computer Studies, Cumulative Present Worth Through the Year 2005 vs. Coal Cost (300 MW Unit Size)	3-76
3.24	Typical Transmission System Characteristics	3-77
3.25	Approximate Power Plant Site Locations	3-78
3.26	Alternative Transmission Plans	3-79
3.27	Plan J.1 Jamshoro Substation One-Line Diagram	3-80
3.28	Plan J.2 Jamshoro Substation One-Line Diagram	3-81
3.29	Plan L.1/K.1 Lakhra/Khanot Substation One-Line Diagram	3-82
3.30	Plan L.1/K.1 Jamshoro Substation One-Line Diagram	3-83
3.31	Plan L.2/K.2 Lakhra/Khanot Substation One-Line Diagram	3-84
3.32	Plan L.2/K.2 Jamshoro Substation One-Line Diagram	3-85

LIST OF EXHIBITS
(Continued)

No.		Page
3.33	Three Phase Short Circuit Currents	3-86
3.34	Comparison of Lakhra Transmission Plans, Transmission Line Length and Major Sub-Station Equipment	3-87
3.35	Capital Costs of Lakhra Alternative Transmission Plans	3-88
3.36	Economic Comparison of Lakhra Transmission Alternatives	3-89
3.37	Computation of Transmission Losses from Lakhra/Khanot to Jamshoro	3-90
3.38	1991 Plan 1, 1 X 300 MW Imported Coal Unit	3-91
3.39	1991 Plans 2 and 2A, 1 X 600 MW Imported Coal Unit	3-92
3.40	1993 Plan 3, 2 X 600 MW Imported Coal Unit	3-93
3.41	1993 Plan 4, 2 X 600 MW Imported Coal Unit	3-94
3.42	Imported Coal 220 kV Substation, Plan 1	3-95
3.43	Imported Coal 220 kV Substation, Plan 2	3-96
3.44	Imported Coal 220 kV Substation, Plan 2A	3-97
3.45	Imported Coal 220 kV Substation, Plan 3	3-98
3.46	Imported Coal 500/220 kV Substation, Plan 4	3-99
3.47	Conceptual KESC 220 kV Substation with Connections to Import Coal Plant, Plan 1	3-100
3.48	Conceptual KESC 220 kV Substation with Connections to Import Coal Plant, Plans 2 and 2A and Plan 4	3-101
3.49	Conceptual KESC 220 kV Substation with Connections to Import Coal Plant, Plan 3	3-102
3.50	Jamshoro 500/220 kV Substation, Plans 1 and 2	3-103
3.51	Jamshoro 500/220 kV Substation, Plan 2A	3-104
3.52	Jamshoro 500/220 kV Substation, Plan 3	3-105

LIST OF EXHIBITS
(Continued)

No.		Page
3.53	Jamshoro 500/220 kV Substation, Plan 4	3-106
3.54	Capital Costs of Imported Coal Alternative Transmission Plans	3-107
3.55	Economic Comparison of Imported Coal Transmission Alternatives	3-108
3.56	Computation of Transmission Losses From Import Coal Plant to Jamshoro	3-109
3.57	Plant and Transmission Capital Costs, Comparison of Lakhra Alternatives	3-110
3.58	Plant and Transmission Capital Cost, Comparison of Lakhra Alternative, First Unit Only	3-111
3.59	Lakhra and Imported Coal Project Comparisons	3-112
3.60	Lakhra and Imported Coal Comparative Parameters, July 1985 Dollars	3-113
3.61	Diversified Maximum Demand at Generation Level (M)	3-114
3.62	Energy Requirement at Generation Level (GWH)	3-115
3.63	System Load Factor	3-116
3.64	Second Series of WASP-3 Computer Studies Generation Expansion Program with the Cost of 5100 Btu/lb Lakhra Coal Equal to $30.50/MT (1081 ¢/KCAL X 10^6)	3-117
3.65	Lakhra or Khanot 500 kV Substation for Two 350 MW Units	3-119
3.66	Capital Costs of Lakhra Alternative Transmission Plans for Two 350 MW Units	3-120
3.67	Plant and Transmission Capital Cost Comparison of Lakhra Alternatives for Two 350 MW Units Year of Expenditure Dollars	3-121

6.0 INSTITUTIONAL DEVELOPMENT

6.1 INTRODUCTION

6.1.1 Description of Tasks

The scope of the consulting services provided for the institutional development of the WAPDA Coal Power Projects Department (CPPD), as described in the Work Plan for the Lakhra Power Feasibility Study, is repeated below. The assistance was divided into two phases: an analysis of institutional development requirements and the development of recommendations for improvement.

Phase 1 Analysis of Institutional Development Requirements

GC II will examine the organization, staffing and management requirements related to the power plant aspects of the Lakhra Project. Organizational structure and staffing plans and needs will be evaluated for the purpose of establishing a basis for providing recommendations for appropriate institutional development. Position descriptions will be prepared covering definition of authority, duties and responsibilities.

The areas to be reviewed will include the following functional activities of the Coal Power Projects Department:

- *Organization, management methods and staffing*
- *Planning*
- *Operations and maintenance*
- *Administrative and financial*

Phase 2 Development of Recommendations for Improvement

The product of the analysis of the institutional requirements will be in the form of recommendations for further improvement and development of the Coal Power Projects Department's performance, efficiency and capacity as related to management of the power plant components of the Lakhra Project.

The thrust of these recommendations will be directed at the individual functions of the Department. In order to provide a comprehensive, objective evaluation of the overall basic strengths and weaknesses that will establish a realistic basis for future planning, the study team will use the information derived from the individual investigations coupled with consideration of other factors. These supplementary factors will involve broader aspects of Department performance such as the approaches followed for determination of policies, application of technology, external relationships and internal communications.

The recommendations will be supported by conclusions drawn from the analysis of strengths and weaknesses performed during the course of the study. Any other measures deemed necessary to further improve the performance of the Department in the discharge of its functions to meet the goals of WAPDA will also be recommended.

In addition to the institutional analysis of the Coal Power Projects Department, the following assistance was required:

Detailed Procedures for Project Implementation and Organization

GCII will prepare recommendations regarding steps that should be taken by WAPDA to develop a management team for the execution of this project. These recommendations will include project organization charts for the office engineering staff and field staff plus start-up and commissioning personnel necessary to carry the project from detailed design through construction to commissioning and operation of the units.

The second component of these recommendations will be suggestions for ways in which the project staff may implement a consolidated project control system which will combine the functions of planning and scheduling, procurement and construction cost accounting and project budget tracking for the work.

6.1.2 Task Approach

The work performed under Task D-100, Institutional Development, was organized to be carried out in several stages, beginning with on-site data collection, continuing with analysis and evaluation of findings derived from on-site observations and discussions, and concluding with the development of institutional recommendations intended to strengthen or improve the operating effectiveness of the Coal Power Projects Department.

The review activity was directed toward exploration of the following major areas of interest, as influenced by present practices, planned changes and the requirements implied by the mission of the Department:

(1) Organizational placement

Reporting level
Designated powers
Policy determination

(2) Organizational relationships

- CPD - WAPDA
- CPD - Thermal Division
  - Planning
  - Design
  - Project Management
  - Operations
- Head Office - Field

(3) Staff development

- Feasibility Analysis through plant commissioning
- Special needs
  - Management of multiple projects
  - New or unfamiliar factors
    - Coal technology
    - Equipment
      - Coal-handling
      - Ash-handling
      - Coal-burning
    - Environmental Impact
  - Interfaces
    - Fuel and Equipment Sources
    - Government/Donor Agencies

(4) Methods, Procedures and Services

- Management and Administrative Processes
- Office and Supporting Services
- Facilities

The data collection phase of the task was performed by the review team in Lahore, Pakistan, during the period from mid-February to mid-March, 1985. During this period, the review activities were primarily directed at the prospective administrative and non-operating functions as influenced by the support requirements of CPPD, as well as the operations, maintenance and technical side of the Department. Extensive interviews and discussions were held with management and representatives of the Coal Power Projects Department and other organizational units within the Water and Power Development Authority. These included Power Wing technical and administrative support groups, management and engineering personnel at the Thermal Division's Jamshoro and Guddu sites, USAID representatives at Islamabad, and representatives of the contractor performing the Coal Mine Feasibility Study. Documentation reviewed included WAPDA organizational descriptions, some position descriptions, service rules, pay scales, descriptions of financial and administrative powers of managers, and studies previously performed.

The basic purpose of this phase of the task was to examine the institutional aspects of the Coal Power Projects Department as they related to the establishment, within WAPDA, of the capability to plan, implement and manage the first two of a series of large-scale coal-fired power plants in support of the goals of the national coal development program. In keeping with this objective, the main thrust of the on-site data collection activity was as follows:

(1) Review of the present organizational and functional activities of CPPD.

(2) Identification of the functional capabilities required to enable the Department to fulfill its intended role, from both a head office and field site viewpoint.

(3) Examination of working relationships between CPPD and other WAPDA service and support groups that might be expected to provide administrative, technical or other support.

(4) Evaluation of management practices, available services or other institutional factors that could influence the effectiveness of performance of CPPD.

Another goal of the review and evaluation process was to obtain some measure of the progress realized by WAPDA in satisfying the conditions of the USAID - Government of Pakistan Project Agreement covering coal-fired power generation development. The excerpted conditions of the Agreement are as follows:

SECTION 4.3. *Conditions Precedent to Selected Disbursement of Funds for Activities under the Coal Mine and Coal Fired Power Generation Development Sub Component of the Coal Resource Assessment and Development Component.*

Except as A.I.D. may otherwise agree in writing, prior to the disbursement of funds under this Project for the Coal Mine and Coal-Fired Power Generation Development Technical Assistance Contract under the Coal Resource Assessment and Development Component of this Project, or to the issuance by A.I.D. of documentation pursuant to which such disbursement will be made, the Grantee, acting through its Planning and Development Division, Ministry of Planning and Development, shall furnish to A.I.D., in form and substance satisfactory to A.I.D., documentation that:

(a) a Coal Projects Department has been authorized and established within WAPDA to promote, plan, and manage

the development and implementation of coal mine and coal-fired power generation projects and adequate funds have been made available for its operations;

(b) The authority, duties and responsibilities of the overall manager and the coal mine and power section managers of the Department have been adequately defined; and,

(c) an adequately trained and experienced overall manager of the Department has been appointed and persons to fill the other two managerial positions have been identified.

During the data collection phase, the steps taken by WAPDA in responding to the condition of the Agreement were investigated as part of the review team's examination of the current and planned development activities for the Coal Power Projects Department.

6.1.3 Organization of Report

This report has been structured to present the results of the institutional development analysis specifically related to the management of the power station components of the Lakhra Project and related projects of the national coal development program. Findings, conclusions and recommendations are presented for each of four major areas of interest covered by the review.

(1) Coal Power Projects Department

In Section 6.2, the overall role of the Department in planning and managing all coal power station development activities is examined. Findings and conclusions are presented for each of a series of institutional categories in Subsection 6.2.1. Following this, in Subsection 6.2.2, corresponding recommendations are presented for these same categories. The effectiveness or needed strengthening of the broad management, organizational and procedural aspects of the Department is addressed, along with any considerations that relate to the Department's interactions with other WAPDA units or external agencies. Stated in another way, the focus of this section is on the broad view of the Department's expected role - across all coal station projects, present and future, rather than on the specific responsibilities associated with the implementation of the Lakhra Project alone. The remaining sections of the report cover the three major areas of functional responsibility of the Coal Power Projects Department in the projected implementation of the Lakhra coal-fired power station.

(2) Project Organization (Design and Construction)

Recommendations covering steps that should be taken by WAPDA to develop a management team, field staff and a project control approach for the execution of the Lakhra Project are presented in Section 6.3.

(3) Project Organization (Start-Up and Test)

Recommendations covering the development of a management team and staff to carry the Lakhra Project from completion of construction through the start-up, test and commissioning steps up to the point of commencement of operations of each unit are presented in Section 6.4.

(4) Lakhra Station Organization (Operations and Maintenance)

In Section 6.5, the recommended operations and maintenance staffing for the Lakhra Coal-fired Power Station are presented.

Findings and recommendations related to areas covered in the review and staffing plans for each of these four major areas are included in the respective sections. Corresponding organization charts are presented and job descriptions are grouped, by section, in an appendix.

It should be noted that the recommendations developed throughout the report were based on data and observations derived from the data collection phase. In those cases where specific areas requiring further study have been identified, they are noted in the text of the report.

6.2 COAL POWER PROJECTS DEPARTMENT

In evaluating the prospective performance responsibilities of the Coal Power Projects Department arising from its intended role in support of the goals of the national coal development program, it soon became apparent that the capabilities of the Department needed to be examined from the perspective of this broader role as well as in relation to the more specific requirements of the Lakhra Project. In addition to planning and managing the implementation of all coal-fired power generation station projects, the Department must represent WAPDA's interests in the corresponding development of coal mines intended to support the fuel needs of the generating stations. This latter responsibility means that the Coal Power Projects Department must be prepared to provide planning and specialized technical support for mining, geology and environmental questions arising from coal-fired power station feasibility analysis and implementation activities. Consequently, this section of the report presents the findings and conclusions of the review team for each of

a series of categories of important institutional characteristics and functional activities of the Department.

In addition, findings and conclusions relating to the institutional environment within which the Department resides are also included since strengthening of the institutional environment around the Department, as may be necessary, will also add to its effectiveness.

6.2.1 Findings and Conclusions

Organization

1. The present organizational placement of the Coal Power Projects Department needs to be changed to permit the Department to fulfill its role effectively.

   To fulfill its designated responsibilities to support the development of coal resources through promotion, planning and management of the development and implementation of coal mines and coal-fired generation stations, the Coal Power Projects Department requires a significant degree of authority and control during the planning, design, construction and start-up phases. Aside from this need for increased autonomy, donor agencies will look to Department management to make timely decisions and provide status information required to manage and monitor project implementation progress.

   Traditionally, WAPDA's approach to implementing new power stations appears to have been to set up an organization specifically for the station project which is eventually transformed into the station operating complement. Head Office staff support groups provide some continuity from project to project. In the case of the Lakhra Project, an unfamiliar technology requires that a base of specialized staff capability be built quickly so that it can support the needs of the two units of the Lakhra Project, as well as those of subsequent coal-fired projects.

   The present reporting relationship of the Chief Engineer, Coal Power Projects Department, as a staff officer of the General Manager, Thermal Generation, with the corresponding assignment of powers as designated by WAPDA policies, does not carry with it the required level of authority over Department budgets, design decisions, project management or start-up activities for major projects. Though this working relationship appears to have worked well and has not seriously impeded the effectiveness of the Coal Power Projects Department during its relatively short existence, the expanded scope and depth of management policy determination and decision-making and quick response required when one or more major coal station implementation

projects are started and underway will require more attention and authority than a staff position provides.

One example is that, under prevailing policy, a staff Chief Engineer has limited authority to directly approve the expenditure of funds for local purchases even though, in the case of the Lakhra Project, the Chief Engineer has full authority over USAID funding for the project. Further, the reporting lines of the present Lakhra Project Engineer appear to be divided with one link to the Chief Engineer, Jamshoro, acting for the General Manager, Thermal, and another through the Chief Engineer, Coal Power Projects Department, who performs in an advisory role to the General Manager for these matters. These reporting arrangements may be adequate for routine activities, but are not suitable for time-sensitive and urgent projects such as Lakhra. The situation is further complicated by the fact that the General Manager has at least eight Chief Engineers reporting to him, of which five are at remote major project locations.

The Book of Financial Powers, 1977 (Amended May 31, 1984), issued by WAPDA, specifies that:

"Officers working as staff officers and not holding independent charge of an office shall not exercise powers delegated to officers of their rank in this book unless they are specially authorized to do so by their respective Heads of Division...".

It does not appear that this special authorization has been made in the case of the Chief Engineer, Coal Power Projects, except possibly in relation to several smaller projects, Duki and Karachi, where the Chief Engineer appears to have some line authority with the Project Directors for these respective projects reporting directly to him. In the case of the Lakhra Project, the Chief Engineer reviews and makes recommendations related to the Lakhra Project Engineer's activities for the approval of the General Manager, Thermal. In his staff role, the Chief Engineer does not have control of the Departmental budget. The CPPD budget needs are included as part of the overall Divisional budget. Staffing requests and local supply expenditures must move through Divisional administrative channels.

In the opinion of the review team, the operating effectiveness of the Coal Power Projects Department will be seriously diminished - with possible consequent negative impact on project implementation schedules and milestone events, if line authority for all coal projects is not delegated to the Chief Engineer.

2. A precedent exists, within WAPDA, for temporary delegation of special powers to Chief Engineers.

At least one precedent for designation of more financial and administrative powers, on an interim basis at least, already exists within WAPDA. The Chief Engineer, Secondary Transmission Grid (S.T.G.) Project, who reports to the General Manager, Transmission and Grids, has been delegated special powers in accordance with loan covenants of donor agencies. The basic reason for this change appears to have been to provide the Chief Engineer with sufficient authority to monitor and control the expenditure of donor funds for a series of field construction projects.

Each of these construction projects is under the direction of a field Chief Engineer who also manages other unrelated projects. These Chief Engineers have a normal reporting relationship to the General Manager, Transmission and Grids, except for the donor-funded S.T.G. projects, in which case their reporting line is to the Chief Engineer, S.T.G. Projects. To support this additional responsibility, adjustments appear to have been made in usual WAPDA staffing policies for both home and field offices to provide the corresponding technical and administrative support staff. In all other respects, the Chief Engineer, S.T.G. Projects, is a functioning staff officer to the General Manager, Transmission and Grids, with the usual designated powers and reporting relationships.

3. The development of the Coal Power Projects Department organization needs stronger emphasis and commitment by WAPDA management.

The authorization and establishment of a Coal Power Projects Department to promote, plan and manage the development and implementation of coal mines and coal-fired power generation projects, in conformance with the USAID/Government of Pakistan Project Agreement, was confirmed in a letter dated 31st March, 1984 from the Ministry of Finance and Economic Affairs of the Government of Pakistan to USAID. The actions taken by WAPDA in responding to the conditions of Section 4.3 of the Grant Agreement between the Government of Pakistan and USAID were found to be satisfactory, as confirmed by Project Implementation Letter No. 7 issued by USAID on April 8, 1984. Supporting documentation, submitted to USAID by the Ministry indicated that these actions included:

(1) Authorization and establishment within WAPDA of a Coal Power Projects Department to promote, plan and manage the development and implementation of coal mine and coal-fired power generation projects, and adequate funds made available for its operation.

(2) Definition of the authority, duties and responsibilities of the overall manager and the coal mine and power section managers of the Department.

(3) Appointment of an adequately trained and experienced overall manager of the Department and identification of individuals to fill the other two managerial positions.

Since that time other developmental events, in line with the continuing evolution of the Coal Power Projects Department, have occurred. One of the purposes of the Institutional Development Task was to review and assess these subsequent events in terms of compliance with the intent of the USAID-GOP Grant Agreement. The Coal Power Projects Department currently has in place a small group of competent and qualified management personnel who can form the nucleus for building a strong organization which can ultimately carry out the diverse and challenging technical and administrative responsibilities required to support the national coal resource development program.

Since these early steps, implementation progress in expanding Department capabilities has been slow and desultory. Some lower level professional and support positions have been authorized and staffed and the reporting relationship with the parent Thermal Generation Division, as well as some working relationships with the Chief Engineer, Jamshoro have been defined. There has been some back-tracking in adjusting and filling Director/Deputy Director level positions, but this appears to have been settled recently. Much of this can be attributed to a perhaps inevitable pause that has taken place after the initial steps while awaiting further direction and clarification of budgetary authorizations that would follow establishment of the feasibility of the Lakhra Project. The recent creation of three separate Directors of Mining, Geology, and Coal Power Projects is a move in the right direction.

There also appears to be an inclination to regard the upcoming Departmental development process as being keyed to routine individual projects, the Lakhra Project being the first major venture. This is as distinct from recognizing the Department's broader role in supporting national coal development which is thus deserving of special attention through insuring that it has available more specialized skills and management. This narrower view is not shared by Department management, which is fully aware of the special goals and needs of the Department.

In summary, while the CPPD development process got off to a good beginning, there are some signs of a loss of momentum, which, if not corrected, will unnecessarily burden future organizational development efforts.

Staffing

1. Adding coal-related staff skills directly to the Coal Power Projects Department would better meet the immediate needs of the national coal development program.

   The staff and experience levels related to the planning, design, project management and operations and maintenance activities of the Thermal Division of WAPDA have been developed in accordance with the broad needs of thermal generation projects not requiring major support of coal-specific technical disciplines and related areas of expertise. Since the WAPDA Power Wing has, in the main, used energy sources other than coal for power generation purposes for various economic and other reasons, the level of experience and accumulation of expertise in equipment, systems, fuel characteristics and facilities related to the coal-specific aspects of power stations has not been extensive. Consequently, the necessary staff skills in an unfamiliar technology will have to be developed through special training, and supplemented during early stages by specialized external assistance which, in itself, will support and complement the training program.

   In view of the pressing time constraints influencing the national coal resources development program, it would be more effective to add the needed special coal-related staff skills, at least on an interim basis, directly to the Coal Power Projects Department as opposed to attempting to extend the responsibilities of existing functional units of the Thermal Division and then requiring the Department to work across these new and untried organizational interfaces. In line with this proposed separate role, it would also be more effective to make the corresponding changes in delegated management authority, again on an interim basis during the implementation phase for major projects, of the Coal Power Projects Department.

2. Compensation policy for Coal Power Projects Department needs special attention.

   The prevailing WAPDA establishment classification structure, pay schedules and service rules follow, more or less, Government-controlled policies and standards with some approved adjustments to correspond to special WAPDA situations. While these compensation and administrative conventions may be appropriate for normal WAPDA personnel management purposes, selected adjustments are

extremely advisable to avoid forcing the national coal development program, and more specifically the Coal Power Projects Department, to operate under a severe staffing handicap. This applies not only to the initial staff building process, but also to attracting and keeping qualified professional and support staff personnel during the construction and operating phases of coal power station projects. Recommendation 2, under the Staffing heading in the Recommendations section of this report, presents specific suggested compensation adjustments.

Current WAPDA policies permit several types of special pay allowances. There is a special pay increment, for example, for generation employees. This is initially 25% of base pay and increases, with length of service, up to 70% within specified limits. Over and above that, additional allowances are granted for assignments in remote or isolated locations. In the case of the Guddu station, for example, this allowance is said to be 75% of base pay. In addition to pay allowances, employees who work at these isolated locations also are entitled to colony living facilities for families, according to job level, and such other benefits as schooling and medical treatment.

3. <u>The development of the Coal Power Projects Department would benefit by encouraging a strong research orientation</u>.

Since the WAPDA Power Wing has traditionally used energy sources other than coal for power generation purposes, for various economic and other reasons, the level of experience and consequent expertise in equipment, systems, fuel characteristics and facilities related to the coal-specific aspects of coal-fired power stations has not been extensive. The establishment of the Coal Power Projects Department, with the gradual acquisition of professional, construction and operating staff supplemented by extensive training programs, will be a significant accomplishment in terms of increasing the body of in-house knowledge available in relation to coal technology. During the early stages, a valuable method for further extending this departmental expertise will be the utilization of specialized and experienced consulting assistance in working jointly with the staff.

From a longer range point of view, in-house activity in some of the applied research aspects of coal-fired power station technology would be of benefit in adding to the capability of the Coal Power Projects Department staff. This would include keeping abreast of developments in the field and carrying out selected research programs whose results could feed into the planning and design stages of new power station projects. This is especially true due to the unique nature of presently identified coal resources within Pakistan and the lack of similar plants burning this

type coal in any other area of the world. To achieve this object, a Research Department should be established immediately. Suggested training background for building this capacity is discussed in Recommendation 3 under the Staffing heading of the Recommendations section of this report.

4. Methods for control and distribution of personnel service rules need improvement.

The Rules Directorate of the Finance Wing prepares and issues all personnel service rules and other general rules applicable to all WAPDA employees. Service rules in use in the Power Wing were observed for Electrical Engineers (Grade 17 and above) (original issue-1965), Administrative Posts (1980) and Accounts Service (1966). The rules define service requirements, terms, and conditions for each post and are amended from time to time as requirements and policies change. The rules also cover appointments and promotions. Rules for lower grade (G16 and below) technical positions in the Power Wing are in the process of being prepared.

These rules are the basis for all recruiting and personnel actions involving WAPDA employees. Administrative support in connection with these activities is performed by staff administrative officers assigned to management officers. There appears to be a need for improving the control and distribution of updating amendments which describe approved changes in the rules, since administrative personnel appear to experience some difficulty in identifying the latest authorized versions of specific rules. This may lead to some unnecessary mishandling or delay of personnel actions relating to recruiting or appointment of qualified personnel to staff posts.

Management Methods

1. Administrative detail appears to require a disproportionate part of the time of technical officers.

In examining the management and administrative environment within which the Coal Power Projects Department exists, it appeared to the review team that there is insufficient recognition of the importance of having a strong administrative capability within organizational units. Though there is a fairly well-structured practice of providing administrative assistance to higher technical officers, the focus of these activities appears to be primarily mechanical in supporting the routine activities of personnel administration, office and clerical services, labor relations, small bill and claim handling, and similar services.

One result of this approach is that the officer level tends to bear a heavy burden of involvement with non-technical matters. These activities range from the need to make decisions that could be made at lower levels, to review of procedural correspondence and paperwork, to collection and compilation of data for reports. To the degree that this takes up management attention and time, it results in distraction and unnecessary diminution of the attention and energy that could be applied to the technical responsibilities of the manager.

Though some of the load on the technical manager can possibly be relieved through refinement or improvement of procedures, or through making greater use of small data processing equipment and related tools, a more fundamental approach would be to examine the administrative requirements and processes at various organizational levels with the intention of seeking a better distribution of responsibility and authority for administrative matters.

The administrative support staffing practices conventionally followed by WAPDA do not appear to be suitable to the special needs of the Coal Power Projects Department since they appear to deal primarily with positions that are limited to providing support for personnel administration matters and office services.

Consequently, it will be necessary to identify some Department administrative positions that may be somewhat unfamiliar and outside of normal WAPDA organizational staffing procedures. These positions relate to project reporting and coordination requirements.

2. <u>The present WAPDA approach to definition of organization and job responsibilities needs improvement</u>.

In reviewing existing WAPDA organizational units involved, in one way or another, with the present or prospective activities of the Coal Power Projects Department, the availability and uniformity of documented descriptions of assigned organizational and individual job responsibilities ranged from good to not-at-all. In a number of cases, it was necessary to attempt to reach some understanding of unit or individual responsibilities through verbal discussions since descriptions were either pending, non-existent or obsolete. In others, position descriptions were extremely detailed, to the extent that they might better be described as procedural descriptions. Similarly, the quality and availability of organization charts was variable and inconsistent. Conflicting versions for the same organization were sometimes observed.

It is recognized that for an institution as large, diverse, and geographically distributed as WAPDA, with constantly changing organizational and individual assignment and functional requirements, the task of creating, managing and controlling descriptive documentation under some system of standards is of a monumental degree. Yet, management needs a reliable, uniform, authoritative reference source of information to provide some basis for a reasonably consistent appreciation and understanding of inter-organizational and individual working relationships and duties. Further, a weak or incomplete definition of functional responsibilities makes it almost impossible to measure performance in any effective way which, in turn, diminishes the ability to take any necessary corrective actions.

Planning

1. The Coal Power Projects Department is not prepared to do full scope feasibility studies.

The present staffing levels within the Coal Power Projects Department, and the level of expertise of its existing personnel preclude the possibility of conducting full scope feasibility studies without the extensive use of outside consultants.

Presently, three feasibility studies of potential coal projects are underway. Each of these studies is being conducted by one or more consultants and being funded by one or more donor agencies.

The Coal Power Projects Department has two roles to play in these studies:

(1) As WAPDA's representative, they must facilitate the conduct of the studies by interfacing with the assigned contractors and donor agencies to assure that the studies are done in a cost effective and timely manner. In performing this function, CPPD authorizes the release of funds as necessary to support the studies.

(2) The CPPD must review the project progress and assure that WAPDA's interests and concerns are addressed in the final reports.

It should be remembered that, although a feasibility study is being funded by a donor agency, the generating plant that will result from an approved project will belong to, be operated by and eventually be paid for by the people of Pakistan and therefore the feasibility study is most important to the eventual success of any projected plant.

Although it is likely that, as long as donor agencies are involved in the process of supplying funding for new generation projects, outside contractors will be conducting the major portions of any feasibility studies. The time will come when these studies will be conducted on a regular basis by the CPPD as part of normal, self funded, expansion. As a result, the capability to manage and control these studies must be developed within the CPPD. Experienced personnel with commensurate pay incentive, as needed, should be provided to CPPD.

Design and Construction

1. The Coal Power Projects Department should be able to manage, perform or oversee the design and construction of a major coal-fired generation plant.

   WAPDA presently relies on consultants for the design, construction and start-up of new generating facilities. The Coal Power Projects Department is not staffed at the proper levels of expertise to perform these functions or to properly oversee their performance by consultants.

   While WAPDA will continue to contract for design, construction and start-up services for the next few years, it must develop the capability to assure that these functions are being performed by their contractors according to standards WAPDA must develop. To help facilitate WAPDA interests in these areas Appendix 6.3 has been attached to the report. Appendix 6.3 contains information for the use of WAPDA in evaluating internal performance and the performance of its contractors. It can be used by WAPDA and the General Manager, Thermal in determining where improvements should be made in managing existing and future projects. G/C is prepared to conduct an evaluation of an existing project and make recommendations should WAPDA desire.

   The evaluation of the Coal Power Projects Department conducted as part of the Lakhra Feasibility Study has resulted in a number of recommendations which are itemized later in this report. Although these recommendations should help WAPDA develop an effective and capable Coal Power Projects Department, it was not the intention of this study or its purpose to evaluate in detail the Thermal Division in the performance of duties as related to other similarly funded projects (i.e., the 250 MW Japanese unit at Hyderabad or the combined cycle units at Guddu). A formal evaluation of WAPDA and either of these projects would be of immense value in determining future directions for WAPDA and the Thermal Organization.

In the area of design and construction it is envisioned that the Coal Power Projects Department, and in particular the Directors of applicable projects, will fulfill a monitoring function assuring WAPDA of the applicability of the subject designs and the integrity of the plants as constructed. In fulfilling these duties, the staffs of the Project Directors (described in Section 6.3 of this report) will be supplied from within applicable areas of the Thermal organization.

Specifically, the project organization will be responsible for monitoring and assuring that the following areas are adequately addressed either within WAPDA's organization or within the contractor(s) organization.

Project Organization and Administration

- Organization Structure
- Management involvement and commitment to quality
- The role of first line supervision and Middle Managers

Design Control

- Design Inputs
- Design Interfaces
- Design Process
- Design Output
- Design Changes

Construction Control

- Construction Engineering
- Construction Facilities and Equipment
- Material Control
- Construction Work Plan
- Control of Construction Process
- Construction Quality Inspections
- Construction Corrective Actions
- Test Equipment Control

Project Support

- Industrial Safety
- Project Planning
- Project Control
- Procurement Process
- Contract Administration
- Document Management
- Corrective Actions

Training

- Training Management Support
- Training Organization and Administration
- General Training and Qualifications
- Facilities Equipment and Material

Quality Programs

- Quality Programs
- Program Implementation
- Independent Assessments

Test Control

- Test Program
- Test Group Organization Staffing
- Test Plan
- System Turnover for Test
- Test Procedures and Test Documents
- System Status Controls
- Turnover of Tested Systems for Plant Operator

It should be noted that these subjects are discussed in detail in Appendix 6.3.

Operations and Maintenance

1. There are no major coal generating stations being operated or maintained within WAPDA.

   WAPDA presently has no major coal-fired generating plants. They do have some small coal generating plants which are operated and maintained by the existing WAPDA organization under the applicable Chief Engineer for their geographical region.

   It is envisioned that new major coal-fired generation plants will remain under the auspices of the Coal Power Projects Department only until commercial operation, when they would be turned over to the applicable Resident Engineer or Chief Engineer as dictated by existing WAPDA policies and procedures.

   The Coal Power Projects Department should develop the technical expertise necessary to be able to offer assistance and recommendations on coal-specific operational and maintenance matters on an as-needed basis.

   The staffing recommendations for the Lakhra station have been included in Section 6.5 of this report. Additionally, an evaluation of the levels of support presently being provided

to existing generation facilities by the Thermal organization should be conducted. This evaluation can be performed internally using the guidance provided in Appendix 6.3 or can be contracted to GCII.

Specific audits of the power generation function within WAPDA and at its facilities can be performed to identify areas for improvement in unit operation and maintenance.

Financial

1. Adequate management and control of CPPD budgets and accounts requires additional staff support.

All WAPDA financial auditing, budgets and account matters are under the overall charge of the Member, Finance, represented in the Power Wing by the General Manager, Finance. The Manager, Finance in the Thermal Division is responsible for overall supervision of financial, budget and accounting activities of divisional groups. Accounting records are maintained in conformance with the WAPDA Code of Accounts according to defined procedures. Divisional Chief Engineers are required to work through the General Manager, Finance staff for budgeting and procurement. At project or operating locations, a Senior Budgets and Accounts Officer with a local staff works under the Project or Resident Engineer but has a working link with the Manager, Finance, Thermal who insures compliance with WAPDA Finance Wing requirements through periodic site visits and review of local records.

The WAPDA annual budget cycle begins in July. Annually, the Division budget is allocated per the requirements of Resident Engineers. For construction projects, the project budget is prepared by the Project Engineer, approved by the Chief Engineer with authority over the project, and reviewed by the staff Chief Engineer. In the case of the Lakhra Project, this is the Chief Engineer, CPPD. The budget is then reviewed, discussed with and coordinated by the General Manager, Thermal before being transmitted to the Power Wing representatives for negotiations with Government representatives.

On a monthly basis, trial balances and other financial statements are submitted to the Manager, Finance, Thermal for review and consolidation. Monthly accounting reports by the site Senior Budgets and Accounts Officers show all project expenditures compared with budgeted allocations. Invoices are also sent to the Manager, Finance, Thermal for review and payment authorization.

All divisional staffing requests are also reviewed and approval obtained through Finance, Power. Departmental or Divisional requests are checked by the Divisional Deputy Director, Administration who checks budget and financial aspects and forwards the requests to the Director, Finance, Power. The requests are reviewed by that office for justification, compared against WAPDA "yardsticks" and, if approved, sent on for Member, Power or Authority approval, depending on grade.

This overall WAPDA mechanism for conducting and managing financial, budgeting and accounting matters appears to be suitable for the general needs of the Coal Power Projects Department. The designation of Senior Budget and Accounts Officers to oversee the activities of local organizational units under the wing of the Divisional Manager, Finance generally extends this control to a sufficient level to insure adequate control. In the case of the Coal Power Projects Department, however, because of the potential necessity to properly oversee and manage the financial affairs of multiple projects, it is desirable to have adequate representation at the Departmental Head Office level to insure sufficient monitoring and coordination of operating and project budgets and accounts. In addition to these requirements, assumption of the responsibility for planning and feasibility studies for coal mine and power station projects under consideration will require analytical financial and economics expertise to fully explore and evaluate the cost/performance aspects of development alternatives.

Administration and Services

1. WAPDA data processing services are adequate for CPPD major applications.

The WAPDA Computer Centre has the capacity to provide support for the Coal Power Projects Department's major data processing needs. The mechanics for arranging, as may be requested, mainframe support or set-up and operation of a local smaller-scale computer by the Computer Centre are in place. The most immediate CPPD applications requiring large-system support would be primarily technical, including load flow, production costing and related analytical studies performed for system planning purposes. In fact, the working relationships for WAPDA support of CPPD's major data processing needs are already established since many of the analytical studies performed for the Lakhra Feasibility Study by GCII specialists in collaboration with the WAPDA Planning group were performed on Computer Centre facilities.

At a lower level, however, there is a need to provide additional support, through the use of personal computer equipment, to the

CPPD Head Office staff. There is, or will be, a heavy typing load for such documents as contractor correspondence, specifications, agreements, contractual material, etc. This type of documentation requires quick preparation and the facility for making frequent, usually small, changes.

Presently, since the manual typing burden appears to be high, CPPD has had to resort to the use of outside word processing facilities for the preparation of time-critical documents related to the Lakhra Project.

Another good candidate application for use of the personal computer system involves the preparation of consolidated project expenditure reports. These reports are presently prepared manually by CPPD management. Disbursement data for commodities and services is extracted from the monthly Lakhra project report, compared against commitments and converted to local currency. The same would be done for the Duki, Karachi and future projects.

On the analytical side, as the Department staff becomes more involved with feasibility and planning studies, the support of a local personal computer and basic generalized software would be of great value for simple forecasting, technical analysis and quick evaluation of alternative solutions. It is our understanding that since the time of this review, some personal computers have been supplied through USAID.

2. Present procurement and stores methods, with some modifications, should serve the needs of the coal projects.

The stores function is now decentralized in the Thermal Generation Division though there is an important move under way within WAPDA to install a modern, centralized, computer-supported Inventory Control System. The new scheme is being implemented in Distribution first and will subsequently be extended, in phases, to all areas of WAPDA. A key feature of this system is the planning of material requirements and coordination of purchasing. When available, these capabilities will be of value to the coal power station development program.

As things stand now, procurement and stores requirements for Thermal Division projects are handled through an Assistant Field Manager, Stores on the staff of the Project Director who is responsible, with his staff, for local purchasing, receiving, inspection, storage, maintenance of records, invoices, and claims. Initially, this support centers on the civil engineering activity for the project and is gradually extended through the construction period, after a warehouse is set up. Local purchases may be authorized by the Project Director, though there appears to be

a problem in that the limits on this authority are said to be too low during construction when purchasing volume is high. Before operations, Design-Thermal, through a Head Office procurement officer, is involved in the purchasing of basic capital equipment, spare parts and imported items. A WAPDA Head Office Purchasing group does large-scale purchasing of such bulk items as cement, cable, etc. All purchasing requests are reviewed by the Manager, Finance, Thermal before invoices are paid.

After operation begins, station purchasing requests are reviewed and approved by Operations-Thermal, which also selects the source according to WAPDA requirements and operates the warehouse.

This approach should generally serve the needs of the Lakhra and other coal projects, with minor exceptions. The staff of the Lakhra Station should include a Stores Officer with a supporting group that is similar to those established at the Guddu station. Provision should be made, however, for installing appropriate receiving and inspection processes, equipment and staff for the coal to be used at the Lakhra units. Guidelines for establishing these procedures are presented in an appendix to this report. These procedures should be supported by analytical laboratory facilities at the station site.

Pending support from the centralized materials planning function, and until it is available, there is a need for reviewing and coordinating individual coal station project material requirements during the construction period. Attention must also be directed, for the longer range, to the preparation necessary to eventually make the transition to the centralized inventory control system.

3. Coal contracts will require specialized negotiation and administration attention.

Fuel contracts are handled presently by the Fuels and Efficiency Officer, after review by the WAPDA Central Contracts Cell which coordinates and brings about uniformity in policies and procedures concerning works, services and supplies contracts. Terms and conditions of foreign exchange or local tenders are reviewed. For oil purchases, prices are set by the Government so price negotiation is not involved. Most of these contracts have been in place for a long period so few changes are required. The Contracts Cell also mediates between WAPDA units and contractors in matters relating to contract administration, contract provisions and claims.

Very little experience in handling coal contracts now exists in either the Central Contracts Cell or the Thermal Division, though

coal purchases from the Pakistan Mineral Development Corporation are now handled for the small Quetta station by the Fuels and Efficiency Officer. Therefore, the ability to do coal contract management should reside in the Coal Power Projects Department with the general guidance of the Contracts Cell. Since coal purchases could be made from many sources, including the private sector, and it appears that prices would be subject to negotiation, a source of knowledgeable support for both Head Office planning and coal procurement activities is needed on the staff of the Chief Engineer, CPPD. In connection with giving special attention to this need, WAPDA has sent two engineers to the USA for training. Additionally, a committee has been established to draft a coal supply contract.

4. Adequate transport equipment and service will be required for CPPD head office and project use.

Presently, there is one transport group in each WAPDA Distribution area that is responsible for maintenance and inspection of transport equipment in the area. Each General Manager can approve the procurement of transport vehicles for organization needs. Purchasing is done through normal WAPDA procurement channels. At project locations, depending on local needs, lower level officers may have responsibility, as part of their duties, for coordinating the vehicle procurement and maintenance needs for the project. Logs are maintained in offices to record usage. These logs are periodically audited. The Coal Power Projects Department now has one vehicle assigned to it and others may be borrowed from the Thermal Division Pool, if available.

When the implementation activities for the Lakhra Project begin, it will be important to assure that adequate transport equipment facilities and service are available to project personnel. The isolated nature of the station location will require self-sufficiency in the availability and maintenance of transport vehicles. At the Head Office location, it will also be necessary to have adequate transport support because of the need for staff travel to scattered project locations and to accommodate an occasional heavy flow of visitors and participants in meetings and activities related to donor agency and government planning and review discussions; private sector and foreign contractor, vendor or supplier visits, and project coordination.

5. File and record handling methods are generally adequate, but could benefit from stronger standards.

Management of office services and supplies is performed by WAPDA Administrative Officers and their staffs assigned to Senior Officers. This includes clerical assistance, typing, inter-office

mail and handling of office files and records. The typing burden is high in some offices, with consequent backlogs and delays. For CPPD, this area of support should consider the use of micro-computer-based word processing. Except for a general instruction, there appear to be no WAPDA-wide standards for document classification or filing systems. Each office sets up its own filing method within the broad guidelines of the general instruction. Logs are used to track the movement of records. Obsolete Head Office records are stored at a power station located near Lahore. Stations store their old records on the station premises.

These methods appear to work, in most cases, reasonably well. Existing record filing and maintenance methods practiced throughout WAPDA offices have served the purpose for many years. However, to avoid penalizing high-activity, critically-located offices and functional units, consideration should be given to re-examination of their present record use requirements and selective upgrading of the broad framework of procedures and tools used to provide these basic services.

6.2.2 Recommendations

The analysis of institutional requirements related to the performance, efficiency and capacity of the Coal Power Projects Department for implementing the power plant components of the Lakhra Project resulted in a series of recommendations for improvement and strengthening of the Department. The recommendations also address the Department's broader role in planning and managing the development of all coal-fired power stations for WAPDA, and in representing WAPDA's interests in interactions with the coal mine component of the Lakhra and other projects. The recommendations are grouped into the same categories used in presenting the findings and conclusions.

Organization

1. The Coal Power Projects Department should be established, on an interim basis, as a semi-autonomous unit of the Thermal Generation Division of WAPDA.

   Initial WAPDA plans for the Coal Power Projects Department involved placing it within the Thermal Generation Division with the Chief Engineer, Coal Power Projects Department functioning as a staff officer of the General Manager, Thermal. Also, WAPDA plans call for the management of construction of the Lakhra plant to be placed under a Project Engineer who reports to the Chief Engineer, Jamshoro, who in turn also reports to the General Manager, Thermal.

The findings of the Institutional Development review performed as part of the Lakhra Feasibility Study were in general agreement with the basic aspects of this organizational placement since development of generation capabilities falls naturally within the broad charter of the General Manager, Thermal Generation. However, examination of the standard WAPDA approach to the distribution of management authority and the use of divisional functional support services, as compared to the special needs of the Lakhra Project, revealed in the opinion of the review team, that several special factors warrant making some exceptions to the adoption of this approach for organizing the Coal Power Projects Department.

First, CPPD's role in coal-project planning and implementation is critical to the goals of the national coal resource development program. The urgency and predicted high cost of the program, as well as the need for a high degree of negotiation and interaction with government, lender and grant agencies, private sector contractors and local and foreign suppliers of services, materials and fuel all point toward a requirement for a more flexible level of management responsiveness and control than is normally necessary for more routine and less-critical generation projects. In later stages, this requirement is also supported by the Department's mandated responsibilities for managing the implementation activities during plant construction and through the start-up process.

It is the opinion of the review team that the impact of these factors is great enough to raise the significant prospect of ineffectiveness of the standard organizational approach. The separation of authority between the Chief Engineer, CPPD and Chief Engineer, Jamshoro, the mixed reporting lines of the Project Engineers or Directors and the need to use divisional support services that are yet largely undeveloped could engender many cross-organizational communications problems and thereby increase the probability for significant delays in management attention or decisions. While these management relationships presently appear to be reasonably good with adequate cooperation among incumbent managers, there is always the possibility that unforeseeable changes in management personalities and corresponding philosophies could create opportunities for conflicts and obstacles that would threaten the execution of this high-visibility, high-priority project within the prevailing time and funding constraints.

Further, there is an important need to keep a broad view of the Coal Power Project Development Program. The Coal Power Projects Department's mandate extends beyond the Lakhra Project. If the Feasibility Study results in moving ahead with the Lakhra Project,

the principal initial activity of the Department will relate to the Lakhra Project design, construction and commissioning, including the interfaces with the mine development. Each of these steps would be phased according to the schedule requirements for each unit. All during these Lakhra power station development stages, the Department will also be responsible for planning and possibly beginning implementation of other coal stations - Karachi, Duki and Sondha, for example - and evaluating the feasibility of new stations. This responsibility will require increasingly more of the CPPD staff resources as the initial Lakhra Project phases out, the benefits of the training program are realized and staff experience accumulates.

It is critical that the Department be organized and emplaced within WAPDA so that it does not tend to become preoccupied with or limited to the Lakhra Project, important as that project is. The dispersal of key implementation responsibilities among existing WAPDA support groups could have this effect because of the absence of a strong focal point for a coordinated and consistent approach to planning, execution and management of the overall program.

Therefore, it is recommended that the Coal Power Projects Department be established as a semi-autonomous organizational unit of the Thermal Division with the Chief Engineer of the Department reporting to the General Manager, Thermal. The General Manager, Thermal would still have full responsibility for the Department, but would delegate authority for management of project planning, design, construction and start-up to the Chief Engineer, CPPD instead of following the usual approach of delegating authority to the Chief Engineer, Jamshoro for field project management and to the divisional staff design and operational support functions for the head office work. Divisional support and field services would still be used for non-coal-specific assistance to CPPD, but the Chief Engineer, CPPD would have the responsibility for overseeing all coal-project planning, design, construction and start-up activities and insuring that they are executed on schedule and within funding limits. The proposed organizational alignment for the Coal Power Projects Department is shown in Section 6.2.3.

The recommendation is to follow this organizational approach on an interim basis, as has been done by WAPDA in at least one other case, the Chief Engineer S.T.G. When the initial objectives of the national coal development program have been achieved, WAPDA management should reassess the prevailing situation. The scope and impact of the coal program have increased; therefore, to execute the project most effectively, the Coal Power Projects Department should be given divisional status with the Chief

Engineer serving as its General Manager. This authority should be granted by March, 1986.

2. The Chief Engineer, Coal Power Projects Department, should report to the General Manager, Thermal Generation, but should be granted line authority for planning and managing project development.

In line with the recommended establishment of the Coal Power Projects Department as a semi-autonomous unit of the Thermal Generation Division, the status of the Chief Engineer, normally a staff position, should be adjusted to provide line authority over implementation of coal projects. The present limitations on the powers of staff officers, as described by the WAPDA Book of Financial Powers, prevent the Chief Engineer from exercising full direct control over all project budgetary and financial matters unless specifically authorized by the General Manager, Thermal Generation.

This fractionation of authority will not permit the Chief Engineer the degree of flexibility and control that is required to effectively manage multiple projects involving unfamiliar technology and to meet the demanding goals of a national coal development program. The Coal Power Projects Department, in successfully carrying out its implementation tasks, must be guided by the adoption of appropriate policies and will require major decision-making in achieving its goals. These processes, to be effective, should be the responsibility of the Department head in addition to the day-to-day management duties that will be required. The review team believes that operating as a staff officer would detract from the Chief Engineer's ability to satisfy these responsibilities. It would introduce an unnecessary and counter-productive lag in management responsiveness that could impede the Department's immediate and long-term progress. The national coal development program, relatively speaking, represents a venture into uncharted waters and can be expected to experience unexpected and frequent changes requiring quick and direct attention. Line status, for coal project implementation matters, will also permit a clearer and more efficient Departmental approach to monitoring project events, measuring performance, responding to unexpected project developments or emergencies, and initiating any corrective actions that may be necessary.

Under this arrangement, the Chief Engineer, CPPD would still report to the General Manager, Thermal Generation and would still be bound by broad WAPDA financial and budgetary policies, practices and reporting requirements but, through the granting of a special exception, would have line responsibility over planning, design, construction and start-up activities of the Department as distinct from the conventional WAPDA approach

where certain of these responsibilities are fulfilled by other divisional support and field officers.

The review team recommends this concentration of authority on an interim basis because of the special circumstances, as described elsewhere, of the coal development program. It further feels that the initial steps already taken by WAPDA in identifying and designating a nucleus of qualified top management personnel for the Department would give a positive impetus to the successful establishment of this non-routine organizational role. When the initial goals of the program are realized, and when its ultimate direction is clearer, perhaps after the second Lakhra unit is commissioned, consideration can be given to whether or not this interim arrangement should be made permanent or modified in some way.

With the implementation of this recommendation, any steps taken to authorize and direct granting of line authority to the Chief Engineer, Coal Power Projects Department should be clearly defined and announced so that all affected parties within both the Thermal Division and WAPDA, in general, have a full understanding of their respective roles, responsibilities and relationships and are encouraged to give full support and cooperation for all aspects of the program.

3. <u>To support multiple coal projects, the Coal Power Projects Department should be centrally located</u>.

To properly meet the needs of the coal project development program, the Coal Power Projects Department should have a strong centrally-located Head Office group, preferably in Lahore. The diverse demands of multiple coal-fired power station projects, in terms of coordination, management control and administration of funds, require that the Chief Engineer be located to minimize communications and access problems, both internal and external to WAPDA. Being co-located with the WAPDA main offices would significantly enhance the ability of the Chief Engineer to deal with day-to-day matters in.olving other WAPDA functional areas as well as meetings with WAPDA management, or with donor and other external agencies. It would also make more accessible, to all projects, the Head Office personnel who would oversee station staff activities in such areas as pollution control and coal analysis and provide specialized technical support to field projects.

Since development of major coal-fired power stations would be a relatively unfamiliar venture to WAPDA, it would be important to have this centralized source of expertise in coal-handling and coal-burning systems. In addition to the Lakhra units, demands for this support could come from the geographically

dispersed areas of the Makkerwal, Dandot, Sondha and Jhang projects, and potentially from others yet to be identified.

A secondary but still important need is for the Coal Power Projects Department to have sufficient office space at the central location. Though this need not be located specifically within the WAPDA House, it is important that it be nearby and that enough space be provided so that the full staff can work in one general contiguous office area to permit free and convenient contact among Department staff and management as the needs and events of the various projects may require.

4. Stronger and more visible emphasis should be given to the development of the Coal Power Projects Department.

Since the formation of the Coal Power Projects Department, subsequent development steps have resulted in the appointment of a nucleus of key management personnel, some supporting administrative staff and the establishment of some basic inter-organizational working relationships. With more clarification of the role, form and placement of the Department, the time is appropriate to move ahead with a full definition of Departmental responsibilities; to begin the acquisition and training of qualified staff members; and to thus proceed with implementing the full functional capabilities of the Department.

These further developmental activities would benefit from a strong promotional policy statement by WAPDA that outlines the Coal Power Projects Department's broad goals and charter, stresses the importance and value of the program and reflects full management support and commitment. Important factors that will contribute to the timely implementation and success of the program include the acquisition of a qualified staff and the cooperation and support of other WAPDA functional units as well as of external government bodies and the private sector. The impetus arising from such a statement would be a valuable contribution to the effectiveness of the implementation process.

Staffing

1. The Coal Power Projects Department should be staffed to permit it to assume its recommended direct role in planning and managing coal projects.

The preceding recommendations have pointed out a number of reasons for adjustments to the organizational status of the Coal Power Projects Department and the authority of the Department Chief Engineer for the purpose of extending the capability of the Department.

In line with these thoughts, the Department should perform these functions:

(1) Feasibility evaluation and planning for all coal power stations, and support of similar activities involving coal mines.

(2) Design engineering for all coal-specific aspects of power station projects, including the ability to perform minor design changes and monitor major design contractors. (Design engineering support for non-coal-specific aspects of projects would be assigned to divisional support units; e.g., Design, Thermal.)

(3) Oversee the construction of coal power stations.

(4) Monitor the start-up and commissioning of coal power stations. (After commissioning, coal plants would be turned over to the applicable Resident Engineer, or Chief Engineer, as dictated by existing WAPDA policy.)

Two basic requirements for the establishment of an appropriate and adequate Department staff must be considered:

(1) To fulfill its responsibilities, the Department must have the ability to perform or exercise control over: coal project budgetary and financial matters; planning, design, project management and the start-up activities leading to plant commissioning.

(2) The Department must move quickly to add the special skills required to carry out its mission. The demands of an unfamiliar technology, multiple projects and a dearth of relevant WAPDA coal-specific experience will further complicate this process.

The most practical immediate approach to acquiring the necessary diversity of skills would be to use several sources of assistance, including the CPPD staff, WAPDA support functions, and consulting assistance from both domestic and expatriate sources. Different and unfamiliar technology relating to such coal-specific aspects of plant development as coal-burning and coal and ash-handling equipment and systems must be addressed and utilized for Lakhra and subsequent projects. During the early program development stages, this or feasibility analysis needs for other projects can be met through the use of outside specialized consulting assistance. For non-coal-specific technical support, Thermal Division or other WAPDA staff functions can make valuable contributions. The proportionate contributions of the respective

participants would gradually change as the CPPD staff broadens the level and scope of its personnel skills, through involvement in project implementation and the supplementary training programs, and assumes more and more direct responsibility for project tasks.

Because of the anticipated involvement of the CPPD staff throughout the whole spectrum of plant development activities from initial feasibility studies to plant commissioning, CPPD should include both a head office group as well as field units. The head office would provide planning and analytical support for both coal power stations and mines, centralized management and technical support for all coal power stations projects, interfacing with internal or external bodies and agencies, and continuity from project to project. Field units would be directly involved with project-specific implementation activities, as described in Sections 6.3, 6.4 and 6.5 of this report. It is also advisable to provide adequate administrative assistance to free the Chief Engineer and his key managers from some of the day-to-day coordination and status reporting matters so that they can concentrate their efforts on policy-related affairs and program direction and management.

The recommended scenario of collaboration and interaction among the various parties that would support coal power station project implementation can perhaps be better explained through a simple tabular summary. Figure 6.2.1 shows the nature of involvement of the Coal Power Projects Department staff and WAPDA functional support groups as well as the use of external consulting assistance during each of the key stages of power station project implementation. Specific involvement of CPPD personnel is shown in Figure 6.2.2 and is described as follows:

Planning

As Figure 6.2.1 indicates, the goal would be for the CPPD staff to be heavily involved in coal project planning activities for both power stations and mines. For project feasibility studies, staff capabilities would be built up and augmented, as shown in Figure 6.2.2, to cover study areas as follows:

Power Plants

Conceptual Design
- Plant Layout
- Coal/Ash Handling
- Coal Burning
- Electrical

Fig. 6.2.1 CPPD RESPONSIBILITIES THROUGHOUT PROJECT PHASES

PROJECT PHASE	PRIMARY RESPONSIBILITY	SUPPORT FROM	COMMENTS
Planning	Execute and Control	Thermal Division WAPDA Planning Consultants	Use more consulting assistance in early phases, less as CPPD staff acquires experience. Use consultants for specialized assistance and third-party role.
Design	Execute and Control	Thermal Division Consultants	Design, Thermal would be involved with all non-coal-specific design, while CPPD would monitor coal-specific design activity. Use consultants as necessary.
Construction	Execute and Control	Thermal Division WAPDA Contracts WAPDA Inventory Control Consultants	Project Directors report to Chief Engineer, CPPD, who also has budget and procurement authority. Use consultants as necessary. At plant completion, some of project management staff move into operations.
Operations	Execute and Control	Thermal Division WAPDA Contracts WAPDA Inventory Control Consultants	Continuation of plant construction up to plant start-up and commissioning. Chief Engineer, CPPD approves budget, staffing, up to operations. After commissioning, the Resident Engineer assumes full responsibility under the existing WAPDA station management organization, with specialized engineering assistance from CPPD as needed. Use consultants as necessary.

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Fig. 6.2.2 RECOMMENDED CPPD HEAD OFFICE STAFF ACTIVITIES

PROJECT STAFF	ACTIVITY	PERFORMED BY	SUPPORTED BY
Planning	Feasibility Studies		
	Power Plant		
	Conceptual Design Specs.	C.E., Design, Thermal	Dir., Coal Power Projects
	Plant Layout	C.E., Design, Thermal	Dir., Coal Power Projects
	Coal/Ash Handling	D.D., Mechanical	Sr., Engs. Ash Handling
	Coal Burning	D.D., Mechanical	Sr. Engs. Coal Boilers/Analysis
	Electrical/I&C	D.D., Electrical	Sr. Engs. Electrical/I&C
	Plant Site Selection	Dir., Coal Power Projects	Consultants
	Fuel Evaluation	Consultants	Dir., Coal Power Porjects
	Power System Planning	C.E., Planning, Power Wing	Dir., Coal Power Projects
	Capital/Operating Cost Analysis	Dir., Finance and Coordination	C.E., Planning, Power Wing. Spec., Econ. & Financial Analysis Dir., Coal Power Projects
	Mine		
	Mining Studies	Dir., Mining	Sr., Eng., Mining
	Geology Studies	Dir., Geology	Sr., Eng., Geology
	Other (for Power Station and Mine)		
	Economic/Financial Analysis	Dir., Finance and Coordination	Dir., Coal Power Projects Spec., Econ. & Fin. Analysis
	Social Impact Assessment	Consultants	Dir., Coal Power Projects
	Environmental Studies	D.D., Environmental Analysis	Consultants
Design	Plant	C.E., Design, Thermal	Dir., Coal Power Projects
	Coal/Ash Handling Systems	D.D., Mechanical	Sr. Engs., Coal/Ash Handling
	Coal/Burning Systems	D.D., Mechanical	Sr. Engs., Coal Boilers/Analysis
	Electrical/I&C	D.D., Electrical	Sr. Engs., Electrical/I&C
Construction	Project Management	Project Director	D.D., Proj., Sched. & Coordination D.D., Contracts D.D., Administration A.D.A. at Project Site (+ Project Mgmt. Staff at Project Site)
Operations	Test, Start-up and Commissioning	Project Director	Same as Above

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Plant Site Selection
Fuel Evaluation
Power System Planning
Capital/Operating Cost Analysis

Mines

Exploration
Mine Location
Extraction Techniques
Coal Quality Analysis

Other (Both Power Plants and Mines)

Economic/Financial Analysis
Social Impact Assessment
Environmental Analysis.

CPPD Head Office staff members to perform planning, oversight and coordination functions in relation to coal mines have also been broadly identified. The specific aspects of this staffing in terms of numbers and qualifications will be defined in the related Lakhra Coal Mine Feasibility Study being performed by the John Boyd Company.

From an administrative point of view, it is also important to develop the capability for anticipating and planning the staffing and training needs across all projects after the initial training program is completed.

Design

During the design stage for coal power station projects, the CPPD staff should be responsible for design review and approval both before and during construction. For coal-specific systems and equipment, CPPD would perform review and approval. For non-coal-specific design, the support of Design, Thermal would be used, but CPPD would still have review and approval authority.

It is anticipated that the Coal Power Projects Department would include specific personnel with expertise in the followng areas:

- Coal Combustion
- Boiler Fundamentals
- Coal Handling Equipment
- Ash Handling Equipment
- Boiler Instrumentation

- Digital Controls
- Computer-Based Controls
- Coal Analysis
- Electrical Equipment in severe environments

Some individuals would have expertise in more than one of the above areas, but it is essential that the Coal Power Projects Department be able to provide this expertise during the design, review, construction and operation phases of plant life. This would be available for the Lakhra Project units and for any subsequent units.

The actual project team would include personnel supplied on a long term basis by the General Manager, Thermal. These personnel would be augmented, on an as-needed basis, by the coal-specific experts in the CPPD.

Construction

For plant construction, the Project Director for a specific plant would monitor and approve field construction activities and would report to the Chief Engineer, CPPD. The reason for having a Project Director head up plant construction rather than a Project Engineer is that, as empowered by WAPDA, the Project Director has more authority over plant financial, budgetary and procurement matters than does a Project Engineer. With the prospect of several overlapping coal-fired power station projects, it would be desirable to reduce the management burden on the Chief Engineer, who will have up to four Head Office Directors reporting to him as well as several Project Directors or Engineers.

By utilizing Project Directors for major projects, and by careful and precise delegation of authority to them, the Chief Engineer should be able to restrict his attention to major policy-level project decisions, overall project progress, and to overseeing the necessary financial and contractual arrangements and negotiations with donor and government agencies and suppliers. A key prerequisite for the success of this type of approach, which basically involves the creation of a "flatter" organization with some delegation of authority, is that a free and adequate flow of information exist among all elements of the organization. This includes guidance and direction information from management on the one hand, and performance and status data from performing units on the other.

To accomplish this, it would be necessary to introduce Head Office administrative staff support for such activities

as project scheduling and coordination (pre-planning for all projects before start of construction); project reporting (project status after construction starts); review and negotiation of contracts; procurement assistance and coordination (over all projects); and coordination of project budgets and accounts. Support needed in coal-specific technical areas would be provided by the CPPD on an as-needed basis. The other non-coal-related technical support needed within each project organization would be provided on a matrix basis by the General Manager, Thermal.

At project field sites, staffing requirements to be satisfied would also include: administration; security; budgets and accounts; medical services, stores and transport. The staffing complement for these activities for the Lakhra Project is discussed in Section 6.3.

Operations

CPPD would not be responsible for plant operation and maintenance after plant commissioning. However, it would be in charge of the start-up and commissioning activities after construction is completed. The technical and administrative staff activities of the construction period would carry through to this point, including all plant staffing and procurement necessary to man, equip and supply the power station.

The recommended staffing plan may be found in Section 6.2.4. Supporting position descriptions are presented in Appendix 6.2.

2. Special compensation policies should be established for the Coal Power Projects Department.

To properly support the development or both the Head Office and project staffs, it is necessary to insure that compensation and benefits policies meet the special needs of the national coal development program. Application of standard WAPDA policies would severely handicap the process of building and maintaining a qualified staff for the critical Lakhra Project as well as any potential subsequent projects. One of the key requirements related to project staffing is the development of staff technical skills in coal-specific equipment and systems. Qualified candidates with appropriate academic and utility background are available through WAPDA's normal staffing channels for selection and specialized training. Restricting the range of choice from this pool of candidates should not be risked because of perceived inadequacies of the wage/benefit picture.

It is the opinion of the review team that special pay allowances, as well as other personnel benefits, for the Lakhra Project should be at least equal to those granted for the Guddu station for those Coal Power Projects Department personnel stationed at the plant site. The Head Office staff should receive at least the equivalent of any special allowances granted to other comparable head office organizations. The administrative and procedural mechanics for definition of the specific details of the allowances should be initiated early so that it can get the necessary management or government approvals in time for the anticipated project start date.

The success of the Coal Power Projects Department staff development process will be heavily dependent on the training program to be set into motion. The training program, in turn, should start early and should not be delayed because of difficulties in attracting and keeping qualified personnel due to non-competitive salary or benefits practices.

3. Staffing of the Coal Power Projects Department should include a research capability.

Though the immediate goal of the Coal Power Projects Department is to manage the implementation of the Lakhra Project, its responsibilities for supporting the national coal resource development program require that its staff capabilities be up-to-date and fully abreast of state-of-the-art coal-fired technology. This can be partially accomplished by the training program and by encouraging participation in all information exchange opportunities available through attendance at seminars and technical meetings, acquisition of technical literature and periodicals.

A valuable adjunct to these efforts would be to set up and maintain a modest level of applied research activity within CPPD. The program would address selected applications or problems in the areas of coal and ash-handling, coal-burning or other coal-specific equipment, systems or processes. It could be established under the part-time guidance of a senior technical staff member and could involve, at any given time, the services of several staff members. Academic training, as indicated in the Training Section of this report, would be provided to assist in the development of required background in such areas as:

Chemical Analysis
Environmental Effects
Advanced Materials Handling
Advanced Boiler Design
Advanced Combustion Controls.

Also, advanced courses could be added to cover additional training in:

Fluidized Bed Combustion
Environmental Control Technology
Mining Technology

and related courses that would support the research program. These contributors could be more senior personnel between assignments or perhaps promising entry-level personnel needing more experience. The overseeing officer would handle the planning and management of the program, together with an advisory board, and would provide continuity for the program.

As soon as the initial organization of the Coal Power Projects Department has been put into place and the implementation activities are underway, consideration should be given to the establishment of a formal Coal Technology Research Cell in the Department Head Office. This Cell would be under the direction of a Deputy Director who would report to the Director, Coal Power Projects. Formal establishment of the Cell at that time would permit identification of promising candidates during the initial training courses.

Local universities and private sector institutions could be invited and encouraged to participate or otherwise provide assistance or facilities. Feedback of practical experience from the Lakhra power plant installation, test and start-up activities as well as later operating experience would stimulate the selection or execution of research programs. In turn, research results would be available for CPPD use in future plant design activities.

4. Strengthen procedures used to distribute and control Service Rules.

The procedures used by the Rules Directorate to prepare, distribute and control Service Rules and subsequent amendments should be revised to insure that the latest approved versions of each set of Rules are clearly identified and circulated. Since the frequency of changes to these rules appears to be high, the issue and distribution of amendments must be done frequently.

This process is an excellent candidate for the use of computer-supported word processing. The ability to keep a master version of each set of Rules in computer language, to quickly and easily make changes, to assign unique identifiers to the revised versions, and to print and transmit the revised versions of the Rules would facilitate the distribution and control of this material to all WAPDA managers. With such an approach, it would be also

possible to set up a master routing list in the computer. This list would be used to automatically address all new issues of Service Rules, and to keep a record of all versions of Rules transmitted to each office.

Management Methods

1. Consider strengthening of administrative support approach for technical managers.

Effective management of the Lakhra and subsequent major coal projects will require adequate Head Office administrative support to perform coordinating and reporting functions. It will be important to be able to quickly collect, organize, process and disseminate project status and expenditure information to satisfy the needs of Department and WAPDA management, as well as the project-monitoring requirements of donor agencies. This type of management information for current Department projects is being collected and assembled now by the Chief Engineer, on a manual basis. As the Department project activities increase, particularly when work begins on the second unit, this reporting load will also grow and means will have to be provided to cope with this important function.

At a more general level, attention should be directed to the examination of the methods used to assign authority for and perform administrative tasks within organizational units. The need for, and benefits arising from a redefinition or restructuring of the administrative staff component of WAPDA units should be established by an analysis of existing administrative procedural activities and methods within the units. Shifting some of the burden of involvement with administrative detail from technical managers could be accomplished by enlarging the role and extending the authority of administrative officers. By doing this in conjunction with introducing more local data processing support for, in the case of CPPD, for example, preparation of project status reports, it should be possible to significantly increase the attention managers can devote to their technical responsibilities. Another no less important payoff is that it opens more meaningful and attractive opportunities and career paths for valuable administrative personnel.

The best way to approach this issue, however, is to establish a solid foundation by performing the analysis suggested earlier. Making hasty and unfounded changes could introduce other problems. Perhaps a pilot approach could be considered, where the review and resulting changes could be restricted to one organizational area. After evaluation of the results, consideration could be given to extending the revised approach to other WAPDA organizations.

Planning

1. Continue present role as facilitator.

   The Coal Power Projects Department should continue to function in its present role as facilitator for feasibility studies being conducted at this time. In this role, they must represent WAPDA's best interests and assure that the reports generated reflect WAPDA's interests and concerns.

   The size and complexity of the Coal Power Projects Department would not have to be increased substantially until a specific project is approved for conceptual design. However, for the reasons cited earlier, it is desirable for the CPPD to develop the capability to execute and control full-scope feasibility studies with minimal contractor assistance.

2. Develop the capability to conduct full scope feasibility studies for future coal-fired generation.

   The Coal Power Projects Department should develop the capability to manage feasibility studies as required by the General Manager, Thermal. Although it is likely that most feasibility work will be performed by outside contractors, as long as donor agencies are involved in project funding, the CPPD must increase its capability to conduct studies of this kind on its own.

   The expertise needed to perform feasibility studies can be acquired through: training of existing staff, training of personnel within the General Manager, Thermal's organization, and the acquisition of personnel with the necessary expertise.

   A major source of training exists at this time and can be taken advantage of by assigning existing personnel to work closely with present feasibility contractors so that they receive on-the-job training.

   The CPPD recommended organization, with the support of other complementing groups within the General Manager, Thermal's organization, should be able to manage feasibility studies within a short period of time, although the use of outside contractors will still be necessary unless WAPDA should decide to develop major design capabilities not anticipated at this time.

Design and Construction

1. WAPDA should contract major design and construction work.

   The design, construction and commissioning of major coal generation facilities should be provided to WAPDA through the use of

contractors. It is not anticipated that WAPDA will, in the near future, develop the capability to perform these functions independently.

The way in which WAPDA contracts for these services will change and it is recommended that WAPDA develop the capability to act as overall project manager for these types of projects.

Of the areas under discussion, the only one that should be considered for complete WAPDA control would be commissioning and, as a first step, WAPDA should consider engaging a consultant other than the Designer or Constructor to perform this function and work very closely with this consultant.

2. The Coal Power Projects Department should have responsibility for the overseeing of contractors.

Any major new coal generation projects will result in plants that will belong to, be operated by and eventually be paid for by the people of Pakistan. No matter how the plants are contracted for, the overall responsibility for seeing that the designs are applicable and that the plant is constructed and started up correctly rests firmly on WAPDA.

WAPDA must provide the proper autonomy and authority to the CPPD to allow it to fulfill this responsibility. The project approach described in this report along with the proper staffing and use of independent consultants should enable the CPPD to fulfill this role.

3. The CPPD should provide coal-specific expertise and design support.

The Coal Power Projects Department must develop coal-specific engineering expertise in the following areas, as it is not expected to be provided by the present staff of CE Design Thermal whose present experience and responsibility cover only steam plants based on gas and oil:

- Coal Combustion
- Boiler Fundamentals
- Coal Handling Equipment
- Ash Handling Equipment
- Boiler Instrumentation
- Digital Controls
- Computer Based Controls
- Coal Analysis
- Electrical Equipment in severe environments

These areas of expertise, in conjunction with the design capabilities for non-coal-related plants existing under the Chief Engineer, Design, would be used to support design and construction activities.

The CPPD should delegate one or more of its staff to be responsible for following and reporting on the state-of-the-art in coal-fired generation, especially as it applies to coal supplies available within Pakistan. This could be done in conjunction with the research emphasis described elsewhere.

Operations and Maintenance

1. Operations and Maintenance of Units should follow existing WAPDA policies.

   It is recommended that new generation plants such as the Lakhra units remain under the auspices of the Coal Power Projects Department until commercial operation, and that they be turned over to the applicable Resident Engineer or Chief Engineer as dictated by existing WAPDA policies.

2. The Coal Power Projects Department should support operating plants with coal-specific engineering expertise.

   The Coal Power Projects Department should develop the technical expertise necessary to be able to offer assistance and recommendations on operational and maintenance matters on an as-needed basis.

   In carrying out this role, it will be necessary for CPPD personnel to keep abreast of and develop a data base including information about operations and maintenance-related activities at WAPDA's facilities and related plants in other areas of the world. The CPPD should be the central clearinghouse for all coal-specific information and expertise within WAPDA.

   The Coal Power Projects Department should also be capable of managing major modifications work for commercial coal generation plants, and should be capable of performing minor design work for these plants independent of outside consultants.

Financial

1. The CPPD staff should include a management-level specialist to support Departmental financial, accounting, and budget control needs.

   Because of the level of prospective activity within the Coal Power Projects Department as successive coal station development

projects are started, there will be a significant amount of accounting, budgeting and financial monitoring to perform. The normal practice within WAPDA is to have Budget and Accounts Officers assigned to projects work through the Divisional Senior Budget and Accounts Officer in compliance with procedural requirements. Because of the heavy existing load within the Thermal Division, and because of the importance of direct and timely management and control of Department project financial affairs, a Director, Finance and Coordination should be assigned to oversee and coordinate all Departmental budgeting and accounting activities. All procedures and reporting would still be performed in accordance with WAPDA Finance Wing requirements. The Director's function would be to provide an intermediate link between the project Budget and Account Officers and the Divisional Finance Officer with the support of a small staff to coordinate Departmental operating and project budgets. This coordination would also extend to accounting records and reports generated by the local accounting staffs of respective coal station projects.

Another important duty of this function would be to provide expert analytical services required to support the evaluation of financial and economic aspects of Departmental feasibility study and planning activities. This would require a somewhat different professional orientation than that required by the Budgets and Accounts support. A specialist with appropriate academic background supplemented by training courses would have to be assigned to fill this position. On-the-job training with outside experts involved with early feasibility analysis would also be helpful. This analytical assistance would be required during the early stages of both power station and coal mine feasibility studies.

2. Yardsticks for staff planning of generation organizations should be improved.

The Finance function of WAPDA has responsibility for reviewing and approving the creation of new posts and organizational units. To assist in this process, yardsticks which define expected performance standards for the various functional activities in terms of expected work loads or other criteria are used. These yardsticks have been developed to a rather detailed state for the Distribution and Transmission formations. In the operations area, development of yardsticks does not appear to have been developed to the same degree. With the emphasis now being directed to conservation policies, efforts now seem to be under way to improve maintenance yardsticks.

The impending development of coal station and other operations and maintenance staffs would benefit from the availability of

this type of tool because it would permit the refinement of staffing approaches to give adequate consideration to WAPDA operating experience and other factors or practices that arise from conditions or situations that must be faced in local environments.

Administration and Services

1. Provide procurement and stores coordinating function in CPPD Head Office.

Until the centralized WAPDA inventory control system is extended to cover the needs of generation, much of the procurement and stores activity for each station will be handled by the Station Stores Officer. Under the coal development program, when several on-going projects will be requiring similar goods, equipment and material, the opportunity for realizing substantial savings in time and money will be lost if each project procurement activity is performed independently. For this reason, a coordinating procurement and stores specialist should be included in the CPPD Head Office staff. The responsibilities of this officer would be essentially to provide coordinating and planning support to the needs of all the coal projects.

Duties would include keeping abreast of the procurement needs of individual coal projects so that purchasing costs can be reduced through larger volume buying from selected sources. Review of longer range material needs for individuals projects would also be done to perform the integrated material planning necessary to insure that stores items are available when needed. In the case of the Lakhra Project, this activity would be particularly important to insure the availability of materials during the transition from construction of the first unit to the second. The coordinating procurement officer would also serve as the point of contact with the centralized inventory control system implementation process, providing a source of advisory information covering coal project stores requirements and assisting with the extension of the new system to support coal project requirements.

The coordinating officer would also provide the collection point, for all coal projects, for procurement requests involving imported goods. These foreign purchasing requirements could still be handled by the Thermal Division procurement office, through the CPPD stores coordination specialist. If the level of foreign procurement becomes large enough, consideration can then be given to performing this procurement within CPPD to provide more direct control. At field sites, local stores officers would have authority to purchase local goods below a specified

price level to avoid unnecessary delays arising from purchases of low-cost items.

2. Consider raising level of authority of Chief Engineer for local purchases for projects.

There appears to be some difficulty arising from the requirement that the Project Engineer responsible for the construction phase of a project get approval for purchases over a specified cost level. This has been the reason for procurement delays involving relatively minor items which, in turn, have impeded the overall progress of implementation of projects.

The designation of these authority levels for various management levels is provided in the WAPDA Book of Financial and Administrative Powers, dated 1977 and amended in 1984. These levels have been established to provide a balance between providing control for higher Head Office management levels and allowing flexibility for local project managers. The present limits for local purchasing of decentralized stores materials are, respectively, RS 10,000 per purchase for Chief Engineers and RS 5,000 for Project Engineers. It is possible that the conditions upon which this balance was reached have changed because of changes in construction methods, staffing considerations, delivery schedules, or prices.

It was not possible, within the scope of the institutional development review, to make a detailed examination of the experience of all project managers with this problem or the extent of the impact on project implementation. These factors should be considered before making any adjustments to the designated powers. If justified on the basis of experience, it may be possible to relieve problems arising from unrealistic limits. Again, with the overlapping phasing of construction for the two Lakhra units, some adjustments here could forestall potential delays that could jeopardize meeting the schedule targets.

It is suggested that a study be conducted of this problem so that the need and urgency for changes can be firmly established. Depending on the pace of implementation of the WAPDA Inventory Control system, it may be advisable to perform this review as a part of the process which extends the support of this centralized system to generation stations.

3. A collection of specialized technical reference documentation should be provided for the Coal Power Projects Department.

With the establishment of a new organization that is charged with performing planning, design, construction and start-up for power stations that will use a relatively unfamiliar fuel source,

it is extremely important that, in addition to developing staff skills, other supplementary tools and services should be available to the staff. One such requirement is the establishment of a source of technical reference literature including texts, periodicals, reports, conference proceedings and related documents. A WAPDA library already exists, but it has had no reason to acquire and maintain an extensive collection of coal-related technical material.

This type of reference source is necessary not only for day-to-day staff use in connection with project feasibility studies and implementation, but also as a valuable tool in support of research-oriented activities carried out by the staff. It is important that a technical reference collection be built up quickly, under the direction and control of the Coal Power Projects Department, so that it will be available during the critical early development stages of the Department's activity. Later, as the Department matures and the development load levels off, consideration can be given to the advisability of consolidating the coal-specific literature collection with the main WAPDA library.

To assist in setting up such a library, a list of candidate relevant titles derived from a search of technical literature reference sources, and other relevant information are provided under separate cover. Subject areas include operations and maintenance aspects of coal and ash handling, coal burning, coal purchasing, coal contracts, coal inspection and related subjects. This information also includes source and cost information that will be useful for acquisition purposes.

4. <u>The Coal Power Projects Department Head Office should install a small office computer system</u>.

The combined word processing, reporting and analytical support needs of the Coal Power Projects Department could be supported by the installation of a small personal computer system. This type of equipment is available from several manufacturers and should be procured from a vendor who provides service, support and supplies in Lahore. Many general purpose analytical (spreadsheet), data base management, word processing and report preparation software tools are available at modest cost and could be used to support such CPPD activities as typing of correspondence, internal memoranda, agreements, contracts, specifications, reports, personnel records and all related office documentation. It should also be used for preparation of monthly project status reports and support of technical analysis related to planning, forecasting and engineering studies for coal projects.

Minimum internal memory capacity for the personal computer should be 512K bytes of storage. It should also have the following minimum equipment and software features:

Fixed Disk storage - 10 megabyte minimum
Display Screen
Floppy Disc Storage - 1 unit
Letter Quality Printer
Full Compatibility with the MS-DOS Operations System
Advanced BASIC Language
Spreadsheet Package
Data Base Package
Report Generator
Word Processing Package
Graphics Package

Consideration should also be given to acquiring a system configuration that will lend itself to a multi-user mode of operation. If level of use becomes high enough, this will permit several independent users to have simultaneous access to the equipment.

Assistance should be obtained from the WAPDA Computer Centre in procuring and installing the equipment and software and in providing training. The Centre has indicated that it is currently planning a program to offer this type of guidance, training and assistance to WAPDA users. Assistance should also be requested in setting up the initial applications and any related data bases and procedures to meet the basic needs identified above. If this internal assistance is not available, the services of an outside consulting firm should be obtained. The scope of this assistance should not be extensive. Once the initial applications that would be useful for supporting the Lakhra Project are established and under way, staff users will acquire familiarity and facility with the available tools and will be in a position to assist with any additional applications that may be considered.

5. A Coal Contracts Specialist should be included in the CPPD Head Office Staff.

To provide the specialized assistance required for the contractual negotiation and administration involving the purchase of coal for station fuel, a trained contracts specialist should be on the Chief Engineer's Head Office staff. The primary duties of this individual would be to provide advisory services for the negotiation of contracts with coal sources based on quality, delivery and related factors. There would be a working relationship with coal receiving and analysis units at project locations as well as with the geology and mining specialists on the CPPD staff.

Assistance would be usually provided by the specialist during the normal course of coal procurement, but there would also be a requirement to provide advisory services and information about prices, sources, delivery conditions and other relevant procurement data for use in feasibility analysis and planning studies performed by the CPPD Head Office staff. General review and guidance would still be provided by the WAPDA Central Contracts Cell. The coal contracts specialist would also be responsible for gathering and maintaining coal procurement data provided by country and foreign governments and vendors, and for keeping conversant with the related activities and programs of national and international cooperative bodies and institutions.

6. Provide adequate transport support for CPPD

Because of the scattered and, in some cases, isolated coal station project locations, adequate transport equipment, facilities and services should be available for staff use. This is also true of the CPPD Head Office which will be involved in (a) staff working trips to different project locations; (b) discussions, planning and status conferences and meetings with visiting donor agency, government, foreign and private sector contractors, suppliers and vendor representatives; and (c) project schedule coordination meetings.

At the Head Office, a minimum of one each of a sedan, station wagon and nine-passenger van should be available for early project stages. At station locations, the number of vehicles should be defined when the station location is chosen and the station staff is designated. Provision should be made, for the Lakhra Project, for meeting the needs of the two units. The responsibility to act as Station Transport Officer should be assigned as part-time duty to one of the station officers. Depending on the location, reasonably convenient service equipment, facilities and personnel should be provided for minor repairs and maintenance. Otherwise, the nearest Distribution area maintenance facility should be used for major repairs or maintenance.

7. Strengthen WAPDA-wide standards for management of records, forms and procedures.

The execution of the functional responsibilities of the typical WAPDA office is accompanied by a flow of correspondence, documents, and other records of various types. This flow of records is fed from sources internal and external to the office. The ability to efficiently locate, retrieve and review specific records when necessary directly influences the effectiveness and cost of office operations. When all the active offices of a large, busy and growing organization such as WAPDA are considered, it

can be seen that the aggregate flow of records during their service life could reach a level where any impediments to, or misrouting or mishandling of, the stream of records would exert a significant negative influence on the overall effectiveness of the organization.

This situation can be addressed by the adoption of a clearly-defined and more detailed level of WAPDA-wide standards. The initiation of such a program should initially focus on what can be done to "tighten-up" or improve certain areas of existing record-processing operations. Then, as experience is acquired and as a better understanding is achieved of the types and levels of services that would be appropriate and feasible for WAPDA needs, standards and planning can be developed for successive stages of development.

Specific activities or tasks that should be considered for the first stage of development of a records management program should include:

Review of Record and Filing Procedures
Review and Development of a Standard File Code
Development of a Record Retention Policy
Review and Documentation of a Records Transfer Program
Development of a Microfilming Program

Another important aspect of the operation of any organization is the general approach followed in recording and disseminating information that describes administrative policies and procedures. The communication of this information in standardized, up-to-date, and unambiguous form is important for use as a reference guide in the day-to-day activities of management and operating personnel. It is also useful to support the orientation and training of new employees as well as the reassignment or promotion of employees to different positions.

As most organizations grow, the tendency is for each individual function to operate in an independent mode and to handle the dissemination of descriptive information covering its procedural activities in a relatively informal way, principally because the assignment of the responsibility for this on a company-wide basis has a lower priority than many of the other urgent needs of a growing organization. The point is often reached where duplication of activities, uncertainty among operating groups as to procedural responsibilities, and unnecessarily repetitive training exercises take place.

In an effort to minimize these problems, a WAPDA group could be established to give some control and uniformity to the process

of maintaining WAPDA-wide procedures through establishment of a strong standardized procedures management program. This program would encompass the activities of procedures design and control as well as form design and control, and also the publication and control of the associated manuals. Consideration should be given to assigning responsibility for establishment and implementation of WAPDA-wide records, procedures and forms management programs to the Organization and Methods Directorate of the Finance Wing. This cell has already provided valuable assistance to WAPDA managers and would be the logical place to oversee administrative programs affecting all WAPDA organizations.

6.2.3 Organization Structure

The recommended organizational structure for the Coal Power Projects Department of the Thermal Generation Division of WAPDA is as shown in Figure 6.2.3. Charts are included for the overall CPPD organization and for its major components. Details for the Mining and Geology components will be provided by the Coal Mine Feasibility Study.

6.2.4 Staffing Plan

The staffing plan for key personnel of the Coal Power Projects Department is presented in Figure 6.2.4, which shows the designation and projected start time for each of the staff personnel. The plan is presented in terms of the schedule for the first major coal-fired generation station that will comprise two 350 MW units. The assignment of the CPPD individual staff members assumes that their main initial activity will be to provide support to this first station. Subsequent or concurrent coal power station development activities will also require the support of this staff and it will have to be modified or extended in accordance with the total project implementation load carried by CPPD.

Figure 6.2.5 presents individual and total estimated base salary costs, by year, for the Coal Power Projects Department staff and for the additional staffing required during each of the major implementation phases. These estimates were based on the WAPDA basic pay scale for the grades assigned to the staff positions identified in this study. For each position, the monthly salary was assumed to be at the high end of the middle increment for that grade. No costs associated with fringe benefits, allowances or other overhead factors are included in these estimates. Suggested position descriptions for each of the positions identified for CPPD and the station staff are included in Appendix 6.2.

Neither the Staffing Plan nor the Base Salary Cost estimates for CPPD include any clerical or other non-professional support personnel

Fig. 6.2.3 RECOMMENDED COAL POWER PROJECTS DEPARTMENT ORGANIZATION Sheet 1 of 3

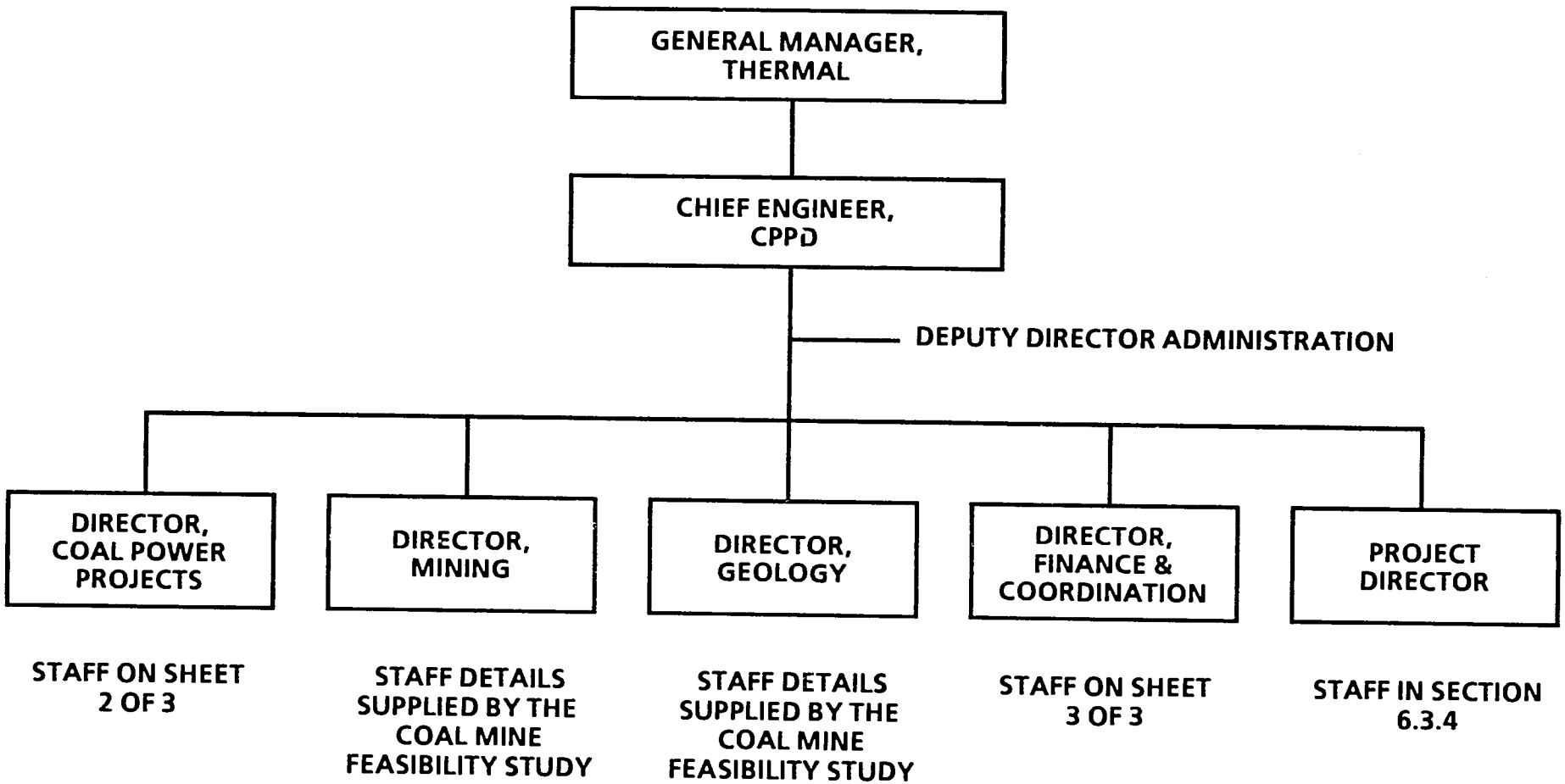

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Fig. 6.2.3 RECOMMENDED COAL POWER PROJECTS DEPARTMENT ORGANIZATION Sheet 2 of 3

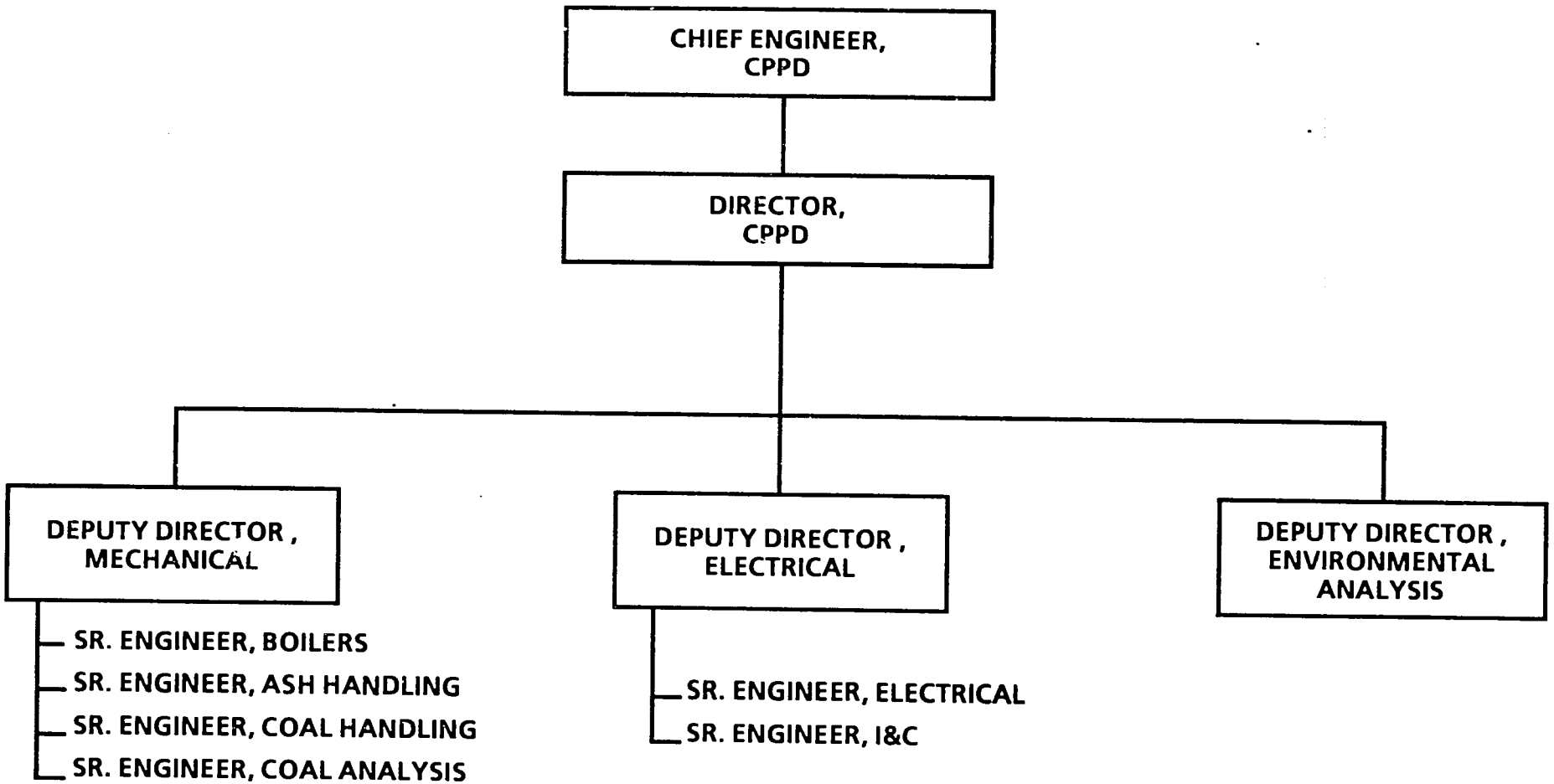

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Fig. 6.2.3 RECOMMENDED COAL POWER PROJECTS DEPARTMENT ORGANIZATION Sheet 3 of 3

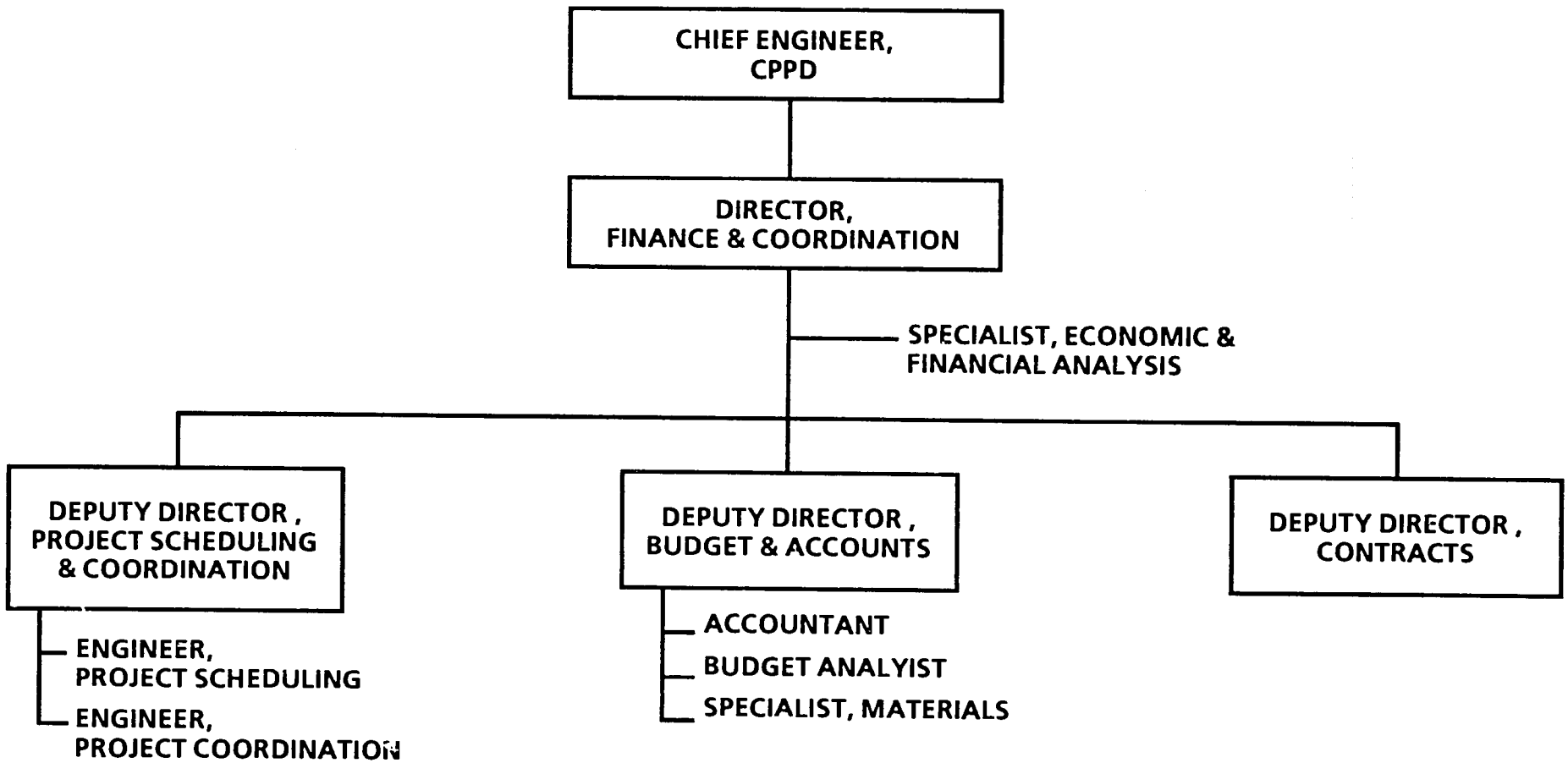

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FIGURE 6.2.4
COAL POWER PROJECTS DEPARTMENT
WAPDA STAFFING PLAN FOR KEY PERSONNEL

	POSITION	SCHEDULE (YEARS)					
		1	2	3	4	5	6
1	Chief Engineer, CPPD						
1	Director, Coal Power Projects						
1	Director, Mining						
1	Director, Geology						
1	Director, Finance & Coordination						
1*	Project Director						
1	Deputy Director, Mechanical						
1	Deputy Director, Electrical						
1	Deputy Director, Environ. Anal.						
1	Deputy Director, Project Scheduling & Coordination						
1	Deputy Director, Budgets and Accts.						
1	Deputy Director, Contracts						
1	Deputy Director, Administration						
1	Specialist, Econ. and Finan. Anal.						
1	Engineer, Project Scheduling						
1	Engineer, Project Reporting						
1	Sr. Engineer, Coal Handling						
1	Sr. Engineer, Ash Handling						
1	Sr. Engineer, Coal Boilers						
1	Sr. Engineer, Coal Analysis						
1	Sr. Engineer, Electrical						
1	Sr. Engineer, I&C						
1	Sr. Engineer, Mining						
1	Sr. Engineer, Geology						
1	Specialist, Materials						
1	Accountant						
1	Budget Analyst						

PROJECT SCHEDULE

Pre-Award						
Preliminary Engineering						
Detailed Engineering						
Construction						
Start-up & Test (Unit #1, #2)					#1	#2
Commercial Operation (Unit #1, #2)					1	2

*As needed. Project Director is considered to be assigned to Project Organization.

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Fig. 6.2.5 SUMMARY OF BASE SALARY COSTS (RUPEES)

ORGANIZATION	PROJECT SCHEDULE (YEARS)					
	1	2	3	4	5	6
Coal Power Projects Department	764,280	991,080	991,080	991,080	991,080	991,080
Project Organization (Design and Construction)	75,600	236,250	800,100	935,550	884,100	699,825
Project Organization (Start-up and Test, including Scrubbers)	–	23,040	211,980	1,024,680	7,939,980	10,186,530
Total	839,880	1,250,370	2,003,160	2,951,310	9,815,160	11,877,435

Note: Operating Base Salary Cost for the Station Organization (Operation and Maintenance is presented in Section 6.5.4.

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required. It is assumed that WAPDA management will assign these personnel according to normal WAPDA policies and practices.

It should also be noted that, while some of the CPPD staff members listed in the Staffing Plan will be assigned on a matrix basis to the project organization, the corresponding base salary costs have been included in the CPPD salary costs.

6.3 PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)

6.3.1 Approach

Based on the review of current WAPDA practices and capabilities, it is anticipated that WAPDA will contract for the major portions of the design, construction and start-up of the Lakhra Station. Depending on the contractual arrangement selected by WAPDA, one, two or three contractors would be responsible for the design, construction and start-up. Thus, WAPDA would not perform primary project management functions, but would perform monitoring and other activities essential to ensuring that the contractor(s) meets the contractual obligations including cost, schedule and technical requirements.

The WAPDA Project Director would be the communication link between the Chief Engineer, Coal Power Projects Department and the contractor. He would need to understand the contractor's approach to management, since he would exercise his leadership through procedural decisions and personal interaction, rather than through line authority. On such a contractual arrangement, the Project Director has power over the contractor(s), since he has responsibility for the release of budget monies and the approval of changes. He also has final responsibility for accepting the contractor's work; thus he can exercise control on quality.

The WAPDA Project Director will need the ability to evaluate the technical options and alternatives as related to time and money.

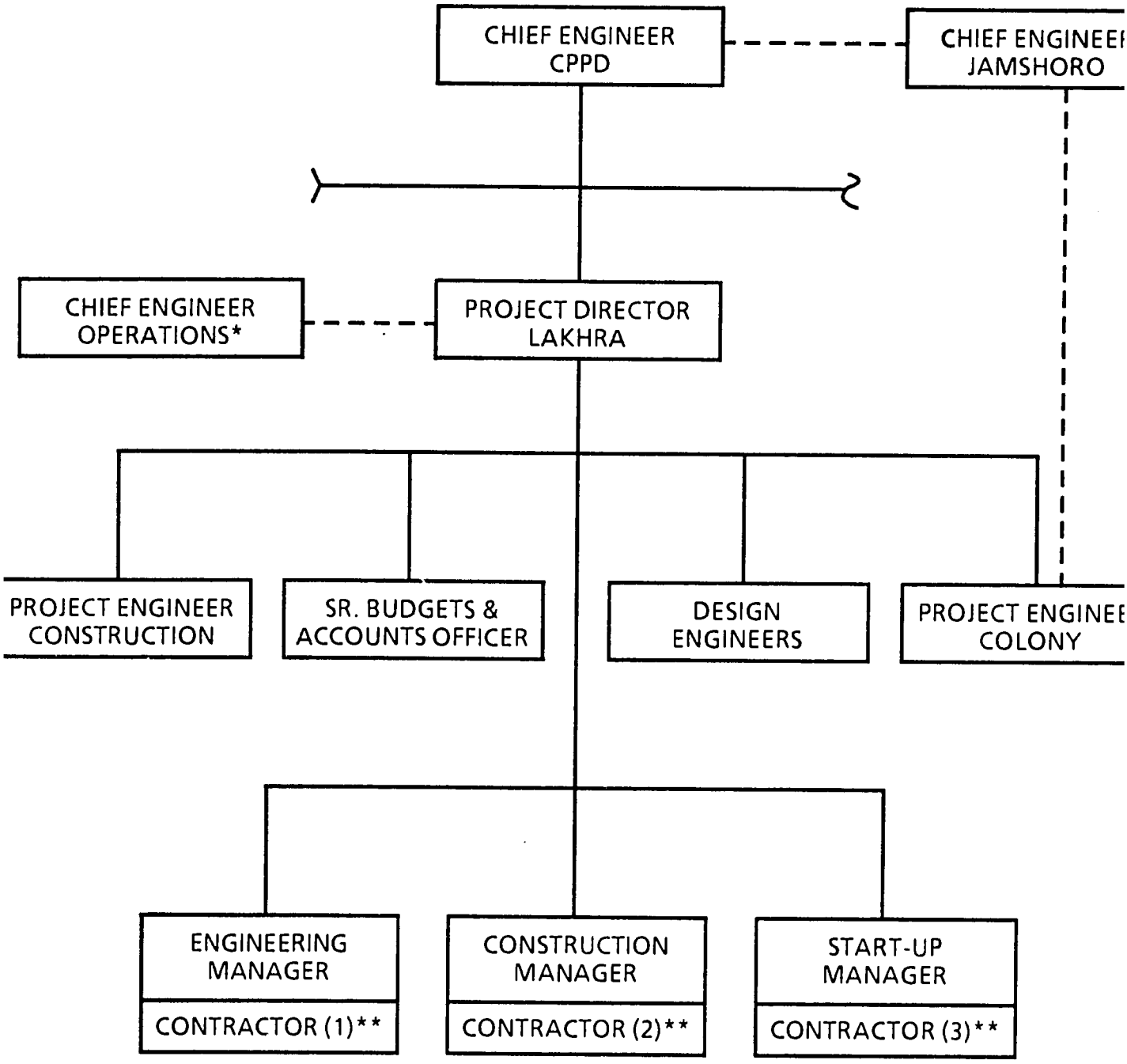
6.3.2 Structure

The project management approach described above, combined with the observed degree of involvement of WAPDA in current, similar projects, results in the recommended project organization shown in Figure 6.3.2(a). Alternatively, one contractor could manage two or all three functions of design, construction and start-up.

The WAPDA Project Director should have reporting to him a number of discipline Design Engineers involved in design reviews and evaluations; both the Project Director and the Design Engineers would be based at the home office. The Design Engineers would be

FIGURE 6.3.2(a)

LAKHRA PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)



Support for Start-up & Test and Operations & Maintenance considerations during the Design & Construction phase of the Project.

As Applicable

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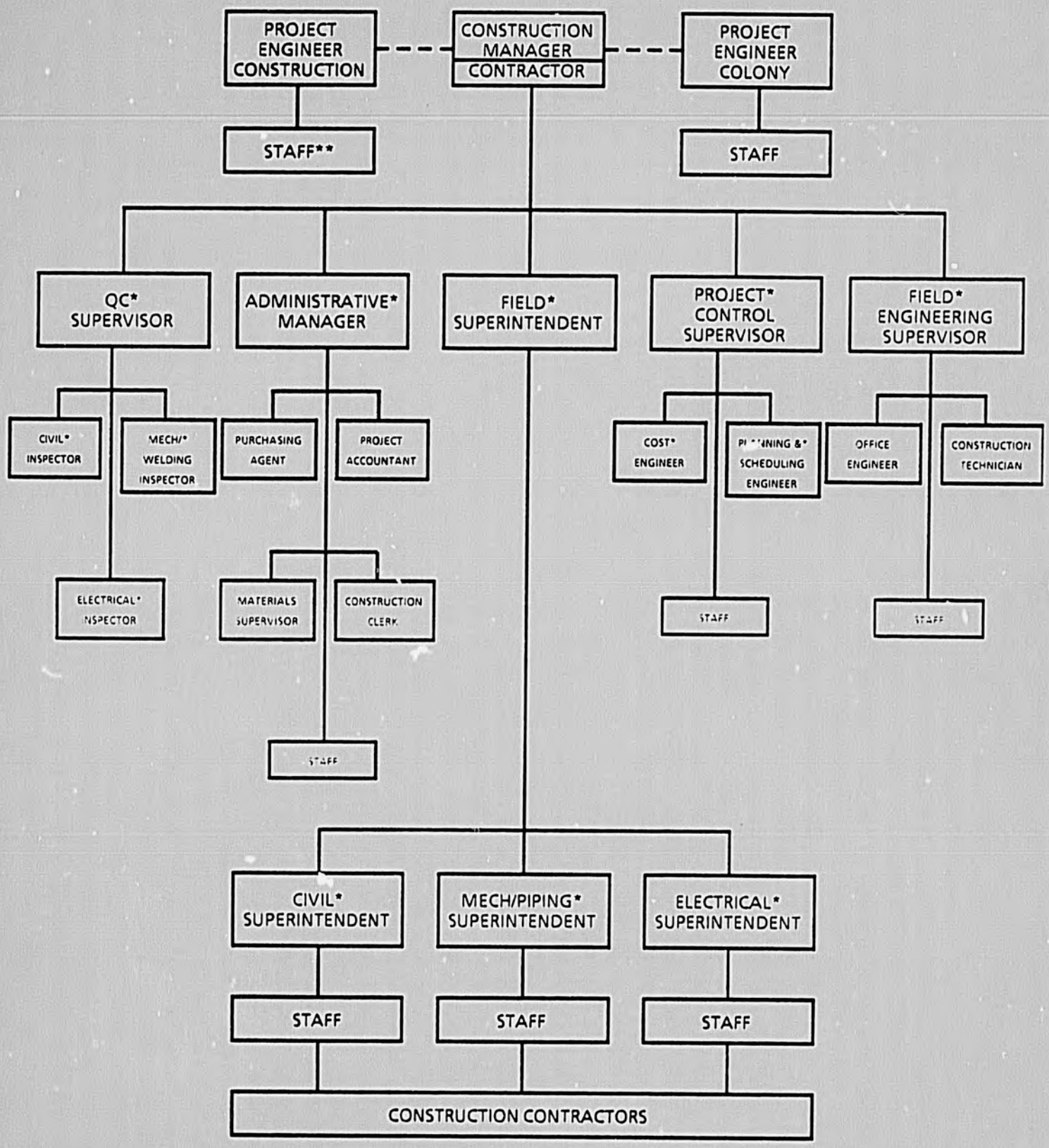
FIGURE 6.3.2(b)
LAKHRA CONSTRUCTION MANAGEMENT ORGANIZATION



* Contractor positions to which WAPDA should assign personnel in a monitoring function
** Assigned to Construction Management Organization

assigned to the project either from Design, Thermal or from the CPPD itself for coal related specialized expertise. WAPDA should also consider assigning Design Engineers to the offices of the contractor or A/E. This would enhance the communication on design related matters and allow WAPDA to monitor the design process more closely. In addition to the Design Engineers assigned to the Lakhra Project on an as-needed basis, a Senior Budget and Accounts Officer and two Project Engineers are recommended and should report to the Project Director.

The Project Engineer (Construction) should be based at the site and monitor the construction of the station. His staff would be assigned to the construction manager's organization (see Figure 6.3.2(b)). Individual staff positions are listed in the staffing plan, Section 6.3.4; personnel would originate from Design, Thermal or Finance, Thermal and in certain special cases from CPPD.

For selected positions, separate personnel are assigned to Units 1 and 2, respectively.

The Project Engineer (Colony) should be based at the site and be in charge of the Colony as well as any infrastructure support work for the station. He should report to the Chief Engineer (Jamshoro) for all administrative matters and to the Project Director (Lakhra) for technical matters directly affecting the station. It is not deemed necessary to present his staff in Figure 6.3.2(a) or (b) because it is envisaged to be similar to the staff of the Project Engineer of the Jamshoro 250 MW oil-fired unit.

The interface of WAPDA with the start-up organization is addressed in Section 6.4.

This approach to the Lakhra Project Organization will give WAPDA considerable control over the technical adequacy of the station and enable WAPDA personnel to develop a detailed understanding of the Lakhra Station.

6.3.3 Project Management

As indicated above, it is anticipated that contractors will perform the primary project management functions for the design and construction of the Lakhra Station and that WAPDA would have a monitoring role. The control elements required for an effective and efficient monitoring of the station design are discussed in Section 6.2; these elements apply equally to those design functions which are performed directly by WAPDA.

With respect to construction, the following essential construction management elements should be monitored by WAPDA:

Planning and Scheduling

WAPDA should monitor the overall construction schedule and verify that activities for which WAPDA is directly responsible are
properly integrated in the overall schedule. Milestones and summary reports must be reviewed against the project payment schedule.

Cost Engineering

WAPDA should monitor overall project cost by reviewing the contractor's reports on project budget, cost to date, committed cost, projected cost to complete and cost at completion. Contractor requests for extra work payments must be reviewed and acted upon.

Purchasing, Expediting, Vendor Inspection

Where WAPDA decides to purchase specific equipment in lieu of including it in the Contract package, standard procurement documents must be developed in accordance with a procurement schedule that must be compatible with the overall construction schedule. Upon the issue of purchase orders, WAPDA must administer the purchase, expedite and perform vendor surveillance and receiving inspection where necessary.

Construction Accounting

WAPDA should review and approve all invoices submitted by the contractor. All invoices must be reviewed against the project milestones and contractual requirements.

Material Control

WAPDA should verify that the contractor has adequate procedures for:

- receiving and storage
- disbursement
- handling of surplus material
- material and equipment records

Reports

WAPDA should review the contractor progress reports, identify problem areas and approve corrective actions proposed by the contractor.

In addition to the monitoring of these construction management elements and the implementation of these elements for construction items directly under WAPDA control, WAPDA should participate in:

Safety, Security and Fire Protection

WAPDA must work with the contractor to establish a safety, security and fire protection program which should include:

- first aid facilities
- work procedures which meet the applicable occupational safety and health requirements
- instructions for fire protection
- construction safety training programs
- access control; installation and maintenance of fences and gates.

Constructability Reviews

WAPDA should verify that the contractor performs adequate reviews for constructability and perform reviews for selected plant areas.

Construction Site Plan Development

WAPDA should review the construction site plan with emphasis on the construction sequence and the requirements for storage facilities, parking and traffic control, construction access and centralized construction support facilities.

To achieve a uniform and continuous implementation of all these activities, it is recommended that a Construction Management Manual be developed for each project. Figure 6.3.3 presents a recommended table of contents for such a manual.

Another tool which should be considered by WAPDA for the control of construction projects such as large coal-fired thermal power stations, is a computerized project control system. In the event that WAPDA decides to perform the primary construction management function for a future thermal station, the use of a computerized project control system becomes a requirement. The G/C CUE computerized project control system has been developed by Gilbert/Commonwealth specifically for application on such projects. Details of G/C CUE are presented in Appendix 6.4.

6.3.4 Staffing Plan

The staffing plan has been developed on the basis that WAPDA perform the functions described in Section 6.3.3. The assignment periods of

WAPDA personnel to the Project and Construction Organization are presented in Figure 6.3.4. In the event that WAPDA cannot provide personnel for all the positions indicated, personnel could be provided by a consultant.

FIGURE 6.3.3
CONSTRUCTION MANAGEMENT MANUAL
TABLE OF CONTENTS

1. Introduction

- Purpose of Manual
- Enforcement Responsibility
- Revisions
- Distribution and Control

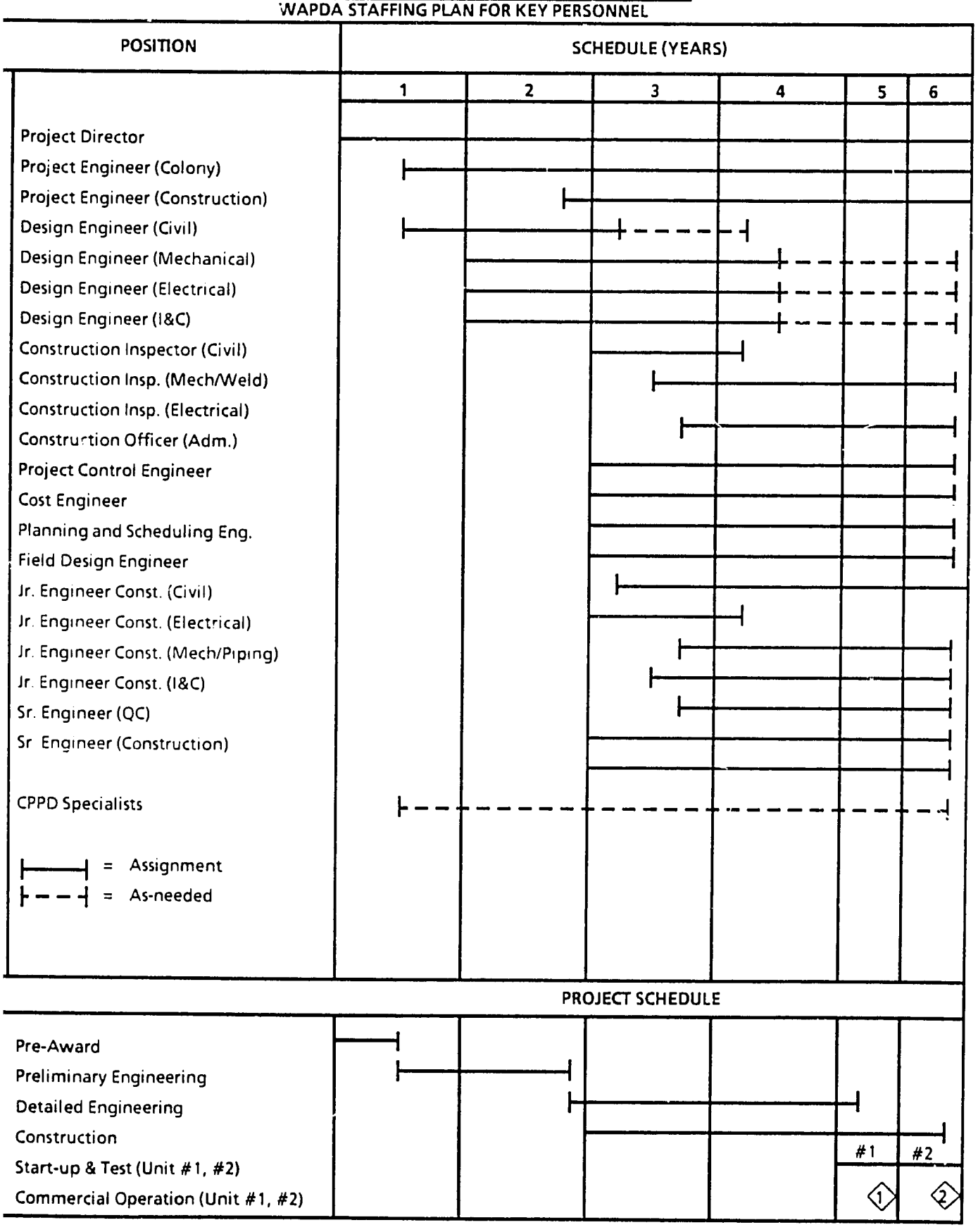
2. Project Organization

- WAPDA Project Organization
- Project Organization Engineering Contractor
- Project Organization Construction Contractor
- Interface and Organizational Relationships
- Communications
- Project Reports

3. Project Controls

- Planning and Scheduling
- Estimating and Cost Engineering
- Construction Accounting
- Procurement and Material Control
- Constructability Reviews
- Construction Contracts and Administrations
- Construction Facilities
- Field Engineering
- Quality Control
- Labor Relations
- Safety/Security
- Records
- Start-up and Test
- Housekeeping and Clean-up

FIGURE 6.3.4
PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)
WAPDA STAFFING PLAN FOR KEY PERSONNEL



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6.4 PROJECT ORGANIZATION (START-UP AND TEST)

6.4.1 Approach

As discussed in Section 6.3, it is anticipated that a Contractor will be in charge of the start-up and test of WAPDA's coal-fired stations. This could either be a Start-up Manager reporting to a Contractor Project Manager or reporting directly to the WAPDA Project Director along with a Contractor Construction Manager and Engineering Manager. In either case, it is recommended that the WAPDA Thermal Generation Division assign future permanent station personnel to the Start-up organization, when preparation for start-up begins through initial operation. The future Resident Engineer should be assigned to work with the Start-up Manager, Shift Engineers, Foremen and Operators with the Contractors' Start-up Engineers. The future Resident Engineer would be responsible for the gradual phasing in of all Station Operation personnel to achieve Station turnover with a complete WAPDA staff.

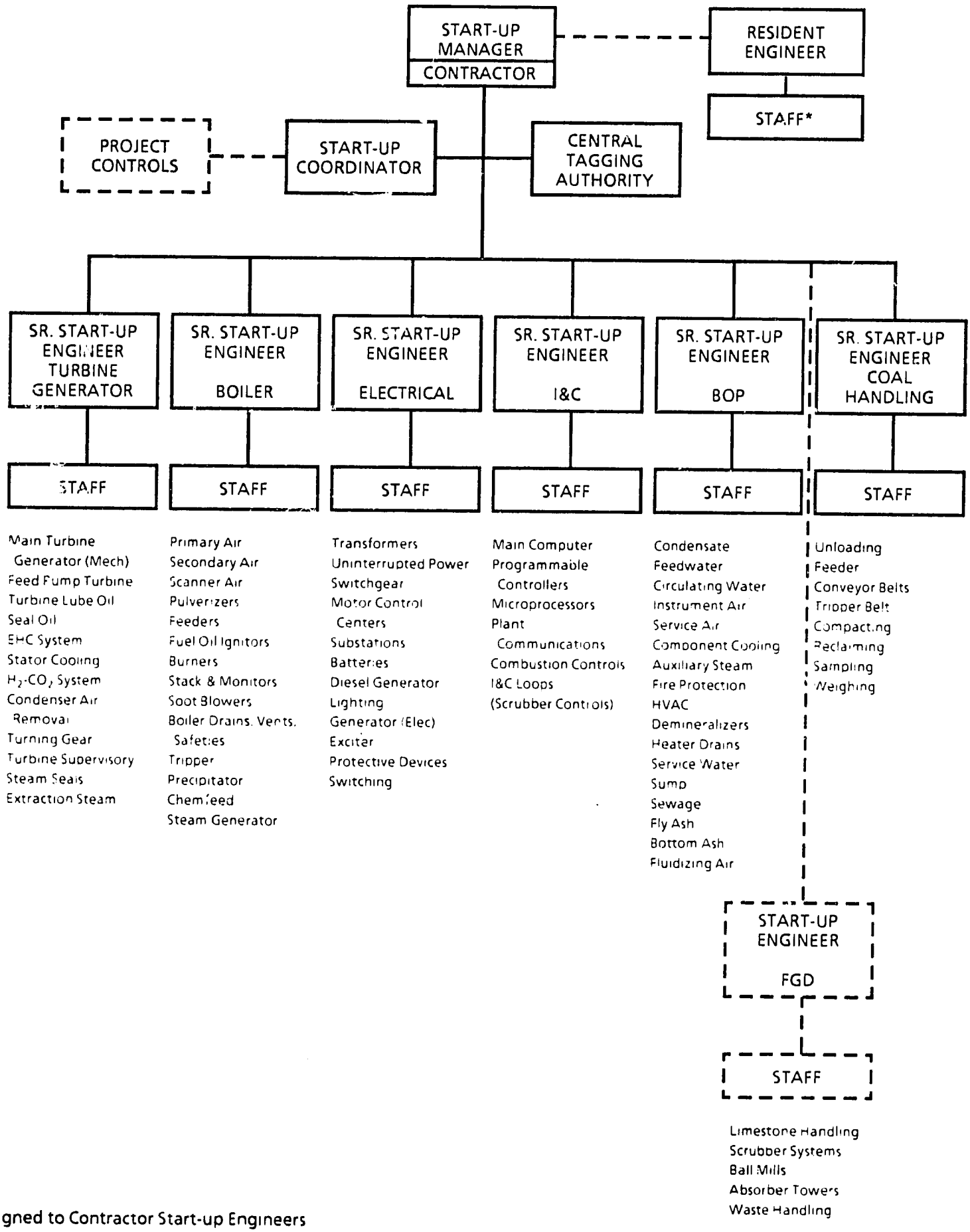
6.4.2 Structure

The structure of the recommended start-up organization is based on the breakdown of the station in six main categories (seven for a unit with a scrubber):

1. Turbine Generator and its associated auxiliaries
2. Boiler and its associated auxiliaries
3. Electrical
4. I&C
5. Balance of Plant (BOP)
6. Coal Handling
7. Flue Gas Desulfurization (FGD)

The recommended start-up organization is presented in Figure 6.4.2.

FIGURE 6.4.2
LAKHRA PROJECT ORGANIZATION (START-UP AND TEST)



*Assigned to Contractor Start-up Engineers

6.4.3 Start-up Management

As with the Construction Management Controls, the project controls applicable to the start-up of the station should be documented in a controlled document, the Start-up Manual. Figure 6.4.3 presents a recommended table of contents for such a manual. The manual documents the organizations, responsibilities and procedures to be used during each of the start-up phases:

- Preparation, which includes:

  Verification of component installation for integrity and operability; data sheets to be used for documenting baseline calibration and operating data.

- Checkout, which includes:

  Loop and functional testing, initial calibration, cable termination verification, meggering, hi-pot, protective relay testing, stroking of valves and alignment checks.

- Start-up, which includes:

  Start-up/Shut-down checks, vibration checks, flushing, boil-out, steam blow, balancing.

- Initial Operation, which includes:

  Checking for system flows; pressure, temperature and flow parameters; system stabilization.

6.4.4 Staffing Plan

The staffing plan for the start-up of the station is based on the approach that (future) permanent station personnel should be phased-in during this period. Working on the station systems during start-up provides the best on-the-job training for both operators and maintenance personnel. Figure 6.4.4 presents an assignment schedule for station key personnel.

The assignment of the Resident Engineer and the Assistant Resident Engineers to the Project Organization (Start-up and Test) has been scheduled following the start of detailed engineering. They should be based at the site when actual construction begins.

Other Senior Engineers have been scheduled to be assigned to the project organization at the site at the approximate time when construction activities specific to their area of responsibility begin.

FIGURE 6.4.3
START-UP MANUAL
TABLE OF CONTENTS

1. Introduction

- Purpose of Manual
- Enforcement Responsibility
- Revisions
- Distribution and Control

2. Project Organization

- Start-up Organization
- Interface and Organizational Relationships
- Responsibilities

3. Project Controls

- Work Flow Diagrams
- Planning and Scheduling
- Records

4. Administrative Procedures

- Test Equipment
- Field Change Requests
- Field Purchase Requisitions
- Safety Tagging Procedure
- Lifted Wire and Jumper Control
- System Turnover
- Construction Work Requests
- Maintenance Work Requests

5. Mechanical Start-up and Test Procedures

- System Flushes
- System Hydrostatic Tests
- Piping and Vessel Inspection
- Valve Inspection
- Pressure Relief Device Inspection
- Pump Inspection and Alignment

FIGURE 6.4.3
START-UP MANUAL
TABLE OF CONTENTS
(CONTINUED)

6. Electrical Start-up and Test Procedures

- Control Circuit Tests
- Protective Relay Calibration
- Motor Operated Valve Tests
- Insulation Tests; Megger & Hi-Pot
- Component Inspection and Test

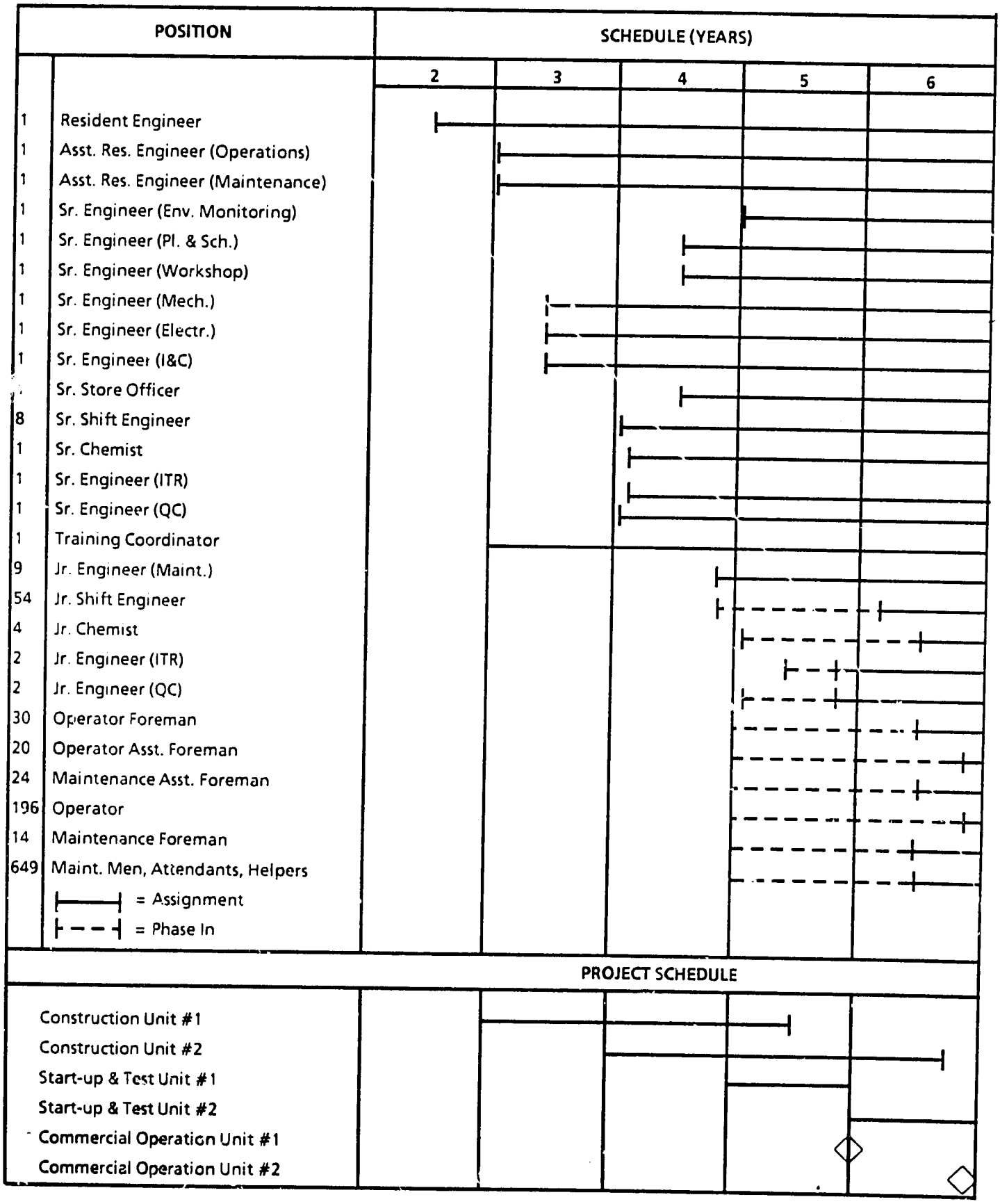
7. Instrumentation and Controls

- Instrument Bench Calibration
- Instrument Loop Calibration

Attachments

- Forms

FIGURE 6.4.4
PROJECT ORGANIZATION (START-UP AND TEST)
WAPDA STAFFING PLAN FOR KEY PERSONNEL



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6.5 STATION ORGANIZATION (OPERATION AND MAINTENANCE)

6.5.1 Approach

The Station Organization and staffing levels presented below have been developed to assist WAPDA in identifying the manpower requirements for the operation and maintenance of a coal-fired thermal power station consisting of two 350 MW units and determining the annual cost of plant personnel.

The recommended organization and staffing for the Lakhra Station is primarily based on the information obtained at the Thermal Power Station Guddu. WAPDA operates steam electric units at Guddu which are of a size similar to the proposed Lakhra units. In addition, station personnel will be housed in a colony similar to the one at Guddu.

Current organization and staffing practices for similar thermal power stations in the USA have also been reviewed and have been taken into account as appropriate.

Although the organization chart and job descriptions identify the station as Lakhra Units 1 and 2, the proposed organization can serve equally as the basis for any other future coal-fired thermal power station of a similar size.

6.5.2 Structure

In developing the organization chart presented in Appendix 6.1, use has been made of existing WAPDA terminology for position identification. Actual job descriptions for key personnel are presented in Appendix 6.2. The organizational structure has been based primarily on the one of Guddu Unit 3. The adjustments made to account for the firing of coal (with oil back-up) are as follows:

Station Operation

The operation of the boiler and turbine-generator supervised by a Junior Shift Engineer (I) and (II) respectively at Guddu Unit 3 is equally applicable to the Lakhra units. However, for each unit additional shifts have been identified for Waste Handling, supervised by the Junior Shift Engineer (III), and Scrubber Operation (as applicable), supervised by the Junior Shift Engineer (V). Because the coal handling system is common for both units, the fuel handling shifts have been identified for one unit only. Staffing levels are based on a 4-shift operation, which is usual at WAPDA.

The chemistry department staff has been increased to account for the sampling and handling of a significant quantity of coal and ash.

Due to the increased complexity of evaluating the station performance, the staff of the Senior Engineer ITR has been increased over the one at Guddu.

The position of Senior Engineer Environmental is recommended as a staff function to the Assistant Resident Engineer (Operation). Working closely with the laboratory, he would be the station spokesman on environmental affairs.

Station Maintenance

Due to the increased complexity of the station, the organization and planning of maintenance work becomes a crucial task. Therefore it is recommended to appoint a Senior Engineer Planning and Scheduling as a staff function to the Assistant Resident Engineer (Maintenance).

Overall, the staffing levels in the maintenance department have been increased somewhat to account for the increased quantity of maintenance work related to coal and ash-handling equipment. Additional personnel are also recommended for station housekeeping and cleanliness on account of coal dust and fly ash.

Training

The position of Training Coordinator is recommended for the coordination of the training of station staff with the various WAPDA Training organizations, to identify station training needs and to maintain station personnel qualification and training records. The Training Coordinator would be responsible for all On-the-Job Training, which would alleviate a concern of the present Director of the Training Center (Guddu) with respect to the implementation of On-the-Job Training programs.

Quality Control

The position of Senior Engineer QC and his staff is recommended due to the increased importance of meeting the specified requirements for materials and performance.

Although it is common practice in the USA to have a Technical Support Department reporting to the Plant Manager, such a department is not included at this time. The reason for this is that it is envisaged that the Coal Power Projects Department will fulfill this function;

traditionally WAPDA has no such departments in their station organizations.

It will be noted that the organization chart presented in Appendix 6.1 does not provide details of the staff of the Senior Engineer Civil, Senior Budget and Account Officer, Assistant Director Administration, Senior Engineer Workshop and Assistant Store Officer. In these parts of the Station Organization, staffing similar to the one at Guddu is considered adequate.

Similarly the staffing of the medical, educational, security and arboriculture departments are the same as the ones at Guddu. Because these functions are not station specific, it is recommended that they report to the Chief Engineer.

The Director (future) Training Center Jamshoro and his organization are not on the organization chart. As discussed in the Preliminary Training Plan Report, it is recommended that this position report elsewhere.

6.5.3 Operations and Maintenance Management

Specific needs and considerations have been identified by reviewing the existing methods used at the WAPDA generating plants at Guddu. It must be emphasized that these concerns were noted during a very brief visit to the site and should not be interpreted as the results of an intensive operational and maintenance audit. It would be advisable to review, in detail, the present state of the power generation sector of WAPDA with the intention of making recommendations which could be utilized to increase plant equivalent availability, reliability and heat rates.

Areas which were seen to be possible concerns for the future are:

1. Results/Plant Betterment
2. Operational Conformance to Procedures
3. Operations Procedures
4. Maintenance Procedures
5. Preventative/Breakdown Maintenance
6. Outage Management
7. Technical Expertise of Operators and Maintenance Personnel

This list is not all inclusive and should only be used as a guideline. Each of these items can and should be addressed as the Lakhra Staff, Operation and Maintenance philosophy and procedures and training programs are developed.

The ability to "build in" quality now is far greater than after commercial operation. After the start of commercial operations the ability to address problem areas is limited by the ability to quantify the extent to which a particular problem or set of problems is affecting operations. To help alleviate this, the installation of reporting systems and record keeping which will indicate how the plant is functioning is mandatory. This requirement can be achieved by statistically analyzing the data normally available and incorporating a results program of the type outlined in Chapter 7, Appendix 7.1 (3003). This analysis will enable the plant management to identify equipment and operating concerns which can be addressed in order to maximize plant availability and efficiency.

As generation facilities become more complex and as the fuels involved become more difficult to handle, it becomes necessary to establish detailed operating and maintenance procedures and ensure that they are understood and followed. The experience WAPDA has gained burning fuels such as gas and occasionally oil, although invaluable, should not be considered as indicative of the problems which can be anticipated when burning Lakhra coal.

Coal and, in particular, lignite will put stresses on equipment which require that an extensive preventive maintenance program be implemented. In the past it appears that breakdown maintenance may have been considered acceptable, especially during power shortages, but this maintenance philosophy will result in frequent and extended outages if used in major coal generation facilities.

As this need for more efficient and effective maintenance increases, the techniques used to manage and monitor this maintenance will become more sophisticated. Coordinated maintenance activities including a sound preventive maintenance program, effective maintenance procedures and competent outage management will be necessary.

The staffing recommendations made for the plant supported by an effective thermal generation division should, with the proper training and extensive pre-planning, be able to adequately address all of the above concerns. In this regard it would be advantageous to prepare the following items before commercial operations of any new facility:

1. Detailed Operating Procedures

2. Detailed Maintenance Procedures

3. Detailed Vendor Manuals for All Equipment

4. Complete As-built Drawings

5. Computer Based Outage Management System

6. Computer Based Preventive Maintenance System

7. Computer Based Work Order System

Both procedures and computer based maintenance management programs are available, and GCII would be in a position to address these areas if asked.

6.5.4 Staffing Plan

The following listing of personnel is intended to assist WAPDA in determining the annual cost of Station personnel. As discussed above, Guddu staffing has been retained for certain parts of the organization.

Base salary for BPS 8 has been used as average salary cost where support personnel have been grouped as staff.

Position	Total Personnel	Annual Salary (Rupees)	Total Base Salary Cost
Resident Engineer's Office			
Resident Engineer	1	46,080	46,080
Steno	2	12,600	25,200
Naib Qasid	2	7,800	15,600
Total	5		86,880
Operation Department (excluding scrubber)			
Assistant Resident Engineer (Operation)	1	37,800	37,800
Senior Engineer	10	37,800	378,000
Junior Engineer	46	33,600	1,545,600
Fire Officer	1	11,760	11,760
Head Fireman	4	9,480	37,920
Fireman	30	8,400	252,000
Chowkidar	8	7,800	62,400
Foreman	30	22,200	666,000
Assistant Foreman	20	16,200	324,000
Operator	164	13,800	2,263,200
Attendant	236	12,600	2,973,600
Helper	208	11,760	2,446,080
Senior Chemist	1	37,800	37,800
Junior Chemist	4	33,600	134,400

Position	Total Personnel	Annual Salary (Rupees)	Total Base Salary Cost
Operation Department Cont'd.			
Assistant Chemist	12	22,200	266,400
Steno	3	12,600	37,800
Clerk	1	10,920	10,920
Coolies	12	6,480	77,760
Naib Qasid	3	7,800	23,400
Fitter	20	9,480	189,600
Electrician	20	10,920	218,400
Instrument Mechanic	8	10,920	87,360
Total	842		12,082,200
Scrubber Operation			
Junior Engineer	8	33,600	268,800
Foreman	8	22,200	177,600
Assistant Foreman	8	16,200	129,600
Operator	32	13,800	441,600
Attendant	48	12,600	604,800
Helper	48	11,760	564,480
Fitter	8	9,480	75,840
Coolies	24	6,480	155,520
Electrician	8	10,920	87,360
Total	192		2,505,600
Maintenance Department			
Assistant Resident Engineer (Maintenance)	1	37,800	37,800
Senior Engineer	6	37,800	226,800
Junior Engineer	10	33,600	336,000
Head Draftsman	1	16,200	16,200
Draftsman	1	13,800	13,800
Traces	2	7,440	14,880
F.A. Operator	1	6,960	6,960
Foreman	14	22,200	310,800
Assistant Foreman	24	16,200	388,800
Fitter	87	9,480	824,760
Welder	8	16,200	129,600
Attendant	18	12,600	226,800
Helper	85	11,760	999,600
Steno	3	12,600	37,800
Naib Qasid	3	7,800	23,400
Clerk	2	10,920	21,840
Miscellaneous Support	260	10,200	2,652,000
Total	526		6,267,840

Position		Total Personnel	Annual Salary (Rupees)	Total Base Salary Cost
Quality Control Department				
Senior Engineer		1	37,800	37,800
Junior Engineer		2	33,600	67,200
Operator		4	13,800	55,200
Steno		1	12,600	12,600
Clerk		1	10,920	10,920
Attendant		3	12,600	37,800
Helper		3	11,760	35,280
	Total	15		256,800
Training Department				
Training Coordinator		1	33,600	33,600
Steno		2	12,600	25,200
Clerk		2	10,920	21,840
Naib Qasid		1	7,800	7,800
	Total	6		88,440
Other Departments as per Guddu (Reporting to the Resident Engineer)				
Civil Engineer		1	37,800	37,800
Staff		161	10,200	1,642,200
	Total	162		1,680,000
Senior Budget & Accounts Officer		1	37,800	37,800
Staff		17	10,200	173,400
	Total	18		211,200
Assistant Director Administration		1	33,600	33,600
Staff		25	10,200	255,000
	Total	26		288,600
Other Departments as per Guddu (Reporting to the Chief Engineer)				
Chief Security Officer		1	37,800	37,800
Staff		212	10,200	2,162,400
	Total	213		2,200,200
Medical Superintendent		1	33,600	33,600
Staff		11	10,200	112,200
	Total	12		145,800

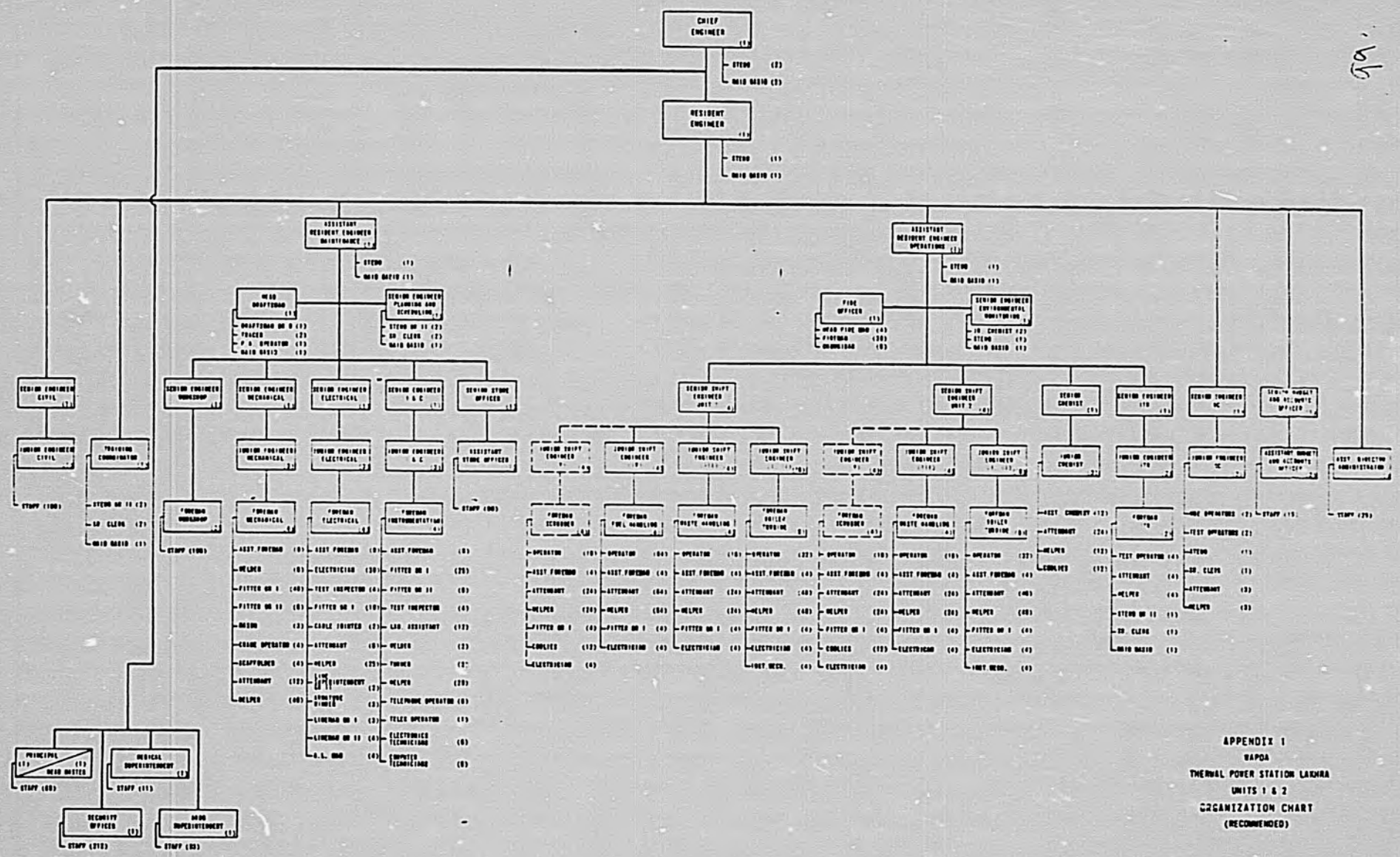
Position		Total Personnel	Annual Salary (Rupees)	Total Base Salary Cost
Other Departments as per Guddu Cont'd. (Reporting to the Chief Engineer)				
School Principal/Headmaster		2	22,200	22,200
Staff		60	10,200	612,000
	Total	62		634,200
Arbo Superintendent		1	16,200	16,200
Staff		93	8,400	781,200
	Total	94		797,400
Total Reporting to and including Resident Engineer		1792		23,467,560
Total Other Reporting to and including Chief Engineer		381		3,777,600
Total Station		2173		27,245,160

*Base salary for BPS 8 has been used as average salary cost where personnel have been grouped as staff.

APPENDIX 6.1

THERMAL POWER STATION LAKHRA
ORGANIZATION CHART

(Recommended)



APPENDIX I

WAPDA

THERMAL POWER STATION LAKHRA

UNITS 1 & 2

ORGANIZATION CHART

(RECOMMENDED)

APPENDIX 6.2

JOB DESCRIPTIONS

INTRODUCTION

This Appendix includes job descriptions prepared, during the course of the Institutional Development task, for each of the main organizational groups addressed by the study:

Coal Power Projects Department
Head Office staff for planning and management of all coal power station development activities.

Project Organization (Design and Construction)
Management and field staff for execution of the Lakhra Project, involving two 350 MW units.

Project Organization (Start-Up and Test)
Management and field staff to carry the Lakhra Project from completion of construction through the start-up, test and commissioning steps for both units.

Project Organization (Operations and Maintenance)
Operations and maintenance staff for both units of the Lakhra Station.

COAL POWER PROJECTS DEPARTMENT

JOB DESCRIPTIONS

This part of Appendix 6.2 presents generic job descriptions for certain of the key positions identified in the staffing plan for the Coal Power Projects Department recommended by the Institutional Development task of the Lakhra Feasibility Study. These descriptions should be adapted to WAPDA requirements as future implementation steps may indicate.

Job Descriptions Key Personnel

Chief Engineer, Coal Power Projects Department
Director, Coal Power Projects
Director, Mining*
Director, Geology*
Director, Finance and Coordination
Deputy Director, Mechanical
Deputy Director, Electrical
Deputy Director, Environmental Analysis
Deputy Director, Project Scheduling and Coordination
Deputy Director, Budgets and Accounts
Deputy Director, Contracts
Deputy Director, Administration**
Specialist, Economic and Financial Analysis
Engineer, Project Scheduling
Engineer, Project Reporting
Senior Engineer, Coal Handling
Senior Engineer, Ash Handling
Senior Engineer, Coal Boilers
Senior Engineer, Coal Analysis
Senior Engineer, Electrical
Senior Engineer, Instruments and Controls
Senior Engineer, Mining*
Senior Engineer, Geology*
Specialist, Materials
Accountant**
Budget Analyst**

*Job descriptions for these positions will be provided through the institutional development analysis performed for the Coal Mine Feasibility Study under a separate contract.

**Job descriptions for these positions are not included since the responsibilities of these positions are defined by WAPDA Finance and Adminstration, respectively.

COAL POWER PROJECTS DEPARTMENT

CHIEF ENGINEER

1.0 SYNOPSIS

The Chief Engineer will assist the General Manager (Generation) and the Authority (WAPDA) in planning and implementing all coal-based power projects. He will function as an overall manager of all coal-based power plant development in the country. He will deal with the World Bank, USAID and other aid-giving agencies, and adequate authority will vest in him to insure compliance with the covenants of those agencies. He will also be responsible for insuring coordination of coal-fired power station development with the activities of other participating government or private sector bodies.

2.0 ORGANIZATION

The Chief Engineer reports to the General Manager, Thermal. Reporting to the incumbent are the Director, Coal Power Projects; the Director, Mining; Director, Geology; Director, Finance and Coordination, and all Project Directors or Project Engineers for coal-fired power station development. The Deputy Director, Administration will report, in a staff capacity, to the Chief Engineer.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing direction for exercising technical, financial and administrative control and supervision over the planning and implementation of all coal-fired power stations of WAPDA.

3.2 Assists the Authority in the development of such policies as are necessary to assure the effectiveness of the Coal Projects Department in meeting its goals.

3.3 Directs and supervises the work of all technical, financial and administrative officers reporting to him.

3.4 Directs and provides general supervision over all Department personnel through his subordinate officers, delegates authority to subordinates, approves Departmental work plans, coordinates the activities of Departments; monitors progress of work and provides guidance in order to maintain maximum effectiveness of Departmental function.

3.5 Approves and forwards Annual or Revised Budgets for Department functional and office activities.

3.6 Approves purchases of parts and materials requested by Project Directors, Project Engineers or other Department Officers within the limits of authority designated by the WAPDA Book of Financial Powers.

3.7 Meets and interacts with representatives of aid-giving agencies to the extent required to insure adequate planning, negotiation and follow-up of loan or grant-related Department activities, and compliance with any related covenants or conditions.

3.8 Responsible, through his subordinate officers, for providing technical and financial planning and feasibility analysis assistance to coal mining components charged with providing fuel coal for WAPDA generating stations.

3.9 Advises and assists subordinate officers in the development and establishment of objectives, plans and programs consistent with overall Department policies and objectives.

3.10 Recommends and administers the technical research policies and programs as are necessary to improve the Department's ability to support the short and long-term goals of the national coal development program.

3.11 Insures that staffing and training activities meet the requirements of the Department and are consistent with the WAPDA policies and programs.

4.0 QUALIFICATIONS

4.1 Electrical Engineer's degree from an accredited college or university.

4.2 Must have had substantial experience in Power Plant Engineering, and in implementing the concepts and technology involved in Thermal Plants.

4.3 Must be thoroughly familiar with all management aspects of oil and coal-fired thermal power stations.

4.4 Must have experience in negotiations and interactions with external donor, government and related bodies and agencies.

4.5 Must meet WAPDA requirements for a BPS 20 position.

COAL POWER PROJECTS DEPARTMENT

DIRECTOR, COAL POWER PROJECTS

1.0 SYNOPSIS

The Director, Coal Power Projects will assist the Chief Engineer, Coal Power Projects Department in planning and implementing all coal-based power projects. He will provide the overall technical expertise for coal specific equipment and functions for all coal-based power plant development in the country. He will also guide the technical support for all coal-based power plant feasibility studies, and resulting design, construction and start-up contracts. He will be responsible for assuring that all equipment planned for or utilized by WAPDA is properly specified and will direct his personnel to support individual project directors in performing their duties. He is responsible for insuring that engineering activities are performed in accordance with policies and procedures established by the General Manager, Thermal.

2.0 ORGANIZATION

The Director, Coal Power Projects reports to the Chief Engineer, Coal Power Projects Department. Reporting to the incumbent are the Deputy Director, Mechanical; Deputy Director, Electrical; and the Deputy Director, Environmental Analysis.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Works with the Chief Engineer, Project Directors and his Deputy Directors in the establishment of appropriate engineering support procedures for coal power station projects.

3.2 Is responsible for providing technical expertise to the Chief Engineer during the planning and implementation of all coal-fired power stations under WAPDA, and for overseeing related research programs.

3.3 Develops, initiates, and implements procedures, practices, and programs as needed to support Department goals.

3.4 Provides personnel on an as-needed basis to the Project Directors to support:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders

- review of contracts
- construction monitoring
- start-up

3.5 Directs and supervises all personnel reporting to him.

3.6 Directs and provides general supervision of all assigned personnel through his Deputy Directors, delegates authority to subordinates, approves work plans, monitors progress of work and provides guidance in order to maintain maximum effectiveness.

3.7 Directs preparation of required reports and data; directs submittal and distribution of same.

4.0 QUALIFICATIONS

4.1 Engineering degree from an accredited college or university.

4.2 Must have had substantial experience in power plant engineering, and in implementing the concepts and technology involved in thermal plants.

4.3 Must have specific experience in the design, construction, and operation of coal-fired generating plants.

4.4 Must meet WAPDA requirements for a BPS 19 position.

COAL POWER PROJECTS DEPARTMENT

DIRECTOR, FINANCE AND COORDINATION

1.0 SYNOPSIS

The Director, Finance and Coordination, will assist the Chief Engineer in monitoring and coordinating the budgeting, accounting and scheduling activities of the coal power station implementation program. He will also guide the support of the power station coal contract negotiation and administration processes, as well as the support of the materials management activities of the coal power station projects. He is responsible for insuring that the budgeting and accounting processes are performed according to policies and procedures established by the Finance Wing of WAPDA.

2.0 ORGANIZATION

The Director, Finance and Coordination reports to the Chief Engineer, Coal Power Projects Department. Reporting to the incumbent are the Deputy Director, Project Scheduling and Coordination; the Deputy Director, Budgets and Accounts; the Deputy Director, Contracts; and the Specialist, Economics and Financial Analysis.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Works with the Chief Engineer, Project Directors and his Deputy Directors in the establishment of appropriate budgeting, accounting and scheduling procedures for coal power station projects.

3.2 Oversees the departmental coordination and reporting required for all coal power station project budgeting, accounting and scheduling processes to insure that the progress and status of the projects can be evaluated.

3.3 Oversees the development and implementation of coal contract review, negotiation and administration procedures.

3.4 Reviews Department budgeting, accounting and contracting activities for compliance with WAPDA Finance and Contract Cell standards and regulations.

3.5 Provides support to the Chief Engineer for financial and economic analysis requirements associated with coal project planning for feasibility study activities involving both coal mining and power plants.

3.6 Monitors the coordination of project stores and procurement requirements to insure compatibility with WAPDA Inventory Control practices and

to provide a basis for long range materials planning and management for coal station projects.

3.7 Assists in identifying the need for and development of systems required to support management and control of Department non-technical operations.

3.8 Assures the integrity of department and project records to support economic and contractual judgments.

4.0 QUALIFICATIONS

4.1 Degree in Accounting or Finance from an accredited college or university.

4.2 Must meet the experience requirements of the WAPDA Finance Wing for BPS 19 position.

4.3 Should have experience or training in general project scheduling techniques, contracts management and analysis of economic/financial alternatives.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR, MECHANICAL

1.0 SYNOPSIS

The Deputy Director, Mechanical will assist the Director, Coal Power Projects in all areas concerning the mechanical coal-specific equipment to be utilized in planned, under construction or operating coal generation facilities. In addition, the Deputy Director will advise and monitor the analysis of coal and make specific suggestions as a result of his findings. He will function as the overall technical resource for all activities associated with coal specific mechanical equipment (not mine related) within WAPDA. He will be responsible for assuring that equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance on an as-needed basis. The incumbent will be responsible for assuring that the mechanical section is properly manned, and that personnel assigned are knowledgeable of the "state-of-the-art" for their related equipment. He will be capable of managing minor design changes on an as-needed basis and will monitor all design activities concerning his related equipment.

After commercial operation is achieved for each plant, the incumbent, through his Senior Engineer, Coal Analysis, will assure that coal quality is known and that operations and maintenance personnel at each plant are cognizant of the coal characteristics. The incumbent will advise and monitor the coal sampling activities at each plant.

2.0 ORGANIZATION

The Deputy Director, Mechanical reports to the Director, Coal Power Projects. Reporting to the incumbent are the Senior Engineers Ash Handling, Coal Handling, Coal Boilers and Coal Analysis.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to Director, Coal Power Projects during the planning and implementation of all coal-fired power stations of WAPDA.

3.2 Provides direction and guidance to the mechanical section.

3.3 Develops, initiates and implements procedures, practices, and programs as needed to support section activities.

3.4 Provides personnel on an as-needed basis to the Project Directors to support:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- review of contracts
- construction monitoring
- start-up

3.5 Monitors mechanical performance of coal-related equipment after installation.

3.6 Advises generating plant on:

- spare parts requirements
- preventative maintenance
- operating characteristics
- recommended modifications

3.7 Directs preparation of required reports and data; directs submittal and distribution of same.

3.8 Coordinates and reviews coal sampling activities at each plant.

3.9 Maintains a high level of technical expertise within his section assuring that the latest developments are known to his personnel.

4.0 QUALIFICATIONS

4.1 Mechanical Engineer's degree from an accredited college or university.

4.2 Must have had substantial expertise in power plant engineering, and in the nature and problems associated with handling and burning coal as a fuel.

4.3 Must meet WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR, ELECTRICAL

1.0 SYNOPSIS

The Deputy Director, Electrical will assist the Director, Coal Power Projects in all areas concerning electrical equipment and instruments and controls (coal-specific) to be utilized in planned, under construction or operating coal generation facilities. He will function as the overall technical resource for all activities associated with coal-specific electrical equipment and instrumentations and controls (not mine-related) within WAPDA. He will be responsible for assuring that equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance on an as-needed basis. The incumbent and his staff will possess expertise in the area of electrical equipment and instrumentation in hazardous environments. The incumbent will be responsible for assuring that the electrical section is properly manned and that personnel assigned are knowledgeable of the state-of-the-art for their related equipment. He will be capable of managing minor design changes on an as-needed basis and will monitor all design activities concerning his related equipment.

2.0 ORGANIZATION

The Deputy Director, Electrical reports to the Director, Coal Power Projects. Reporting to the incumbent are the Senior Engineer, Electrical and Senior Engineer, Instrumentation and Controls.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to Director, Coal Power Projects during the planning and implementation of all coal-fired power stations of WAPDA.

3.2 Provides direction and guidance to the electrical section.

3.3 Develops, initiates and implements procedures, practices, and programs as needed to support section activities.

3.4 Provides personnel on an as-needed basis to the project directors to support:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents

- review of tenders
- review of contracts
- construction monitoring
- start-up

3.5 Monitors electrical performance of all coal related equipment after installation.

3.6 Advises generating plant on:

- spare parts requirements
- preventive maintenance
- operating characteristics
- recommended modifications

3.7 Directs preparation of required reports and data; directs submittal and distribution of same.

3.8 Maintains a high level of technical expertise within his section assuring that the latest developments are known to his personnel.

4.0 QUALIFICATIONS

4.1 Electrical Engineer's degree from an accredited college or university.

4.2 Must have substantial expertise in power plant engineering and in the nature and problems associated with installing, operating and maintaining associated equipment in a coal environment.

4.3 Must meet WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR, ENVIRONMENTAL ANALYSIS

1.0 SYNOPSIS

The Deputy Director, Environmental Analysis will assist the Director, Coal Power Projects in all areas concerning the environmental analysis to be utilized in planned, under construction or operating coal generation facilities or mines. He will function as the overall technical resource for all activities associated with environmental analysis requirements, standards and equipment within WAPDA. He will be responsible for assuring that equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance. He will recommend sampling frequencies, limits and recommended courses of action when limits are exceeded. The incumbent will be completely familiar with environmental standards and requirements of Pakistan and any overriding requirements as may be established by lending agencies. The incumbent will be responsible for assuring that he has additional personnel assigned as needed to perform his duties.

2.0 ORGANIZATION

The Deputy Director, Environmental Analysis reports to the Director, Coal Power Projects. He will have personnel assigned to him on an as-needed basis to support his workload.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Director, Coal Power Projects during the planning and implementation of all coal-fired power stations of WAPDA, and all associated coal mines.

3.2 Provides direction and guidance to personnel as assigned.

3.3 Develops, initiates and implements procedures, practices, and programs as needed to support his section's activities.

3.4 Provides expertise and, when needed, personnel to support the Project Director's efforts to develop:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- construction monitoring

- start-up

3.5 Specifies the type of frequency of environmental analyses to be performed, including associated standards.

3.6 Advises generating plants on:

- spare parts requirements for analysis equipment
- preventive maintenance
- operating characteristics
- recommended modifications

3.7 Prepares required reports and data and directs submittal and distribution of same.

4.0 QUALIFICATIONS

4.1 Related degree from an accredited college or university.

4.2 Must have substantial expertise in power plant operations and mining as related to effects on the environment and how to measure these effects.

4.3 Must demonstrate expertise in environmental standards and requirements.

4.4 Must meet WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR,
PROJECT SCHEDULING AND COORDINATION

1.0 SYNOPSIS

The Deputy Director, Project Scheduling and Coordination is responsible for tracking and coordination of all coal power station project scheduling activities to assist the Chief Engineer in planning, reviewing and managing overall station implementation. The incumbent will also work with Project Directors in facilitating the allocation of Departmental resources for individual projects schedule planning.

2.0 ORGANIZATION

The Deputy Director, Project Scheduling and Coordination reports to the Director, Finance and Coordination. Reporting to the incumbent is the Engineer, Project Scheduling, and the Engineer, Project Reporting.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Monitors all individual project scheduling activities such as schedule development, updates, progress analysis and problem analysis to insure compliance with Departmental standards.

3.2 Develops procedures for collecting and coordinating individual project scheduling and progress reporting data, and preparing consolidated schedule summaries and progress reports for use by the Chief Engineer.

3.3 Directs the activities of the Engineer, Project Scheduling in tracking and coordinating individual project schedules.

3.4 Directs the activities of the Engineer, Project Reporting in collecting individual project progress reports and consolidating them into reports required by the Chief Engineer.

3.5 Works with Project Directors and the Director, Coal Power Projects, to plan and coordinate assignments of Coal Projects Department Head Office support personnel for project implementation.

3.6 Works with the Chief Engineer and other Department senior officers in determining requirements for reports to be submitted to Authority and donor agencies.

3.7 Establishes methodologies for, and oversees transmittal of project scheduling data to office of Managing Director, Project Monitoring, WAPDA.

4.0 QUALIFICATIONS

4.1 Engineering degree from an accredited college or university.

4.2 Should have experience or training in one or more of the following: project planning and scheduling, field construction planning or other project control areas.

4.3 Must meet WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR,
BUDGETS AND ACCOUNTS

1.0 SYNOPSIS

The Deputy Director, Budgets and Accounts will supervise the gathering and coordination of the budgeting and accounting information developed in the coal power station implementation program. The incumbent will oversee the completion of overall summary reports of budget and accounting performance of individual projects for use by the Chief Engineer.

2.0 ORGANIZATION

The Deputy Director, Budgets and Accounts reports to the Director, Finance and Coordination. Reporting to the incumbent are the Accountant and the Budget Analyst.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Acts as coordinator for preparation of operating and project budgets.

3.2 Works with project budgets and accounts officers in installing appropriate account classification methods according to WAPDA Code of Accounts and budget and accounting procedures.

3.3 Develops and installs procedures, for gathering and consolidating project budget and accounting information and preparing summary reports.

3.4 Guides and directs the activities of the Accountant and Budget Analyst in gathering and consolidating project budget and accounting information, including monthly trial balances and financial statements.

3.5 Maintains liaison with Manager, Finance, Thermal to insure required circulation of Department budget and accounts reports.

4.0 QUALIFICATION

4.1 Accounting degree from accredited college or university.

4.2 Accounting experience per WAPDA requirements for BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

DEPUTY DIRECTOR, CONTRACTS

1.0 SYNOPSIS

The Deputy Director, Contracts prepares, assists in negotiation of, and administers contracts for coal to be used by coal-fired generation stations. The incumbent will assist the Chief Engineer in establishing and enforcing contracting policies and standards. He will also be responsible for insuring that coal contracts are in compliance with Authority guidelines and regulations.

2.0 ORGANIZATION

The Deputy Director, Contracts reports to the Director, Finance and Coordination.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Works with the Chief Engineer and WAPDA Contracts Cell to draft coal contracting policies that conform with Coal Power Projects Department objectives and comply with Authority and legal regulations.

3.2 Develops standard contracts and related forms for use in procurement of coal.

3.3 Furnishes support to the Chief Engineer, Project Directors and Resident Engineers in assembling bid packages, developing, negotiating and administering coal contracts with vendors.

3.4 Maintains awareness of vendor sources and corresponding pricing, terms and conditions, and delivery policies and practices and compiles related documentation and information sources for use by the Department.

3.5 Reviews and audits coal project contracting activities for compliance with Department and Authority contracting policies and procedures.

3.6 Works with the WAPDA Contracts Cell, which mediates between WAPDA units and contractors, in matters relating to contract administration, contract provisions and claims.

4.0 QUALIFICATIONS

4.1 Business administration degree from accredited college or university.

4.2 Two to four years experience in fuel contract administration.

4.3 On-the-job training in coal contract management and negotiation.

4.4 Must meet WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SPECIALIST,
ECONOMIC AND FINANCIAL ANALYSIS

1.0 SYNOPSIS

The Specialist, Economic and Financial Analysis supports Department planning and feasibility study requirements for economic or financial analysis of alternatives. The incumbent also provides this analytical assistance to the Coal Mining components of coal power station projects as may be required.

2.0 ORGANIZATION

The Specialist, Economic and Financial Analysis reports to the Director, Finance and Coordination.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Performs economic and financial analysis of alternatives as may be required in support of Coal Power Projects Department and Coal Mining component planning and feasibility studies.

3.2 Works with the Chief Engineer and his senior officers in preparation and analysis of Departmental Financial Forecasts.

3.3 Maintains familiarity with state-of-the-art economic and financial analysis techniques for potential application to Department needs.

3.4 Uses, where applicable, Department microcomputer system and related general-purpose programs to perform required analysis.

3.5 Establishes communications with Thermal and WAPDA Finance and WAPDA Planning offices to provide for information sources for support of Departmental economic/financial analysis activities.

4.0 QUALIFICATIONS

4.1 Engineering or MBA degree from accredited college or university.

4.2 Two to four years in economic/financial analysis.

4.3 Training in economic/financial analytical techniques.

4.4 Must meet WAPDA requirements for BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

ENGINEER, PROJECT SCHEDULING

1.0 SYNOPSIS

The Engineer, Project Scheduling, performs tracking and coordination of all individual coal power station project scheduling activities for use in planning and managing overall station implementation.

2.0 ORGANIZATION

The Engineer, Project Scheduling reports to the Deputy Director, Project Scheduling and Coordination.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Assists Deputy Director, Project Scheduling and Coordination in development of procedures for collection and coordination of project schedule data and preparation of consolidated schedule summaries.

3.2 Collects individual project schedule data and update information and prepares coordinated schedule summaries for use by the Chief Engineer.

3.3 Develops methodology to permit use of microcomputer system and general programs for storage of project summary data and preparation of related summary or special reports.

3.4 Maintains necessary communications with individual project scheduling functions to facilitate acquisition of required information.

3.5 Prepares project scheduling information for transmittal to office of Managing Director, Project Monitoring, WAPDA.

3.6 Maintains sufficient familiarity with procedures followed by Engineer, Project Reporting to be able to perform in back-up role in event of unexpected absences.

4.0 QUALIFICATIONS

4.1 Engineering degree from an accredited college or university.

4.2 Training in project planning and scheduling techniques and use of microcomputer systems and related general-purpose programs.

4.3 Must meet WAPDA requirements for BPS 17 position.

COAL POWER PROJECTS DEPARTMENT

ENGINEER, PROJECT REPORTING

1.0 SYNOPSIS

The Engineer, Project Reporting collects and assembles individual coal project progress reports primarily involving project expenditures and consolidates them into summary reports for the use of the Project Manager.

2.0 ORGANIZATION

The Engineer, Project Reporting reports to the Deputy Director, Project Scheduling and Coordination.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Assists Deputy Director, Project Scheduling and Coordination in development of procedures for collection and coordination of project expenditure data and preparation of consolidated or special summaries.

3.2 Collects individual project expenditure data and update information and prepares coordinated or special summaries for use by the Chief Engineer.

3.3 Develops methodology to permit use of microcomputer system and related general programs for storage of project budget and actual expenditure data and preparation of related summary or special reports.

3.4 Maintains necessary communications with individual project scheduling functions to facilitate acquisition of required information.

3.5 Prepares project expenditure information for transmittal to office of Managing Director, Project Monitoring, WAPDA.

3.6 Maintain sufficient familiarity with procedures followed by Engineer, Project Scheduling to be able to perform in back-up role in event of unexpected absences.

4.0 QUALIFICATIONS

4.1 Engineering degree from an accredited college or university.

4.2 Training in project management techniques and use of microcomputer systems and related general-purpose programs.

4.3 Must meet WAPDA requirements for BPS 17 position.

COAL POWER PROJECTS DEPARTMENT

SENIOR ENGINEER, COAL HANDLING

1.0 SYNOPSIS

The Senior Engineer, Coal Handling will assist the Deputy Director, Mechanical in all areas concerning coal handling, coal storage and coal transportation to be utilized in planned, under construction or operating coal generation plants. He will function as the technical resource for all activities associated with coal handling within WAPDA. He will be responsible for assuring that coal handling equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance on an as-needed basis. He will be responsible for keeping abreast of new developments concerning his equipment. The incumbent will make recommendations concerning preventive maintenance programs, spare parts requirements and operations characteristics of coal handling equipment.

2.0 ORGANIZATION

The Senior Engineer, Coal Handling reports to the Deputy Director Mechanical. Reporting to the incumbent will be Junior Engineers and their staffs when needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Mechanical on coal handling and coal handling equipment.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- construction monitoring
- start-up

3.4 Develops a program of monitoring the performance of coal handling equipment after installation and start-up, maintaining records of availability, maintenance requirements, and operating experience.

3.5 Advises generation on:

- spare parts requirements
- maintenance procedures
- preventive maintenance requirements
- operating characteristics
- recommended modifications

3.6 Prepares required reports and data, directs submittal and distribution of same.

3.7 Maintains a high level of expertise in the field of coal handling including new methods and new equipment.

4.0 QUALIFICATIONS

4.1 Mechanical Engineering degree from an accredited college or university.

4.2 Must have substantial expertise in power plant engineering and specific knowledge of coal handling equipment.

4.3 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SENIOR ENGINEER, ASH HANDLING

1.0 SYNOPSIS

The Senior Engineer, Ash Handling will assist the Deputy Director, Mechanical in all areas concerning ash handling and ash handling equipment to be utilized in planned, under construction or operating coal generation plants. He will function as the technical resource for all activities associated with ash handling within WAPDA. He will be responsible for assuring that ash handling equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance on an as-needed basis. He will be responsible for keeping abreast of new developments concerning his equipment. The incumbent will make recommendations concerning preventive maintenance programs, spare parts requirements and operations characteristics of ash handling equipment.

2.0 ORGANIZATION

The Senior Engineer, Ash Handling reports to the Deputy Director, Mechanical. Reporting to the incumbent will be Junior Engineers and their staffs when needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Mechanical on ash handling and ash handling equipment.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- construction monitoring
- start-up

3.4 Develops a program of monitoring the performance of ash handling equipment after installation and start-up. Maintains records of availability, maintenance requirements, and operating experience.

3.5 Advises generating plant on:

- spare parts requirements
- maintenance procedures
- preventive maintenance requirements
- operating characteristics
- recommended modifications

3.6 Prepares required reports and data, directs submittal and distribution of same.

3.7 Maintains a high level of expertise in the field of ash handling including new methods and new equipment.

4.0 QUALIFICATIONS

4.1 Mechanical Engineering degree from an accredited college or university.

4.2 Must have substantial expertise in power plant engineering and specific knowledge of ash handling and equipment.

4.3 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SENIOR ENGINEER, COAL BOILERS

1.0 SYNOPSIS

The Senior Engineer, Coal Boilers will assist the Deputy Director, Mechanical in all areas concerning coal boilers to be utilized in planned, under construction or operating coal generation plants. He will function as the technical resource for all activities associated with coal boilers within WAPDA. He will be responsible for assuring that coal boilers and associated systems planned for or utilized by WAPDA are properly specified and will monitor their installation and operating performance on an as-needed basis. He will be responsible for keeping abreast of new developments concerning his equipment. The incumbent will make recommendations concerning preventive maintenance programs, spare parts requirements and operating characteristics of coal boilers.

2.0 ORGANIZATION

The Senior Engineer, Coal Boilers reports to the Deputy Director, Mechanical. Reporting to the incumbent will be Junior Engineers and their staffs when needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Mechanical on coal boilers and related equipment.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- construction monitoring
- start-up

3.4 Develops programs for monitoring the performance of coal boilers after installation and start-up. Maintains records of availability, efficiency, maintenance requirements, outages and operating experience.

3.5 Advises generation on:

- operating characteristics
- impact of different fuel characteristics
- spare parts requirements
- maintenance procedures
- operating procedures
- preventive maintenance requirements
- recommended modifications

3.6 Prepares required reports and data, directs submittal and distribution of same.

3.7 Maintains a high level of expertise in the field of coal boiler and support equipment including maintenance techniques, operating methods and new equipment.

4.0 QUALIFICATIONS

4.1 Mechanical Engineering degree from an accredited college or university.

4.2 Must have substantial expertise in power plant engineering and specific knowledge of coal boilers.

4.3 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SENIOR ENGINEER, COAL ANALYSIS

1.0 SYNOPSIS

The Senior Engineer, Coal Analysis will assist the Deputy Director, Mechanical in all areas concerning coal analysis and quality control. He will function as the technical resource for all activities concerning the proper storage, handling and boring of coal within WAPDA. He will be responsible for assuring that all equipment specified for planned, under construction, or operating coal-fired generating facilities reflects the characteristics of the coal to be utilized as a fuel supply. He will assure that the coal sampling systems to be established at each generating facility are adequately installed according to specifications and started up correctly. He will monitor the coal analysis function at each plant. He will be responsible for keeping abreast of new developments within his field.

2.0 ORGANIZATION

The Senior Engineer, Coal Analysis reports to the Deputy Director, Mechanical. Reporting to the incumbent will be Junior Engineers and their staff when needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Mechanical in the areas of coal storage, handling and burning.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design
- specification development
- generation of tender documents
- review of tenders
- construction monitoring
- start-up

3.4 Develops programs for coordinating and reviewing the coal sampling activities at each generating facility. Maintains records of

supplies, coal quality and storage and burning characteristics experience correlated to specific coal.

3.5 Advises generation on:

- coal burning characteristics
- storage requirements
- handling characteristics
- recommendations for modifications
- changes in sampling methods and/or frequencies

3.6 Prepares required reports and data, directs submittal and distribution of same.

3.7 Maintains a high level of expertise in his field.

4.0 QUALIFICATIONS

4.1 Degree in Chemical Engineering or equivalent.

4.2 Substantial expertise in power plant engineering.

4.3 Substantial expertise in coal storage, handling and burning, specifically lignite.

4.4 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SENIOR ENGINEER, ELECTRICAL

1.0 SYNOPSIS

The Senior Engineer, Electrical will assist the Deputy Director, Electrical in all areas concerning electrical equipment to be utilized in planned, under construction or operating coal-fired generating plants and exposed to the severe environment resulting from the utilization of coal as a fuel supply. He will function as the technical resource for all activities concerning the use and placement of electrical cable and equipment in severe environments within WAPDA. He will be responsible for assuring that the electrical specifications for all equipment planned for or utilized by WAPDA are adequate and will monitor its installation and operating performance on an as-needed basis. He will be responsible for keeping abreast of new developments within his field. The incumbent will make recommendations concerning preventive maintenance programs, spare parts requirements and operating characteristics of his related equipment.

2.0 ORGANIZATION

The Senior Engineer, Electrical reports to the Deputy Director, Electrical. Reporting to the incumbent will be Junior Engineers and their staffs as needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Electrical on electrical equipment in severe environments.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design review
- specification development
- generation of tenders
- review of tenders
- construction monitoring
- start-up

3.4 Develops programs for monitoring the performance of electrical equipment after installation and start-up. Maintains records of availability, maintenance requirements and operating experiences.

3.5 Advises generation on:

- spare parts requirements
- maintenance procedures
- preventive maintenance requirements
- recommended modifications

3.6 Prepares required reports and data; directs submittal and distribution of same.

3.7 Maintains a high level of expertise in his field, including new methods, materials and equipment.

4.0 QUALIFICATIONS

4.1 Electrical Engineering degree from an accredited college or university.

4.2 Must have substantial expertise in power plant engineering and specific knowledge of electrical equipment in severe environments.

4.3 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENTS

SENIOR ENGINEER, INSTRUMENTATION AND CONTROLS

1.0 SYNOPSIS

The Senior Engineer, Instrumentation and Controls (I&C) will assist the Deputy Director, Electrical in all areas concerning I&C equipment of coal-related systems and boilers to be utilized in planned, under construction or operating coal generation plants. He will function as the technical resource for all activities associated with I&C for coal-related equipment and boilers within WAPDA. He will be responsible for assuring that I&C equipment planned for or utilized by WAPDA is properly specified and will monitor its installation and operating performance on an as-needed basis. He will be responsible for keeping abreast of new developments within his field. The incumbent will make recommendations concerning preventive maintenance programs, periodic calibration, equipment spare parts requirements and operating characteristics of his equipment.

2.0 ORGANIZATION

The Senior Engineer, I&C reports to the Deputy Director, Electrical. Reporting to the incumbent will be Junior Engineers and their staffs when needed.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing technical expertise to the Deputy Director, Electrical on I&C equipment.

3.2 Provides direction and guidance to personnel when assigned.

3.3 Provides expertise and, when needed, requests and supplies additional personnel to support the following activities:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- construction monitoring
- start-up

3.4 Develops programs for monitoring the performance of I&C equipment after installation and start-up. Maintains records of calibration problems, failure to control, availability, maintenance requirements and operating experience.

3.5 Advises generation on:

- spare parts requirements
- maintenance methods and procedures
- preventive maintenance requirements
- control characteristics
- recommended modifications

3.6 Prepares required reports and data; directs submittal and distribution of same.

3.7 Maintains a high level of expertise in his field.

4.0 QUALIFICATIONS

4.1 Electronics degree or equivalent.

4.2 Substantial expertise in power plant engineering.

4.3 Specific expertise in digital instrumentation.

4.4 Specific expertise in programmable controllers.

4.5 Specific expertise in computer-based data gathering systems.

4.6 Must meet the WAPDA requirements for a BPS 18 position.

COAL POWER PROJECTS DEPARTMENT

SPECIALIST, MATERIALS

1.0 SYNOPSIS

The Specialist, Materials observes and coordinates project procurement and inventory practices to assure that they meet WAPDA requirements, and provides planning assistance so that parts and materials are available when required. These activities of the incumbent are performed in relation to WAPDA-managed construction. He also performs surveillance and auditing of contracted procurement and stores services.

2.0 ORGANIZATION

The Specialist, Materials reports to the Director, Finance and Coordination.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Performs coordination of procurement and materials planning for projects.

3.2 Works with Stores Officers assigned to project to develop and install uniform procedures and records for receiving, stores, inspection, tests or other checks to verify receipt of proper materials or equipment.

3.3 Assists project Stores Officers in preparing and assembling bid packages, reviewing the commercial content and coordinating with technical and legal review.

3.4 Performs surveillance and audits of contracted services of procurement, expediting, traffic and warehousing performed for projects.

3.5 Maintains contacts with WAPDA Inventory Control to observe system performance and installation characteristics to prepare for extension to Department needs.

4.0 QUALIFICATIONS

4.1 Engineering degree from an accredited college or university.

4.2 Several years experience with utility procurement or stores management functions.

4.3 Training in materials management.

4.4 Must meet WAPDA qualifications for BPS 18 position.

PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)
THERMAL POWER STATION LAKHRA
JOB DESCRIPTIONS

This part of the Appendix presents the job descriptions of non-permanent CPPD personnel assigned to the recommended Project Organization (Design and Construction).

Job descriptions of personnel assigned to the Project Organization from other organizations within the Thermal Division are not included.

Job Descriptions Key Personnel

Project Director
Project Engineer (Colony)
Project Engineer (Construction)

COAL POWER PROJECTS DEPARTMENT

PROJECT DIRECTOR

1.0 SYNOPSIS

The Project Director will assist the Chief Engineer, Coal Power Projects Department in planning and implementation of a specific coal-based power project. He will function as the overall manager of such assigned coal-based power project. He will deal with the World Bank, USAID and other donor agencies, and will assure the covenants of these agencies are complied with. He will be the direct liaison between specific contractors and vendors and WAPDA and will have adequate authority vested in him to ensure contract compliance on the part of these groups. He will be responsible for the cost effectiveness of the delivery of contracted goods and services including the completed project. He will interface with operations and other groups within the Coal Power Projects Department and WAPDA to achieve these goals.

2.0 ORGANIZATION

The Project Director reports to the Chief Engineer, Coal Power Projects Department. Reporting to the incumbent are Project Engineer, Colony; Project Engineer, Construction; Senior Budgets and Accounts Officer; assigned design engineers and contractor representatives as determined by individual contracts.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for providing direction for exercising technical, financial and administrative control and supervision over the planning and implementation of his assigned coal-based power station project.

3.2 Develops, initiates, and implements procedures, practices, and programs as needed to support project goals.

3.3 Directs and supervises the work of all technical, financial, and administrative personnel reporting to him.

3.4 Directs and provides general supervision over all assigned personnel through his subordinate officers, delegates authority to subordinates, approves project work plans, coordinates the activities of assigned personnel and contractors, monitors progress of work and provides guidance in order to maximize the effectiveness of the project team.

3.5 Recommends and forwards project budgets.

3.6 Approves purchases of parts and materials requested by project engineers within the limits of authority designated by the WAPDA Book of Financial Powers.

3.7 Meets and interacts with representatives of aid-giving agencies to the extent required to insure adequate planning, negotiation and follow-up of loan or grant-related project activities, and compliance with any related convenants or conditions.

3.8 Directs and/or coordinates the following activities through the effective use of contractor personnel and/or WAPDA personnel:

- feasibility studies
- preliminary design review
- specification development
- generation of tender documents
- review of tenders
- review of contracts
- construction monitoring
- start-up

4.0 QUALIFICATIONS

4.1 Degree in construction engineering or related engineering field from an accredited college or university.

4.2 Must have had substantial experience in power plant engineering and in implementing the concepts and technology involved in thermal plants.

4.3 Must be thoroughly familiar with the construction process and management aspects thereof.

4.4 Must have experience in negotiations and interactions with external donor and government agencies.

4.5 Must have experience in negotiations and interactions with contractors and vendors.

4.6 Must meet WAPDA requirements for a BPS 19 position.

THERMAL POWER STATION LAKHRA

PROJECT ENGINEER (COLONY)

1.0 SYNOPSIS

The Project Engineer (Colony) is responsible for the establishment of the Power Station Colony and the Infrastructure related to the Power Station. The incumbent plans and schedules the construction work under his responsibility, in close coordination with the Project Director (Lakhra) and the Construction Manager.

2.0 ORGANIZATION

The Project Engineer (Colony) reports to the Chief Engineer (Jamshoro) for all administrative matters and to the Project Director (Lakhra) for all technical matters directly relating to the Power Station. Reporting to the incumbent is a staff similar to the one for the 250 MWe oil-fired unit under construction at Jamshoro.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the construction of the Power Station Colony as well as other infrastructure works in support of the Power Station, on schedule and within budget.

3.2 Develops a construction schedule for the colony which is commensurate with the construction schedule of the Power Station.

3.3 Supervises construction contractors and advises the Chief Engineer (Jamshoro) of any contractual problems encountered.

4.0 QUALIFICATIONS

4.1 Appropriate engineering degree from an accredited university or college.

4.2 Must be familiar with Power Station construction practices and the WAPDA approach for the establishment of Power Station Colonies.

THERMAL POWER STATION LAKHRA

PROJECT ENGINEER (CONSTRUCTION)

1.0 SYNOPSIS

The Project Engineer (Construction) is responsible for the monitoring of the Power Station Construction project as implemented by the Contractor's Construction Manager. The incumbent assigns staff to the Contractor's Construction Management Organization and reports on construction progress, problems and their resolution and on the overall quality of the construction work. The incumbent is directly responsible for the execution of construction work for which WAPDA has assumed responsibility; he coordinates this work closely with the Contractor's construction schedule. The incumbent supports the Contractor in communications with the WAPDA home office or other WAPDA organizations.

2.0 ORGANIZATION

The Project Engineer (Construction) reports to the Project Director (Lakhra). Reporting to the incumbent is a staff which monitors the Construction Management in the areas of Administration, Project Controls, Quality Control, Field Engineering and Construction Supervision.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the monitoring of the Power Station Construction Project; prepares periodic reports on progress, problems and their resolution and construction quality.

3.2 Develops and supervises the implementation of procedures by which his staff, which is assigned to the Construction Management Organization, performs the monitoring function.

3.3 Develops schedules for the construction work for which WAPDA has assumed direct responsibility and integrates these schedules into the overall construction schedule to the extent necessary.

3.4 Supervises WAPDA contractors for WAPDA scope work and advises the Project Director (Lakhra) of any contractual problems encountered.

3.5 Assists the Contractor Construction Manager in communication with the appropriate WAPDA organizations involved in the project.

4.0 QUALIFICATIONS

4.1 Mechanical or electrical engineering degree from an accredited university or college.

4.2 Must have experience in the construction of Thermal Power Stations.

4.3 Must be familiar with construction project management techniques.

PROJECT ORGANIZATION (START-UP AND TEST)
THERMAL POWER STATION LAKHRA
JOB DESCRIPTIONS

As discussed in Section 6.4.4, the Start-up and Test staff is recommended to be made up of future permanent station personnel. Job descriptions of those personnel are included in the following section of this Appendix.

STATION ORGANIZATION (OPERATIONS AND MAINTENANCE)
THERMAL POWER STATION LAKHRA
JOB DESCRIPTIONS

This part of the Appendix presents a generic job description of key positions of the recommended Station Organization, i.e. all positions from the level of Junior Engineer to Resident Engineer. Not included are Job Descriptions of the Senior and Junior Civil Engineer, Senior Budgets and Accounts Officer and Assistant Director Administration. Functions performed by these key personnel are too specific to WAPDA work methods to be detailed without extensive personnel interviews. Similarly, the job descriptions that follow must be regarded as a comprehensive basis for the development of final job descriptions for specific power stations. In particular, the detailed qualification requirements which WAPDA already has established for each position, should be incorporated. Finally, it must be emphasized that the individual duties for each position must be amplified through the use of management manuals and procedures.

It is recommended that periodic or scheduled duties such as checks, entering of data in log-books, etc., be summarized in a Station Standing Order Manual and not included in individual job descriptions.

Job Descriptions Key Personnel

Resident Engineer
Assistant Resident Engineer (Operation)
Senior Engineer Environmental
Fire Officer
Senior Shift Engineer
Junior Shift Engineer (I)
Junior Shift Engineer (II)
Junior Shift Engineer (III)
Junior Shift Engineer (IV)
Junior Shift Engineer (V)
Senior Chemist
Junior Chemist
Senior Engineer ITR
Junior Engineer ITR
Assistant Resident Engineer (Maintenance)
Senior Engineer Planning & Scheduling
Head Draftsman
Senior Engineer Mechanical
Junior Engineer Mechanical
Senior Engineer Electrical
Junior Engineer Electrical
Senior Engineer Instrumentation
Junior Engineer Instrumentation
Senior Store Officer
Assistant Store Officer

Senior Engineer Workshop
Senior Engineer QC
Junior Engineer QC
Training Coordinator

THERMAL POWER STATION LAKHRA

RESIDENT ENGINEER

1.0 SYNOPSIS

The Resident Engineer is charged with the responsibility for efficient and safe operation of the power station and overall maintenance of the facilities. The incumbent seeks to achieve the highest possible equivalent availability and thermal efficiency consistent with good management practices, safe operation and WAPDA policies and procedures. The incumbent prepares, justifies and manages the power station budget consistent with the annual work plan, station priorities and long term goals. The incumbent provides leadership and guidance for all station personnel for the performance of their tasks in a productive and cost effective manner.

2.0 ORGANIZATION

The Resident Engineer reports to the Chief Engineer. Reporting to the incumbent are the Assistant Resident Engineer (Operation), the Assistant Resident Engineer (Maintenance), the Sr. Engineer Civil, the Sr. Engineer QC, the Sr. Budgets and Accounts Officer, the Assistant Director Administration and the Training Coordinator.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the efficient, dependable, economical and safe operation and maintenance of the power station.

3.2 Directs and provides general supervision over all station personnel through his subordinate supervisors; delegates authority to subordinates; plans general work assignments; coordinates phases of operating and maintenance work; monitors progress of work and provides guidance in order to maintain maximum efficiency, reliability and safety of plant operation.

3.3 Is responsible for all work involving the maintenance and repairs of the boiler, turbine-generator, fuel handling systems and all electrical and mechanical power station systems, as well as the buildings, structures and grounds.

3.4 Is responsible for the preparation, justification and management of the overall power station budget; monitors actual versus projected expenditures and makes adjustments where necessary.

3.5 Supervises the power station administration.

3.6 Supervises the power station overall safety program.

3.7 Supervises the power station overall training program.

3.8 Establishes and maintains effective employee relations; assists in the selection and upgrading of trainees and personnel.

3.9 Initiates, supervises and conducts studies of power station operating, maintenance and administrative activities; makes regular station inspections in order to keep informed of personnel performance and housekeeping conditions; directs improvements as required.

4.0 QUALIFICATIONS

4.1 Mechanical or electrical engineering degree from an accredited college or university.

4.2 Must be thoroughly familiar with all aspects of oil- and coal-fired thermal power stations; must have experience in power station engineering, supervision, operation and/or maintenance.

4.3 Must have capability for the preparation of manuals, procedures and instructions for station operation and maintenance personnel.

THERMAL POWER STATION LAKHRA

ASSISTANT RESIDENT ENGINEER (OPERATION)

1.0 SYNOPSIS

The Assistant Resident Engineer (Operation) is responsible for the efficient and safe operation of the power station. The incumbent initiates, develops and implements policies and procedures in support of station operation. The incumbent will coordinate closely with the Assistant Resident Engineer (Maintenance) for the performance of all maintenance and repair activities. The incumbent will liaise with the Chief Engineer (Power Control), WAPDA, Lahore to achieve station operation in accordance with the needs of the WAPDA system. The incumbent will prepare the annual station operation budget and conrol actual expenditures.

2.0 ORGANIZATION

The Assistant Resident Engineer (Operation) reports to the Resident Engineer. Reporting to the incumbent are the Sr. Shift Engineer, the Senior Chemist and the Sr. Engineer I.T.R. Also reporting to the incumbent as staff functions are the Fire Officer and the Sr. Engineer Environmental Monitoring.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the efficient, dependable, economical and safe operation of the power station, including meeting the environmental requirements under all operating conditions.

3.2 Directs start-up, shut-down and operation in accordance with the needs of the WAPDA system as required by the Chief Engineer (Power Control), WAPDA, Lahore.

3.3 Monitors all maintenance and repair work to station equipment, as well as power station buildings, structures and grounds.

3.4 Directs and provides general supervision over all station operating personnel through subordinate supervisors; delegates authority to subordinates; plans general work assignments; coordinates with all maintenance work; monitors progress of work and provides assistance, advice and guidance in order to maintain efficient, safe and reliable plant operation.

3.5 Initiates, supervises and conducts studies of power station operating activities; makes regular station inspections in order to keep informed of operation personnel performance; directs improvements as required.

3.6 Identifies training needs for station operators and implements operator training activities in close coordination with the Station Training Coordinator.

3.7 Establishes and maintains all station operation procedures and reviews recommendations for improvements submitted by station personnel.

3.8 Directs the preparation of the daily load reports and monthly progress reports in accordance with WAPDA standards.

3.9 Participates in the analysis of system and equipment malfunction and adjusts operating practices if required.

3.10 Responsible for the adequacy of the fire-fighting personnel and equipment.

3.11 Administers the power station safety program; establishes safety rules and regulations; bears responsibility for the safety of all operations personnel.

3.12 Prepares the annual station operation budget, controls actual expenditures and makes adjustments as required.

4.0 QUALIFICATIONS

4.1 Mechanical or Electrical engineering degree from an accredited college or university.

4.2 Must be thoroughly familiar with the operation and/or maintenance of oil- and coal-fired thermal power stations.

4.3 Must have writing capability for the preparation of procedures and operating instructions for power station operations personnel.

4.4 Must have experience in training or instructing power plant operations personnel either in the field or in the classroom.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER ENVIRONMENTAL MONITORING

1.0 SYNOPSIS

The Senior Engineer Environmental Monitoring is responsible for the verification of station compliance with the applicable requirements for emission controls. The incumbent will monitor all station emissions and verify that applicable limits are not exceeded. The incumbent will develop monitoring and sampling programs based on the pre-construction environmental data baseline and prepare periodic reports in accordance with WAPDA and local government requirements.

2.0 ORGANIZATION

The Senior Engineer Environmental Monitoring reports as a staff function to the Assistant Resident Engineer (Operations). Reporting to the incumbent are a Junior Chemist, Steno and Naib Qasid.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Responsible for the development and implementation of a monitoring and sampling program to verify station operation within the environmental emission limits.

3.2 Prepares periodic reports in accordance with WAPDA, local government and other requirements as applicable.

3.3 Directs the Junior Chemist in his staff to perform any chemical and/or physical analyses required to determine compliance with regulations.

3.4 Advises the Assistant Resident Engineer (Operations) on station environmental emissions which exceed prescribed limits so that timely corrective action can be taken.

4.0 QUALIFICATIONS

4.1 Suitable engineering degree from an accredited college or university.

4.2 Must meet the requirements of WAPDA for BPS 18.

4.3 Must have experience in chemical analyses as they apply to the operation of a thermal power station.

4.4 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

FIRE OFFICER

1.0 SYNOPSIS

The Fire Officer is responsible for the fire protection of the power station, buildings and coal pile. The incumbent will develop emergency plans and procedures and train his staff in effective firefighting methods. The incumbent will be responsible for the monitoring of the readiness and adequacy of all firefighting equipment.

2.0 ORGANIZATION

The Fire Officer reports as a staff function to the Assistant Resident Engineer (Operations). Reporting to the incumbent is a staff of Head Firemen, Firemen and Chowkidars.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Develop emergency plans and procedures for effective firefighting of all potential types and locations of fires in the station.

3.2 Is responsible for the operational readiness and adequacy of fire detection equipment, firefighting equipment and personnel.

3.3 Coordinates with the Training Coordinator the training of all station personnel in response methods and procedures upon the detection of fires.

3.4 Directs the firefighting activities in case of fires and coordinates efforts with the medical staff in the event of accidents or injuries.

3.5 Conducts investigations of accidents and fires and recommends station improvements if necessary.

3.6 Maintains fire protection system diagrams up-to-date with valve positions indicated; maintains drawings of all station buildings showing exit paths and location of firefighting equipment.

4.0 QUALIFICATIONS

4.1 Experience in thermal power station fire protection and completion of an industrial or utility fire protection course.

4.2 Certification in first aid and rescue methods.

4.3 Must have completed additional training for firefighting specific to coal-fired steam electric stations, as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

SENIOR SHIFT ENGINEER

1.0 SYNOPSIS

The Senior Shift Engineer is responsible for the operation of the power generating unit and all associated auxiliary equipment. The incumbent supervises the entire operation of the unit during his shift to achieve and maintain plant operation in accordance with the requirements of the WAPDA system. The incumbent will supervise start-up and shut-down of the unit and its auxiliaries under normal operation conditions and emergency conditions within the prescribed operating parameters.

2.0 ORGANIZATION

The Senior Shift Engineer reports to the Assistant Resident Engineer (Operations). Reporting to the incumbent are the Junior Shift Engineers (I, II), Junior Shift Engineer (III), Junior Shift Engineer (IV), and in the event that the unit is equipped with a scrubber the Junior Shift Engineer (V). Also reporting to the incumbent are an Assistant Foreman (Electrical), Electrician, Instrument Mechanic and Fitter.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Assumes the duties and responsibilities of the Assistant Resident Engineer (Operations) in his absence; carries out all work assignments as directed by the Assistant Resident Engineer (Operations).

3.2 Under the direction of the Assistant Resident Engineer (Operations) provides general supervision of power station operations personnel; delegates authority and renders necessary assistance, advice and council to subordinates and trainees.

3.3 Responsible for the proper operation of the power station boilers, generators and all auxiliary equipment, including control room operation and electrical switching; implements and enforces plant safety tagging procedures.

3.4 Provides operations liaison for the activities of the Senior Engineer (I.T.R.) including periodic review of the findings and results of the Senior Engineer (I.T.R.).

3.5 Coordinates during his shift the maintenance activities with plant operation in planning work and equipment outages in a manner to maintain plant integrity.

3.6 Regularly checks general station operation and individual plant equipment performance; makes regular station inspections to keep informed of operating, maintenance, fire protection and housekeeping conditions.

3.7 Participates in the development of improvements and changes in equipment and station operation; investigates faulty operation and equipment failures and recommends corrective action.

3.8 Assists in the preparation of operating procedures and instructions.

4.0 QUALIFICATIONS

4.1 Mechanical or Electrical engineering degree from an accredited university or college.

4.2 Must be thoroughly familiar with all phases of oil- and coal-fired power station operation.

4.3 Must be an experienced supervisor capable of effectively administering and monitoring all operation activities.

THERMAL POWER STATION LAKHRA

JUNIOR SHIFT ENGINEER (I)

1.0 SYNOPSIS

The Junior Shift Engineer (I) is in charge of the operation of the boiler, including all air, water and steam systems and their auxiliaries; the operation of the coal mills and auxiliary equipment is also under his responsibility. The incumbent will supervise the operation of the equipment in accordance with the instructions of the Senior Shift Engineer and all applicable procedures.

2.0 ORGANIZATION

The Junior Shift Engineer (I) reports to the Senior Shift Engineer. Reporting to the incumbent are the Boiler Foreman, 4 Operators, 6 Attendants and 5 Helpers.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Under the direction of the Senior Shift Engineer, directs the operation of the boiler and all air, water and steam systems and their auxiliaries; assures compliance with operating procedures and instructions during the assigned shift.

3.2 Directs personnel placing electrical and mechanical equipment inservice or removing it from service; implements station safety and tagging procedures to allow maintenance activities.

3.3 Makes inspection tours during the assigned shift to inspect performance and operating conditions of station equipment; makes necessary changes for optimum operation; reports abnormal conditions to the Senior Shift Engineer, investigates causes of equipment failure.

3.4 Participates in the instruction and training of personnel in operation, as well as fire protection, first aid and safety.

3.5 Maintains all required shift logs and records.

3.6 Monitors cleanliness and housekeeping in his area of responsibility.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR SHIFT ENGINEER (II)

1.0 SYNOPSIS

The Junior Shift Engineer (II) is in charge of the electrical control room, turbine-generator and electrical switchyard. The incumbent will supervise the operation of the equipment in accordance with the instructions of the Senior Shift Engineer and all applicable procedures.

2.0 ORGANIZATION

The Junior Shift Engineer (II) reports to the Senior Shift Engineer. Reporting to the incumbent are the Turbine Foreman, 4 Operators, 6 Attendants and 5 Helpers.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Under the direction of the Senior Shift Engineer, directs the operation of the unit from the electrical control room, the turbine-generator and the electrical switchyard; assumes compliance with operating procedures and instructions during the assigned shift.

3.2 Directs operators to achieve plant start-up, shut-down, normal operation and emergency operation in accordance with operating procedures; implements station safety procedures.

3.3 Makes inspection tours during the assigned shift to inspect performance and operating conditions of station equipment under his responsibility; makes necessary changes for optimum operation; reports abnormal conditions to the Senior Shift Engineer; investigates causes of equipment failure.

3.4 Participates in the instruction and training of personnel in operation, as well as fire protection, first aid and safety.

3.5 Maintains all required shift logs and records.

3.6 Monitors cleanliness and housekeeping in his area of responsibility.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR SHIFT ENGINEER (III)

1.0 SYNOPSIS

The Junior Shift Engineer (III) is in charge of the operation of the Waste Handling Systems, consisting of the bottom-ash equipment, fly-ash equipment and associated waste water treatment equipment. The incumbent will supervise the operation of the equipment in accordance with the instructions of the Senior Shift Engineer and all applicable procedures.

2.0 ORGANIZATION

The Junior Shift Engineer (III) reports to the Senior Shift Engineer. Reporting to the incumbent are the Waste Handling Foreman and Assistant Foreman, 4 Operators, 6 Attendants, 6 Helpers, 1 Fitter and 1 Electrician

3.0 DUTIES AND RESPONSIBILITIES

3.1 Under the direction of the Senior Shift Engineer directs the operation of the bottom-ash disposal equipment, precipitators and fly-ash disposal equipment and associated waste water equipment; assures compliance with operating procedures and instructions during the assigned shift.

3.2 Directs foreman and operators placing system equipment in service or removing it from service; implements station safety and tagging procedures to allow maintenance activities.

3.3 Makes inspection tours during the assigned shift to inspect performance and operating conditions of station equipment under his responsibility; makes necessary changes for optimum operation; reports abnormal conditions to the Senior Shift Engineer; investigates causes of equipment failure.

3.4 Participates in the instruction and training of personnel in operation as well as fire protection, first aid and safety.

3.5 Maintains all required shift logs and records.

3.6 Monitors cleanliness and housekeeping in his area of responsibility.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR SHIFT ENGINEER (IV)

1.0 SYNOPSIS

The Junior Shift Engineer (IV) is in charge of the operation of the fuel handling systems, consisting of the coal handling equipment from coal arrival at the coal pile through coal transportation, crushing and storage in the bunkers, as well as the fuel oil equipment The incumbent will supervise the operation of the equipment in accordance with the instructions of the Senior Shift Engineer and all applicable procedures.

2.0 ORGANIZATION

The Junior Engineer (IV) reports to the Senior Shift Engineer. Reporting to the incumbent are the Fuel Handling Foreman and Assistant Foreman, 16 Operators, 16 Attendants, 16 Helpers, 1 Fitter and 1 Electrician.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Under the direction of the Senior Engineer directs the operation of the coal transportation equipment including car, dumpers, bulldozers, compactors, coal crushers and coal conveyor belts; the incumbent also directs the operation of the fuel oil equipment.

3.2 Directs foreman and operators placing system equipment in operation or removing it from service; directs stacking and reclaiming of coal in accordance with the instructions from the Senior Shift Engineer; implements station safety and tagging procedures to allow maintenance.

3.3 Makes inspection tours during the assigned shift to inspect performance and operating conditions of station equipment under his responsibility; reports abnormal conditions to the Senior Shift Engineer; investigates causes of equipment failure.

3.4 Participates in the instruction and training of personnel in operation as well as fire protection, first aid and safety.

3.5 Maintains all required shift logs and records.

3.6 Monitors cleanliness and housekeeping in his area of responsibility.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR SHIFT ENGINEER (V)

1.0 SYNOPSIS

The Junior Shift Engineer (V) is in charge of the operation of the flue gas scrubber system. The incumbent will supervise the operation of the equipment in accordance with the instructions of the Senior Shift Engineer and all applicable procedures.

2.0 ORGANIZATION

The Junior Engineer (V) reports to the Senior Shift Engineer. Reporting to the incumbent are the Scrubber Foreman and Assistant Foreman, 4 Operators, 6 Attendants, 6 Helpers, 1 Fitter, 1 Electrician and 4 Coolies.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Under the direction of the Senior Shift Engineer directs the operation of the scrubber and all its auxiliaries; assures compliance with operating procedures and instructions during the assigned shift.

3.2 Directs foreman and operators placing system equipment in service or removing it from service; implements station safety and tagging procedures to allow maintenance activities.

3.3 Makes inspection tours during the assigned shift to inspect performance and operating conditions of station equipment under his responsibility; makes necessary changes for optimum operation; reports abnormal conditions to the Senior Shift Engineer; investigates causes of equipment failure.

3.4 Participates in the instruction and training of personnel in operation as well as fire protection, first aid and safety.

3.5 Maintains all required shift logs and records.

3.6 Monitors cleanliness and housekeeping in his area of responsibility.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

SENIOR CHEMIST

1.0 SYNOPSIS

The Senior Chemist is responsible for the operation of the Station laboratory and the water treatment plants. The incumbent will develop procedures for the operation of the laboratory and water treatment plant and supervise their implementation. The incumbent will be responsible for maintaining water, oil and waste fluids within the specified chemical composition, as well as performing fuel (coal, oil) analysis.

2.0 ORGANIZATION

The Senior Chemist reports to the Assistant Resident Engineer (Operation). Reporting to the incumbent are 3 Junior Chemists and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Provides supervision of the chemists and is responsible for the analytical activities and quality control function of the laboratory; supervises the operation of the water treatment plants.

3.2 Responsible for all fluid systems chemical and physical analyses and for the chemical control of fluid systems.

3.3 Assures proper inventory of chemicals and materials for the laboratory and water treatment plants.

3.4 Provides guidance and assures level of proficiency required of laboratory personnel for the performance of analyses and interpretation of results.

3.5 Develops procedures for the implementation of laboratory analyses and the operation of the water treatment plants.

3.6 Keeps abreast of developments in chemistry and develops techniques for the optimum performance of station equipment.

3.7 Develops procedures for the sampling and analysis of coal, fuel oil and fly ash, as well as the feed materials for the scrubber when applicable.

4.0 QUALIFICATIONS

4.1 Engineering degree in Chemistry or Physics from an accredited engineering college or university.

4.2 Must have experience in the operation of a laboratory and water treatment plant at a thermal power station.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR CHEMIST

1.0 SYNOPSIS

The Junior Chemist is responsible for the conduct of the analyses in the laboratory and the supervision of the operation of the water treatment plant. The incumbent will implement station procedures that control plant chemistry conditions and provide the necessary laboratory services.

2.0 ORGANIZATION

The Junior Chemist reports to the Senior Chemist. Reporting to the Junior Chemist are Assistant Chemists, Attendants, Helpers and Coolies.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Supervises the performance of laboratory analyses coal sampling and the operation of the water treatment plant; responsible for the chemical control of fluid systems.

3.2 Assists Senior Chemist in maintaining a proper inventory of chemicals and materials for the laboratory and water treatment plants.

3.3 Provides guidance to the Assistant Chemists for the implementation of procedures and the interpretation of results, in particular with respect to the coal and ash analysis.

3.4 Maintains the required files pertaining to the laboratory, station system chemical control and water treatment plant.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have experience in the operation of chemical analyses.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER ITR

1.0 SYNOPSIS

The Senior Engineer Inspection, Tests, Records (ITR) is responsible for station testing and interfacing with the Operations and Maintenance departments on matters of station efficiency and improvement. The incumbent will develop and implement procedures for the performance of periodic station tests to determine station efficiency and heat rate. The incumbent will be responsible for the daily, weekly and monthly reporting of station performance.

2.0 ORGANIZATION

The Senior Engineer (ITR) reports to the Assistant Resident Engineer (Operation). Reporting to the incumbent are 2 Junior Engineers (ITR) and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Develops procedures and implements a program for the periodic testing of equipment performance as well as station performance.

3.2 Directs the preparation of routine station reports such as daily, weekly and monthly station performance, periodic coal and ash reports and station availability reports; reviews all data for oil, coal, fuel and natural gas (if applicable) received, burned and in inventory.

3.3 Assists the operations department in the review and analysis of station daily operating data and directs the calculation and tracking of important performance parameters such as net station heat rate, availability, capacity factor and boiler efficiency.

3.4 Reviews equipment and system specifications against performance and recommends changes, maintenance or replacement when warranted.

4.0 QUALIFICATIONS

4.1 Mechanical or Electrical engineering degree from an accredited university or college.

4.2 Must be thoroughly familiar with all phases of thermal power generation and have experience in station engineering or operations supervision.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR ENGINEER ITR

1.0 SYNOPSIS

The Junior Engineer Inspection, Tests, Records (ITR) is responsible for the conduct of station and station equipment testing for the determination of station, system and equipment performance. The incumbent will conduct and coordinate post maintenance acceptance tests and routine surveillance and performance tests.

2.0 ORGANIZATION

The Junior Engineer (ITR) reports to the Senior Engineer (ITR). Reporting to the incumbent are a Foreman, Test Operators, Attendants, Helpers, a Steno Gr II, a Senior Clerk and a Naib Qasid.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Conducts and coordinates station performance testing and system and equipment post maintenance acceptance and routine surveillance and performance testing.

3.2 Coordinates test equipment installation and calibration

3.3 Performs the analysis of test data to determine performance level and efficiency of the station, system or equipment.

3.4 Prepares routine station reports such as daily, weekly and monthly station performance, periodic coal and ash reports, capacity factor and station availability and other station statistics as required by WAPDA.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have experience in station design or operations.

4.3 Must have completed the additional training as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

ASSISTANT RESIDENT ENGINEER (MAINTENANCE)

1.0 SYNOPSIS

The Assistant Resident Engineer (Maintenance) is responsible for the maintenance of all power station equipment, as well as the building, structures and grounds. The incumbent initiates, develops and implements policies, procedures and schedules that will allow the station to be operated as required. The incumbent will coordinate closely with the Assistant Resident Engineer (Operation) for the performance of the maintenance and repair activities. The incumbent will maintain an adequate supply of spare parts and consumables in support of scheduled and unscheduled maintenance activities. The incumbent will prepare the annual station maintenance budget and control expenditures.

2.0 ORGANIZATION

The Assistant Resident Engineer (Maintenance) reports to the Resident Engineer. Reporting to the incumbent are the Senior Engineer Mechanical, Senior Engineer Electrical, Senior Engineer Instrumentation and Control, Senior Engineer Workshop and Senior Store Officer. Also reporting to the incumbent as staff functions are the Senior Engineer Planning and Scheduling and the Head Draftsman.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the maintenance of all power station equipment, as well as the building, structures and grounds; directs the planning of Periodic Maintenance activities during station operation and during planned outages; directs maintenance activities and sets priorities during unplanned outages.

3.2 Directs and provides general supervision over all maintenance personnel through discipline Senior Engineers and the Senior Store Officer; delegates authority to subordinates; provides guidance for the planning of all maintenance work and coordinates with station operation.

3.3 Directs the administration of the maintenance department safety program; establishes and enforces the safety rules for maintenance personnel; assures the proper and strict use of safety tagging procedures for the protection of personnel and equipment.

3.4 Directs the supervision of clerical, accounting and inventory control; maintains the spare parts inventory program; responsible for maintenance department records keeping and the issue of administrative reports.

3.5 Identifies training needs for station maintenance personnel and implements maintenance training activities in close coordination with the Station Training Coordinator.

3.6 Directs the supervision of the efficient and economical use, care and handling of maintenance tools, materials and supplies.

3.7 Establishes and maintains all station maintenance procedures and reviews recommendations for improvements submitted to station personnel.

3.8 Establishes and maintains the station Technical Library of system and component manuals.

3.9 Supervises the coordination of station contracted or vendor representative performed maintenance; studies equipment malfunctions and improvement plans.

4.0 QUALIFICATIONS

4.1 Mechanical or Electrical engineering degree from an accredited college or university.

4.2 Must be thoroughly familiar with the maintenance of oil- and coal-fired thermal power stations.

4.3 Must have writing capability for the preparation of procedures and maintenance instructions for power station maintenance personnel.

4.4 Must have experience in the training or instructing of power plant maintenance personnel.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER PLANNING & SCHEDULING

1.0 SYNOPSIS

The Senior Engineer Planning & Scheduling is responsible for the planning, coordination, scheduling and tracking of station corrective and preventive maintenance activities. The incumbent schedules maintenance work in a manner consistent with priorities identified by the Assistant Resident Engineer (Maintenance). The incumbent will implement the administrative procedures which will allow tracking of all maintenance activities and to make adjustments to the maintenance schedules if necessary.

2.0 ORGANIZATION

The Senior Engineer Planning & Scheduling reports as a staff function to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are Steno's, Clerks and a Naib Qasid.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Receives and reviews all Work Requests with all supporting data which will allow the scheduling of the work and the coordination of maintenance work between disciplines.

3.2 Plans and schedules all maintenance work in accordance with the identified priority and available manpower.

3.3 Tracks the implementation of the work and adjusts schedules in accordance with changing requirements and conditions.

3.4 Plans, coordinates, monitors and reports on outage maintenance work to effect the most effective utilization of station downtime.

3.5 Maintains maintenance work files which will serve as reference material for the planning and scheduling of future similar work.

4.0 QUALIFICATIONS

4.1 Mechanical or Electrical Engineering degree from an accredited college or university.

4.2 Extensive experience in the conduct of corrective and preventive maintenance at a thermal power station.

4.3 Completed formal training for the development and implementation of planning and scheduling methods.

THERMAL POWER STATION LAKHRA

HEAD DRAFTSMAN

1.0 SYNOPSIS

The Head Draftsman is responsible for the maintenance of all station drawings. The incumbent develops and implements a drawing filing system, monitors all station modifications and updates station drawings to reflect the as-built condition. The incumbent prepares drawings in support of station modification work packages and procurement of materials.

2.0 ORGANIZATION

The Head Draftsman reports as a staff function to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are a Draftsman, Tracers and an F. A. Operator.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the filing of all station drawings in a manner which allows easy retrieval.

3.2 Monitors all station modifications and updates station drawings to reflect the as-built condition.

3.3 Supports station staff in the preparation for station modifications and procurement.

4.0 QUALIFICATIONS

4.1 Must be an experienced draftsman familiar with thermal power station design and maintenance.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER MECHANICAL

1.0 SYNOPSIS

The Senior Engineer Mechanical is responsible for the maintenance of all mechanical equipment as well as station buildings and structures. The incumbent initiates and develops maintenance procedures and schedules the day-to-day maintenance activities in accordance with the maintenance schedule. The incumbent will provide the required information for an adequate supply of mechanical spare parts. The incumbent will maintain equipment maintenance history files for all mechanical equipment.

2.0 ORGANIZATION

The Senior Engineer Mechanical reports to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are the Junior Engineers Mechanical and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the effective and efficient maintenance and repair of all mechanical equipment of the station, as well as the buildings and structures.

3.2 Directs and provides general supervision over the Junior Engineers Mechanical and their shift personnel; assigns work packages to the Junior Engineers to satisfy the overall station maintenance schedule.

3.3 Directs the maintenance department safety program for his area of responsibility; enforces the proper and strict use of the safety tagging procedures and practices for equipment and personnel safety.

3.4 Controls the interface with the Senior Engineer Workshop for all mechanical maintenance support work provided by the workshop.

3.5 Controls the interface with the Senior Store Officer for the requisition of spare parts and consumables; advises the Senior Store Officer on proper stock levels for spare parts.

3.6 Provides input to the Senior Engineer Planning & Scheduling for the development of periodic, outage and emergency maintenance schedules.

3.7 Develops and maintains all mechanical maintenance procedures including welding procedures and equipment history files; assures that mechanical maintenance staff is adequately trained and qualified for the implementation of the mechanical maintenance procedures.

3.8 Controls the interface with the Senior Engineer QC for the performance of the necessary inspections and tests at the completion of maintenance repairs.

4.0 QUALIFICATIONS

4.1 Mechanical engineering degree from an accredited university or college.

4.2 Must be thoroughly familiar with the mechanical maintenance of thermal power stations.

4.3 Must have completed the additional training for the mechanical maintenance of coal and ash-handling equipment as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR ENGINEER MECHANICAL

1.0 SYNOPSIS

The Junior Engineer Mechanical is responsible for the implementation of the maintenance activities for assigned station mechanical equipment, buildings or structures. The incumbent supervises the ongoing maintenance work, verifies that it is conducted in accordance with the applicable procedures, assembles the equipment history file and reports on status and progress. The incumbent reviews spare part requisitions and repair methods. The incumbent interfaces with the other Maintenance Engineers, the Shift Engineers and the Engineers QC for the coordination of maintenance activities.

2.0 ORGANIZATION

The Junior Engineer Mechanical reports to the Senior Engineer Mechanical. Reporting to the incumbent are a Foreman Mechanical and his crew.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the proper implementation of maintenance activities for assigned station mechanical equipment, buildings or structures.

3.2 Provides direct supervision to the Foreman Mechanical and his crew; prepares and processes all administrative support documentation for the maintenance work.

3.3 Implements the maintenance department safety program for each maintenance activity; verifies the strict use of the safety tagging procedures.

3.4 Reports to the Senior Engineer Mechanical on work status and progress and any difficulties encountered.

3.5 Initiates the development of maintenance procedures where a need is identified and the revision of existing procedures where necessary.

3.6 Requests support from the Shift Engineers and the Engineers QC when required.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must be thoroughly familiar with the equipment which is assigned to him.

4.3 Must have completed additional training as recommended in the Preliminary Training Plan, if applicable.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER ELECTRICAL

1.0 SYNOPSIS

The Senior Engineer Electrical is responsible for the maintenance of all electrical equipment of the Station. The incumbent initiates and develops maintenance procedures and schedules the day-to-day maintenance activities in accordance with the maintenance schedule. The incumbent will provide the required information for an adequate supply of electrical equipment spare parts. The incumbent will maintain equipment maintenance history files for all electrical equipment.

2.0 ORGANIZATION

The Senior Engineer Electrical reports to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are the Junior Engineers Electrical and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the effective and efficient maintenance and repair of all electrical equipment of the station, including the switchyard.

3.2 Directs and provides general supervision over the Junior Engineers Electrical and their shift personnel; assigns work packages to the Junior Engineers to satisfy the overall station maintenance schedule.

3.3 Directs the maintenance department safety program for his area of responsibility; enforces the proper and strict use of the safety tagging procedures and practices for equipment and personnel safety.

3.4 Controls the interface with the Senior Engineer Workshop for all electrical maintenance support work provided by the workshop.

3.5 Controls the interface with the Senior Store Officer for the requisition of spare parts and consumables; advises the Senior Store Officer on proper stock levels for spare parts.

3.6 Provides input to the Senior Engineering Planning and Scheduling for the development of periodic, outage and emergency maintenance schedules.

3.7 Develops and maintains all electrical maintenance procedures and equipment history files; assures that electrical maintenance staff is adequately trained for the implementation of the electrical maintenance procedures.

3.8 Controls the interface with the Senior Engineer QC for the performance of the necessary inspections and tests at the completion of maintenance repairs.

4.0 QUALIFICATIONS

4.1 Electrical Engineering degree from an accredited university or college.

4.2 Must be thoroughly familiar with the electrical maintenance of thermal power stations.

4.3 Must have completed the additional training for electrical maintenance of coal and ash-handling equipment as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR ENGINEER ELECTRICAL

1.0 SYNOPSIS

The Junior Engineer Electrical is responsible for the implementation of the maintenance activities for assigned station electrical equipment. The incumbent supervises the ongoing maintenance work, verifies that it is conducted in accordance with the applicable procedures, assembles the equipment history file and reports on status and progress. The incumbent reviews spare part requisitions and repair methods. The incumbent interfaces with the other Maintenance Engineers, the Shift Engineers and the Engineers QC for the coordination of maintenance activities.

2.0 ORGANIZATION

The Junior Engineer Electrical reports to the Senior Engineer Electrical. Reporting to the incumbent are a Foreman Electrical and his crew.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the proper implementation of maintenance activities for assigned station electrical equipment.

3.2 Provides direct supervision to the Foreman Electrical and his crew; prepares and processes all administrative support documentation for the maintenance work.

3.3 Implements the maintenance department safety program for each maintenance activity; verifies the strict use of the safety tagging procedures.

3.4 Reports to the Senior Engineer Electrical on work status and progress and any difficulties encountered.

3.5 Initiates the development of maintenance procedures where a need is identified and the revision of existing procedures where necessary.

3.6 Requests support from the Shift Engineers and the Engineers QC when required.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must be thoroughly familiar with the equipment assigned to him.

4.3 Must have completed the additional training for electrical maintenance of coal and ash-handling equipment as recommended in the Preliminary Training Plan, if applicable.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER INSTRUMENTATION

1.0 SYNOPSIS

The Senior Engineer Instrumentation is responsible for the maintenance of all instrumentation and control equipment, including the station computer systems. The incumbent initiates and develops maintenance and calibration procedures and schedules the day-to-day maintenance activities in accordance with the maintenance schedule. The incumbent will provide the required information for an adequate supply of spare parts for equipment under his responsibility. The incumbent will maintain equipment maintenance history files for all instrumentation and control equipment.

2.0 ORGANIZATION

The Senior Engineer Instrumentation reports to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are the Junior Engineers Instrumentation and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the effective and efficient maintenance, calibration and repair of all instruments and control systems of the station, as well as the station computer systems.

3.2 Directs and provides general supervision over the Junior Engineers Instrumentation and their shift personnel; assigns work packages to the Junior Engineers to satisfy the overall station maintenance schedule and periodic calibration requirements.

3.3 Directs the maintenance department safety program for his area of responsibility; enforces the proper and strict use of safety tagging procedures and practices for equipment and personnel safety.

3.4 Controls the interface with the Senior Engineer Workshop for all instrumentation maintenance support provided by the workshop.

3.5 Controls the interface with the Senior Store Officer for the requisition of spare parts and consumables; advises the Senior Store Officer on proper stock levels for spare parts.

3.6 Provides input to the Senior Engineer Planning and Scheduling for the development of periodic, outage and emergency maintenance schedules.

3.7 Develops and maintains all instrument maintenance and calibration procedures and equipment history files; assures that instrument and computer maintenance staff is adequately trained and qualified for the implementation of the instrument maintenance and calibration procedures.

3.8 Controls the interface with the Senior Engineer QC for the performance of the necessary inspections at the completion of repairs.

4.0 QUALIFICATIONS

4.1 Electrical engineering degree from an accredited university or college.

4.2 Must be thoroughly familiar with the instrumentation, control and computer systems of steam power stations.

4.3 Must have completed the additional training for the instrumentation and computer maintenance as recommended in the Preliminary Training Plan.

THERMAL POWER STATION LAKHRA

JUNIOR ENGINEER INSTRUMENTATION

1.0 SYNOPSIS

The Junior Engineer Instrumentation is responsible for the implementation of the maintenance, calibration and repair activities of assigned station instrumentation and computers. The incumbent supervises the ongoing maintenance work, verifies that it is conducted in accordance with the applicable procedures, assembles the equipment history files and reports on status and progress. The incumbent reviews spare part requisitions and repair methods. The incumbent interfaces with the other Maintenance Engineers, the Shift Engineers and the Engineers QC for the coordination of maintenance activities.

2.0 ORGANIZATION

The Junior Engineer Instrumentation reports to the Senior Engineer Instrumentation. Reporting to the incumbent are a Foreman Instrumentation and his crew.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the proper implementation of maintenance and calibration of assigned station instrumentation.

3.2 Provides direct supervision to the Foreman Instrumentation and his crew; prepares and processes all administrative support documentation for the maintenance and calibration work.

3.3 Implements the Maintenance Department Safety Program for each maintenance activity; verifies the strict use of the safety tagging procedures.

3.4 Reports to the Senior Engineer Instrumentation on work status and progress and any difficulties encountered.

3.5 Initiates the development of maintenance and calibration procedures where a need is identified and the revision of existing procedures where necessary.

3.6 Requests support from the Shift Engineers and the Engineers QC when required.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must be thoroughly familiar with the equipment assigned to him.

4.3 Must have completed the additional training in station instrumentation for coal and ash-handling systems and station computer systems, if applicable.

THERMAL POWER STATION LAKHRA

SENIOR STORE OFFICER

1.0 SYNOPSIS

The Senior Store Officer is responsible for establishing an efficient and reliable warehouse inventory control system for expedient availability of mechanical, instrumentation and control and electrical spare parts and materials. Within guidelines the incumbent will develop procedures and instructions to maintain a warehouse program. The incumbent will be responsible for the receiving inspection of all spare parts and materials.

2.0 ORGANIZATION

The Senior Store Officer reports to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent are the Assistant Store Officer and his staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Supervises and directs the warehouse staff.

3.2 Establishes and maintains control over the spare parts and materials inventory control system.

3.3 Responsible for the receiving inspection of all spare parts and materials; coordinates receiving inspections with the Senior Engineer QC where applicable.

3.4 Initiates replacement purchase requisitions as programmed by the inventory control system.

3.5 Implements shipping, handling and storage procedures where applicable.

3.6 Responsible for the warehouse cleanliness.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have several years experience at a steam electric station in maintenance, operation or store operation.

THERMAL POWER STATION LAKHRA

ASSISTANT STORE OFFICER

1.0 SYNOPSIS

The Assistant Store Officer is responsible for the implementation of the warehouse procedures and instructions. The incumbent supervises the receiving, storing and distribution of spare parts and supplies. The incumbent administers the stock levels and initiates adjustments in accordance with the warehouse procedures.

2.0 ORGANIZATION

The Assistant Store Officer reports to the Senior Store Officer. Reporting to the incumbent is the warehouse staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Receives and inspects incoming shipments for order conformity; coordinates receiving inspection with the QC inspectors where applicable.

3.2 Stores materials and supplies in accordance with procedures, affording proper environment and facility for retrieval.

3.3 Assists in maintaining proper housekeeping in the warehouse area.

3.4 Implements the administrative procedures to maintain stock quantities at the required level.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER WORKSHOP

1.0 SYNOPSIS

The Senior Engineer Workshop is responsible for supporting station operation and maintenance by performing repair and overhaul of equipment in the Station Workshop. The incumbent is also responsible for the maintenance of all station vehicles and cranes.

2.0 ORGANIZATION

The Senior Engineer Workshop reports to the Assistant Resident Engineer (Maintenance). Reporting to the incumbent is the Workshop Staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Establishes and maintains all workshop equipment and tools in support of station maintenance.

3.2 Plans, schedules and performs repair and overhaul of station equipment; maintains equipment records and provides input to equipment history file.

3.3 Develops and implements a periodic maintenance and test program for all cranes at the station; maintains a file for all cranes.

3.4 Manages and maintains all vehicles assigned to the station.

4.0 QUALIFICATIONS

4.1 Mechanical or electrical engineering degree from an accredited university or college.

4.2 Must be familiar with maintenance of thermal power station equipment.

THERMAL POWER STATION LAKHRA

SENIOR ENGINEER QC

1.0 SYNOPSIS

The Senior Engineer Quality Control (QC) is responsible for developing and administering effective methods to verify that all material, equipment and workmanship comply with station specifications. The incumbent will develop and implement a Quality Control program, which addresses the control of all special processes, station testing and receiving inspections where applicable.

2.0 ORGANIZATION

The Senior Engineer QC reports to the Resident Engineer. Reporting to the incumbent are 2 Junior Engineers QC and their staff.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Reviews all plans, specifications, requirements and governing regulations and develops a Quality Control Program.

3.2 Supervises and directs the Junior Engineers QC and staff in the implementation of the Quality Control Program.

3.3 Monitors and inspects the warehouse, storage, use and handling of materials and coordinates with Senior Store Officer for the development of measures to conform to the Quality Control Program.

3.4 Coordinates with the Assistant Resident Engineers and Senior Engineer ITR for the performance of inspections and tests.

3.5 Maintains all records and files which are required to demonstrate compliance with the Quality Control Program.

4.0 QUALIFICATIONS

4.1 Suitable engineering degree of an accredited engineering college or university.

4.2 Must be experienced in matters of thermal power station equipment testing, welding, non-destructive examinations and metallurgy.

4.3 Must have a thorough knowledge of manufacturing processes and industry Codes and Quality Control.

THERMAL POWER STATION LAKHRA

JUNIOR ENGINEER QC

1.0 SYNOPSIS

The Junior Engineer Quality Control (QC) is responsible for the implementation of the Quality Control Program activities. The incumbent will supervise the inspections of materials received at the station and monitors compliance of examinations and testing of station equipment with specified requirements.

2.0 ORGANIZATION

The Junior Engineer QC reports to the Senior Engineer QC. Reporting to the incumbent are non-destructive examination operators, test operators, a Steno, a Clerk, Attendants and Helpers.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Supervises the required inspections of materials and equipment during installation, maintenance and repairs, as well as during receiving and storage.

3.2 Inspects fabrication and testing, installation and maintenance of equipment as required by the Quality Control Program.

3.3 Reports on deviations from specified requirements and assists in the implementation of corrective action.

3.4 Prepares and maintains all records required for the implementation of the Quality Control Program.

3.5 Maintains special personnel records in support of the qualification of all personnel involved in the performance of special processes, such as welding and NDE.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have experience and training in one or more facets of Quality Control.

4.3 Must have a knowledge of manufacturing processes and ability to interpret specifications, apply industry codes, read blueprints and interpret test results.

THERMAL POWER STATION LAKHRA

TRAINING COORDINATOR

1.0 SYNOPSIS

The Training Coordinator is responsible for the coordination of the training of all station staff with the training programs of the various WAPDA training facilities, as well as any other "outside" training programs. The incumbent will maintain all training records for the Station Staff. The incumbent will monitor the performance of On-the-Job Trainers and On-the-Job Trainees at the Station.

2.0 ORGANIZATION

The Training Coordinator reports to the Resident Engineer. Reporting to the incumbent area 1 Steno and 1 Senior Clerk.

3.0 DUTIES AND RESPONSIBILITIES

3.1 Is responsible for the coordination of the training of all Station Staff with the WAPDA Technical Training Institutes, the WAPDA Academy, the WAPDA Accounts Training Institute and other WAPDA training facilities as applicable; provides for "outside" training where necessary.

3.2 Maintains personnel training records and schedules in accordance with WAPDA requirements; initiates personnel training and retraining in coordination with the training program schedules of the WAPDA training facilities.

3.3 Instructs and monitors the performance of On-The-Job Trainers and On-the-Job Trainees.

3.4 Identifies training needs in consultation with Station Staff.

3.5 Prepares reports on all activities, accomplishments and requirements relating to training of Station Staff.

4.0 QUALIFICATIONS

4.1 Must meet the requirements of WAPDA for BPS 17.

4.2 Must have completed the WAPDA basic training for Junior Engineers.

4.3 Must have experience in operation or maintenance of steam electric stations; must have attained a minimum level of Jr. Shift Engineer or equivalent.

4.4 Must be familiar with all WAPDA training facilities and their programs.

APPENDIX 6.3

GUIDELINES FOR EVALUATION OF PROJECT ORGANIZATIONS, MAJOR CONSTRUCTION PROJECTS, AND SUPPORT OF OPERATIONS AND MAINTENANCE ACTIVITIES

TABLE OF CONTENTS

	PAGE NO.
INTRODUCTION	6-191
PROJECT ORGANIZATION AND CONTROL OF MAJOR CONSTRUCTION PROJECTS	6-193
Organization and Administration	6-195
Design Control	6-203
Construction Support	6-211
Project Support	6-221
Training	6-231
Test Control	6-237
Quality Programs	6-245
SUPPORT OF OPERATIONS AND MAINTENANCE	6-251
Conduct of Operations	6-253
Maintenance Support	6-256
Technical Support	6-258
Materials Management	6-261
Training and Qualification	6-262
Personnel	6-265
Chemistry	6-267
Industrial Safety	6-268

INTRODUCTION

WAPDA is presently involved in supporting the operation and maintenance of many generating stations of various designs. In addition, a number of very large construction projects are being undertaken and are in various stages of planning, construction or commissioning.

This document can be utilized by WAPDA to determine how well they are supporting, monitoring or directing these activities.

It is not anticipated that WAPDA will have direct responsibility for many of the areas addressed in the "Project Organization and Control of Major Construction Projects" portion of this document. However, WAPDA should evaluate their contractors or hire a consultant to evaluate their contractors to determine the contractor's compliance.

This document can also be effectively utilized when used as a guideline for the development of the Coal Power Projects Department, the improvement of the General Manager, Thermal's organization and the formation of the Lakhra Project Organization.

PROJECT ORGANIZATION
AND
CONTROL OF
MAJOR CONSTRUCTION PROJECTS

ORGANIZATION AND ADMINISTRATION

	PAGE NO.
ORGANIZATIONAL STRUCTURE	6-197
MANAGEMENT INVOLVEMENT AND COMMITMENT TO QUALITY	6-199
THE ROLE OF FIRST LINE SUPERVISORS AND MIDDLE MANAGERS	6-201

ORGANIZATIONAL STRUCTURE

PERFORMANCE OBJECTIVE

WAPDA and all other organizations responsible for the design, engineering, planning, scheduling, construction, quality, and testing of a new generating facility should provide an organizational structure that ensures effective project management.

CRITERIA

A. The project organizational structure should be defined clearly and establis an effective relationship among WAPDA and its contractors, responsible executives and managers for design, construction, procurement, planning, testing, and quality to support the success of the project.

B. Managers associated with the project, either WAPDA's major vendors, archite engineering firms, or contractors, at the executive, corporate, project, design, procurement, construction, start-up, operations, and quality levels clearly understand their relationships regarding the project, including their authorities, responsibilities, and accountabilities.

C. WAPDA's manager assigned principal responsibility for the project activitie (hereafter referred to as Project Director) should have this as his primary responsibility and preferably as his sole responsibility, and he should have the authority to direct the project.

D. WAPDA's project level managers should be assigned responsibility for the following listed functional areas in support of the project activities. Sufficient authority must be held by each individual to carry out assigned responsibilities.

   1. Project control, including planning, scheduling, and cost control
   2. Engineering, analysis, and design control
   3. Procurement control
   4. Construction control
   5. Management information systems
   6. Training and qualifications
   7. Construction testing and turnover control
   8. Quality
   9. Material receipt, handling, storage, and maintenance
   10. Record and document management
   11. Legal and licensing
   12. Staffing

E. The Project Director should exercise control in those functional areas assigned to managers who do not report to him to ensure that the plant is

engineered, designed, and constructed in a manner resulting in a safe and reliable plant.

F. The Project Director's relationship to higher WAPDA management and ultimately to the Member, Power could be clearly defined and documented.

G. Clearly defined access to the Project Director must be provided to other managers having responsibility for the functional areas under Criterion D.

H. WAPDA administration of contracts should be delegated clearly with contractual obligations well-understood and enforced. Responsibility and appropriate authority for prompt action on contract changes, renegotiations, or violations of contractors should be assigned.

I. Staffing for all project organizations should be adequate for the authorities and responsibilities assigned.

MANAGEMENT INVOLVEMENT AND COMMITMENT TO QUALITY

PERFORMANCE OBJECTIVE

Senior and middle managers in the main office of WAPDA, designer's office, and at the construction site who are assigned functional responsibility for matters relating to the project should exhibit, through personal interest, awareness, and knowledge, a direct involvement in significant decisions that could affect their responsibilities.

CRITERIA

A. Written statements of policy should address the subjects relating to the engineering, design, and construction of projects. These statements should include policies related to project quality such as workmanship, problem identification and correction, tracking of action items, reporting, and procedure compliance.

B. Project personnel in the Lahore office and at the construction site and designer's offices must be aware of these policy statements and have them readily available for reference. They should be able to explain how these policies are put into practice and the policies should have a high degree of credibility.

C. Project personnel should demonstrate compliance with these policy statements and the statements should have a high degree credibility.

D. Both vertical and horizontal communication of significant problems and corrective actions should be effective and coordinated to provide an accurate representation of conditions.

E. Meetings involving WAPDA and project management personnel should result in the regular review of key aspects of the project.

F. WAPDA managers should be made aware of and utilize appropriate design and construction progress data and trends in setting goals and objectives and in management decisions involving the project.

G. Methods should be established that permit data and trends to be compared with results/performance at similar construction projects.

H. WAPDA managers responsible for the project should be familiar with activities and reports that affect design and construction. They should be cognizant of and sensitive to problems and external factors that might affect progress or quality. Examples of such involvement include the following:

   1. Review of applicable evaluation, and inspection results conducted by internal and external organizations.

2. Personal interface with the engineering, design, and construction organizations and personal observations of their activities.

3. Review of industry's engineering, design, and construction experience and trends.

4. Review of project plans and schedules and reports of actual progress versus planned progress.

5. Review of worker performance indicators such as rework and reject rates.

I. Management support and actions should reflect appropriate attention to areas such as project management, cash flow management, scheduling, planning, staffing, training, compensation, personnel relations, and WAPDA-contractor relations affecting project quality.

J. Designated managers associated with the project should have responsibility and authority, by policy and practice, to stop or delay engineering, design, or construction activities when their judgment indicates that continuation will result in a failure to meet the project objectives.

K. Management accountability for the projects should be consistent with the project structure and extend to the contractors, architect engineering firm, and vendors.

THE ROLE OF FIRST LINE SUPERVISORS AND MIDDLE MANAGERS

PERFORMANCE OBJECTIVE

The project first line supervisors and middle managers should be qualified by verified background and experience and have the necessary authority to carry out their functional area responsibilities.

CRITERIA

A. Position descriptions or the equivalent should be employed for each key management and supervisory position.

B. Minimum qualification, experience, and training requirements should be defined for project first line supervisors and middle managers.

C. Authorities and responsibilities should be defined clearly. Personnel should clearly understand and accept their relationship in the organization and their authorities, responsibilities, and accountabilities.

D. The first line and middle managers should be actively and personally involved in the project functional activities. Functions that could be performed include the following:

   1. Approval of qualification requirements for positions that report directly to them.

   2. Provisions of input to and understanding of project policies governing each functional area covered in this document.

   3. Assessment of selected programs and activities relating to project activities, including follow-up on corrective actions.

   4. Close involvement with review groups performing independent reviews of matters affecting safety and reliability.

   5. Assurance that effective actions are taken on reports of significant and unusual project deficiencies in their area of responsibility.

   6. Regular review of project status and current problems.

   7. Review selected data and trends discussed in the functional sections of this document.

   8. Monitoring organization's performance against established goals and objectives.

9. Involvement in and understanding of trending programs and corrective actions related to developing adverse trends.

10. Active involvement in ensuring that construction practices and procedures are followed in a manner that enhances the quality of the end product.

11. Ensuring that workers are qualified for their individual assignments and that they perform their work to project standards.

E. The project middle managers should be sensitive to the need to control work assignments to ensure that project-related effort is not diluted.

F. Appropriate supervisory, technical, and procedural training should be conducted for first line and middle managers having responsibilities for functional areas in support of project activities, records of attendance, material presented, and test results (if given) should be retained.

DESIGN CONTROL

	PAGE NO.
DESIGN INPUTS	6-205
DESIGN INTERFACES	6-206
DESIGN PROCESS	6-207
DESIGN OUTPUT	6-209
DESIGN CHANGES	6-210

DESIGN INPUTS

PERFORMANCE OBJECTIVE

Inputs to the design process should be defined and controlled to achieve complete and quality designs.

CRITERIA

A. Design inputs such as Codes, standards, criteria, and other design basis should be identified, clearly defined, documented, evaluated, and approved, and their scope of applicability must be defined prior to their use in the design process.

B. The design inputs must consider all of the requirements necessary to produce a quality design.

C. Plant constructability, operability, inspectability and maintainability must be considered in plant designs.

D. The design inputs should consider feedback from pertinent industry engineering, design, and construction experience.

E. The design inputs should be provided at a level of detail and clarity necessary to be useable and understandable by all persons using these inputs.

F. A systems, components, and materials experience information base, to the extent available, is a key element in the design process. Specifications for equipment that do not have a substantial service history should contain a requirement for supplier acceptance tests.

G. The issuance and use of design inputs should be controlled by the use of complete and understandable procedures.

H. All changes to the approved design inputs are documented and approved prior to their use. Approval is by a configuration control group consisting of discipline and operating personnel.

I. Design personnel utilize supplier expertise as applicable in the design process.

J. Design and design control information is readily available for use by all design personnel.

DESIGN INTERFACES

PERFORMANCE OBJECTIVE

Design organization external and internal interfaces should be identified and coordinated to ensure a final design that satisfies all input requirements.

CRITERIA

A. The flow of design information between both external and internal organizations should be controlled and timely.

B. The external and internal interfaces and responsibilities must be defined and controlled by procedures.

C. Oral and other informal means of communications, including letters and memorandums, which provide significant design information, should be confirmed and promptly made a part of the design input by a controlled document.

D. System interaction must be considered in system design and analysis.

E. Systematic and effective lines of communication should be established.

F. Design and design change information should be coordinated effectively with all impacted disciplines and operating personnel.

G. Transfer of design responsibilities and documents from one organization to another should be planned and implemented in a controlled manner.

DESIGN PROCESS

PERFORMANCE OBJECTIVE

The management of the design process should result in designs that are safe, reliable, verifiable, and in compliance with the design requirements.

CRITERIA

A. The design process should be documented, planned, and scheduled to ensure an orderly sequenced process for completing design.

B. Responsibility for controlling each function of the design process, including the preparation, review and approval of input, in-process, and output documents, should be defined clearly, documented, and understood.

C. The overall design review process should include system design reviews; verification of calculations, methods, and computer runs; and validations of computer codes and models.

D. Design documents should include their scope and applicability as well as the identity of the originator and checker.

E. Calculations and analyses should clearly specify information such as applicability, assumptions, design inputs, references, methods, and results in a manner that allows a technically qualified person to understand the calculations or analyses.

F. When an independent check of calculations and analyses is required, it should be performed by a technically qualified person, and the method of checking should be noted on the documents.

G. Design process problems should be identified, and decisions made to resolve the problems in a timely and effective manner.

H. Supervisory and management involvement in the design process should be evident by the quality and timeliness of the output information and resolution of design problems.

I. Design personnel should provide timely technical support and follow-up on systems they have designed.

J. Design processes should be monitored for compliance with design commitments.

K. Design control measures, such as procedures and checklists, should be used to ensure that design inputs, such as design criteria, design bases,

codes, and standards, are translated correctly into design documents, including specifications, calculations, drawings, procedures, instructions, and other documents needed to build a plant.

L. Drawings, specifications, and other design documents should be prepared under a controlled process that establishes standards for pertinent items such as format, content, status, and revision.

DESIGN OUTPUT

PERFORMANCE OBJECTIVE

Project design documents should specify constructable designs in terms of complete, accurate, and understandable design requirements.

CRITERIA

A. The purpose of each type of design document should be defined clearly.

B. Design output documents must reflect a constructable, operable and maintainable design that meets the design input requirements.

C. The total design package should be complete and understandable without the need for extensive coordination or interpretation by construction or vendor personnel.

D. The design organization should be aware of the capabilities and requirements of the supplier and the construction organization.

E. Sufficient detail, legibility, and clarity for interpretation and reproduction must be provided in design output documents to facilitate correct implementation of the design.

F. The design organization should be responsive to the need for clarification of design output documents where these needs are identified.

G. Design output documents should be issued and kept current using a controlled process.

DESIGN CHANGES

PERFORMANCE OBJECTIVE

Changes to released project design documents should be controlled to ensure that constructed designs comply with the most recent design requirements.

CRITERIA

A. The design organization should be responsive in a timely and effective way to the need for changes when these needs are identified.

B. Reasons for the change should be identified, evaluated, and, if necessary, actions taken to avoid future problems.

C. The responsible design organization should consider inputs to the original design before a change is issued.

D. Design changes should be coordinated with any affected discipline and/or organization in a timely manner.

E. Appropriate procedures and methods should be revised if design changes make these revisions necessary.

F. Prior to the approval of the design change, consideration should be given to quality, safety, cost, and schedule.

G. Changes should be subject to control measures commensurate with those of the original design.

H. A system should be utilized to determine whether or not the change being made impacts other parts of the system being changed, other areas of the plant, or other plants under construction.

I. Methods must be in place to ensure that changes are implemented in a timely manner.

J. All changes, including those initiated by construction, vendor, or design, should be properly approved by the design organization and incorporated into the design documents.

K. Appropriate design changes should be evaluated promptly by each affected discipline and necessary corrective action should be taken and documented in a timely manner.

L. Design change review should consider the change impact on items such as calculations, system functional requirements, inspectability, maintainability, and selection of equipment and material.

CONSTRUCTION SUPPORT

	PAGE NO.
CONSTRUCTION ENGINEERING	6-213
CONSTRUCTION FACILITIES AND EQUIPMENT	6-214
MATERIAL CONTROL	6-215
CONSTRUCTION WORK PLAN	6-216
CONTROL OF CONSTRUCTION PROCESSES	6-217
CONSTRUCTION QUALITY INSPECTIONS	6-218
CONSTRUCTION CORRECTIVE ACTIONS	6-219
TEST EQUIPMENT CONTROL	6-220

CONSTRUCTION ENGINEERING

PERFORMANCE OBJECTIVE

Engineering and design performed under the authority of the construction organization should be controlled as to consistency with the basic design criteria.

CRITERIA

A. Construction engineering authority should be documented and limits of responsibility and authority should be defined clearly.

B. Procedures should be effective in controlling the engineering and design processes of the construction engineering organization.

C. Guidelines should be issued to ensure that the basic design criteria used by the construction engineering organization is consistent with that used in the original plant design.

D. Interface links between architect engineering home office and the construction engineering group should be defined clearly, efficient, and effective.

E. Interface links between major vendors and subcontractors and the construction engineering group must be defined clearly, efficient, and effective.

F. Construction engineering field change control should be effectively maintained as required to support the construction effort and to ensure final as-built conditions as defined.

G. Construction engineering should support major construction equipment processes (e.g., special rigging studies and transportation studies) with calculations and design prior to important field construction effort.

H. State-of-the-art, engineering and design verification should exist for construction engineering processes.

I. Proper engineering and design issuance approval processes should exist to support quality and the construction process and to ensure internal management awareness of generic problems in original design, design changes, or construction processes.

J. Field detail sketches and drawings for fabrication and installation should accurately reflect basic design drawings and documents.

K. Linkage to the document control system should exist to ensure engineering and design documents are handled properly.

CONSTRUCTION FACILITIES AND EQUIPMENT

PERFORMANCE OBJECTIVE

Construction facilities and equipment should be planned for, acquired, installed, and maintained consistent with project needs to support quality construction.

CRITERIA

A. A site plan should provide for key location facilities such as warehouses, craft shops, equipment storage and production facilities.

B. Construction equipment should be acquired in a manner to support the construction schedule and be maintained in an optimum condition to support quality work.

C. Facilities and equipment, both temporary and permanent, should meet the project needs and specifications, and be maintained in accordance with established requirements.

D. Periodic inspections or surveillances of the work areas and activities should be performed to ensure that facilities and equipment support construction needs.

MATERIAL CONTROL

PERFORMANCE OBJECTIVE

Material and equipment should be inspected, controlled, and maintained to ensure the final as-built condition meets design and operational requirements.

CRITERIA

A. The receiving process must ensure that receiving inspections evaluate incoming materials and equipment against the procurement specifications and results in proper and timely disposition of deviations.

B. Materials and equipment should be identified properly to control installation and use.

C. Quality documentation for received material should be accounted for, reviewed, accepted, filed, and retrievable.

D. Items received should be processed in a timely manner to allow early identification of those items requiring special handling, storage, and preventive maintenance.

E. Non-conforming items should be identified and controlled to prevent unapproved use.

F. Material and equipment storage, handling, and security should be controlled effectively in accordance with specified requirements.

G. The warehousing facility should have an accurate inventory control system that provides for the timely location of items.

H. The issuance process should ensure that correct material is issued in accordance with engineering requirements.

I. Effective preventive maintenance should be initiated at the appropriate time and continued throughout the construction process.

J. Systems and equipment, both received and installed, must be maintained to prevent deterioration and to ensure appropriate cleanliness. Environmentally sensitive equipment must be protected adequately from the degrading effects of temperature, humidity and dirt.

CONSTRUCTION WORK PLAN

PERFORMANCE OBJECTIVE

Work should be planned and coordinated in a manner that results in effective and efficient use of manpower.

CRITERIA

A. Elements of work should be defined into manageable segments that can be accomplished by a typical work unit on a definite schedule.

B. Elements of work should be defined in a way that clearly identifies the construction unit or discipline responsible for the work.

C. Based on input from those involved, a controlling construction schedule must exist that provides a schedule of completion for basic work elements and that provides management with an overview method of tracking milestones.

D. Elements of work should be recorded in a tracking system that is prepared prior to the work being performed and allows the status of the work to be determined based on installed quantities.

E. Work activities should be integrated into the controlling construction schedule in a manner that facilitates construction erection sequence and minimizes interference.

F. Quality control hold point inspections should be integrated with the work activities.

G. The work activities should address support requirements for the segments of work to be accomplished.

H. Work plans should provide for a smooth transition from bulk scheduling to system completion scheduling.

CONTROL OF CONSTRUCTION PROCESSES

PERFORMANCE OBJECTIVE

The construction organization should monitor and control all construction processes to ensure the project is compieted to design requirements and that a high level of quality is achieved.

CRITERIA

A. Construction activities should be identified in advance to allow for development of procedures; and selection, training, and qualification of personnel.

B. Work procedures and instructions should have sufficient detail to ensure that construction activities are in accordance with engineering requirements.

C. Construction activities should be performed in accordance with work procedures and instructions, and the current revisions of drawings approved for construction.

D. Rework activities should be performed in accordance with established procedures and subject to required inspections.

E. Work must be performed by and under the supervision of qualified personnel who recognize and accept a responsibility for quality.

F. Proper tools must be available and used correctly.

CONSTRUCTION QUALITY INSPECTIONS

PERFORMANCE OBJECTIVE

Construction inspections should verify and document that the final product meets the design and quality requirements.

CRITERIA

A. The inspection process should be defined accurately prior to the start of the work and controlled to meet the requirements of the project.

B. Inspection procedures should be clear, define the inspection process in detail, and reference appropriate acceptance criteria.

C. Construction inspection should be integrated into the construction processes and work schedules.

D. Construction inspections should be performed using written procedures.

E. Calibrated equipment used in construction inspections must be of the proper type, range and accuracy.

F. The records should clearly indicate the scope of the inspections, the inspector, and the results.

G. An effective system should be in place to encourage the reporting of degraded quality without penalty.

H. Construction inspections should be performed by WAPDA or their contracted representative, not by the constructor or contractor.

CONSTRUCTION CORRECTIVE ACTIONS

PERFORMANCE OBJECTIVE

The construction organization should evaluate audits, inspections and surveillances, and process replies, perform follow-up, and take corrective action to prevent recurrence.

CRITERIA

A. The construction organization must track construction audits and surveillances, prepare well-researched replies that address the deficiencies, and take prompt and effective corrective action.

B. The construction organization should evaluate audits for generic problems and trends and take appropriate action to prevent recurrence.

C. Nonconformances should be identified, tracked, and closed out in a timely manner.

D. The construction organization should review nonconformances to ensure corrective actions have been taken, evaluate for trends, and report problem areas to upper management.

TEST EQUIPMENT CONTROL

PERFORMANCE OBJECTIVE

Measuring and test equipment should be controlled to support construction testing effectively.

CRITERIA

A. Measuring and test equipment utilized for testing should be identified uniquely.

B. Measuring and test equipment should be controlled to ensure that only properly calibrated equipment is used for testing.

C. Specific programs should be implemented to provide regular calibration of instrumentation and to track status and calibration of each instrument used for testing.

D. Special procedures should be implemented to identify retest requirements when instrumentation is found to be defective.

E. The construction organization should track equipment out-of-tolerance reports and work performed so incorrect work can be corrected.

F. The construction organization should establish regular maintenance and calibration intervals for all equipment and ensure timely calibration for each device.

G. Calibration should be accomplished correctly using certified equipment traceable to recognized standards or methods. Calibration records should be retained and retrievable.

PROJECT SUPPORT

	PAGE NO.
INDUSTRIAL SAFETY	6-223
PROJECT PLANNING	6-224
PROJECT CONTROL	6-225
PROCUREMENT PROCESS	6-226
CONTRACT ADMINISTRATION	6-227
DOCUMENT MANAGEMENT	6-228
CORRECTIVE ACTIONS	6-229

INDUSTRIAL SAFETY

PERFORMANCE OBJECTIVE

The construction site industrial safety program should achieve a high degree of personnel safety.

CRITERIA

A. An effective industrial safety program with clearly defined policies, procedures, scheduled training requirements, and individual responsibilities must be implemented, with the full support of managers and supervisors.

B. Selected data and trends of industrial safety activities should be monitored, including the following:

   1. Summary analysis of first aid treatments
   2. Analysis of accidents requiring doctor's care
   3. Incidence of lost time accidents
   4. Frequency of safety violations identified

C. General housekeeping practices should prevent the accumulation of debris and trash.

D. A safe and orderly job site working environment should exist.

E. Lifting and rigging equipment should be checked regularly.

F. A fire protection program should be defined, organized, and well-publicized.

G. The site should effectively control hazardous materials.

H. A safety tagging program should exist and be implemented effectively to protect equipment, personnel, and material.

PROJECT PLANNING

PERFORMANCE OBJECTIVE

Project plans should ensure completion of the project to the highest industry standards by identifying, inter-relating, and sequencing the tasks of the project organizations.

CRITERIA

A. The project master plan should present the inter-relationships of tasks within and among the plans for the various elements of the project.

B. The project plans must be documented and approved by the appropriate level of management.

C. The project plans must be updated to reflect changing conditions.

D. The project plans should be communicated to the responsible project members.

E. Clear lines of authority and responsibility should exist between the individual assigned responsibility for plan development and those responsible for plan implementation.

F. Individuals assigned responsibility for planning for each functional area of the project must provide the necessary data.

PROJECT CONTROL

PERFORMANCE OBJECTIVE

Control over project schedules, costs, estimates, and related activities should ensure that the objectives of the project plan are met.

CRITERIA

A. Individuals responsible for functional areas must demonstrate awareness of the need for project controls and carry out those controls as required.

B. Data generated by the management information systems must be clear, concise, and understood by corporate management and those individuals responsible for the functional areas.

C. Deviations from project plan, schedule, and cost estimate objectives must be identified. Corrective actions should be implemented and their effectiveness measured.

D. Project controls should address resource allocation (i.e., manpower, cash flow, equipment, design information).

E. Quantities and unit rates should be tracked accurately to ensure validity of schedules and budgets.

F. Schedules and cost estimates, at various levels of detail, should be used to monitor the project effectively.

G. The impact of regulatory, productivity, design and similar changes should be analyzed for trends. Appropriate actions should be taken to modify the plan and schedule.

H. Schedules, costs, estimates and related control elements should be maintained in a current status.

I. Follow-up and tracking systems should ensure that project commitments are met in a timely manner.

PROJECT PROCUREMENT PROCESS

PERFORMANCE OBJECTIVE

The project procurement process should ensure that equipment, materials, and services furnished by suppliers or contractors meet project requirements.

CRITERIA

A. Procurement documents should provide clear and adequate technical, commercial and administrative information required to define the scope and requirements of the contract.

B. The preparation, review and approval of procurement documents should be controlled in accordance with established procedures.

C. A list of qualified suppliers or contractors should be used in the procurement process.

D. Only those suppliers or contractors who are listed as qualified should be requested to furnish bids or proposals.

E. Proposals and bids must be evaluated for compliance with the requirements and scope defined in the procurement documents. These evaluations should be performed by the personnel responsible for the preparation of the procurement specifications.

F. The recommendation and contract award should be conducted in accordance with established procedures.

G. Sub-tier suppliers or contractors must be contractually bound to adhere to related portions of the contract.

H. Supplier and contractor performance histories should be used to improve the procurement process.

CONTRACT ADMINISTRATION

PERFORMANCE OBJECTIVE

Methods for administering and controlling contractors and suppliers, and for managing changes to their contracts, should ensure effective control of performance.

CRITERIA

A. Changes are prepared, reviewed, and should be approved in the same manner as the original requirements.

B. Changes must be justified with respect to quality, safety, cost, and schedule and are approved by an appropriate level of management.

C. All verbal or informal changes should be approved and confirmed promptly in writing within the guidelines of the change procedures.

D. Performance should be monitored and corrective action is implemented as required.

E. Contractors should provide both incentives and penalties as a result of the final product's quality.

DOCUMENT MANAGEMENT

PERFORMANCE OBJECTIVE

The management of project documentation should support the effective control and coordination of project activities.

CRITERIA

A. Administrative policies and procedures should be employed to control project documents.

B. The project should have a system that is effective in identifying the current status of project documents such as:

   1. Drawings
   2. Component support drawings
   3. Specifications
   4. Structure/system descriptions
   5. Vendor drawings and manuals
   6. Design criteria and procedures

C. The project should have a structured program that effectively incorporates approved changes or revisions into the project documents within an acceptable time frame.

D. A distribution system should be defined and ensure timely distribution of current project documents to engineering, construction, and project support personnel within the project organization, and appropriate contractors and vendors.

E. The project should maintain master files of the latest revision of project documents that are correct and accessible.

F. Storage of document should provide for secure maintenance of permanent and non-permanent records.

CORRECTIVE ACTIONS

PERFORMANCE OBJECTIVE

Conditions requiring corrections or improvements should be resolved in an effective and timely manner.

CRITERIA

A. Conditions adverse to quality should be reported promptly and accurately.

B. The responsible organization must assume its responsibility for and its management must be involved in and support the correction of adverse quality.

C. The senior levels of management should be apprised of adverse quality conditions and hold the responsible supervisors accountable.

D. Corrective action should resolve not only the reported item, but also the basic cause in a manner that ensures the quality of future activities.

E. Effective corrective action should be taken in a timely manner.

F. Quality trends should be developed and analyzed to effectively address generic problems and basic causes of degraded quality.

TRAINING

	PAGE NO.
TRAINING MANAGEMENT SUPPORT	6-233
TRAINING ORGANIZATION AND ADMINISTRATION	6-234
GENERAL TRAINING AND QUALIFICATION	6-235
TRAINING FACILITIES, EQUIPMENT, AND MATERIAL	6-236

TRAINING MANAGEMENT SUPPORT

PERFORMANCE OBJECTIVE

Management should ensure that an effective program exists for indoctrination, training, and qualification of personnel involved in the project.

CRITERIA

A. Corporate managers in each area should have an active interest and involvement in the training program.

B. Training of corporate managers should be conducted in areas related to their role in the design and construction of a safe and reliable plant.

C. Training should be neither interrupted, deferred, or cancelled, nor should personnel be routinely diverted from training to other activities.

D. Management and supervisors should be actively involved in assessing the qualifications and training needs of individuals with respect to their assigned tasks.

E. Management should make use of feedback information to improve the effectiveness of the training program.

F. Actions taken as a result of monitoring training and qualification trends should be reviewed on a periodic basis.

TRAINING ORGANIZATION AND ADMINISTRATION

PERFORMANCE OBJECTIVE

The training organization and administration should ensure effective control and implementation of training activities.

CRITERIA

A. The training organization should be defined clearly.

B. Training and qualification goals and objectives must be established.

C. Training and qualification efforts should be governed by procedures that outline responsibilities of the training organization.

D. Training personnel should be provide training and opportunities to enhance their performance as instructors.

E. Training programs should address organizational needs at appropriate levels.

F. Technical and non-technical training requirements for individuals should be defined clearly and documented.

G. An active program should exist to acquire feedback for the purpose of developing, modifying, or improving the training programs.

H. Training activities should be conducted regularly and results documented.

GENERAL TRAINING AND QUALIFICATION

PERFORMANCE OBJECTIVE

The training program should ensure that all employees receive indoctrination and training required to perform effectively, and that they are qualified where necessary.

CRITERIA

A. Initial selection, training and indoctrination should enable individuals to perform assigned responsibilities effectively.

B. The previous qualification and training of new hires and transfers should be verified.

C. Individuals should be qualified as appropriate for their assigned responsibilities.

D. Training on a continuing basis, both formal and on-the-job, should maintain the employee's ability to perform consistently and effectively.

E. Continuing training should provide an effective means of keeping employees up-to-date regarding changes to policies, procedures, processes, instructions, and commitments.

F. Individuals should be requalified or recertified as required to keep their current qualifications.

G. There should be an active program to acquire and use feedback to modify and improve training methods and content.

TRAINING FACILITIES, EQUIPMENT, AND MATERIAL

PERFORMANCE OBJECTIVE

The training facilities, equipment, and material should support and enhance training activities.

CRITERIA

A. Classroom facilities should be provided for group instruction.

B. Reference materials should be up to date and readily accessible.

C. Equipment should be available as needed to support training material development.

D. Training aids and material should be provided to support the program.

E. Test and certification records should be available and regularly updated, and a follow-up system for required recertification of personnel should be utilized.

TEST CONTROL

	PAGE NO.
TEST PROGRAM	6-239
TEST GROUP ORGANIZATION AND STAFFING	6-240
TEST PLAN	6-241
SYSTEM TURNOVER FOR TEST	6-242
TEST PROCEDURES AND TEST DOCUMENTS	6-243
SYSTEM STATUS CONTROLS	6-244

TEST PROGRAM

PERFORMANCE OBJECTIVE

The test program should verify the plant's full capability to operate as intended by functionally testing the plant's sytems.

CRITERIA

A. A clear policy should be developed and endorsed by top management which describes the test organization's responsibility for component, system, and preoperational testing.

B. The principal design organization should be involved in formulating test objectives and acceptance criteria.

C. The test program should describe the scope of system testing, provide detailed guidance for conduct of testing, and include methods for evaluation of completed tests.

D. Nonconforming conditions and discrepancies should be identified and tracked, and appropriate resolution or corrective action should be achieved.

E. Adequacy of plant operating, maintenance, and emergency procedures must be demonstrated.

F. The test program should describe the quality program under which it functions.

TEST GROUP ORGANIZATION AND STAFFING

PERFORMANCE OBJECTIVE

The test group organization and staffing should ensure effective implementation of the test program.

CRITERIA

A. The test group organizational structure and organizational relationship to interfacing organizations should be defined clearly.

B. The staff build-up must accommodate the early requirements for testing procedure and schedule preparation.

C. The staff size should be sufficient to accomplish the assigned tasks as dictated by the test schedule.

D. Permanent plant personnel should be utilized during testing, to the maximum extent practical, in order to enhance their experience and training.

E. Key management, supervisory and professional positions should be described in writing.

F. Personnel who are assigned to perform testing should meet the experience and qualification requirements delineated in written position descriptions.

G. Qualifications of test personnel should be maintained by on-going training.

TEST PLAN

PERFORMANCE OBJECTIVE

The test organization should prepare a plan and a schedule that describe the sequence of system or component testing to support major schedule milestones.

CRITERIA

A. The plan and schedule should be developed by personnel experienced in test and start-up operations.

B. The plan and schedule should be coordinated with the engineering and construction schedules such that restraints are identified for project management action.

C. The plant systems should be scoped into logical, bounded, well-defined subsystems which can be tested as units.

D. The schedule for individual system or component testing should describe the required elements of testing, including those systems that are required to support individual system testing.

E. The status of testing should be monitored by a tracking system.

SYSTEM TURNOVER FOR TEST

PERFORMANCE OBJECTIVE

The construction testing and turnover process should be controlled effectively to ensure that program objectives are met.

CRITERIA

A. Jurisdiction must be delineated for organizations responsible for the conduct of tests, acceptance of results, and turnover to succeeding test programs.

B. Tests must be performed and results evaluated for conformance to design requirements.

C. Retests should be performed when necessary, and controlled to ensure completeness of verification.

D. System walk-downs should be conducted by appropriate and qualified individuals and entities, who effectively identify engineering, maintenance and construction deficiencies

E. System turnover procedures should clearly identify participants, duties, responsibilities, and documentation necessary for the turnover process.

F. Turnover documents should identify boundaries, material, equipment, deficiencies, and exceptions existing at the time of turnover.

G. Turnover exceptions must be tracked effectively and corrected in a timely manner.

H. The lead design, construction, quality control and testing organizations should integrate project needs effectively and accomplish the turnover process in a timely manner.

TEST PROCEDURE AND TEST DOCUMENTS

PERFORMANCE OBJECTIVE

Test procedures and test documents should provide appropriate direction and should be used effectively to verify operational and design features of respective systems.

CRITERIA

A. Necessary technical data should be used in test procedure preparation.

B. Approved test procedures should be available at least 60 days prior to their intended use.

C. The test procedures should clearly describe the objectives, prerequisites, system boundaries, and acceptance criteria for tests.

D. Test procedures and results should receive a prescribed review before approval.

E. Tests should be performed in accordance with approved procedures.

F. Necessary retesting should be conducted when design changes occur during the test phase.

G. System and area cleanliness and maintenance programs must be continued during the test phase.

SYSTEM STATUS CONTROLS

PERFORMANCE OBJECTIVE

A method should exist to identify the status of each system or component and the organization holding control or jurisdiction of that system or component to prevent interference and ensure equipment and personnel safety.

CRITERIA

A. Policies and procedures for plant status controls must be implemented during testing.

B. A system should be implemented to ensure current knowledge of the status of systems.

C. Activities affecting the status of systems and changes of status should be authorized by designated personnel and be appropriately documented.

D. Tagging systems must be coordinated among the various groups involved in the project to ensure control of status, and equipment and personnel safety.

E. Procedures should be implemented to install, control, remove, and periodically review temporary field modifications.

F. Jurisdiction and control of construction work on systems after initial turnover should be clearly defined and implemented.

G. Complete and current system documentation packages, including all changes and revisions resulting from the testing program, should be provided to the plant operating staff in a timely manner.

QUALITY PROGRAMS

	PAGE NO.
QUALITY PROGRAMS	6-247
PROGRAM IMPLEMENTATION	6-248
INDEPENDENT ASSESSMENTS	6-249

QUALITY PROGRAMS

PERFORMANCE OBJECTIVE

The quality program scope, content, and applicability should be appropriate, defined clearly, and understood.

CRITERIA

A. The quality programs should include all necessary program elements.

B. Day-to-day activities should be observed and monitored under a continuing program designed to ensure the highest quality of personnel performance, workmanship and attention to detail.

C. The quality program should be applied, in an appropriately graduated way, to the entire project.

D. The relationship between manuals and the applicability of procedures should be defined clearly and understood.

E. Surveillance schedules should be modified as appropriate to verify the effectiveness of program implementation and to reflect the need for increased monitoring.

F. WAPDA should conduct evaluations of the quality program of contractors with sufficient regularity and in sufficient depth to ensure program effectiveness.

G. The program should provide for training of personnel as necessary to ensure that suitable proficiency is achieved and maintained.

PROGRAM IMPLEMENTATION

PERFORMANCE OBJECTIVE

Quality control functions should be performed in a manner to support and control the quality of the project activities.

CRITERIA

A. The relationship of the quality control organization with other organizations and individuals should be defined clearly to ensure their independence.

B. Quality control personnel should have a cooperative relationship with other project personnel and should be free of harrassment and intimidation.

C. Quality control should function in a manner to support management.

D. Quality control should support the development and maintenance of the qualified bidders list to ensure sources of quality products and services are available.

E. The quality programs of vendors and contractors should include measures to achieve quality, and should be implemented in an effective manner.

F. Project organizations should utilize technical specialists in the implementation of the quality requirements.

G. Project management should review the methods, including incentive plans, developed by project organizations to ensure that quality is achieved.

H. Purchasing and contract documents should be reviewed to ensure inclusion of requirements to achieve quality.

INDEPENDENT ASSESSMENTS

PERFORMANCE OBJECTIVE

Management should provide an effective, independent assessment of project activities impacting the quality of the project.

CRITERIA

A. A plan should be implemented to ensure that audits and surveillances effectively assess applicable project activities in a timely manner.

B. The results of independent assessments should identify substantive issues affecting performance.

C. Independent assessments should be performed by individuals with no direct functional responsibilities for the area being assessed.

D. Independent assessments should be performed by individuals suitably qualified to conduct the assessment.

E. The results of the assessments and evaluations should be directed to and used by the management of organizations to improve their effectiveness.

F. Periodic evaluations of the effectiveness and adequacy of the total quality program should be performed. Results should be reported to the senior management level, and appropriate action should be implemented.

SUPPORT OF
OPERATIONS
AND
MAINTENANCE

247

CPD SUPPORT OF OPERATIONS

	PAGE NO.
CONDUCT OF OPERATIONS	6-255
MAINTENANCE SUPPORT	6-256
TECHNICAL SUPPORT	6-258
MATERIALS MANAGEMENT	6-261
TRAINING AND QUALIFICATION	6-262
PERSONNEL	6-265
CHEMISTRY	6-267
INDUSTRIAL SAFETY	6-268

CONDUCT OF OPERATIONS

PERFORMANCE OBJECTIVE

Certain aspects of the conduct of station operations should be monitored by Coal Power Projects Department management. As a result of this effort, support, guidance, and assistance should be provided to the station(s) as required to ensure and enhance plant safety and reliability.

CRITERIA

A. Plant conditions, trends, and operational data should be monitored. Examples of items that could be monitored include the following:

   1. Availability, efficiency, and capacity factors
   2. Unplanned outages due to various causes
   3. Unplanned power reductions, and start-up or trip recovery delays due to various causes
   4. Efforts to reduce or eliminate operator distractions in the control room(s), such as (1) alarms/annunciators in an alarm or abnormal condition, (2) faulty or out-of-calibration instrumentation, (3) requirements for long-term tagging of equipment, and (4) long-term use of jumpers and lifted leads
   5. Unanticipated or unusual occurrences
   6. Operator performance
   7. Operator staffing levels

B. The underlying causes of problems should be identified by monitoring the conduct of station operations. Effective corrective actions should be initiated and tracked to completion.

C. Methods should be established that permit data and trends, such as those cited above, to be compared with results/performance at other plants of similar design.

D. Actions taken as a result of monitoring operations data and trends should be reviewed with higher levels of WAPDA management on a periodic basis.

MAINTENANCE SUPPORT

PERFORMANCE OBJECTIVE 1

Maintenance activities at the station(s) should be monitored by CPPD management. As a result of this effort, support, guidance, and assistance should be provided to the station(s) to ensure and enhance plant safety and reliability.

CRITERIA

A. The plant conditions, trends, and maintenance data should be monitored. Examples of items that could be monitored include the following:

   1. Availability, efficiency, and capacity factors
   2. Unscheduled outages due to material and equipment problems
   3. Work order status and trends, including outage performance and end-of-outage backlog
   4. Work order and modification planning for the next major scheduled outage
   5. Preventive maintenance deferrals and backlog
   6. Significant recurring corrective maintenance on selected major components or systems
   7. Summary status of faulty or out-of-calibration instruments

B. The underlying cause of problems should be identified by monitoring station maintenance activities. Effective corrective action should be initiated and tracked to completion.

C. Action taken as a result of monitoring maintenance data and trends should be reviewed with higher levels of corporate management on a periodic basis.

PERFORMANCE OBJECTIVE 2

CPPD management should ensure that adequate personnel are supplied from its resources or contractors to provide support for the station(s).

CRITERIA

A. CPPD supplied or contracted personnel should be made available when required and comply with the following guidelines:

   1. Work to the same standards required of station personnel
   2. Utilize the same procedures as station personnel or procedures approved by the station, including quality assurance procedures
   3. Comply with station policies and directives (such as those governing industrial safety)
   4. Are responsive to station management

B. A designated person in CPPD organization should be responsible for the quality of work performed by contracted personnel.

C. The utilization of CPPD and contracted personnel should not place an excessive administrative or supervisory burden on station personnel.

TECHNICAL SUPPORT

PERFORMANCE OBJECTIVE

The CPPD engineering/technical staff should be sufficient to carry out the engineering and/or engineering review functions necessary to ensure safe and reliable plant operation.

CRITERIA

A. The engineering/technical staff should have the capability for or access to* engineering and/or engineering review in the following areas (which may be divided among various groups):

1. Plant safety
2. Fuels management
3. Fluids systems
4. Instrumentation, control, and electrical systems and components
5. Metallurgy and materials
6. Stress analysis
7. Operations and maintenance support
8. Structural and mechanical
9. Fire protection
10. Industrial safety
11. Chemistry
12. In-service inspection
13. Plant performance
14. Computer technology
15. Security
16. Environmental monitoring

B. Persons in the technical disciplines described above should be qualified for the tasks assigned. The engineering/technical group should include individuals with operating plant experience.

C. The engineering/technical groups should be involved in plant support activities, including the following:

1. Evaluating station operations and operational data, including abnormalities, to detect trends and recommend, where necessary, changes in operating or maintenance procedures or plant design changes.

* Preferably, the technical staff should have engineering review capability in each area listed. Where this is not the case, the staff should have established access to a third party organization with this capability.

2. Reviewing plant system and equipment problems and performance and defining corrective or upgrading actions.

3. Reviewing and/or approving plant design changes and modifications including safety evaluations, specifying quality level, and monitoring accomplishment of the work.

4. Providing technical support and appropriate specifications for maintenance work.

5. Providing technical support in the development of training programs, security controls, and emergency plans.

6. Supporting the control program for drawings, specifications, and vendor documentation.

7. Issuing material specification control procedures.

8. Providing support in preparing and revising operating and test procedures, construction and maintenance procedures, and special test or special one-time procedures.

9. Determining applicability of and appropriate action in response to technical correspondence or documentation from outside sources.

D. There should be effective coordination and communication between WAPDA and the plant(s) designer and/or architect-engineer in all areas for which WAPDA is dependent on their services.

E. Contracted engineering/technical personnel used to perform specifically defined tasks should be under the control of someone within the WAPDA's organization who is responsible for the results.

F. WAPDA should exercise review and approval of contracted engineering work to the degree necessary to ensure that proper design controls are employed and that applicable codes, standards, and regulations are met.

1. Contractors utilized by WAPDA meet WAPDA's qualification requirements.

2. WAPDA reviews and approves quality programs of contractors.

3. WAPDA conducts evaluations of the quality program of contractors with sufficient regularity and in sufficient depth to ensure the program is effective.

G. WAPDA should have a method to handle technical problems and emergencies after normal working hours and on weekends.

H. In addition to handling normal, day-to-day technical support activities, the engineering/technical staff should have capable personnel available to assist during site emergency (accident) conditions.

I. Effective coordination and communications should exist between on-site and off-site engineering/technical groups.

MATERIALS MANAGEMENT

PERFORMANCE OBJECTIVE 1

WAPDA support of materials management of the station(s) should ensure that necessary parts and material are available when needed.

CRITERIA

A. An effective program should be in place that ensures that the proper parts and material are on hand in time to support schedule outages.

B. Mechanisms should be in place to provide for the expeditious procurement of parts and material on a high priority basis to support unschedule repairs.

C. Parts or components critical to safe and reliable plant operation should be subject to special controls that could include the following:

   1. Minimum quantity levels are established and maintained.
   2. These parts are properly stored so that specification requirements are maintained.

D. Proper engineering control and approval should be obtained on any deviation from the ordering specifications for parts or material used in plant systems.

PERFORMANCE OBJECTIVE 2

Materials management activities in support of the station(s) should be monitored by WAPDA management. As a result of this effort, improvements should be initiated as required to ensure and enhance plant reliability.

CRITERIA

A. Appropriate selected data and trends should be monitored to assess materials management performance and identify areas needing improvement.

B. The underlying causes of problems should be identified by monitoring materials management activities. Effective corrective action should be initiated and tracked to completion.

C. Actions taken as a result of monitoring material data and trends should be reviewed with higher levels of WAPDA management on a periodic basis.

TRAINING AND QUALIFICATION

PERFORMANCE OBJECTIVE 1

Senior management attention and support should be given to the program of developing experienced, trained, and qualified personnel required for the operation and support of WAPDA generating station(s).

CRITERIA

A. WAPDA's training program should establish the training and education requirements necessary to ensure the safe and reliable operation and support of WAPDA's generating station(s). Responsibility for developing trained and qualified personnel should be clearly delineated at the General Manager, Thermal's level.

B. WAPDA's support of the training effort should be evidenced by an adequate training staff and facilities.

C. WAPDA managers in each functional area should demonstrate active interest and involvement in WAPDA's training program.

D. Appropriate training and indoctrination of senior management officals should be conducted in matters related to their role in the operations of WAPDA.

PERFORMANCE OBJECTIVE 2

The WAPDA manager with principal responsibility for training in generation matters should ensure adequate support for and coordination of station and off-site training activities.

CRITERIA

A. Training and qualification efforts shall be governed by procedures that outline responsibilities of the training organization.

B. Training and qualification goals and objectives should be established.

C. Projected short- and long-term manpower needs should be considered in training and qualification plans.

D. Training and qualification plans should be periodically reviewed at the corporate level.

E. Personnel qualification requirements, including experience, education, and training, should be prescribed or approved at the General Manager Thermal's level.

F. Training and qualification plans should address intial training and qualification and continuing training needs for operation, chemistry, maintenance, technical support (on-site and off-site), engineering, and managerial positions.

G. There should be an active program to acquire and use feedback to modify and improve training methods and content.

H. Methods should be established to provide training to operational personnel in diagnosing plant conditions during off-normal and emergency situations.

I. Methods should be established to assess the ability of operations personnel to diagnose plant conditions and to apply the proper procedures in recovering from off-normal and emergency situations.

J. Training requirements for temporary employees and transient workers should be established and should be appropriate for the tasks to be assigned.

K. Policies governing exemption of new hires or transfers from training and qualification requirements should be implemented. These policies must ensure exempted personnel have the requisite job qualification.

L. Procedures should be implemented that provide for handling individuals whose performance during training is marginal or unsatisfactory.

PERFORMANCE OBJECTIVE 3

Training and qualification activities related to operations should be monitored by CPPD management. As a result of this effort, support, guidance, and assistance should be provided to ensure that training and qualification programs support safe and reliable plant operation.

CRITERIA

A. Selected training activities and results should be monitored, including the following:

1. The ability of the training organization to provide qualified personnel support staffing needs.

2. Changes to qualification requirements.

3. Utilization of feedback from on-the-job performance.

4. Pass/fail ratios and trends on selected training and qualification examinations.

5. Station programs for identifying poor performers in training examinations, and actions to improve their performance.

B. Requirements regarding personnel qualifications should be monitored, and assistance and guidance provided when appropriate.

C. Contracted training services should be monitored to ensure acceptable quality and effectiveness.

D. CPPD support and assistance in training should be evidenced by periodic visits to training facilities for the purpose of monitoring activities and assessing needs.

E. Effective follow-up action should be taken to address problems identified by monitoring training and qualification activities.

F. Actions taken as a result of monitoring training and qualification trends should be reviewed with higher levels of WAPDA management on a periodic basis.

PERSONNEL

PERFORMANCE OBJECTIVE

WAPDA personnel policies and practices should support safe and reliable operation of generating station(s) by providing sufficient numbers of capable personnel. Personnel management actions should be consistent with the station(s) goals and objectives.

CRITERIA

A. Policies governing assignment of management, technical, and craft personnel to key positions should be implemented. These policies should provide that only qualified people will be used to perform a broad range of functions, and provide for the definition of the qualifications required for each function or position, as appropriate.

B. Prospective WAPDA officers and managers responsible for coal-fired plant generation shall gain coal plant experience. A reasonable number of such prospective officers and managers should gain actual control room operational experience.

C. Individuals should be rotated through selected positions in the organization, recognizing the following:

   1. The unique nature of certain key station and corporate positions with respect to management development potential.

   2. The need to provide experience in key positions to a number of individuals at the station(s) and at the Head Office who have the potential for growth.

   3. The existence of certain positions (such as station manager) that involve a high degree of stress.

D. Appropriate WAPDA officials, including the managers responsible for recruiting and hiring, should be familiar with staffing requirements for key positions and are responsive to the needs of the managers who utilize the personnel.

E. A staffing forecast should be periodically conducted to identify personnel requirements. Forecasting includes or accounts for at least the following:

   1. A review of current personnel assets
   2. Personnel turnover (attrition) rates
   3. Projected changes to requirements such as the following:
      a. Construction plans
      b. Fuel changes

4. Training and qualification lead times
5. Projected short- and long-term supply and demand of personnel.

F. Action programs should be established and responsibilities assigned for meeting identified personnel requirements.

G. WAPDA should have a process to determine whether new hires and transfers fulfill position qualifications or can be trained to meet them. Insofar as practical, the process should be tailored to the position the candidate is ultimately expected to fill. For example, applicants for jobs that may lead to positions such as control room operator or instrument and control technician should be required to meet criteria suitable to those positions.

1. Selection procedures (including appropriate tests) should be implemented for key operating, maintenance, and support positions (such as computer or chemistry technicians).

2. The selection procedures in use should encompass the following:

a. Are based upon accurately determined knowledge, skills, and abilities required for the position being filled.

b. Identify potential for aberrant or unreliable behavior that might be caused by factors such as stress or substance abuse.

c. Have acceptable levels of reliability, validity, and freedom from bias.

d. Establish qualifications for administrators of the selection procedures.

3. Managers should be involved (normally by interview) in the decision process for new hires or transfers who will come under their supervision. The degree of involvement depends on the position being filled.

H. An effective appraisal program should be implemented, and feedback on performance should be provided to employees.

I. WAPDA should have a means by which personnel who fail to demonstrate either the requisite competence or desire to perform can be removed from their assignments.

J. An effective method should be established to evaluate the success of the organization in meeting personnel requirements. The results should be reviewed with higher levels of WAPDA management on a periodic basis.

CHEMISTRY

PERFORMANCE OBJECTIVE

Chemistry activities at the generating station(s) should be actively supported and monitored by corporate management. Corporate policy, guidance, and assistance should be provided to stations as needed to ensure proper chemistry control.

CRITERIA

A. Chemistry data and trends should be monitored. Examples of items that could be monitored include the following:

   1. Selected out-of-specification conditions
   2. Selected station chemistry graphs
   3. Results of periodic quality control checks

B. The underlying causes of problems should be determined by monitoring station chemistry activities. Effective corrective actions should be initiated and tracked to completion.

C. Actions taken as a result of monitoring chemistry data and trends should be reviewed with higher levels of WAPDA management on a periodic basis.

D. The CPPD staff should conduct periodic assessments of station chemistry performance.

E. The CPPD staff should provide technical guidance to the station(s) in chemistry matters, such as the following:

   1. Station chemistry specifications
   2. Procedural guidance on actions to be taken when out-of-specification chemistry conditions occur
   3. Chemistry quality control procedures

INDUSTRIAL SAFETY

PERFORMANCE OBJECTIVE

Activities related to industrial safety at the generating station(s) should be supported and monitored by WAPDA management. WAPDA policy, guidance, and assistance should be provided to the station(s) as needed to ensure the safety and health of each employee.

CRITERIA

A. Corporate policy on industrial safety rules and practices should be clearly established.

B. Selected data and trends of industrial safety activities at the generating station(s) should be monitored, such as the following:

   1. Incidence of lost time accidents
   2. Incidence of other accidents requiring medical attention
   3. Frequency of safety violations identified in the station(s)

C. Methods should be established to correct the underlying causes of industrial accidents and of industrial safety problems identified by monitoring of station activities and accidents.

D. The interface and functional relationships between home office and station groups involved with industrial safety and accident prevention should be clearly delineated and understood.

E. Applicable industrial safety information from all sources (industry, national, state, and local) should be obtained and interpreted by WAPDA headquarters; relevant material and required actions should be effectively disseminated to the station(s).

F. The General Manager, Thermal's staff should conduct periodic assessments of station performance in industrial safety.

G. WAPDA support of station industrial safety should be evidenced by periodic visits to the station(s) to monitor activities and provide assistance.

H. The status of industrial safety at the station(s) and corrective actions in progress or planned should be reviewed with senior WAPDA managers on a periodic basis.

APPENDIX 6.4

G/C CUE

G/C CUE

INTRODUCTION

G/C CUE is an interactive project control system designed for easy application to any project. It combines the first hand experience of Gilbert/Commonwealth, a leading professional engineering/consulting organization with the extensive planning and scheduling system background of K & H Project Systems Inc.

The System is modular in design and is the first system to incorporate all project control functions into one truly integrated package. Each module of the System is tailored to management needs in a specific area of project control:

- Planning and Scheduling
- Estimating
- Project Accounting
- Cost and Performance Measurement
- General Ledger
- Purchase Agreement Control
- Accounts Payable
- Data Management
- Report Writer
- Payroll
- Property Records
- Probabilistic Network Analysis

BENEFITS

The benefits of using G/C CUE for construction management and maintenance management are many, and include:

- Easy adaptation of existing construction and maintenance documentation format for use on G/C CUE
- On-line analysis of alternative construction or outage networks, resulting in maximum utilization of available manpower and materials
- Better planning through the capability of frequent on-line input of progress data by multiple users simultaneously
- Time saving through instantaneous access to relevant information
- Cost saving through reduction of hard copy documentation

SYSTEM FEATURES

Completely Interactive Operation

Because G/C CUE is an interactive system, changes to data are made immediately with the result that the most up-to-date information is always available for display on the terminal or in a report.

English Language Commands

All input to the System, as well as requests for output, is with easy-to-understand commands which represent the exact action to be performed: ADD PROJECT ESTIMATE, DELETE ACTIVITY, WRITE REPORT, PLOT CASH FLOW ANALYSIS.

Three Levels of Security

Data in G/C CUE is protected through three levels of security: system, executive, and project/user. A user must first be validated by the System in general. Executive security is required for high level functions such as adding and deleting projects. To access project data, a user must be valid for a particular project and within the project, only the commands in the user's permission set can be executed.

On-Line Documentation

On-line documentation is available through the help text which can be displayed on the terminal. Detailed information regarding the use of each command appears on the terminal simply be entering "HU" (HELP USER) and the name of the command.

Cost/Scheduling Integration

To produce cash and quantity flows and performance measurement analyses which reflect the project status at any given time, estimating accounts at any level of detail can be related to scheduling activities.

Multi-Project/Multi-User Operation

Data for over 1200 projects can be maintained separately on one system. Depending on the hardware configuration, this data can be accessed simultaneously by over 100 users.

Strong Simulation Capability

Both the scheduling and estimating packages allow for simulation situations to be created since 62 individual estimates and networks (each network with up to 99 copies) can exist in one project. Powerful COPY and GLOBAL UPDATE commands facilitate manipulating data for simulation exercises.

Transfer of Data between Projects

The COPY PROJECT command allows number structures and report formats, as well as actual data, to be copied from one project to another. This eliminates the need to re-enter data when similar account structures are used on multiple projects. In this way, standard or reference projects can be established to streamline overall project control operation.

Planning and Scheduling

The Planning and Scheduling module provides for comprehensive time and resource analyses based on CPM (Critical Path Method) techniques.

The subsystem is designed to allow a manager to designate objectives within the constraints of time, budget, manpower, material resources and technical specifications. The manager defines the time for performance of a task, the necessary manpower and the materials and specifications for work to progress as scheduled.

Special features include:

- Precedence and Arrow (I/J) Capabilities
- 62 Networks per project
- 99 Generations per network
- 12 character activity identifier (8 levels)
- 200 character description
- 32,000 activities per network
- 10 calenders per network
- Weekly, daily, shift, hourly and quarter-hourly time units
- Supports equipment scheduling (slippable activities)
- 10 character resource identifier
- Unlimited resources per network
- Unlimited resources per activity
- Supports activity splitting (with split duration and interval control)
- Global Updating

Estimating

The Estimating module allows a manager to estimate engineering concepts in a number of ways: by value, quantities or manhours.

Estimates are a vital part of project planning and can impact financing, benchmarking competitive bids, and the measurement of actual performance. Manual estimates are time-consuming and expensive.

The System helps the user perform calculations, extensions, and global updates involved in adding and maintaining project costs including:

Direct Cost
Indirect Costs
Interest
Contingency
Contract Reserve
General and Administrative Costs
Management Reserve

Special features include:

- 62 target estimates per project
- 22 character account identification (8 levels)
- 120 character account description
- Records both purchased and installed quantities
- User-defined units of measure and wage rates
- Automatic extensions (manhours, labour costs, material costs, and unit rates)
- Facilitates copying entire estimates
- Global Updating

Project Accounting

The Project Accounting module provides the manager with a basis to report and record all actual and committed costs for a project.

The subsystem can be used to track discounts, freight charges, miscellaneous costs and accounts receivable transactions resulting from deposits and back-charges. It also stores actual expenditure, ledger posting by period by account, balancing invoices and ledgers, and records tax data by jurisdiction. The subsystem not only maintains committments by account, but also restricts expenditures from exceeding purchase agreement totals and develops a detailed audit trail of expenditure ledger entries by account.

Special features include:

- Monitors purchase orders and contracts
- Tracks history of change orders and supplements against main agreement
- 12 character identification of purchase orders, contracts, change orders and supplements
- 120 character description of purchase orders, contracts, change orders and supplements
- 12 character voucher identification
- 12 character invoice identification
- Tracks ledger postings by 22 character work breakdown structure
- 40 character description of eacn ledger posting
- Supports commitments by account
- Automatic commitment and expenditure validation
- Balances invoices with ledger entires
- 4 tax codes (optional)
- Controls opening and closing of purchase orders, contracts, change orders, supplements and acounts
- Accommodates joint and shared ownership
- Tracks retention, discounts, freight and other micellaneous costs

Cost and Performance Measurement

With the Cost and Performance Measurement module, management is able to monitor all cost and scheduling aspects of a project and determine how best to handle any variations from the project plant. By integrating data from accounting, estimating and planning and scheduling, the subsystem can provide the information necessary to measure performance, revise estimates, prepare cash flows, track quantities and determine project status by earned value.

Special features include:

- Supports cost/schedule integration at any level
- Cash flow simulation technique
- Standard earned value algorithms
- Automatic and manual cost to complete calculations
- Physical percent complete analysis
- Quantity flow projections

General Ledger

The General Ledger module is an expanded version of Project Accounting, providing a single entry point for updating general ledger accounts as well as the accounts of all related projects. Complete transaction history files are maintained for the general ledger and for each project. A single batch posting run updates all affected company and project accounts.

Special features include:

- Flexible 28 character account structure
- Up to 62 reporting levels for General Ledger accounts
- Four budgets per period for each account
- User-Determined Number of Years of Historical Actuals
- Mass generation and update of budgets
- Mass generation of accounts and account relationships
- Cost allocation formulae (fixed rates and account ratios)
- Prior period and statistical journal entries
- Extensive error checking

Purchase Agreement Control

The Purchase Agreement Control module produces escalation and cash flow analysis per vendor based on itemised purchase agreements. When interfaced with Accounts Payable it matches committed, received and invoiced information per agreement item for a powerful, automated control of all expenditures. Optional features include automatic commitment to project accounts and invoice account distribution to the general ledger and to projects based on account specifications per agreement item.

Special features include:

- Master Vendor File
- Invoiced and paid amounts recorded per period per vendor
- Separate tracking of retention paid and payable
- Escalation percentages defined weekly, monthly or yearly
- 1,000 items per agreement
- Automatic extensions for calculation of agreement item amounts or unit costs
- Easy reference to each purchase agreement for commitments and expenditures to date

Accounts Payable

Unlike Project Accounting, which tracks only paid expenditures, Accounts Payable statuses invoices from the approval process through account distribution to selection for payment by either manual or automated cheque writing. Both booked and paid actuals are maintained per project account and they are updated automatically as the payment status of an invoice changes. Through a simple, three step prompt, each invoice can be distributed to multiple purchase agreements (e.g., the original purchase order and any change agreements), to the general ledger and to any related accounts.

Special features include:

- Multiple invoices per cheque
- Complete statusing of all cheques - manual, unused, clear and voided.
- Invoice amounts categorised by base, freight, escalation, discount and retention with four tax amounts
- Hold payment code set at vendor, agreement or invoice level
- Partial payment of invoices
- Single process for distributing invoices to general ledger and project accounts

Data Management

The Data Management module provides management with control and output of data in almost any user determined format. This subsystem is designed to relieve the user of much of the detail work inherent in high volume data storage and retrieval. It provides a tool for the retrieval categorization and manipulation of such information as equipment, valve, instrument or drawing lists.

Special features include:

- 62 reporting levels of Data Management accounts
- Data retrieval by access to either a unique main identifier (22 characters) or via 24 sort/select code fields for each reporting level.
- 11 data fields are provided for each reporting level for numerical amounts (maximum value 10 billion each)

- Automatic data transfer with other applications
- Unit of measure transfer
- Unlimited number of user defined item equations for performing mathematical calculations of dates and numerical amounts
- Performs backward pass calculations from a single point of integration with schedule date records. For example, ten dates could be calculated and compared to ten manually entered actual or forecasted dates.

Report Writer

The G/C CUE Report Writer has been designed to facilitate customized reporting. Individual preferences can easily be accommodated without the time and cost expenditures which usually accompany programmed report formats.

Special features include:

- Multiple data set reporting
- Totalling and subtotalling
- Additions, deletions, modifications and repositioning
- Sort and select on entire or partial data elements
- Selections based on logical expressions
- Variable report titles and column headings
- Mathematical calculations
- Simultaneous generation of detailed and summary reports
- Global variables

Other Modules

Payroll, Property Records and Probabilistic Network Analysis

G/C CUE also includes "custom" designed and optional subsystems that are normally not part of the basic package but that may be required by users.

The Payroll subsystem provides a responsive on-line way of processing wages, deductions and benefits. While eliminating complex input procedures, the subsystem calculates payroll, creates cheques, develops appropriate registers and produces the required tax reports.

The Property Records subsystem is designed to meet the needs of utility customers. The subsystem draws on accounting and estimating information to allocate direct and indirect expenses according to corporate or Governmental requirements. The subsystem provides efficient and economical property record development.

The Probabilistic Network Analysis subsystem will enable entry of a random range of durations to each activity in order for a probabilistic time analysis to be performed. Full risk analysis and weather modelling features will be available.

TRAINING, DOCUMENTATION AND SUPPORT

A comprehensive training program is offered in two optional phases. The first phase consists of five eight-hour sessions. Classes are small in order to give participants individual attention, provide extensive practice in using G/C CUE and create an environment in which all questions and concerns can be addressed. The second phase consists of follow-up on-site workshops conducted approximately four weeks subsequent to the phase one training. This phase is designed directly around each user's needs. Project control application specialists provide whatever reinforcement the user feels is necessary to complete the implementation of the system.

The documentation which accompanies G/C CUE will furnish the user with information encompassing all aspects of the operation of the system. The three primary sources of documentation are the Help Text, which is displayed on the terminal, the User's Manual, which describes in general the commands needed to perform various functions, and the Reference Manual, which provides supplementary data. Secondary sources of documentation include an Operations Manual, which addresses the interfaces between G/C CUE and the computer's operating system and a small User's Reference Card, which summarizes the basic information and can be used as a quick reference by the user.

Illustrative examples of the G/C CUE Capablities follow this text.

Support for G/C CUE is provided at the following locations:

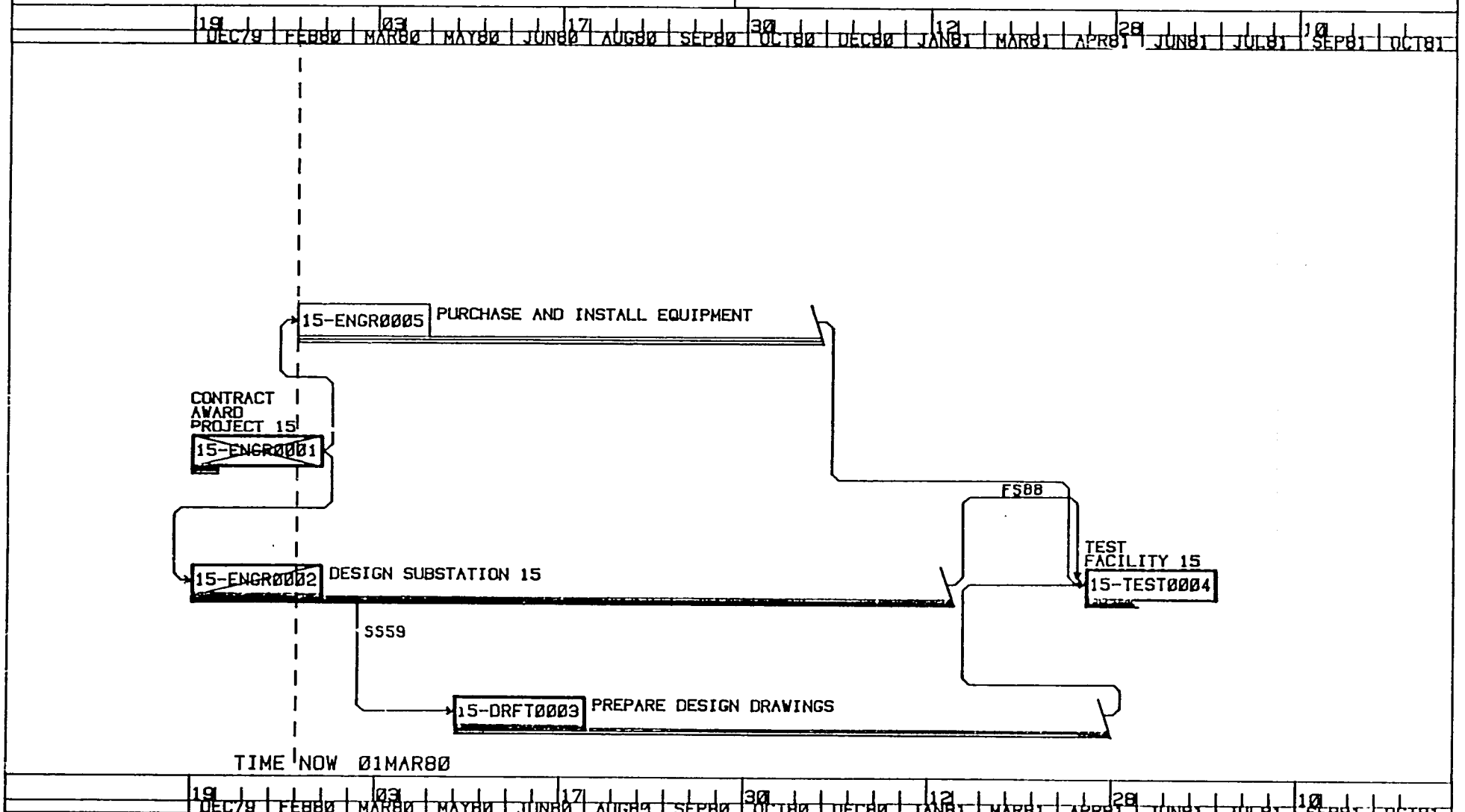
Reading, Pennsylvania, USA
Sparta, New Jersey, USA
Calgary, Alberta, CANADA
London, ENGLAND
Melbourne, AUSTRALIA
Jackson, Michigan, USA
Houston, Texas, USA
Toronto, Ontario, CANADA
Rome, ITALY
Johannesburg, SOUTH AFRICA

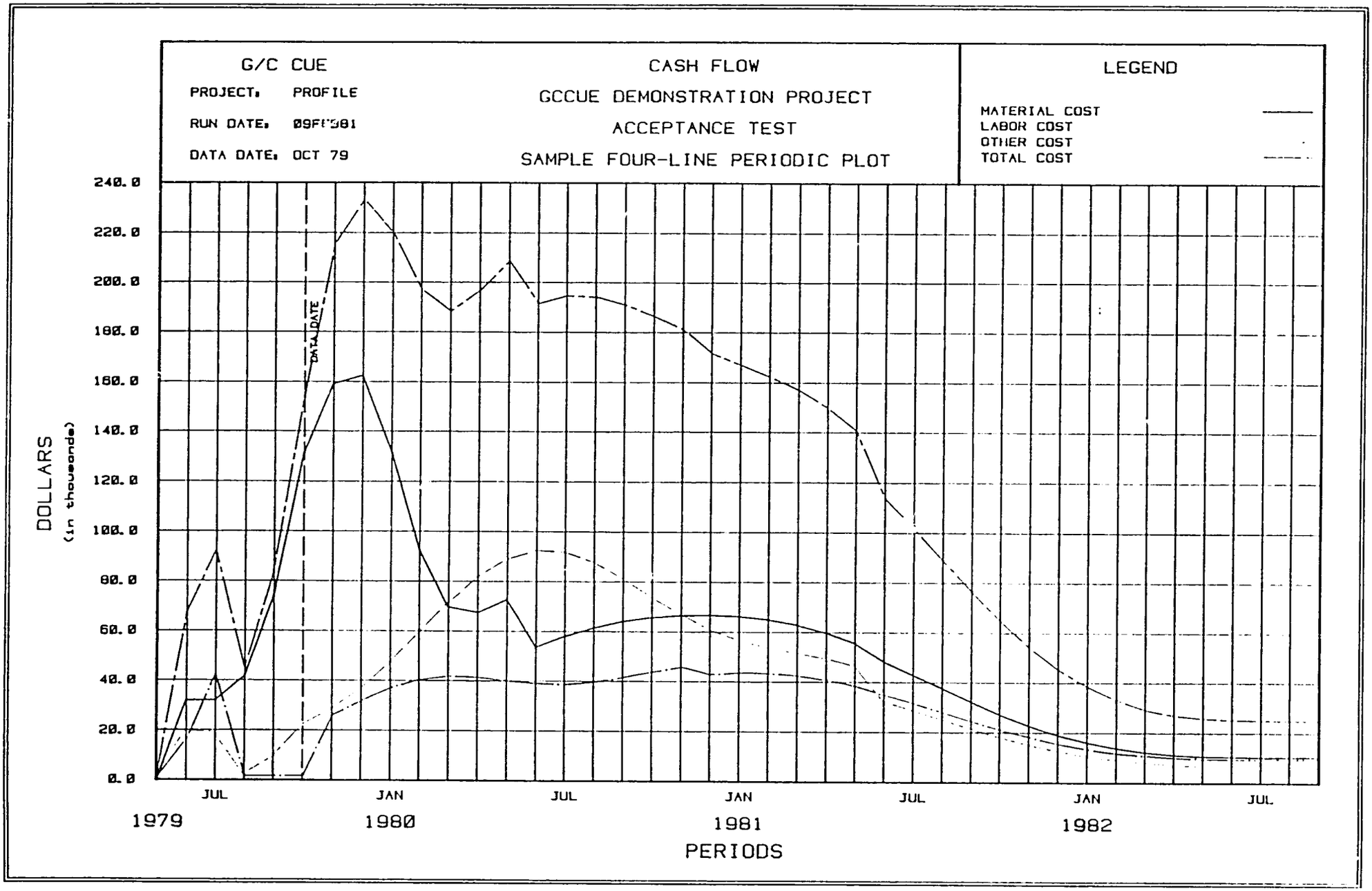
G/C CUE
TEST NETWORK

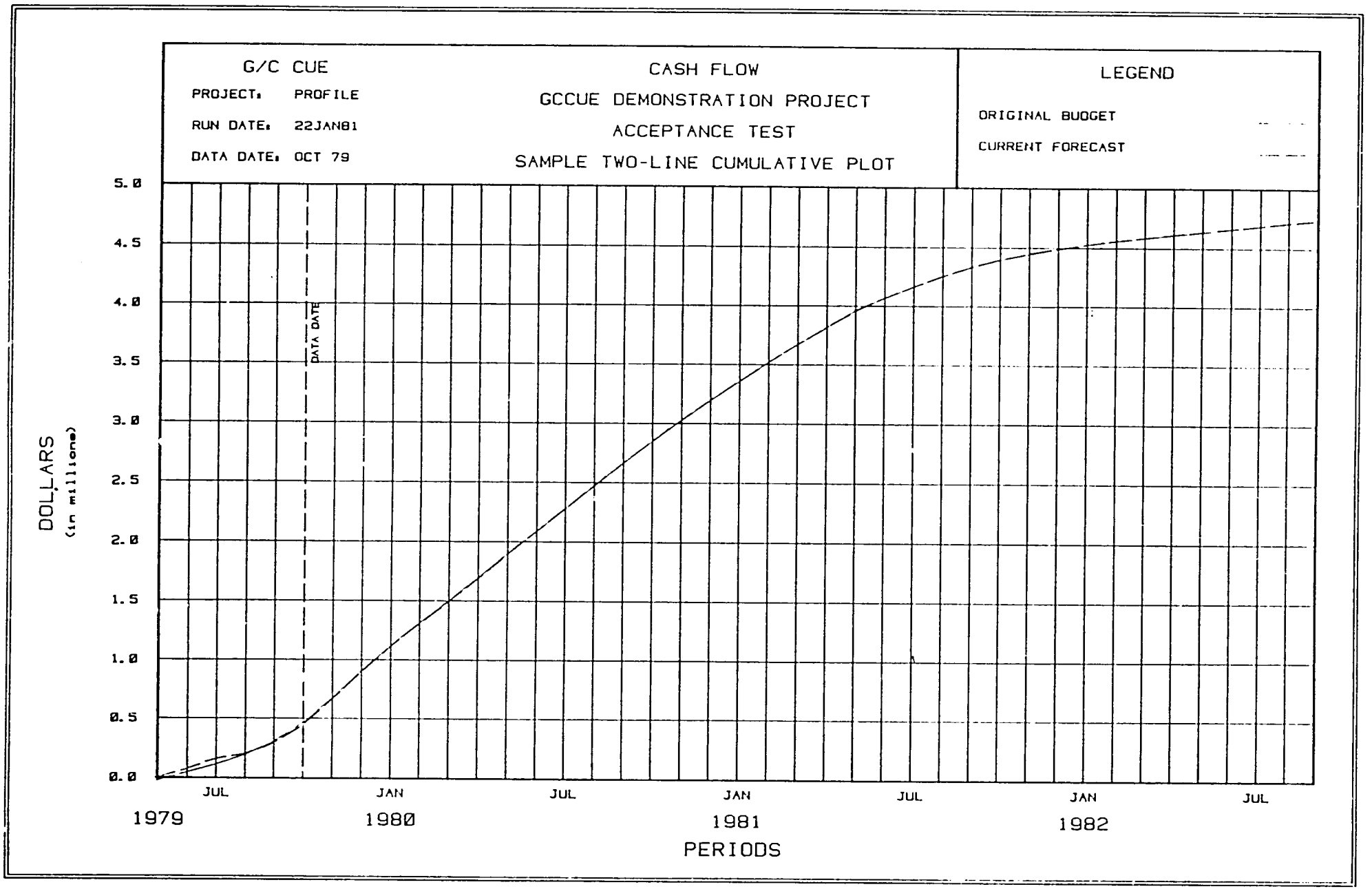
NETWORK PLOT
LINEAR TIME SCALED PLOT

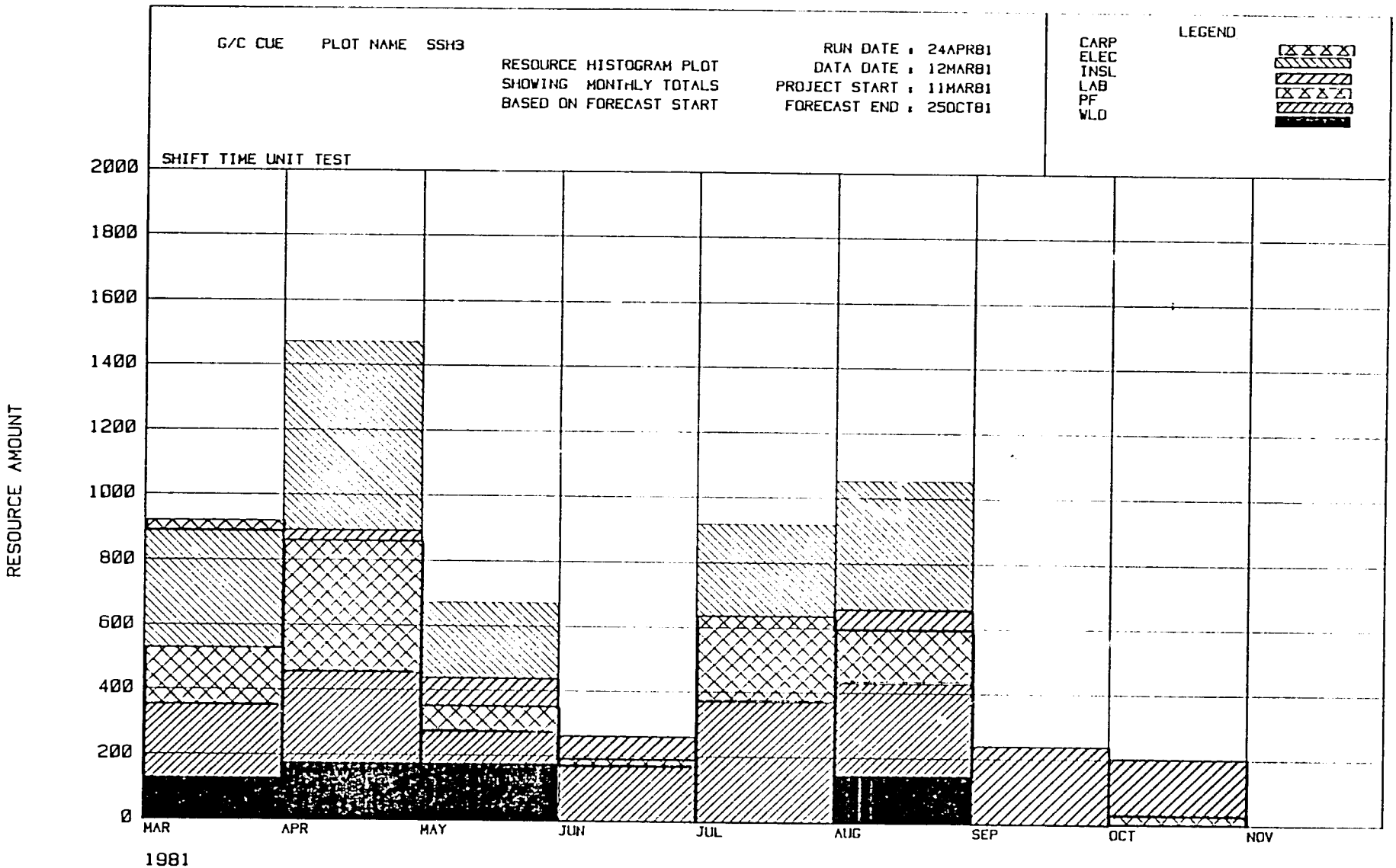
RUNDATE : 21JUL81
DATA DATE : 01MAR80
PROJECT START : 01JAN80
FORECAST END : 08JUN81

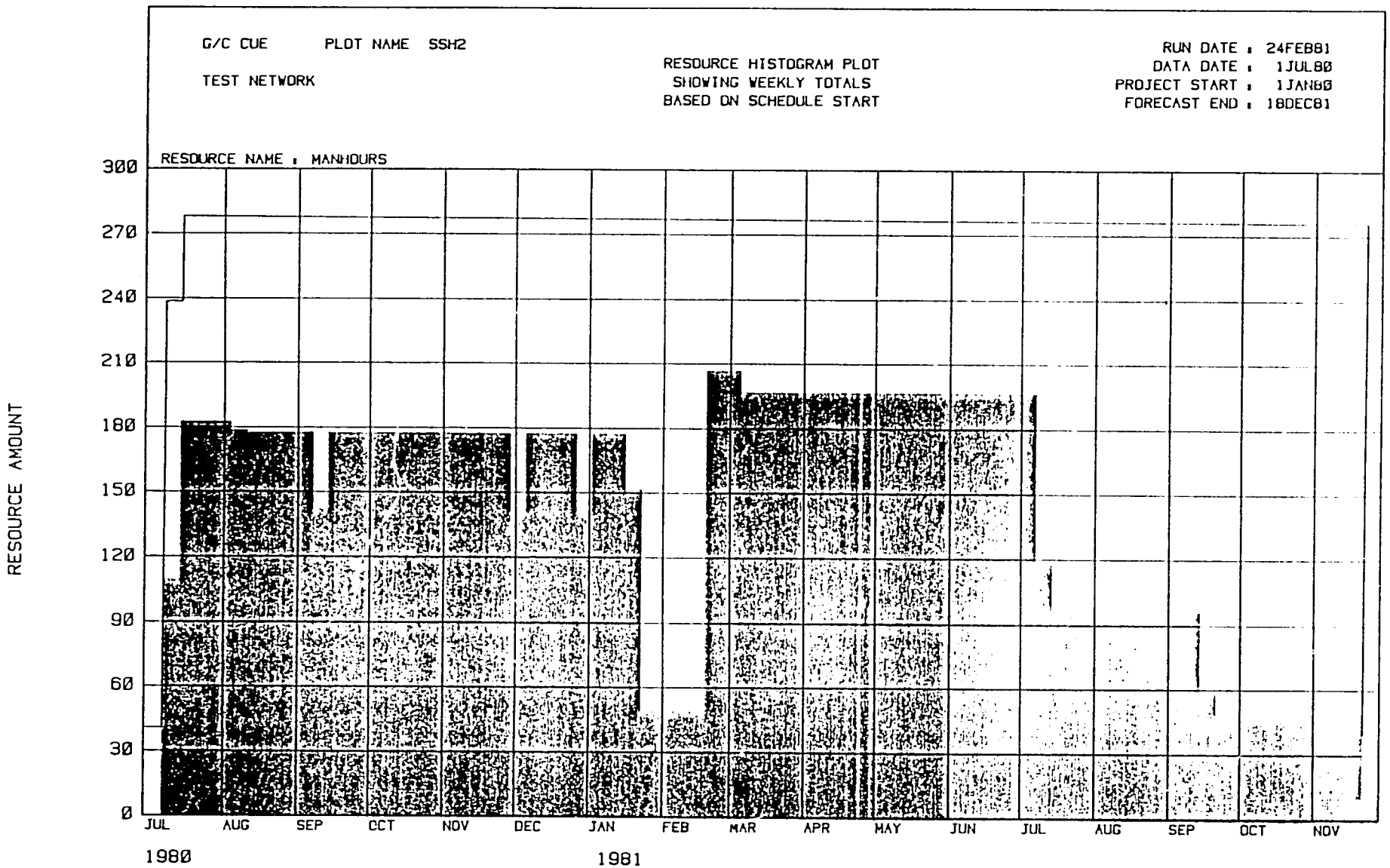
LEGEND
REGULAR ACTIVITY-
CRITICAL ACTIVITY-
MILESTONE ACTIVITY-
COMPLETED ACTIVITY-
STARTED ACTIVITY-

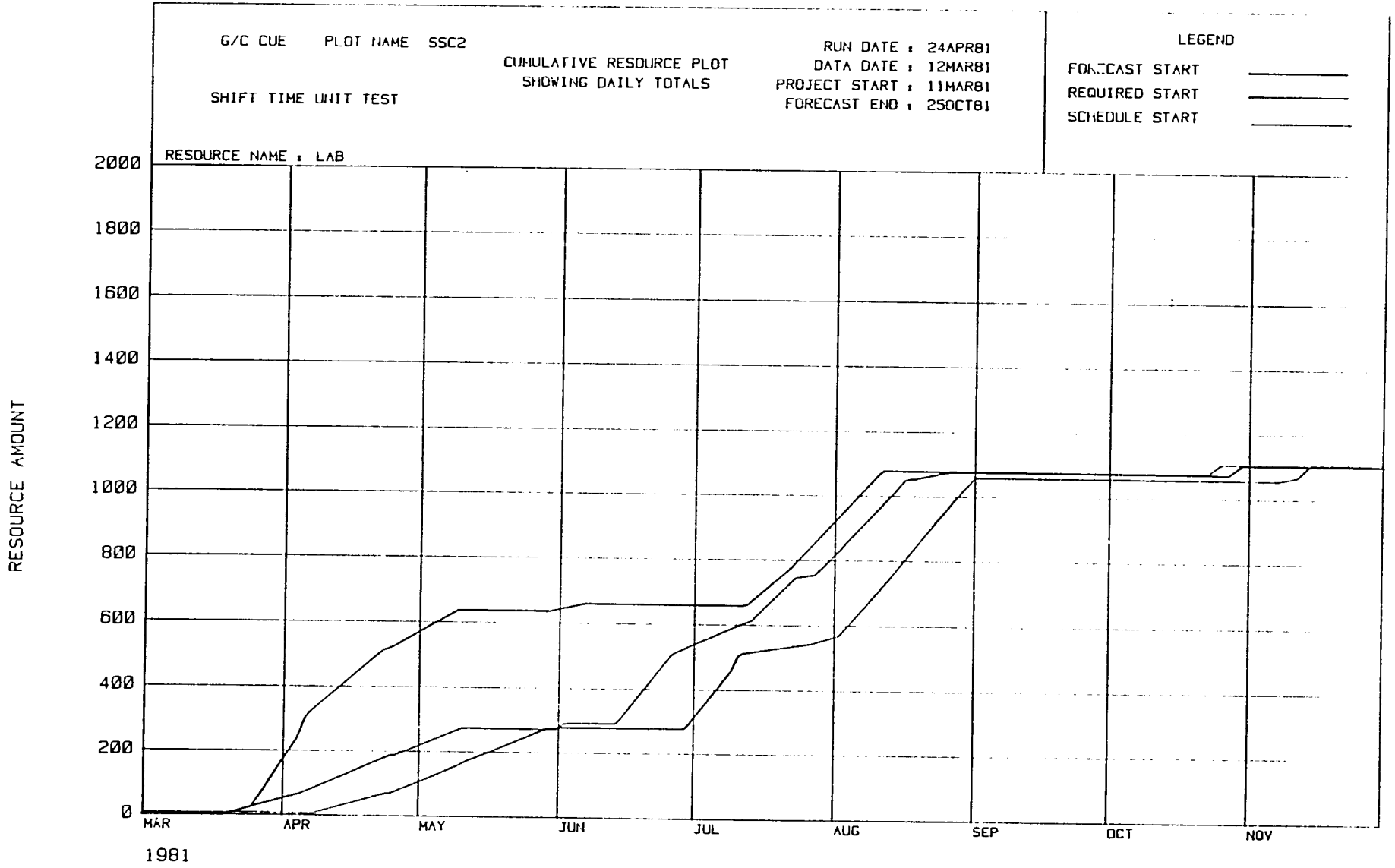



G/C CUE
PROJECT: PROFILE
RUN DATE: 09FEB81
DATA DATE: OCT 79
CASH FLOW
GCCUE DEMONSTRATION PROJECT
ACCEPTANCE TEST
SAMPLE FOUR-LINE PERIODIC PLOT
LEGEND
MATERIAL COST
LABOR COST
OTHER COST
TOTAL COST
DATA DATE
DOLLARS
(in thousands)
240.0
220.0
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
JUL
JAN
JUL
JAN
JUL
JAN
JUL
1979
1980
1981
1982
PERIODS


G/C CUE
PROJECT: PROFILE
RUN DATE: 22JAN81
DATA DATE: OCT 79
CASH FLOW
GCCUE DEMONSTRATION PROJECT
ACCEPTANCE TEST
SAMPLE TWO-LINE CUMULATIVE PLOT
LEGEND
ORIGINAL BUDGET
CURRENT FORECAST
DATA DATE
DOLLARS
(in millions)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
JUL
JAN
JUL
JAN
JUL
JAN
JUL
1979
1980
1981
1982
PERIODS


G/C CUE PLOT NAME SSH3
RESOURCE HISTOGRAM PLOT
SHOWING MONTHLY TOTALS
BASED ON FORECAST START
RUN DATE : 24APR81
DATA DATE : 12MAR81
PROJECT START : 11MAR81
FORECAST END : 25OCT81
LEGEND
CARP
ELEC
INSL
LAB
PF
WLD
SHIFT TIME UNIT TEST
RESOURCE AMOUNT
2000
1800
1600
1400
1200
1000
800
600
400
200
0
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
1981


G/C CUE
PLOT NAME SSH2
TEST NETWORK
RESOURCE HISTOGRAM PLOT
SHOWING WEEKLY TOTALS
BASED ON SCHEDULE START
RUN DATE : 24FEB81
DATA DATE : 1JUL80
PROJECT START : 1JAN80
FORECAST END : 18DEC81
RESOURCE NAME : MANHOURS
RESOURCE AMOUNT
300
270
240
210
180
150
120
90
60
30
0
JUL
AUG
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
1980
1981


G/C CUE
PLOT NAME SSC2
SHIFT TIME UNIT TEST
CUMULATIVE RESOURCE PLOT
SHOWING DAILY TOTALS
RUN DATE : 24APR81
DATA DATE : 12MAR81
PROJECT START : 11MAR81
FORECAST END : 25OCT81
LEGEND
FORECAST START
REQUIRED START
SCHEDULE START
RESOURCE NAME : LAB
RESOURCE AMOUNT
2000
1800
1600
1400
1200
1000
800
600
400
200
0
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
1981

277

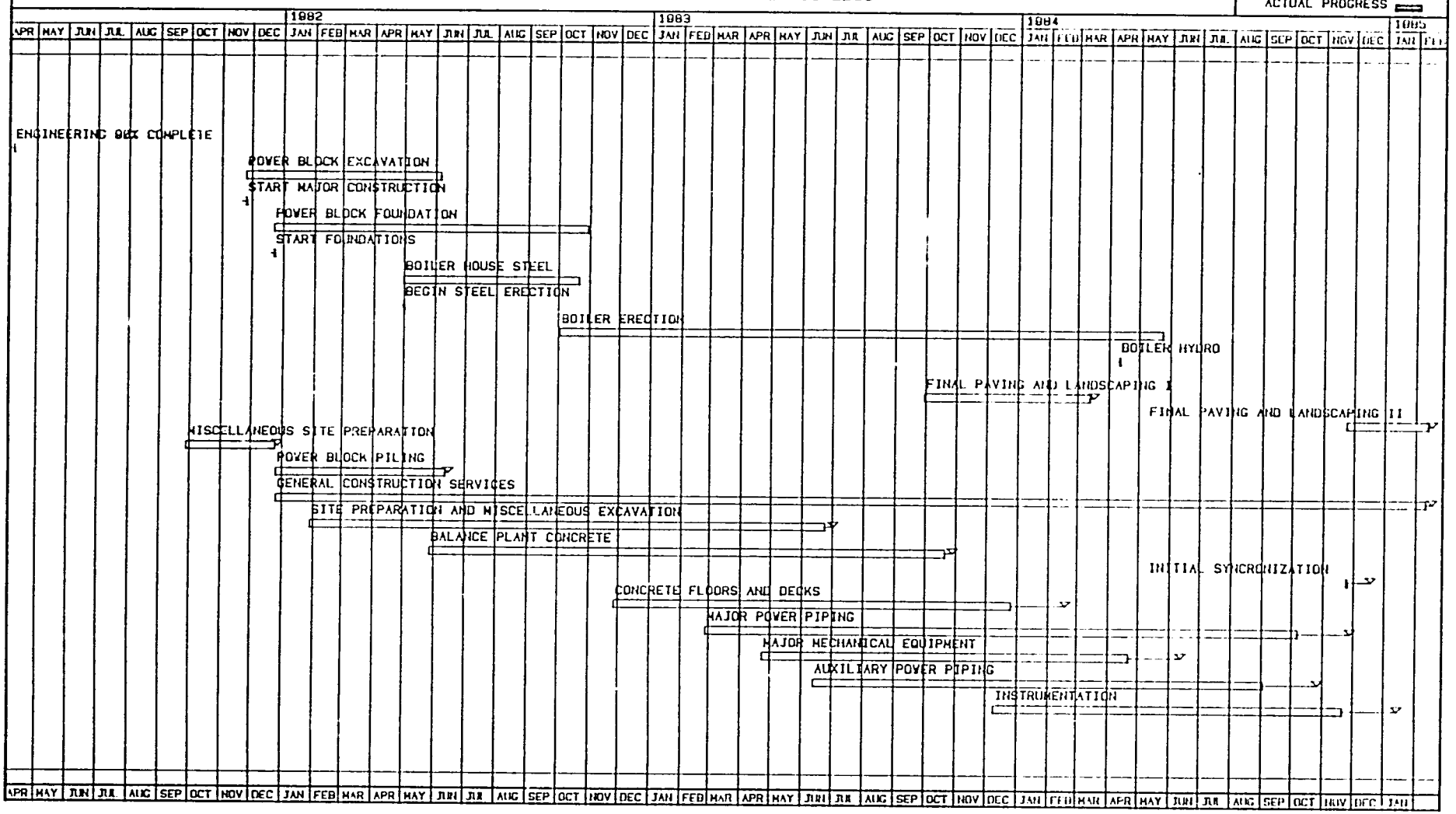
G/C CUE

B A R - C H A R T P L O T

PAGE 1

RUN DATE 10OCT80
DATA DATE 1APR81
PROJECT START 1APR81
FORECAST END 19FEB85

LEGEND
EARLIEST START
EARLIEST FINISH
LATEST FINISH
ACTUAL PROGRESS



G/C CUE CLIENTS

Architect/Engineering

Boskalis Westminster Intergroup BV
Jacobs Engineering Group, Inc.
Toyo Engineering Corp.

Construction

British Metro Consultants Group
Crooks, Michell, Peacock, Stewart Pty., Ltd.
Dillingham Construction Company
Dillingham Corporation Canada, Ltd.
Dong ah Construction Ind. Co., Ltd.
Dongsan Construction
Hawaiian Dredging & Construction
Hanyang Corporation
Kasler Corporation
SNC Group

Defense

U.S. Army Computer Systems Selection and Acquisition Agency

Education

Stanford University

Electronics/Aerospace

Digital Communications Corporation
United Technologies - Mostek

Environmental

Peabody Process Systems, Inc.

Food Service

Kentucky Fried Chicken (KFC)

Manufacturing

Eastman Kodak Corporation

Mining

Anglo American Corporation of South Africa, Ltd.
Exxon Minerals Company

Petrochemical

Black, Sivalls, & Bryson, Inc.
Exxon Chemical Australia
(Altona Petrochemical Co., Ltd.)
Exxon Chemical Company
Foster Wheeler Petroleum Dev., Ltd.
Shell Ned Raffinaderij
Shell UK Limited

Service Bureau

Shaker Computer & Management Services, Inc.
Siyakon Holdings Pty., Ltd.
Virtual Computing Systems, Ltd.

Shipbuilding

Norfolk Shipbuilding & Drydock Corp.

Utility

General Electric Company
Minnesota Power Company
New York State Electric & Gas
Northwest Energy Services
Ontario Hydro
Pennsylvania Electric Company
Potomac Electric Power Company
Tampa Electric Company
Texas Municipal Power Agency
Westinghouse Electric Corporation
(Steam Turbine Generator Division)
Westinghouse Electric Corporation
(Westinghouse Nuclear International)
Westinghouse Nuclear Belgium
Westinghouse Nuclear Espanola
Westinghouse Electric Corp
(Philippine Nuclear Power Plant Unit 1)

7.0 TRAINING

7.1 INTRODUCTION

With respect to the generation of electricity, one of the goals of the Government of Pakistan is to reduce the dependence on the use of oil and gas and develop coal as the fuel for WAPDA thermal generating stations.

The use of indigenous resources, coupled with the goal of selecting additional power generating capability as an element of a least cost expansion plan, has led WAPDA to consider the construction of a thermal power station firing Lakhra coal.

The implication of these considerations for the organization and capabilities of the WAPDA staff is threefold. For the identification of future coal-fired power stations as elements of a least cost expansion plan, WAPDA needs to develop its capabilities to conduct or manage the required feasibility studies. Once individual units have been selected for construction, WAPDA must have the necessary skills for efficient project management. For the resulting coal-fired stations to remain elements of low cost in the WAPDA electric generating system, WAPDA needs to enhance its capabilities for efficient operation of these units.

The preliminary training plan is based on a review of the current WAPDA training organization and capabilities and a training needs assessment as it relates to these unique capabilities required of the Coal Power Projects Department (CPPD) and Station Organization staff.

While the training needs assessment and the preliminary training plan developed in this chapter of the feasibility study report refer to the Lakhra Project, its recommendations apply essentially to any future WAPDA coal-fired thermal power station.

7.2 WAPDA TRAINING CAPABILITIES AND ORGANIZATION

7.2.1 Approach

To develop the Preliminary Training Plan for WAPDA with respect to the planning, construction and operation of coal-fired power stations, three elements have been considered. These elements are the current training capabilities of WAPDA, the availability of qualified personnel and the identification of the skills which are needed for the implementation of the required tasks in support of coal projects. This section reviews WAPDA's training capabilities as they relate to the tasks of planning, constructing and operating a coal-fired power station and assesses the availability of qualified personnel.

Training needs in support of coal projects are identified in Section 7.3.1 for Coal Power Projects Department personnel and in Section 7.3.2 for Thermal Power Station personnel.

With respect to the recruitment of qualified personnel for the staffing of these WAPDA organizations, it was found that the availability of engineering graduates from technical universities and colleges is good. The availability to WAPDA is possibly limited due to somewhat unfavorable salary levels as compared to the private industry. In some cases the need for Junior Engineers to work (at least initially) at remote site locations may aggravate this limitation. However, it is considered that in general, WAPDA can rely on engineering graduates whose quantity and quality meet its needs for Junior Engineers. This condition must be seen in the context of a WAPDA policy which states that normally WAPDA does not fill positions above the level of Junior Engineer (BPS17) by outside recruitment. All levels above Junior Engineer are filled by promotion and hence are all college graduates. In terms of training for Junior Engineers and above, the training needs assessment takes this condition into account.

With respect to the station operation and maintenance staff from the level of Helper to Foreman (BPS16), WAPDA has an established policy to fill positions either by direct recruitment or by promotion. An adequate quantity of graduates from Polytechnical Institutes or Vocational Schools is potentially available for recruitment by WAPDA.

In addition to the recruitment of skilled craft, WAPDA has developed and implements basic and advanced craft courses to meet station specific needs and to provide for personnel development. Again, the present training needs assessment is based on the continued availability of craftsmen qualified in their general trade.

With respect to the above-mentioned WAPDA organizations involved in coal projects, essentially two WAPDA training organizations will be involved in their training: the WAPDA Academy at Tarbela and the Technical Training Institutes. The following two sections identify the current training capabilities of these organizations and how they would relate to the coal projects organizations.

During the discussions with WAPDA personnel, a number of concerns relative to the functioning of the Training Centers were identified. Although not strictly part of the present training needs assessment, recommendations to alleviate these concerns have been included.

7.2.2 WAPDA Academy

The WAPDA Academy at Tarbela services the entire WAPDA organization.

Organization

The WAPDA Academy resides organizationally in the Finance Wing and the Director of the Academy reports directly to the Member Finance.

Scope of Training

The Academy offers management courses for Junior, Middle and Senior management as well as Project Management. Other courses included in the 1985 Training Program do not specifically relate to the planning, construction or operation of thermal power stations. In general, the management training courses do relate to the management functions of the CPPD and the (future) coal-fired station project organizations.

7.2.3 WAPDA Training Institutes

In the Power Wing of WAPDA, a number of training institutes and centers exist, each of which is responsible for the training of personnel for the performance of tasks in power generation, transmission or distribution. Of the five training institutes for the implementation of Generation Training, three presently offer training programs which can support functions in Thermal Power Generation:

1. Training Institute at 200 MW Gas Turbine Power Station, Faisalabad

2. Training Institute at T.P.S., Guddu

3. Training Institute at N.G.P.S., Multan

In general, WAPDA has established training institutes at the locations of major power generation stations with their associated large staff. The staff from the smaller power stations also receive training at these institutes.

Organization

The Director Training of each Institute reports to a Chief Engineer who is overall responsible for the power station or region in which the Institute is located. Presently, it is therefore the General Manager Thermal who is ultimately responsible for the Thermal Generation Training Institutes through his Chief Engineers. In addition, a coordinating role between all WAPDA training organizations is performed by the Director Training WAPDA.

As evidenced by the resources which are allocated to the Training Institutes, WAPDA recognizes the importance of proper training of its power station staff. The importance of the training facilities will only increase with the number and size of the thermal generating units. In reviewing the operation of the Guddu and Faisalabad

Training Centers, however, it was found that a number of impediments to attracting and retaining a qualified training staff exist.

One impediment is that in the present organizational structure with the Director Training reporting to the Chief Engineer, no career path exists for the Director inside the WAPDA training organization. The second impediment is that, even though at Guddu the training staff retains their generation and Guddu allowance, the overall fringe benefits of the Station staff appear to outweigh those of the Training staff.

Although the above observations were made at Guddu and Faisalabad, this concern for the continued staffing of the WAPDA Training Institutes with qualified and motivated personnel may be equally applicable cable to other Training Institutes involved in training for transmission and generation.

It is therefore recommended that:

- Directors of Training Institutes (T&G) should report to the (newly proposed)* General Manager Technical.

- Consideration should be given to establish a "Training Allowance" for all staff engaged in training activities.

* By a study of another WAPDA Consultant.

The planned additions to the thermal generating capacity, particularly at Guddu and Hyderabad, will significantly increase the number of personnel to be trained in station operation and maintenance. The construction of oil-fired units at Jamshoro, coupled with the likelihood that the first coal-fired units will also be constructed in the Hyderabad area, will create a major power generation center near Hyderabad. Consequently, the operation and maintenance staff of the generating stations near Hyderabad will need to be supported by a major training effort.

It is therefore recommended that:

- A Training Center similar to the one at Guddu, but with the addition of training programs tailored for coal-fired units, be established at Jamshoro.

Scope of Training

The scope of the training programs which are provided by the Training Centers which support the operation and maintenance of the thermal generating units, is summarized in Table 7.2.3 for the Guddu Training Center. Based on discussions with WAPDA personnel and a

review of course material from the Faisalabad Training Center, it appears that the Guddu curriculum is representative of the WAPDA training capabilities in the area of operation and maintenance training for all levels of station staff.

TABLE 7.2.3
TRAINING COURSES ADMINISTERED AT GUDDU TRAINING CENTER

Course No.	Title	Category of Trainees	Duration (Months)
C-1	New Entrant Engineers	New Jr. Engineers	12
C-2	Advanced Operator	Experienced Operators and Attendants	3
C-3	Basic Operator	New Operators, Attendants and Helpers	3
C-4	Basic Craft (Electrical)	New Electricians, Electrical Fitters	6
C-5	Basic Craft (Mechanical)	New Mechanical Fitters, Helpers	6
C-6	Basic Craft (Instrument)	New Instrument Fitters	6
C-7	Advanced Craft (Instrument)	Experienced Instrument Fitters	1
C-7	Advanced Craft (Electrical)	Experienced Electricians, Electricians, Fitters	1
C-7	Advanced Craft (Mechanical)	Experienced Mechanical Fitters	1
C-8	Advanced Chemical	Experienced Jr. Chemists, Assistant Chemists	3
C-9	Basic Chemical	New Jr. Chemists, Assistant Chemists, Chemical Attendants	3
(C-10	Illiterates Class	As Applicable	-)

At Guddu the training for new entrant engineers is made up of 3 months classroom training on station operation and 3 months on-the-job training (OJT) in operation, followed by 3 months classroom training on station maintenance and 3 months OJT in maintenance. Typically, at the completion of this training program the Junior Engineer is placed either in the position of Junior Shift Engineer (Operations) or Junior Engineer (Maintenance). In addition to this plant training, all new Junior Engineers also attend the management course for fresh entrants at the WAPDA Academy and the Accounts Training course at the Accounts Training Institute at Lahore.

Basic and advanced craft courses for mechanical, electrical and instrument fitters and electricians as well as their assistants and helpers have been developed and are implemented. Basic and advanced courses for chemists are also in place.

The Junior Engineer and craft courses are followed by personnel from the Guddu, Sukkur and Hyderabad power stations. The courses for chemists are followed by personnel from all the WAPDA thermal power stations.

In the near future, the Faisalabad Training Center will have the additional capability of simulator training for a thermal power station. This simulator is currently being installed. However, it is a replica of the oil/gas-fired Unit #3 at Guddu, which may restrict its use for operation training for other units.

It is therefore recommended that:

- A training simulator capable of simulating the operation of coal-fired stations be installed in the recommended Jamshoro Training Center.

7.3 TRAINING NEEDS ASSESSMENT

7.3.1 Approach

This training needs assessment for the construction, operation and maintenance of WAPDA's first large coal-fired power station identifies broad training areas for the development of the required skills in support of such projects. No attempt has been made to assess in detail the adequacy of existing WAPDA training programs and courses, or the current proficiency of operations or maintenance personnel. This section identifies those training areas which are not included in existing WAPDA training programs. These training needs relate mainly to the unique considerations of firing coal and the introduction of new technologies. Additional training needs which have been identified will enhance existing WAPDA training courses in the areas of general and project management and certain station operation and maintenance tasks critical for a coal-fired station.

Outlines of recommended training courses which correspond to these needs are presented in Appendix 7.1. Other personnel training which will be required, but is already included in current WAPDA training programs, will need to be integrated in the Final Training Plan. Course outlines for these training courses are not included in Appendix 7.1.

Although existing training programs from the Tarbela Academy and the Training Institutes appear to meet the current needs of WAPDA's thermal power stations and are largely applicable to coal-fired stations, it is recommended that:

- A comprehensive review be made of existing WAPDA training courses to determine their adequacy in support of coal projects.

The training needs assessment and the preliminary training plan are based on the adequacy of the existing WAPDA training courses.

7.3.2 Coal Power Projects Department

The training needs assessment of CPPD personnel is based on the recommended functions of the CPPD as discussed in Chapter 6 of the report. Training for CPPD personnel addresses the general functions of the CPPD as well as project management functions during the design and construction phases of a coal-fired thermal power station.

Training required for CPPD personnel will therefore consist of general management, project management and engineering courses. A review of the current training capabilities of the WAPDA Academy at Tarbela shows that its courses provide for training in a number of these areas. The management courses offered by the Academy for Junior, Middle and Senior Management, as well as project management, can provide valuable support for the functions of the CPPD and the Lakhra project organization. To support the specific needs of the CPPD, it is therefore recommended that:

- Existing management courses of the Tarbela Academy be expanded or additional courses added to address functions unique to the management of coal projects.

Listed below are training needs which relate either to the general functions of the CPPD or to specific project management functions in support of the design and construction of coal-fired stations.

With respect to functions other than technical support, the following training areas have been identified:

1. Coal Contracting
2. Evaluation Techniques for International Power Plant Tenders

3. Materials Management
4. Quality Programs

With respect to the technical support functions, a number of training areas have been identified for the permanent CPPD Engineers. In most cases, thes areas parallel the ones identified as training needs for the operation and maintenance staff of the Station:

1. Coal and Ash Handling Systems
2. Digital and Computer Based Controls
3. Environmental Protection
4. Coal Fired Boiler Design and Operation
5. Performance of Electrical Equipment in Severe Environments

Unlike the training of station personnel, the initial training of CPPD personnel in these areas precedes the formation of the station specific training courses. For the initial staffing of the CPPD technical support group it is therefore recommended that personnel who have already some experience in the above areas be selected. Their training should then be complemented by overseas OJT.

7.3.3 Thermal Generation Station Organization

The training needs assessment for Station personnel is based on the recommended organizational structure and associated functions as presented in Section 6.5 of the report. Training for Station personnel includes start-up and test personnel, based on the approach that most permanent Station personnel will be phased in during the start-up and test phase of the project.

The review of the current training capabilities of WAPDA shows that the existing training programs of the WAPDA Training Institutes provide for training in many of the functional areas which are required for the operation and maintenance of coal-fired stations. To avoid a duplication of effort for training courses which are not unique to coal-fired stations, it is therefore recommended that:

- Full use be made of existing training facilities and courses from the Guddu, Multan and Faisalabad Training Centers for the training of station operation and maintenance personnel of coal-fired stations.

Listed below are training needs which have been identified and relate either to functions and skills which are required for the operation and maintenance activities unique to coal-fired stations, or to functions that should be enhanced to achieve the efficient operation of a thermal power station firing coal.

Operation and Maintenance of Coal and Ash Handling Systems

As compared to a gas-fired thermal power station, the station availability and performance depends extensively on the smooth operation of the fuel handling systems. Training will be required for the operation and maintenance of these systems, both as classroom training and OJT.

Performance of Analytical Tasks

Unique to the firing of coal is the implementation of certain analytical tasks, such as chemical analysis of coal and ash and the chemical and physical analysis of environmental samples. Classroom training will be required in support of these tasks.

Familiarization with Advanced Computer Technology

This area of training is not unique to the firing of coal, but to the introduction of technology which is not presently being used in WAPDA Thermal Power Stations. This relates primarily to the station computer/micro-processor controls and instrumentation. Again, training courses will need to be developed for both operation and maintenance personnel consisting of classroom training and OJT.

Planning and Scheduling of Maintenance

This activity is also not unique to thermal stations firing coal, but the proper planning and scheduling of maintenance work at a coal-fired station is substantially more critical for continued operation than that of a gas-fired station. Classroom training is recommended in this area.

Quality Control

Training in the development and implementation of a QC program is currently not included in the WAPDA training programs. To achieve and maintain performance and availability goals of a thermal power station using state-of-the-art equipment requires the close control of the quality of hardware and services. Classroom and OJT is included in the Preliminary Training plan for the staff of a Quality Control Department.

Performance Testing

A training need has been identified in station performance monitoring and testing. The determination of system and station performance is substantially more complex for a coal-fired station than a gas-fired station. The Senior Engineer (ITR) and his staff would require extensive classroom training and OJT for the implementation of the station performance tests.

Fire Protection

For coal-fired power stations, additional training is required for fire protection. The use of coal for the firing of a thermal power station increases the risk of fires. Specific measures have to be taken to prevent coal fires. Classroom training will need to be included for the station firefighters as well as all other station personnel.

Simulator Training

It is recommended to include training of station operators on a station simulator in the training program in addition to the OJT. The increased complexity of a thermal station capable of firing coal and oil over one firing gas, coupled with the intent to construct additional coal-fired stations, justifies the use of a simulator for operator training.

Start-up and Test

On the Job Training during start-up and test is highly recommended for station maintenance personnel and operators. Following classroom station orientation courses and/or station fundamentals, operation and maintenance personnel should be assigned to the start-up and test team for OJT for the entire period from the beginning of start-up and test to commissioning and turn-over of systems.

Station Orientation and Fundamentals

Station specific classroom orientation courses will be required for all station personnel. Station fundamental courses similar to existing WAPDA courses, but including coal and ash handling systems, will be required for all entry level personnel.

7.3.4 Training Institute Organization

In discussions with the Directors of the Training Centers at Faisalabad and Guddu, a need was identified for a formalized training course for instructors. This course (identified as 1008 in Appendix 7.1) would be beneficial both at the existing training institutes and the recommended Jamshoro training center. It would provide technical experts with instructional methods and techniques to develop or improve their teaching abilities in a learning environment.

The recommended course is divided into three phases to let those participants with sufficient education and/or experience to "test out" of section of demonstrated competency.

Orientation

Phase I - Instructor Competency Analysis

Phase I evaluation is conducted prior to course presentation. Each participant will be evaluated in three areas: evaluation of prior education and/or experience; "testing out" (each participant will take a test in each section); and a video critique (each participant will write a lesson plan and present it while being videotaped for evaluation). It is possible for a participant to go from Phase I to Phase III (certification).

Presentation

Phase II - Instructor Training and Examination

Participants will only be enrolled in those sections they require for certification as established in the Phase I testing. Each section is designed to be both participant-centered and self-contained. There is a post-examination at the end of each section. The last two days of the instructional period include a final video presentation analysis of a lesson for critique.

Certification

Phase III - Instructor Certification

An evaluation of documentation and/or examinations would be made by a certified instructor to determine if all qualifications for certification have been met. If so, the participant will be issued a Certified Instructor Certificate.

7.4 PRELIMINARY TRAINING PLAN

7.4.1 Organization

The training courses identified in the Preliminary Training Plan have been organized into four modules:

1000 - Management
2000 - Design

3000 - Operation
4000 - Maintenance

The individual courses of the Management, Design, Operation and Maintenance modules are either general or system specific. The system specific courses are identified using the system description numbers

assigned elsewhere in the report and summarized in Table 7.4.1, using 3 digits. Examples are:

2100 - Design course on the Closed Cooling Water System
3050 - Operation course on Steam Extraction System
4130 - Maintenance course on Ash Handling Systems and Equipment

Individual courses associated with the training needs identified in Section 7.3 are listed in Appendix 7.1. Existing WAPDA training courses and future station specific courses can be inserted in the training course listing by simply assigning a module number as well as a system number for system specific courses and a sequential number if required. This numbering system facilitates the presentation of the preliminary training plan.

1000 - Management

Training included in the 1000 series of courses 1001-1009 is intended for CPD and/or Station Management (Junior Engineers and above).

It covers general management courses for Junior, Middle and Senior Management as well as project management. WAPDA already has training courses included in the curriculum of the Tarbela Academy which address these areas. Management training courses from 1010-1230 are station specific and serve to familiarize management with the station design, operation and maintenance. These courses are similar to the design courses, but shorter in duration, emphasizing to CPPD management, station management and supervisors the specific concerns and problems that station operators and maintenance personnel have to address.

2000 - Design

Training included in the 2000 series of courses is intended for CPPD and Design, Thermal Engineers. The courses cover station and system design in terms of design basis, system characteristics and station and system operation. The courses would provide the CPPD and Design, Thermal engineering personnel with the basis for the monitoring of system design and the evaluation of options and alternative designs.

3000 - Operation

Training included in the 3000 series of courses is intended primarily for station personnel. Classroom training for station operators covers specific equipment, system and station operating requirements. The courses would cover the safe start-up, load follow and shutdown of each system based on detailed operating procedures specific to the station. Classroom instruction would include lectures by vendor specialists.

In addition to classroom training, it is recommended that station operators complete extensive OJT, either during start-up and test of the station or, for later assignments, during station operation. Operator training should also include simulator training.

The installation of a replica simulator at Faisalabad shows that WAPDA has already recognized the benefits of the use of a simulator. With the likelihood that the Lakhra Station will be the first of a series of coal-fired thermal stations, a simulator installed at Jamshoro as part of the proposed Training Institute is likely to be economic.

4000 - Maintenance

Training included in the 4000 series of courses is intended primarily for station personnel. Classroom training for maintenance management and supervisors covers Planning and Scheduling of periodic maintenance during plant operation and outages. Classroom training for other personnel covers the planned approach to maintenance followed by equipment maintenance requirements. The courses cover the specific requirements for mechanical, electrical and instrumentation equipment and instruct maintenance personnel how to maintain station equipment using vendor manuals and include the development of maintenance records and spare parts requirements.

TABLE 7.4.1
SYSTEM DESIGN DESCRIPTIONS

010	Main Cycle
020	Main and Reheat Steam
030	Condensate
040	Boiler Feedwater
050	Extraction Steam
060	Circulating Water
070	Makeup and Service Water
080	Potable Water
090	Waste Treatment
100	Closed Cooling Water
110	Auxiliary Steam
120	Service and Instrument Air
130	Ash Handling
140	Flue Gas and Air Quality Control
150	Wastewater
160	Fire Protection
170	HVAC
180	Cycle Makeup Treatment Systems
190	Plant Coal Handling Dust Control
200	Coal Handling
210	Electrical Power Supply
220	Emergency Power Supply
230	Instrument and Control System

In addition to training courses identified in each of the four above modules, the Preliminary Training Plan incorporates training which has already been planned by or committed to by WAPDA. This training is identified in the PC-II Training (1985) and in the WAPDA/USAID participant training plans for FY-1985 Energy Planning and Analysis.

An extract of the PC-II is included in Appendix 7.3 and identifies all planned overseas OJT in support of thermal power stations. Although none of the planned OJT is unique to coal-fired stations, all is equally applicable to a coal-fired thermal station.

Appendix 7.2 is an extract of a participant training plan identified (and funded) by USAID. All training identified in this plan is coal station specific and incorporated in the Preliminary Training Plan.

7.4.2 Plan

The Preliminary Training Plan for (future) personnel from the CPPD and Station Organization is presented in Figure 7.4.2(a), (b) and (c).

Training courses are scheduled with reference to the project and construction schedule of WAPDA's first large coal-fired station, which will probably be the Lakhra Station.

In general, training courses are scheduled by module number; in some cases individual course numbers are identified. Each bar on the schedule indicates within which time period the classroom training (identified with module number only) or OJT (identified with module number followed by OJT and O for Overseas or L for In Country) is recommended to take place.

The Final Training Plan should schedule individual classroom training and OJT within these time slots and coordinate between disciplines.

Examples:	2000	=	Applicable Design Course Classroom
	3000 OJT/L	=	Applicable Operations OJT In Country
	3000 S	=	Applicable Operations Simulator Training
	4000 OJT/O	=	Applicable Maintenance OJT Overseas

Refresher training is not scheduled on the Preliminary Training Plan. Essentially, all courses identified in the plan can be presented as refresher training to address:

- o Plant system and component changes
- o Procedure changes
- o Industry and in-house operating experiences
- o Selected topics to reinforce seldom-used knowledge and skills

Scheduling of refresher courses should commence during the start-up and test period.

FIGURE 7.4.2(a)
COAL POWER PROJECTS DEPARTMENT
PRELIMINARY TRAINING PLAN

	POSITION	SCHEDULE (YEARS) 1	2	3	4	5	6
1	Chief Engineer, CPPD	1007 1004(C)(D)	1005 OJT/O	1009			
1	Director, Coal Power Projects	1002 1004(C)(D)		1009	1001		
1	Director, Mining	1002					
1	Director, Geology	1002					
1	Director, Finance & Coordination	1002					
1	Project Director	1004(C)(D)	1005 OJT/O	1009			
1	Deputy Director, Mechanical			1009			
1	Deputy Director, Electrical			1009			
1	Deputy Director, Environ. Anal.	1141					
1	Deputy Director, Project Scheduling & Coordination	1004(B) OJT/O					
1	Deputy Director, Budgets and Accts.						
1	Deputy Director, Contracts	1007	1005 OJT/O	1009			
1	Deputy Director, Administration						
1	Specialist, Econ. and Finan. Anal.	1006					
1	Engineer, Project Scheduling	1004(B) OJT/O					
1	Engineer, Project Reporting	1004(A)					
1	Sr. Engineer, Coal Handling	2000 OJT/O		1009			
1	Sr. Engineer, Ash Handling	2000 OJT/O		1009			
1	Sr. Engineer, Coal Boilers	2000 OJT/O		1009			
1	Sr. Engineer, Coal Analysis	2000 OJT/O		1009			
1	Sr. Engineer, Electrical	2000 OJT/O		1009			
1	Sr. Engineer, I&C	2000 OJT/O		1009			
1	Sr. Engineer, Mining						
1	Sr. Engineer, Geology						
1	Specialist, Materials				4003		
1	Sr. Accountant						
1	Sr. Budget Analyst						

PROJECT SCHEDULE						
Pre-Award						
Preliminary Engineering						
Detailed Engineering						
Construction						
Start-up & Test (Unit #1, #2)					#1	#2
Commercial Operation (Unit #1, #2)					1	2

R1 844667 GE

FIGURE 7.4.2(b)
PROJECT ORGANIZATION (DESIGN AND CONSTRUCTION)
PRELIMINARY TRAINING PLAN

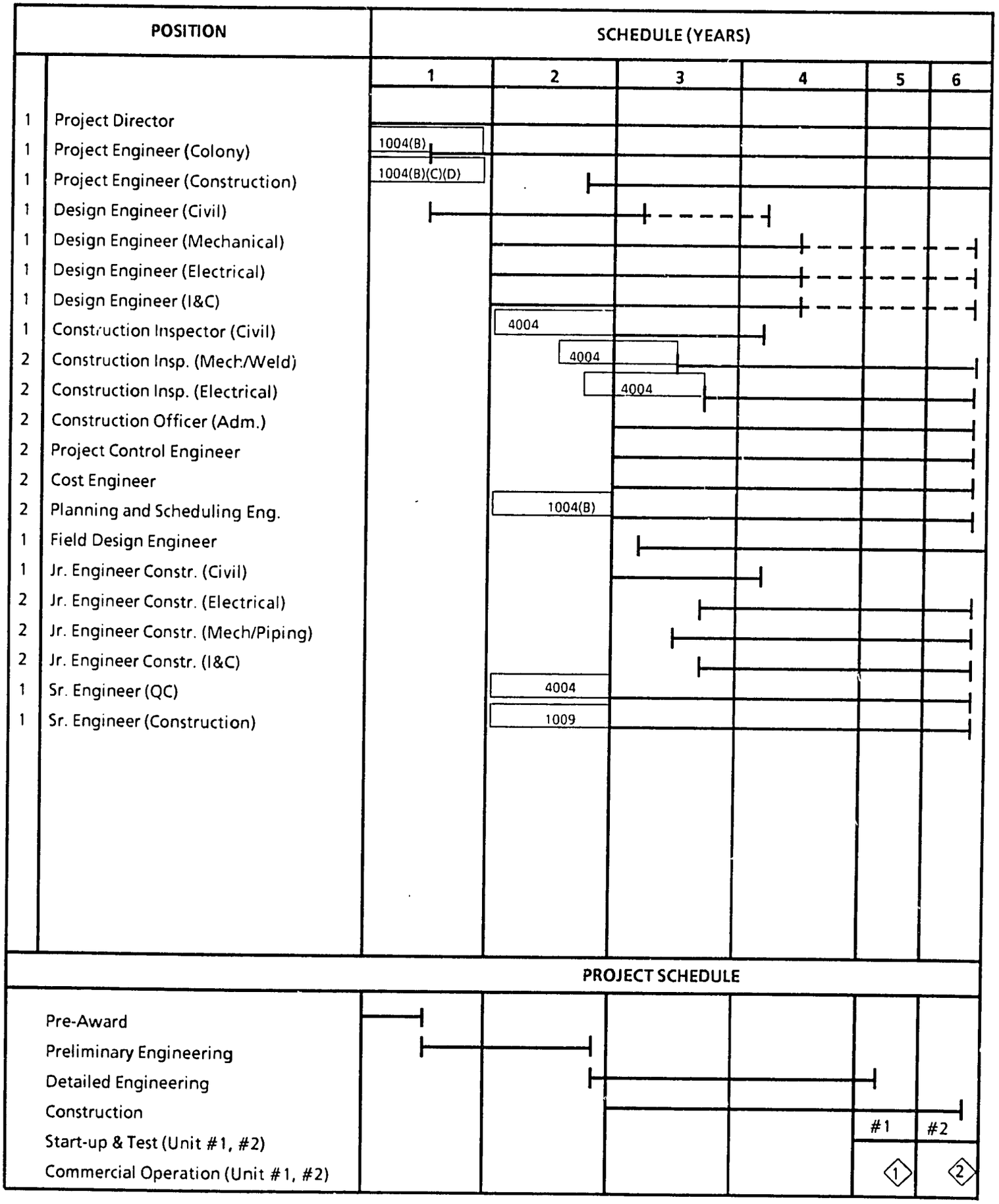


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FIGURE 7.4.2(c)
PROJECT ORGANIZATION (START-UP AND TEST)
PRELIMINARY TRAINING PLAN

	POSITION	SCHEDULE (YEARS) 2	3	4	5	6
1	Resident Engineer	3000 OJT/O	1009	1000		
1	Asst. Res. Engineer (Operations)	3000 OJT/O	1009		3000 S	
1	Asst. Res. Engineer (Maintenance)	4003 OJT/O	1009		4000	
1	Sr. Engineer (Env. Monitoring)		2141 + OJT/O	1000		
1	Sr. Engineer (Pl. & Sch.)		1004(B) + OJT/O	1000		
1	Sr. Engineer (Workshop)			4000		
1	Sr. Engineer (Mech.)		1009 4003 + OJT/O	4000		
1	Sr. Engineer (Electr.)		1009 4003 + OJT/O	4000		
1	Sr. Engineer (I&C)		1009 4003 + OJT/O	4000		
1	Sr. Store Officer			4000		
8	Sr. Shift Engineer			3000 + S + OJT/L		
1	Sr. Chemist			3000 + OJT/O		
1	Sr. Engineer (ITR)			3000 + OJT/O		
1	Sr. Engineer (QC)			4004		
1	Training Coordinator		1009	1000		
9	Jr. Engineer (Maint.)			4003 1000 + 4000 + OJT/L		
54	Jr. Shift Engineer			1000 + 3000 + S + OJT/L		
4	Jr. Chemist			1000 + 3000 + OJT/L		
2	Jr. Engineer (ITR)			1000 + 3000 + OJT/L		
2	Jr. Engineer (QC)			4004		
30	Operator Foreman			3000 + S + OJT/L		
20	Operator Asst. Foreman			3000 + S + OJT/L		
24	Maintenance Asst. Foreman			4000 + OJT/L		
196	Operator			2001 + 3000 + S + OJT/L		
14	Maintenance Foreman			4000 + OJT/L		
649	Maintenance Men			2001 + 4000 + OJT/L		
	Attendants, Helpers			2001 + OJT/L		
	Note: All station personnel should attend a station orientation course			2002		

PROJECT SCHEDULE

	2	3	4	5	6
Construction Unit #1					
Construction Unit #2					
Start-up & Test Unit #1					
Start-up & Test Unit #2					
Commercial Operation Unit #1					
Commercial Operation Unit #2					

7.4.3 Estimated Cost

The cost associated with the implementation of the Preliminary Training Plan is presented in Table 7.4.3(a), (b), (c) and (d) for Modules 1000, 2000, 3000 and 4000, respectively.

The initial presentation of most courses is assumed to be done by expatriate instructors, as indicated in the tables. Local OJT is indicated at the Lakhra site and is recommended to take place during the commissioning period when contractor personnel are available to transfer system knowledge.

Cost estimates for expenses and fees are based on:

- International Airfare - $2000
- Local Transportation - $250
- Per Diem for WAPDA personnel in USA - $60
- Per Diem for US personnel in Pakistan - $60
- Rate for Expatriate Instructor in Pakistan - $600/day
- Rate for Expatriate Instructor in USA - $500/day

Fees in Tables 7.4.3 include those for course preparation; this estimate has been based on a ratio of 1 to 10, i.e. one classroom hour of training is based on 10 hours preparatory work, which is considered an industry average.

The cost of the Training Center, located at Jamshoro is estimated at $8,333,000 present day costs (which includes the simulator estimated at $5,000,000).

Total expenditure for training (excluding the Training Center) over the project schedule is estimated to be:

Year	1	2	3	4	5	6	Total
Cost	375,050	116,230	175,840	511,020	455,125	61,800	1,695,065

The total estimated cost of expatriate instructors is:

In Pakistan	18 months @ $600/day + per diem	= $236,000
In USA	5 months @ $500/day	= $ 47,500

The total estimated cost of OJT/O for WAPDA personnel (excluding salary cost) based on 96 OJT months at a per diem of $60 = $172,800.

TABLE 7.4.3(a)

ESTIMATED COST OF MODULE 1000
TRAINING COURSES

COURSE NO.	LOCATION: CLASSROOM: IN COUNTRY	LOCATION: CLASSROOM: LAKHRA SITE	LOCATION: CLASSROOM: OUT OF COUNTRY	LOCATION: OJT: LAKHRA SITE	LOCATION: OJT: OUT OF COUNTRY	INSTRUCTOR: LOCAL	INSTRUCTOR: EXPATRIATE	NUMBER OF STUDENTS	ESTIMATED COST (In U.S. Dollars): INTL. TRAVEL	IN-COUNTRY TRAVEL	PER DIEM	FEES	TOTAL
1004(B)	X				X		X	7	6,000	1,750	6,660	9,000	23,410
1004(C)	X				X		X	5	4,000	1,250	4,860	9,000	19,110
1004(D)	X				X		X	5	4,000	1,250	4,860	9,000	19,110
1005			X		X		X	3	6,000	750	6,300	2,500	15,550
1006			X				X	1	2,000	250	840	5,000	8,090
1007			X				X	2	4,000	500	1,680	5,000	11,180
1008	X						X	20	2,000	5,000	1,680	12,000	20,680
1009	X						X	21	2,000	5,250	840	6,000	14,090
Systems(1)		X			X(2)		X	66	4,000	250	4,320	36,000	44,570
												Total	175,790

Note (1) System specific courses 1021 1141
1130 1200
1140 1201

(2) Cost of OJT/O for selected Sr. Engineers covered under Module 3000

TABLE 7.4.3(b)

ESTIMATED COST OF MODULE 2000
TRAINING COURSES

COURSE NO.	LOCATION: CLASSROOM: IN COUNTRY	LOCATION: CLASSROOM: LAKHRA SITE	LOCATION: CLASSROOM: OUT OF COUNTRY	OJT: LAKHRA SITE	OJT: OUT OF COUNTRY	INSTRUCTOR: LOCAL	INSTRUCTOR: EXPATRIATE	NUMBER OF STUDENTS	ESTIMATED COST (In U.S. Dollars): INTL. TRAVEL	IN-COUNTRY TRAVEL	PER DIEM	FEES	TOTAL
2001		X		X		X		845	-	-	-	(1) 21,125	21,125
2002		X				X		1,793	-	-	-	2,000	2,000
Systems(2)			X		X		X	7	14,000	1,750	50,400	20,000	86,150
												Total	109,275

Note (1) Cost of 1 course manual/student

(2) System specific courses 2021 2141 2231
2130 2200
2140 2201

TABLE 7.4.3(c)

ESTIMATED COST OF MODULE 3000
TRAINING COURSES

COURSE NO.	LOCATION CLASSROOM IN COUNTRY	LOCATION CLASSROOM LAKHRA SITE	LOCATION CLASSROOM OUT OF COUNTRY	OJT LAKHRA SITE	OJT OUT OF COUNTRY	INSTRUCTOR LOCAL	INSTRUCTOR EXPATRIATE	NUMBER OF STUDENTS	ESTIMATED COST (In U.S. Dollars) INTL. TRAVEL	IN-COUNTRY TRAVEL	PER DIEM	FEES	TOTAL
3003			X		X		X	4	8,000	1,000	21,600	10,000	40,600
3004			X		X		X	3	6,000	750	8,000	5,000	19,750
3005		X		X			X	188	2,000	250	1,800	12,000	16,050
3006		X					X	4(1)	4,000	-	3,600	24,000	31,600
Systems(3)		X		X	X(2)		X	308	20,000	-	57,600	48,000	125,600
												Total	233,600

Note (1) 2 expatriate instructors to train 4 WAPDA Engrs. as simulator instructors.

(2) Sr. Shift Engrs. OJT/O, others OJT/L

(3) System specific courses 3021 3200
3130 3201
3140
3141

TABLE 7.4.3(d)

ESTIMATED COST OF MODULE 4000
TRAINING COURSES

COURSE NO.	LOCATION CLASSROOM IN COUNTRY	LOCATION CLASSROOM LAKHRA SITE	LOCATION CLASSROOM OUT OF COUNTRY	OJT LAKHRA SITE	OJT OUT OF COUNTRY	INSTRUCTOR LOCAL	INSTRUCTOR EXPATRIATE	NUMBER OF STUDENTS	ESTIMATED COST (In U.S. Dollars) INTL. TRAVEL	IN-COUNTRY TRAVEL	PER DIEM	FEES	TOTAL
4003		X			X		X	18	10,000	-	30,000	6,000	46,000
4004		X			X		X	32	4,000	-	7,200	12,000	23,200
Systems(1)		X		X	X(2)		X	55	4,000	-	7,200	24,000	35,200
												Total	104,400

Note (1) System specific courses 4021
4130
4140
4141
4200

(2) Sr. Engineers (Maint.) OJT/O, others OJT/L

APPENDIX 7.1

TRAINING COURSE OUTLINES

APPENDIX 7.1
TRAINING COURSE OUTLINES

Training courses are presented in the following format:

- o Course Number and Title
- o Classroom Training
  - Duration
    - Short : 1 day-2 weeks
    - Medium : 2-6 weeks
    - Long : >6 weeks
  - Class Size
    - Small : 1-6
    - Medium : 7-20
    - Large : >20

  Note: No classroom size over 35 is recommended.

- o OJT

		In Country	Overseas
- Duration	Short	up to 1 month	up to 3 months
	Medium	1-3 months	4-6 months
	Long	over 3 months	over 6 months

  - No. of Trainees
    - Small : 1-4
    - Medium : 5-10
    - Large : >10

- o Source : Vendor
  Utility
  Professional Training Institute
  Gilbert/Commonwealth
- o Course Outline

MODULE 1000
MANAGEMENT

1001 Senior Management (Tarbela Academy Course)
1002 Middle Management (Tarbela Academy Course)
1003 Junior Management (Tarbela Academy Course)
1004 Project Management (A. Tarbela Academy Course)
(B. Planning and Scheduling)
(C. Engineering Monitoring)
(D. Construction Monitoring)
1005 Coal Contracting
1006 Economic and Financial Analysis
1007 Evaluation Techniques for International Power Plant Tenders
1008 Instructor Training
1009 Quality Programs
1021 Coal Burning Systems and Equipment
1130 Ash Handling Systems and Equipment
1140 Flue Gas and Air Quality Control
1141 Environmental Impact of Coal Firing
1200 Coal Handling
1201 Coal Properties and Combustion

No. 1004(B) - Planning and Scheduling

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Medium
- o Source : Professional Training Institute Gilbert/Commonwealth

1004(B) - Course Outline

A. Scheduling Methods

- o Empirical - Discussion of Gantt Charts, Milestone Charts, Quantity Curves
- o Evolution of Network Diagramming Techniques
  - Project Evaluation and Review Technique (PERT)
  - Critical Path Method (CPM)
- o Advantages of Network Based Scheduling

B. Critical Path Method Scheduling

- o Definitions of Terms and Concepts
- o Fundamentals of Network Diagramming Techniques
- o Network Development
- o Preparing the Activity List
- o Level of Detail
- o Activity Identification and Coding
- o Estimating Activity Durations
- o Computation of Critical Path/Sub-Critical Path
- o Determination and Interpretation of Float
- o Imposing Target and Conditional Dates
- o Progress Reporting and Network Updating

C. Standard CPM Formats

- o Summary Level Logic Network Format
- o Detailed Logic Network Format
- o Time Scaled Logic Network
- o Typical Outage/Maintenance Project Networks

D. Scheduling - Resources Considerations

- o Identification and Allocation of Resources (Manpower/Equipment)
- o Time Constraints versus Resource Constraints
- o Use of Early Start and Late Finish Histograms
- o Determination of Resource Leveled Schedule

E. Use of CPM in Cost Forecasting

- o Cash Flow Forecasting
- o Cost Expediting
- o Use of CPM in "What If..." Analysis

F. Schedule Baseline Plan

- o Understanding the Importance of a Schedule Baseline Plan
- o Factors to Consider in Developing a Plan
- o Identifying 'Plan Versus Actual' Performance Variance
- o Corrective Action Planning

G. Methods of Measuring Job Progress

- o Requirements for Timely and Factual Progress Data
- o Labor Units Tracking

H. Schedule Analysis Techniques

- o Methodologies
- o The Meaning and Use of the Schedule Performance Index
- o Float Trending
- o Forecasting Impact

I. Schedule Reporting

- o Factors to Consider
- o Essential Features of an Executive Summary Report
- o Project Management Level Reports
- o Supervisory Level Reports
- o "Production Line" Level Information

J. Schedule Change Control

- o Importance of Effective Change Control
- o Assuring Documentation and Traceability of Baseline Changes Through Control Procedures

K. Scheduling Software Considerations

- o Benefits of Usage
- o Guidelines for Use of Computer Software
- o Review of Latest Hardware and Software Systems

L. Maintenance Applications

- o Activity Planning
- o Manpower Planning
- o Inventory Control
- o Performance Records and Updates
- o Equipment History File

M. Project Schedule and Contractor Claims

- o Legal Implications of the Project Schedule
- o Use of Schedule in Claim/Scheduling Analysis
- o Demonstration of Time Impact Evaluation
- o Guidelines for Negotiating Time Impact Claims

N. Contractor Evaluation

- o Contract Specification - Ensuring the Availability of Schedule/Cost Performance Data
- o Analysis of Contractor Submittals
- o Monitoring the Contractor's Schedule
- o Essential Features of the Contractor Progress Report

No. 1004(C) - Engineering Monitoring

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Utility
  Gilbert/Commonwealth

1004(C) - Course Outline

A. INTRODUCTION TO PROJECT MANAGEMENT NEEDS

- o Planning
- o Budgets
- o Quality

B. PREPARING TURNKEY REQUEST FOR PROPOSAL (SCOPE DOCUMENTS)

- o Contract Administration
- o Technical Requirements
- o Defining Owner's Involvement

C. BIDDING TO TURNKEY CONTRACTORS

- o Review of Final Bid Package
- o Evaluation of Bids
- o Negotiation of Contract with Low Bidder
- o Value Engineering Input to Bid Evaluations

D. MONITORING ENGINEERING AFTER AWARD

- o Progress Evaluations (Cost/Schedule)
- o Conformance to contract
- o Quality
- o Monitoring Procurement Methods
- o Operational and Construction Review of Design

E. QUALITY

- o Review of Codes and Standards
- o Review of Specifications and Drawings
- o Review of Procurement/Vendor Surveillance

No. 1004(D) - Construction Monitoring

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Utility
  Gilbert/Commonwealth

1004(D) - Course Outline

A. INTRODUCTION

- o Organizational Structures for Construction Projects
- o Owner/Contractor Relationships
- o Types of Construction Contracts

B. RISK IN CONSTRUCTION

- o Risk Mangement
- o Engineering Related Risk
- o Construction Related Risk
- o Allocation and Control of Risk

C. ELEMENTS OF A CONSTRUCTION MONITORING PROGRAM

- o Construction Planning
- o Constructibility Reviews
- o Bid and Award
- o Contract Administration
- o Site Coordinator
- o Cost and Schedule Control
- o Quality Control and Inspection
- o Material Control
- o Construction Records
- o Site Services

D. ELEMENTS OF A CONSTRUCTION CONTRACT

- o Agreement
- o Bonds
- o General Conditions
- o Special Conditions
- o Scope of Work
- o Technical Sections
- o Drawings

E. CONSTRUCTION CONSIDERATIONS DURING DESIGN

- o Development of the Overall Project Approach
- o Contracting Strategies
- o Presentation of Design
- o Layouts that Lend Themselves to Construction and Maintainability
- o Administration of the Work
- o Integration of Design and Construction Schedules to Assure a Smooth Flow of Work

F. INCORPORATION OF THE CONSTRUCTION VIEWPOINT

- o Owner and Management Commitments
- o Input During Early Design Phases
- o Acceptance of Construction Viewpoint by Engineering
- o Construction Personnel

G. FUNCTION DUTIES OF THE CONSTRUCTION PROGRAM

- o Quality - ASME Code Familiarization
  - Inspection Training
  - Fundamentals of Quality Programs
- o Expediting
- o Warehousing and Storage Procedure Review
- o Office Administration
- o Change Control
- o Checklist of Structural Requirement
- o Checklist of Mechanical and Piping Requirement
- o Checklist of Instrument and Control Requirement
- o Checklist of Electrical Requirement
  - Typical to all disciplines
    - o Quantity Tracking
    - o Testing Procedures
    - o Methods of Installation
    - o Progress Payments Verification
- o Project Field Accounting
- o Claims and Disputes

315

No. 1005 - Coal Contracting

- o Classroom Training
  - Duration : Short
  - Class size : N/A
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Utility
  Gilbert/Commonwealth
  Mining Consultant

1005 - Course Outline

A. PURCHASE AND SALE

- o Scheduled Quantities
- o Annual Quantities

B. DELIVERIES

- o Point of Delivery
- o Accept/Reject
- o Weighing
- o Transportation

C. QUALITY OF COAL

- o Sampling
- o Analysis
- o Specifications
- o Processing
- o Low Quality

D. PURCHASE PRICE

- o Capital Costs
- o Operating Costs
- o Escalation

E. RECORDS

F. INSURANCE

No. 1006 - Economic and Financial Analysis Methodology

- o Classroom Training
  - Duration : Short
  - Class size : Small
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert/Commonwealth Professional Training Institute

1006 - Course Outline

OBJECTIVE:

To provide students responsible for planning and economic analysis with an understanding of the techniques employed to evaluate the feasibility of projects, compare alternatives and determine revenue requirements.

COURSE DESCRIPTION:

The course addresses both economic and financial analysis techniques. It includes a review of present worth methodology, a discussion of the forecasting and determination of revenue requirements, fixed charge rates, depreciation, discount requirements and tax effects. The development of O&M costs is addressed as is the analysis of financial terms and conditions and calculation of debt service requirements.

No. 1007 - Evaluation Techniques for International Power Plant Tenders

- o Classroom Training
  - Duration : Short
  - Class Size : Small
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert/Commonwealth Professional Training Institute

1007 - Course Outline

OBJECTIVE:

To acquaint students responsible for the evaluation of international power plant tenders with the methodology employed by Gilbert/Commonwealth to determine recommended bidders.

COURSE DESCRIPTION:

The course covers both technical and economic evaluation of bids and presents techniques which have proven to be successful and applicable for the evaluation of international plant tenders. The inter-relationships of technical, economic, political, contractual and organizational elements is discussed. The course contractual focuses on the evaluation of capital, Operations/Maintenance fuel costs and the determination of an overall economic figure of merit.

No. 1008 - Instructor Training

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert/Commonwealth Professional Training Institute

1008 - Course Outline

A. ROLE OF THE INSTRUCTOR

- o Instructor Qualities
- o Creating the Positive Instructional Environment

B. PRINCIPLES OF LEARNING

- o Thorndike's Law of Learning
- o Basic Principles of Learning

C. UNDERSTANDING THE TRAINEE

- o Hierarchy of Needs
- o Motivational Factors
- o Counseling

D. ASSESSMENT OF NEEDS

- o Job and Task Analysis
- o Determine Education and Training Requirements

E. WRITING OBJECTIVES

- o Parts of the Objective
- o Developing Criterion Objectives

F. MEASUREMENT AND EVALUATION

- o Selective/Supply Test Construction
- o Performance Checklist
- o Test Evaluation Criteria

G. USE OF MEDIA

- o Basic Types of Media
- o Classroom Usage
- o Media Development

H. ADMINISTRATIVE MANUALS, INSTRUCTOR MANUALS, AND LESSON PLANS

- o Instructor and Administrative Manuals
- o Lesson Plan Usage
- o Lesson Plan Construction

I. STUDENT MANUALS AND REFERENCE MANUALS

- o Relating Printed Material to Instructional Objectives
- o Advantages and Disadvantages of Student Manuals and Reference Manuals
- o Material Assessment

J. INSTRUCTIONAL TECHNIQUES

- o Communication Skills
- o Three Major Lesson Presentations (Lecture, Discussion, Demonstration-Performance (Lab))
- o Questioning Techniques and Strategies

K. CLASSROOM/ONE-ON-ONE/SELF-STUDY

- o Classroom Dynamics
- o One-on-One Learning Environment
- o Self-Study

L. STATION/WALK-THROUGH TOURS

- o Station Walk-Through Importance
- o Walk-Through Tour Preparation
- o Evaluation

M. LABORATORY SESSIONS AND DEMONSTRATIONS

- o Laboratory Session Importance
- o Sequencing the Presentation
- o Laboratory Session Preparation

N. ON-THE-JOB TRAINING

- o Planning and Implementation of OJT
- o Documentation

O. PROGRAM EVALUATION AND CHANGES

- o Course Validation
- o Test Analysis
- o Internal and External Evaluation Methods

No. 1009 - Quality Programs

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert/Commonwealth

1009 - Course Outline

A. Introduction

- Concept of a Quality Program for a Fossil Thermal Power Station

B. Elements of a Quality Program

- Design Control
- Procurement Control
- Fabrication and Manufacturing Control
- Construction Control
- Control of Special Processes
- Control of Measuring and Test Equipment
- Operation and Maintenance Control
- Management Reviews

C. Organizing for Quality

D. Measuring the Cost of Quality

No. 1021 - Coal Burning Systems and Equipment

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

1021 - Course Outline

A. Furnace Size

B. Superheater and Reheater

- o Surface Required
- o Material

C. I.D. and F.D. Fans

- o Sizing Considerations
- o Type of Fan

D. Pulverizers - Ball and Race or Roll and Race

E. Coal Metering - Feeders

F. Air Heater - Purpose and Control

No. 1130 - Ash Handling Systems and Equipment

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Vendor
Utility
Gilbert/Commonwealth

1130 - Course Outline

A. Types of Ash and Distribution

- o Fly Ash 75-80%
- o Bottom Ash 20-25%

B. Types of Ash Conveyors - Advantages and Disadvantages

- o Steam - Oldest, BTU and Water Loss
- o Pneumatic
  - Vacuum - Leakage, Capacity
  - Pressure - Capacity, Leakage
- o Hydraulic - Water Use, Elevation Limitations

C. Methods of Ash Disposal

- o Sluice to Fill Area Via Hydraulic Conveyor
  - Water Usage and Recycling
- o Truck to Fill Area
  - Dewatering Bins
  - Fly Ash Storage and Unloaders

D. Safety Considerations - Mainly Mechanical Near Moving Equipment Driven by Electric Motors

No. 1140 - Flue Gas and Air Quality Control

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

1140 - Course Outline

A. Types of Flue Gas Cleaning

- o Precipitators - Power Requirements
- o Bag Filters - Pressure Drop Considerations
- o Scrubbers - Wet and Dry

B. Chemical Flue Gas Enhancement

- o Ammonia Injection (pH Control)
- o SO_3 Injection (To Enhance Precipitation)

C. Other Air Quality Control

- o NO_x - Mostly through Combustion Control

D. Safety Considerations

- o Mechanical Hazards - Moving Equipment, Temp.
- o Electrical Hazards - High Voltage Key Interlock System
- o Chemical Hazards - Ammonia and SO_3 Toxicity

No. 1141 - Environmental Impact of Coal Firing

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Utility
  Gilbert/Commonwealth

333

1141 - Course Outline

A. Stack Emissions

- o SO_x
- o NO_x
- o Particulate

B. Noise - Range of Intensity

C. Thermal Pollution

- o Receiving Streams
- o Atmospheric

D. National and International Regulations

No. 1200 - Coal Handling

- o Classroom Training
  - Duration : Long
  - Class Size : Medium
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Vendor
Utility
Gilbert/Commonwealth

1200 - Course Outline

A. Delivery and Unloading

- o Railroad Car
- o Truck

B. Coal Pile Management

- o Small Due to Fire Hazard
- o Storage and Recovery

C. Transport of Coal at Site

- o Reclaim - Bulldozer, Apron Feeder
- o Main Conveyor Belts
- o Crushing
- o Sampling
- o Weighing

D. Other Considerations

- o Dust Mitigation
- o Control
- o Maintenance of Equipment

E. Safety

- o Mechanical Hazards - Moving Machinery
- o Chemical Hazards - Fires and Explosions

No. 1201 - Coal Properties and Combustion

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : N/A
N/A
  - No. of Trainees : Medium
- o Source : Utility
Mine Operator
Gilbert/Commonwealth

1201 - Course Outline

A. Physical Properties

- o Density
- o Grindability

B. Chemical

- o Composition
- o Ultimate Analysis
- o Heating Value

C. Combustion Calculations

- o Chemical Equations
- o Stoichiometric and Excess Air
- o Products of Combustion

MODULE 2000
DESIGN

2001 Fundamentals
2002 Station Orientation
2021 Coal Burning Systems and Equipment
2130 Ash Handling System and Equipment
2140 Flue Gas and Air Quality Control
2141 Environmental Impact of Coal Firing
2200 Coal Handling
2201 Coal Properties and Combustion
2231 Familiarization with Advanced Instrumentation and Control

No. 2001 - Fundamentals

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Long - In Country
  - No. of Trainees : Large
- o Source : Professional Training Institute Gilbert/Commonwealth

<u>Note</u>: This course should be presented by WAPDA instructors from the training institute who have fossil power station experience.

2001 - Course Outline

A. The Power Plant Concept

- o History
- o Basic Theory
- o Major Systems

B. Fuels and Combustion

- o Origin
- o Composition
- o Characteristics
- o Combustion Potentials

C. Fuel Handling

- o Delivery
- o Storage
- o Preparation

D. Steam Generation

- o Boiler
- o Heat Transfer

E. Turbine Generator

- o Turbine Components
- o Generator Components
- o Auxiliary Equipment

F. Condensate and Feedwater System

- o System Components
- o System Operation

G. Water Treatment

- o Impurities
- o Treatment Methods
- o Corrosion

H. Air and Gas Handling Equipment

- o System Components
- o Air Heater Types

I. Instrumentation and Controls

- o Logic Diagrams
- o Operation of Controls
- o Control Loops

J. Emission Control

- o Environmental Considerations
- o Precipitators
- o Filters
- o Scrubbers
- o Separators

K. Electric Systems

- o Main Power System
- o Auxiliary Power
- o Start-up

L. Start-up and Testing

- o System Testing
- o Plant Start-up

No. 2002 - Station Orientation

- o Classroom Training
  - Duration : Short
  - Class Size : Large
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert/Commonwealth

<u>Note</u>: Course to be presented by WAPDA; course could be prepard by Station A/E.

2002 - Station Orientation

A. Security

- o Access Control by Fencing
- o Guard Shack - Sign-in Procedure

B. Safety - Use of Safety Equipment

- o Hard Hats
- o Safety Glasses
- o Hearing Protection
- o Safety Shoes

C. Emergency - Procedure to Follow and Numbers to Call in the Event of:

- o Fire
- o Accident
- o Medical Emergency - Acute Illness

D. Plant Layout

- o Administrative Area
- o Power Block
- o Emergency Facilities
- o Coal Receiving and Storage
- o Ash Disposal

E. Details of Power Block

- o Internal Coal and Ash Handling (including Precipitator and/or FGD)
- o Boiler Area
- o Turbine Generator Area
- o Heater Bay
- o Control Room
- o Electrical Items
- o Circulating Water System
- o Fan Systems - F.D. and I.D. Ducts

F. WAPDA Procedures and Reports

No. 2021 - Coal Burning Systems and Equipment

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Vendor
Utility
Gilbert/Commonwealth

2021 - Course Outline

A. Furnace Sizing and Configuration
(Note those parameters which pertain exclusively to coal firing)

B. Superheater and Reheater Surface

- o Radiant vs. Convective Characteristics
- o Material Suitable to Temperature and Ash Type Service

C. ID & FD Fans

- o Type of Fan Axial vs. Centrifugal
- o Capacity Considerations and Margin
- o Head (Static Pressure) and Margin
- o Driver and its Control (including couplings)
- o Air Flow and Pressure Control

D. Pulverizer Type and Selection - Type of Coal

- o Ball and Race
- o Roller
- o Tube Mill - Anthracite
- o Exhauster Fans
- o Control and Feed

E. Coal Feeders

- o Volumetric
- o Gravimetric
- o Table

F. Air Heater

- o Tubular or Recuperative
- o Plate or Regenerative
- o Seals and Leakage

No. 2130 - Ash Handling System and Equipment

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Vendor
Utility
Gilbert/Commonwealth

2130 - Course Outline

A. Bottom Ash - Quantities and Types Produced

- o Bottom Ash Hopper - Seal Trough, Nozzles, Ash Sluice Gate
- o Clinker Grinder - Types and Principle of Operation
- o Sluicing Pump - Jet Pump vs. Centrifugal, Motive Water, Pumping Efficiency
- o Conveying Line - Material Selection and Routing
- o Disposal Point - Ash Pond or Dewatering Bin

B. Fly Ash Handling and Storage

- o Hopper Feed Assist Mechanisms
  - Vibrators
  - Heating
  - Fluidizing Air
- o Hopper Outlet Feeder
  - Vacuum Type
  - Pressurized Type
- o Conveyor Piping - Material Selection and Routing
- o Vacuum/Pressure Producing Device
  - Water Exhauster - With and Without Air Separator
  - Steam Exhauster
  - Mechanical Blower
- o Storage Silo - Capacity and Structural Design
  - Vent Filter
  - Fluidizing Facilities
  - Safety Considerations
- o Unloader at Silo
  - Feeder Mechanism
  - Unloader Design and Operation
  - Water Requirements
  - Safety Considerations

No. 2140 - Flue Gas and Air Quality Control

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

2140 - Course Outline

A. Precipitator - Mechanical and Electrical Designs

- o Design Parameters
  - % ash in coal
  - concentration of fly ash in flue gas
  - resistivity
  - other physical properties
- o Type of Equipment
- o Physical Layout of Equipment
- o Safety-Key Interlock System

B. Fabric Filter

- o Design Parameters of Fly Ash
- o Design Parameters of Collector
  - Cloth to Air Ratio
  - Cycle Timing
  - Method of Removing Ash from Fabric
  - Filter Material
- o Safety

C. Dry Scrubbers

- o Design Parameters of Flue Gas
- o Design Considerations of Scrubber
  - Velocity
  - Number of Vessels
  - Conveying Consideration of Dry Product
- o Other Equipment - Spray Preparation
- o Safety

D. Wet Scrubbers

- o Design Parameters of Flue Gas
- o Design Consideration of Scrubber
  - Temperature
  - Velocity
  - Number of Vessels
- o Support Equipment
  - Make Up
  - Pumps
  - Thickener and Concentrate Conveying
  - Vacuum Filter
- o Ultimate Disposal of Waste Concentrate
- o Safety

No. 2141 - Environmental Impact of Coal Firing

- o Classroom Training
  - Duration : Medium
  - Class size : Small
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Utility
  Gilbert/Commonwealth

2141 - Course Outline

A. Gaseous - Stack

- o SO_x
- o NO_x
- o Airborne Particulate

B. Liquid

- o Coal Pile Run Off
- o Building Drains
- o Oily Drains

C. Solid

- o Fly Ash
- o Bottom Ash
- o Mill Rejects
- o Flue Gas Desulfurization Wastes

D. Noise - Sources and Range of Intensity

E. Thermal

- o Receiving Streams
- o Atmosphere

F. Control Equipment

- o Precipitator
- o Fabric Filter
- o Scrubber
- o Liquid Waste Treatment Plant
- o Fly Ash and Bottom Ash Disposal
- o Sound Attenuation and Muffling
- o Circulating Water Duty

No. 2200 - Coal Handling

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Medium - Overseas
  - No. of Trainees : Small
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

2200 - Course Outline

A. Receiving - Truck or Rail Car

- o Weighing
- o Unloading - Type of Equipment
- o Coal Pile - Bulldozer Operation - Compacting
- o Sampling
- o Safety

B. Transporting

- o Reclaim by Bulldozer
- o Apron Feeder
- o Conveyor Belts and Transfer Towers
- o Magnetic Separator
- o Crusher
- o Tripper Belt

C. Storage - Bunker and Coal Pile

D. Dust Suppression

E. Sampling and Weighing

F. Safety - Fire and Explosion Prevention

No. 2201 - Coal Properties and Combustion

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Short - Overseas
  - No. of Trainees : Small
- o Source : Utility
Mine Operator
Gilbert/Commonwealth

2201 - Course Outline

A. Physical Properties

- o Density
- o Composition by Weight
- o Composition by Volume
- o Ultimate Analysis
- o Rank - Lignite to Anthracite
- o Heating Value
- o Slagging Temperature
- o Ash Analysis

B. Effects of Coal Characteristics on Coal Burning Equipment

- o Flame Temperature
- o Slagging Characteristics
- o Ash Content

C. Concept of a Mole (Pound Mole)

D. Conservation of Matter

E. Conservation of Energy

F. Ideal Gas Law

G. Combustion Calculations

- o Chemical Equations
- o Heat of Combustion
- o Air
- o Losses
- o Products of Combustion
- o Tabular Solution Format - ("Steam")

H. Measure of Total Excess Air

I. Flue Gas Analysis

J. Flue Gas Sampling

K. Metering Combustion Air

No. 2231 - Familiarization with Advanced Instrumentation and Control

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Medium - Overseas
  - No. of Trainees : Small
- o Source : Vendor
  Utility
  Professional Training Institute
  Gilbert/Commonwealth

2231 - Course Outline

A. Objectives of the Process Control System

B. Instrument and Controls

- o Terms and Definitions

C. Control-Loop Signals and Components

- o Signal Transmission
- o Measurement Signal Transmitter
- o Recorders, Indicators and Logging

D. Pneumatic Instruments

- o The Bourdon Tube
- o Factors Affecting Pressure Measurement
- o Factors Affecting Flow Measurement and Orifice Design
- o Factors Affecting Liquid Level Measurement
- o Link and Lever Mechanisms
- o Pneumatic Instruments Calibration
  - D/P Instruments
  - Pressure Transmitters
  - Level Transmitters
  - Temperature Transmitters
  - Pneumatic Positioners

E. Control Valve Design and Maintenance

- o Control Valve Selection
- o Maintenance of Control Valves

F. Pneumatic Process Controllers

- o Control Actions
  - On/Off Control
  - Proportional Response
  - Types of Controllers
- o System Lags and Capacity
- o Controller Characteristics
  - Controller Gain
  - Automatic Reset
  - Proportional-Plus Automatic Reset
  - Derivation Mode
- o Specific Types of Controllers
  - Foxboro
  - Fisher
  - Bailey

- Honeywell
- Others

G. Electronic Instruments

- o Electronic Fundamentals
  - Electron Flow
  - Electronic Symbols
  - D-C Voltage Circuits
  - A-C Voltage Circuits
- o Measurement Circuits and Primary Elements
- o Solid State Fundamentals
- o Solid Sate Amplifiers
- o Ph Measurement
- o Electronic Transmitters
- o Electronic Controllers
- o Electronic Converters
  - Millivolt to Current
  - Millivolt to Pressure
- o Magnetic Transmitters and Converters
- o Electronic Data Collection and Logging

H. Introduction to Computers

- o Computer Functions
- o Computer Terms
- o Computer Math
  - Converting Numbering Systems
  - Repetitive Division
  - Expansion of Power
  - Computer Arithmetic Procedures
- o Block Diagrams
- o Command Timing
- o Debugging
- o Memory/Interrupt
- o Input/Output
- o Interconnections
- o Auxiliary Equipment

MODULE 3000
OPERATION

3003 Station Performance Testing
3004 Coal and Environmental Sampling and Analysis
3005 Fire Protection
3006 Simulator Training
3021 Coal Burning Systems and Equipment
3130 Ash Handling Systems and Equipment
3140 Flue Gas and Air Quality Control
3141 Environmental Impact of Coal Firing
3200 Coal Handling
3201 Coal Properties and Combustion

No. 3003 - Station Performance Testing

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Medium - Overseas
  - No. of Trainees : Medium
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

3003 - Course Outline

A. Power Plant Performance Introduction

- o Terminology
  - Efficiency
  - Power Plant Performance
  - Plant Efficiency
  - Heat Rate
  - Turbine Heat Rate
  - Plant Heat Rate
  - Non-Recoverable Losses
  - Recoverable Losses
  - Controllable Losses
  - Optimum Heat Rate
  - Design Heat Rate
  - Base Line Heat Rate
  - Combustion Efficiency
  - Thermal Efficiency
  - Boiler Efficiency

B. Basic Applied Thermodynamics

- o Steam
  - Properties of Steam
  - Saturation vs. Superheated Steam
- o Combustion
  - Boiler Unit
  - Combustion of Fuel
  - Heat Transfer
  - Conduction
  - Convection
  - Radiation
  - Heat Transfer Processes Inside a Boiler
  - Forced Circulation
  - Natural Circulation
  - Boiler Capacity Limitations
  - Induced and Forced Draft Fans

C. System Descriptions/Characteristics

- o Basic Power Plant Cycle
- o Modern Steam Power Plant Cycle

D. Stack and System Losses

- o Combustion Efficiency
- o Combustion Monitoring

- o Plant Cycle Efficiency
- o Cycle Efficiency Monitoring

E. Practical Power Plant Practices

- o Training
  - Operators
  - Maintenance
- o Staffing
  - Placement, Experience
- o Human Factors Engineering
- o Adequate Reference Materials
- o Following Procedures
- o Deviations from Optimum Heat Rate and How They Affect Plant Performance (Utilizing Plant Specific Heat Balance)
  - Main Steam Temperature
  - Main Steam Pressure
  - Reheat Steam Temperature
  - Superheat Spray Flow
  - Reheat Spray Flow
  - Feedwater Temperature
  - Boiler Efficiency
  - Station Power
  - Turbine Efficiency
  - Condenser Backpressure
  - Circulating Water Temperature
  - Other Systems
- o Efficiency Operation of Major Components/Systems
  - Steam Generator
    - Fuel Handling Equipment
    - Fans
    - Combustion Equipment
    - Temperature Controls
    - Corrosion/Erosion/Deposition
  - Turbine/Generator
    - Variable Pressure Operation
    - Off Design Operation
    - The Generator
  - Auxiliary Steam
  - Cooling Water
  - Compressed Air
  - Condensate/Feedwater
  - Auxiliary Power System
  - Water Treatment

F. Basic Thermodynamics, Heat Transfer, and Fluid Flow

- Basic Concepts and Equations
- Basic Properties of Systems: Definitions and Equations for Calculations
- Principal Forms of Energy
- Conservation of Energy as Expressed in First Law of Thermodynamics
- Heat Transfer
- Introduction to Fluid Flow, Piping, and Pumps as Factors in Transfer of Energy
- Perfect Gas Laws and Energy Relations During Ideal Process
- Effects of Heat
- Introduction to Vapors and Use of Steam Tables and Mollier Chart
- Efficiency of Steam Cycles

3003 - Appendix

PERFORMANCE MONITORING

When using the terms "performance test" this means the determination of the actual ability of equipment to do its function. The ability is measured with precision test instruments and is accomplished by following a procedure to guarantee the repeatability of the test results. The term "performance trending" is used to describe the process of tracking performance by plotting data which will serve as an indicator of the actual performance. The indicators may be expressed in the same measurement units as the performance test results or the indicator may be expressed in different measurement units. Performance trending is useful because indicators are selected which do not require special instrumentation or large quantities of manpower to collect and prepare. They will give solid indications of changes in performance.

A comprehensive program of performance monitoring should include either or both performance testing and/or performance trending. In certain instances the cost of instrumentation and the number of manhours are not justified by the information gathered by the test. In those cases the performance trending can provide adequate information to indicate deviation in performance which may require action. By using performance information from either or both testing and/or trending you can establish a program which will adequately provide the information needed to support your decisions.

WHY MONITOR?

1. To determine the need for maintenance and guard against unscheduled loss of capacity.

2. To provide information for the proper and efficient operation of unit and/or equipment.

3. To meet regulatory requirements by proving compliance with standards.

WHAT TO MONITOR?

1. Equipment where unscheduled repair would cause a loss of capacity.

2. Equipment where the operating efficiency has a discernible effect on the cost of operation.

3. Equipment required to meet a regulatory standard.

HOW TO MONITOR?

1. Run baseline performance test with needed precision and repeatability.

2. Establish indicators for performance trending and set acceptable levels of deviation of indicators.

3. Using changes in performance trends, initiate the appropriate action. This may include additional testing and a cost benefit evaluation of repair.

PERFORMANCE MONITORING PROGRAM

A recommended list of equipment or systems to be monitored is shown in Tables I and II. In addition to the equipment/system is the type of performance test or performance trending which can be done. Based upon the priority for monitoring, each equipment/system should be reviewed to determine the best combination of testing and trending to meet the needs for monitoring. Table I shows the recommended tests and the respective frequency of the tests. Table II shows the recommended trending, the respective frequency for trending and the implementation period.

An implementation plan should be integrated into the "Goals and Objectives" of the department personnel. For each of the test or trending recommendations you will need to review the specific requirements. The steps to be followed should include:

- o Review of existing procedures
- o Review of ASTM, ASME or other standards for testing methods
- o Determine instrumentation requirements
- o Determine modifications to plant to accept test equipment
- o Procuring instrumention
- o Modify plant and install test ports for equipment
- o Establish test procedure

The results of each performance test series should be prepared in a report and provided to the respective management. Appropriate charts or tabulations should be kept current and available for review. Copies of charts or tabulations should be provided with recommended actions when the trends indicate a significant deviation. Semi-annually, copies should be provided for review to respective management.

TABLE I

Equipment/System	Test	Frequency*
Generating Unit	Capability Input-Output	Summer/Winter Annual
Main Turbine	Isentropic Efficiency	Annual, Before and After Overhaul
Boiler	Efficiency	Annual
Air Heater	Seal Leakage	Annual
Condenser	Percent Cleanliness	Annual, Before and After Cleaning
Cooling Tower	Thermal Performance	Annual
Feedwater Heater	Terminal Temperature Difference/Degree of Approach	Biannually
Boiler Feed Pump Turbine	Isentropic Efficiency	Not Recommended
Boiler Feed Pump	Head-Capacity	After Overhaul
Boiler Feed Booster Pump	Head-Capacity	After Overhaul
Circulating Water Pump	Head-Capacity	After Overhaul
Condensate Pump	Head-Capacity	After Overhaul
Deep Well Pump	Head-Capacity/Draw Down	After Overhaul
Electrostatic Precipitator	Mass Emissions	Biannually, After Major Rebuilds
Soot Blowing Air Compressor	Head-Capacity-Power	After Overhaul

*A test may be required at any significant change in trend data.

TABLE II

Equipment/System	Test	Frequency
Generating Unit	Heat Rate	Weekly
Main Turbine	Operating Isentropic Efficiency Stage Pressure Turbine Heat Rate	Monthly Monthly Weekly
Boiler	Operating Efficiency Excess Air	Weekly Weekly
Air Heater	Cold End Temperature	Weekly
Condenser	Terminal Temperature Difference Vacuum Pump Air Flow	Weekly Weekly
Cooling Tower	Range, Approach	Quaterly
Feedwater Heater	Operating Terminal Temperature Difference/Operating Degree of Approach	Monthly
Boiler Feed Pump Turbine	Input Energy/Speed/Flow/Head	Monthly
Boiler Feed Pump	Single Point Head-Capacity Leak Off Pressure-Flow	Biannually Biannually
Boiler Feed Booster Pump	Single Point Head-Capacity	Biannually
Circulating Water Pump	Single Point Head-Capacity	Biannually
Condensate Pump	Single Point Head-Capacity	Biannually
Deep Well Pump	Single Point Head-Capacity	Biannually
Electrostatic Precipitator	None Recommended*	
Soot Blowing Air Compressor	Single Point Head-Capacity	Biannually
Pulverizer	Coal Fineness	Biannually

*Since this is a regulated device, operation and maintenance should monitor daily.

No. 3004 - Coal and Environmental Sampling and Analysis

- o Classroom Training
  - Duration : Medium
  - Class Size : Small
- o OJT
  - Duration : Medium - Overseas
  - No. of Trainees : Small
- o Source : Vendor
  Utility
  Gilbert/Commonwealth

3004 - Course Outline

A. Introduction to Environmental Analysis

- o Environmental Analysis
  - Definition
  - Scope
- o Environmental Degradation
  - Levels
    - o Local
    - o Regional
    - o National
    - o Continental
    - o Global
  - Effects
    - o On Man
    - o On Animals
    - o On Vegetation
    - o On Nonliving Materials

B. Air Analysis - Particulates

- o Air Pollution
  - Definitions
  - Classifications
  - Sources
  - Effects
- o Particulates
  - Classification by Size
  - Sources
  - Hazards
- o Analysis Procedures
  - Atmospheric
    - o Gravity technique
    - o Filtration Technique
    - o Inertial Technique
    - o Precipitation Technique
  - Stack Sampling
    - o Purpose
    - o Consideration
    - o Equipment
- o Practical Applications

C. Air Analysis - Gaseous Pollutants

- o Gaseous Pollutants
  - Inorganic Gases
    - o Sulfur Compounds

            - o Nitrogen Compounds
            - o Chloride Compounds
            - o Fluoride Compounds
            - o Carbon Compounds
            - o Oxidants
        - Organic Gases
            - o Hydrocarbons
            - o Hydrocarbon Derivatives
    - o Formation of Gaseous Pollutants
    - o Hazards
        - Effects on Man
        - Effects on Environment
    - o Sampling Techniques
        - Absorption Sampling
        - Adsorption Sampling
        - Condensation Sampling
        - Grab Sampling
    - o Analysis of Specific Gases
        - NO_x
        - SO_x
        - CO
        - Hydrocarbons
    - o Practical Applications

D. Water Analysis

- o Major Classifications of Water Pollutants
    - Types
    - Sources
    - Effects
- o Regulation of Water Discharge
- o Sampling Techniques
- o Specific Analyses
    - DO
    - BOD
    - COD
    - Total Suspended Solids
    - pH
    - Chlorine
    - Hardness
    - Total Iron
    - Fecal Coliform
- o Practical Applications

E. Solid Wastes

- o Solid Waste
    - Types
    - Sources

- o Problems
  - Aesthetics
  - Health Hazard
  - Pollution
- o Methods of Disposal
  - Landfill
  - Incineration
  - Open dumps
  - Recycling
- o Considerations
  - Government Regulations
  - Economics
  - Environment

F. Air Emission Monitoring

- o Purpose of Monitoring Air Emissions
- o Air Sampling Techniques
- o Analysis Procedures
  - Particulates
  - SO_x
  - NO_x
  - CO
  - Oxidants
  - Hydrocarbons
- o Practical Applications

G. Coal Sampling and Analysis

- o Coal Properties
  - Major Coals
  - Coal Sources
- o Coal Testing
  - Sampling and Sizing
  - Proximate Analysis
    - o Moisture
    - o Volatile Matter
    - o Fixed Carbon
    - o Ash
    - o Grindability
    - o Ash Fusion Temperature
  - Ultimate Analysis
    - o Sulfur
    - o Hydrogen
    - o Carbon
    - o Nitrogen
    - o Oxygen
  - Heating value determination by using bomb calorimeter

H. Combustion Chemistry

I. Practical Applications

No. 3005 - Fire Protection

- o Classroom Training
  - Duration : Short
  - Class Size : Large
- o OJT
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Vendor
  Gilbert/Commonwealth

3005 - Course Outline

A. General

- o How Fires Start
- o Fire and Explosion Hazards
- o Preventing Fires
- o Four Classes of Fires
- o Portable Fire Extinguishers
- o Firehose Handling and Maintenance

B. Coal Station Fire Protection

- o Fire Protection Systems
- o Station Fire Precautions
- o Station Fire Fighting Procedures
- o Location of Station Fire Fighting Equipment
- o Station Evacuation Procedures

No. 3006 - Simulator Training

- o Classroom Training*
  - Duration : 2 Weeks
  - Class size : Small
- o OJT Included Above
  - Duration : N/A
  - No. of Trainees : N/A
- o Source : Gilbert Associates/Autodynamics

*Location depends on location of simulator

3006 - Course Outline

Day One - Classroom

Introduction to the Simulator Course

Objectives of the Course
Organization of the Program
Organization of the Simulator Training Manual
Testing and Evaluation

Reading Training Proficiency Review (TPR)
Quizzes, Homework, and Exams

Introduction to the Control Board

Control Board Layout through Photographs
Brief Layout of the Systems

Auxiliary (Main Feed Pump or Forced Draft Fan) Turbine Start-up Review
Simulator System Review
Feedwater and Condensate Review

Day One - Simulator

Tour of Control Board

Utilization of Textbook Photos and Instrument List
Board Position Assignments and Responsibilities

Detailed Auxiliary Turbine Start-up Instruction
Detailed Pulverizer Start-up Instruction
Detailed Feedwater and Condensate System Operation Instruction

During this period the trainees are required to become familiar with the control board as quickly as possible. They are required to raise load as high as they can safely and efficiently attain while placing in service feed pump, forced draft fan, induced draft fan, and pulverizers. They will be required to do this at least twice during this session, with the trainees moving to different board positions after each exercise.

Day Two - Classroom

Review Previous Day's Classroom and Simulator Exercises
Describe the Main Boiler and Auxiliaries
Simulator System Review

Purge and Firing Interlocks
Auto/Manual Start-up

Review Combustion Air and Flue Gas Sytem
Turbomat Control Panel Description and Operation
Quiz

Day Two - Simulator

Repeat Exercises Started During Day One
- Change Board Positions (until each trainee has experience in all four locations)
- Increase Load Escalation Rate
- All Controls on Manual

Start Exercises on the Turbomat Panel

- Place in Operator Guide (Manual)
- Place in Automatic
- Place in Integrated Mode

Day Three - Classroom

Review Quiz and Previous Day's Exercises

Review Cold Start-up Procedure

- Start Circulating Water System and Establish Vacuum
- Establish Water Cleanup Flow
- Establish Water Flow through the Boiler
- Initial Purge and Firing of Boiler
- Boiler Primary Superheater Pressurization Ramp
- Cold Roll Turbine and Synchronization of Generator
  - Compare with Hot Turbine Roll
  - Utilize Procedures of Integrated Start-up
- Describe Steam Systems
  - Main Steam and Reheat System
  - Extraction and Heater Drains and Vents System
  - Start-up System
    - Review Secondary Superheater Pressurization Ramp
  - Auxiliary Steam System
    - Auxiliary Boiler Start-up and Operation
- Quiz

Day Three - Simulator

Conduct Cold Start-up of the Plant

Utilize different Initial Conditions to maintain continuous trainee board interface up to Cold Turbine Roll

Change Board Positions and Repeat Cold Turbine Roll
Snapshot board configuration at end of day for use on following day to continue cold unit start-up

Day Four - Classroom

Review Quiz and Previous Day's Exercises
Review Shutdown Procedure

Variable Pressure vs. Constant Pressure
Weekend Shutdown vs. Long Term Shutdown

Simulator System Review

Integrated Feedforward Mode
Boiler Following
Turbine Following
Constrained Mode
Cross-limits
Runbacks
Manual to Auto Procedure

Day Four - Simulator

Initialize simulator at snapshot initial condition from preceding day and complete start-up. Stabilize the unit and then reduce load. Remove turbine and boiler from service for a weekend shutdown.

Initialize at Hot Turbine Roll initial condition and allow all trainees to roll a hot turbine.

Day Five - Classroom

Review Quiz and Previous Day's Exercises
Review Malfunction Recovery Procedures for the following equipment:

Main Feed Pump Trip - Manual/Automatic
Primary Air Fan Trip - Manual/Automatic
Induced Draft Fan Trip - Manual/Automatic

Review the entire week's training session and identify areas where the trainees have had the most difficulty.

Quiz

Day Five - Simulator

Initialize the simulator and increase load with all the controls in manual.

Initialize the simulator at full load. Each trainee will operate the control board, individually, during:

Main Feed Pump Trip
PA Fan Trip
ID Fan Trip

Day Six - Classroom

Review Quiz and Previous Day's Simulator Exercises

Instructor will present TPR Analyses for each trainee's malfunction exercise of the previous day. A review, evaluation, and explanation of each will take place.

Review Malfunction Recovery Procedures for the following equipment:

Forced Draft Fan Trip
Air Heater Trip
Condensate Booster Pump Trip
Hotwell Pump Trip
High Pressure Heater Bypass

Day Six - Simulator

Initialize the simulator at full load. Decrease load with all the controls in manual.

Initialize the simulator at full load. Each trainee will operate the control board, individually, during:

Forced Draft Fan Trip
Air Heater Trip
Condensate Booster Pump Trip
Hotwell Pump Trip
High Pressure Heater Bypass

Day Seven - Classroom

Review Quiz and Previous Day's Simulator Exercises

Instructor will present TPR Analyses for each trainee's malfunction exercise of the previous day. A review, evaluation, and explanation of each will take place.

Review Unit Trip Procedure

Preparations for Hot Restart

Review problems that can occur in the pulverized coal system:

Pulverizer Trip
Pulverizer Plugging
Pulverizer Fire
West Coal

Quiz

Day Seven - Simulator

Initialize the simulator; increase load with all the controls in manual. Instructor will enter malfunctions previously covered in the classroom.

Instructor will enter unit trip malfunction if the trainees maintain unit on the line. Proper unit trip recovery procedure will be covered.

Initialize the simulator at full load. Permit each trainee to continue to practice individual malfunction recovery procedures.

Day Eight - Classroom

Review Quiz and Previous Day's Simulator Exercises

Instructor will present TPR Analyses for each trainee's malfunction exercise of the previous day. A review, evaluation, and explanation of each will take place.

Review the detailed description of the Simulator System. Emphasize:

Feedwater Limited
Firing Rate Limited
Air Flow Limiting Fuel Flow
Constrained Mode

Review common boiler and turbine malfunctions encountered during normal operations:

Boiler Waterwall Tube Leak
Boiler Secondary Superheater Tube Leak
Main Turbine Operating Device Failure
Main Turbine Steam Valve Failure

Quiz

Day Eight - Simulator

Initialize the simulator; increase load with all the controls in manual. Instructor will enter malfunctions previously covered in the classroom.

Demonstrate through the use of malfunctions the typical boiler and turbine problems that were described in the classroom. These include:

Boiler Waterwall Tube Leak
Boiler Secondary Superheater Tube Leak
Main Turbine Operating Device Failure
Main Turbine Steam Valve Failure

Day Nine - Classroom

Review Quiz and Previous Day's Simulator Exercises

Instructor will present TPR Analyses for each trainee's malfunction exercise of the previous day. A review, evaluation, and explanation of each will take place.

Review the malfunction recovery procedures that are most problematic to the trainees.

Day Nine - Simulator

Initialize the simulator; increase load with all the controls in manual. Instructor will enter malfunctions previously covered in the classroom.

The instructor will cause the unit to trip with the main boiler stop valves and a turbine stop and control valve failed open. The proper recovery procedure will be demonstrated and practiced by the trainees.

Initialize the simulator at full load. Permit each trainee to continue to practice individual malfunction recovery procedures.

Day Ten - Classroom

Review Quiz and Previous Day's Simulator Exercises

Instructor will present TPR Analyses for each trainee's malfunction exercise of the previous day. A review, evaluation, and explanation of each will take place.

Summarize and discuss all of the TPR Analyses and identify the trainees' individual areas of weakness.

Final Exam

Day Ten - Simulator

Run malfunctions or operations identified in the classroom discussions as being the most problematic areas of the trainees.

Initialize the simulator at full load. Permit each trainee to continue to practice individual malfunction recovery procedures.

Initialize the simulator at part load and conduct the group evaluation utilizing the TPR feature of the simulator.

Initialize the simulator at full load, enter a malfunction, and conduct the individual trainee evaluation utilizing the TPR feature of the simulator.

Request the trainees fill out of the simulator training questionnaire.

.332

No. 3021 - Coal Burning Systems and Equipment

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Vendor
Utility
Gilbert/Commonwealth

3021 - Course Outline

A. Furnace Pressure Control - A Balance of F.D. and I.D. Fan Operation

B. Superheat and Reheat Temperature Control

- o Burner Tilt
- o Fuel Firing Rate
- o Attemperation

C. F.D. and I.D. Fan Control

- o Start-up Sequence
- o Speed
- o Damper Position
- o Shutdown and Trip

D. Control of Coal Supply (Firing Rate)

- o Feeder Control
- o Pulverizer Operation
- o Exhauster Fan Operation
- o Start-up and Shutdown

No. 3130 - Ash Handling Systems and Equipment

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Vendor
Utility
Gilbert/Commonwealth

3130 - Course Outline

A. Bottom Ash System Configuration

- o Bottom Ash Hopper - Operation and Limitations
- o Clinker Grinder - Operation, Clearing Jams
- o Sluice Pump - Start-up Sequence
- o Control System Operation
- o Mill Rejects Conveyor Operation
- o Safety Considerations

B. Fly Ash Systems and Storage

- o Fly Ash Hopper Feeders
  - Types
  - Operation
  - Control
- o Vacuum/Pressure Producing Device
  - Types
  - Operation
  - Safety Considerations
- o Storage Silo - Operation and Safety
- o Unloading Operation
  - Safety
  - Dust Suppression

No. 3140 - Flue Gas and Air Quality Control

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Vendor
Utility
Gilbert/Commonwealth

3140 - Course Outline

A. Fly Ash Collecting Device

- o Type - Precipitator, Fabric Filter, etc.
- o Operation - Electrical and Mechanical Control
- o Safety - Key Interlock System

B. Flue Gas Treatment

- o Scrubbing - Wet or Dry
  - Operation - Pumps, Reaction Vessel, Disposal
  - Safety
- o SO_3 Gas Conditioning - Safety, Operation, Source of SO_3
- o Ammonia Injection - Safety

C. Other Air Quality Control

NO_x - Combustion Control

No. 3141 - Environmental Impact of Coal Firing

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Utility
Gilbert/Commonwealth

3141 - Course Outline

A. Stack Emissions

- o SO_x - Measurement and Control
- o NO_x - Measurement and Control - Combustion
- o Particulate - Before and After Collecting Equipment

B. Liquid Wastes - Control and Treatment of:

- o Coal Pile Runoff
- o Building Drains
- o Oily Drains
- o Water Treatment Wastes

C. Solid Wastes - Control and Disposal of:

- o Fly Ash
- o Bottom Ash
- o Mill Rejects
- o Flue Gas Desulfurization Wastes

D. Noise - Main Sources and Methods of Control

E. Thermal Pollution - Control of:

- o Thermal Pollution of Receiving Steams
- o Atmospheric Thermal Pollution

No. 3200 - Coal Handling

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Vendor
Utility
Gilbert/Commonwealth

3200 - Course Outline

A. Delivery

- o Truck
- o Railroad Car
- o Barge

B. Unloading Operations

- o Weighing
- o Unloading - Type of Equipment
- o Transport to Coal Pile

C. Coal Pile Management

- o Stock Out
- o Compact
- o Reclaim
- o Fire Prevention

D. Coal Supply to Plant

- o Apron Feeder Operation
- o Conveyor Belt Operation
- o Magnetic Separator
- o Crusher Operation
- o Tripper Belt
- o Safety Considerations - Emergency Trips

E. Coal Storage in Plant - Bunker Operation

F. Feed to Furnace

- o Sampling and Weighing
- o Feeder Operation
- o Pulverizer Operation

G. Burner Control

No. 3201 - Coal Properties and Combustion

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Short - In Country
  - No. of Trainees : Medium
- o Source : Utility
Mine Operator
Gilbert/Commonwealth

3201 - Course Outline

A. Physical Properties

- o Weight - Conveying Characteristics, Ease of Handling
- o Grindability - As It Relates to Pulverizer Operation

B. Chemical Properties

- o Composition - Fixed Carbon and Volatile Content
- o Analysis - Burning, Ash and Slagging Characteristics

C. Combustion

- o Stoichiometric Air Required
- o Excess Air Required
- o Control of Fire to Affect other Factors such as:
  - Slagging
  - NO_x Production
  - Superheat and Reheat Temperatures

MODULE 4000
MAINTENANCE

4001 Outage Planning and Scheduling (see 1004(B))
4003 Preventive Maintenance
4004 QC
4021 Coal Burning Equipment and Auxiliaries
4130 Ash Handling Systems and Equipment
4140 Flue Gas and Air Quality Control
4141 Environmental Impact of Coal Firing
4200 Coal Handling

No. 4003 -- Preventive Maintenance

- o Classroom Training
  - Duration : Short
  - Class Size : Small
- o OJT
  - Duration : Medium - Overseas
  - No. of Trainees : Small
- o Source : Utility
  Gilbert/Commonwealth

4003 - Course Outline

A. Maintenance Manuals

- o Procedures
- o Instructions
- o Standing Orders
- o Vendor Manuals

B. Outage Management

- o Scheduled
- o Forced
- o Contracting

C. Planning

- o Routine Maintenance
- o Equipment Overhaul
- o Discipline Interfaces

D. Spare Parts

- o Fitness for Purpose
- o Stock Levels
- o Specifications

E. Documentation

- o Equipment History File
- o Failure Analysis

F. Work Orders

- o Scoping
- o Tracking

No. 4004 - Quality Control

- o Classroom Training
  - Duration : Medium
  - Class Size : Medium
- o OJT
  - Duration : Short - Overseas
Medium - In Country
  - No. of Trainees : Medium
- o Source : Professional Training Institute
Gilbert/Commonwealth

4004 - Course Outline

A. Basic QC Inspector

- o General Employee Training
- o Plant Fundamentals
- o Communication Skills
- o Quality Control Indoctrination
- o Document Control and Records Management
- o Procurement
- o Material Receipt Inspection
- o Storage Inspection
- o Measuring and Test Equipment
- o Basic Inspection Tools
- o Drawing and Print Reading
- o Cleanliness and Housekeeping Inspection

B. Mechanical QC Inspector

- o Pump and Seal Inspection
- o Valve Inspection
- o Mechanical Closure Inspection
- o Pipe Inspection
- o Fastener Inspection
- o Hanger Inspection
- o Hydrostatic Testing
- o Flow Element Inspection
- o Crane Inspection
- o Turbine Inspection
- o Lubrication Inspection
- o Fire Protection Inspection

C. Welding QC Inspector

- o Welding Documentation Preparation and Review
- o In-Process Welding Inspection
- o Visual Welding Inspection
- o Welding Dimensional and Mechanical Checks
- o Welding Record and Report Inspections

D. Electrical QC Inspector

- o Electrical Equipment Installation Inspection
- o Raceway Inspection
- o Cable Pulling Inspection
- o Splicing and Termination Inspection
- o Pressure Seal and Fire Stop Inspection
- o Valve Operator Inspection

E. Instrumentation and Controls Inspector

- Measuring and Test Equipment
- Instrumentation Inspection
- Instrument Loop Inspection
- Instrument Installation Inspection
- Bench Repair Inspection

F. Civil QC Inspector

- Soils Testing - Field
- Structural Steel Erection Inspection
- Structural Steel Fabrication Inspection
- Structural Steel Connections Inspection
- Batch Plant Inspection
- Concrete Pre-Placement Inspection
- Concrete Placement Inspection
- Concrete Post-Placement Inspection
- Rebar and Wire Mesh Inspection
- Cadweld Inspection
- Painting and Coating Inspection
- Grouting Inspection
- Blasting Inspection
- Masonry Inspection
- Surveying Inspection
- Liner Plate Inspection
- Piling and Caissons Inspection
- Subsurface Investigation
- Rock Bolting Inspection
- Post-Tensioning Inspection
- Drilled-In Anchors Inspection
- Rigging Inspection
- Laboratory Testing
- Paving Inspection
- Pre-Cast Concrete Inspection
- Roofing Inspection
- Insulation and Fireproofing Inspection
- Glass and Glazing Inspection

400

No. 4021 - Coal Burning Equipment and Auxiliaries

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : Medium - In Country
  - No. of Trainees : Medium
- o Source : Vendor Gilbert/Commonwealth

4021 - Course Outline

A. I.D. and F.D. Fan

- o Lubrication and Bearings
- o Cleanliness and Rotor Balance
- o Driver Maintenance
- o Proper Functioning of Air/Flue Gas Flow Controls

B. Pulverizers - Ball and Race Type, Roller Type and Tube Mill Type

- o Lubrication
- o Primary Air - Exhausters
- o Replacement of Grinding Elements
- o Mill Rejects
- o Controls

C. Coal Feeders - Gravimetric vs. Volumetric

- o Working Elements
- o Cleanliness

D. Air Heaters - Tubular vs. Regenerative

- o Cleanliness
- o Leakage
- o Lubrication
- o Seals

No. 4130 - Ash Handling Systems and Equipment

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : Medium - In Country
  - No. of Trainees : Medium
- o Source : Vendor Gilbert/Commonwealth

4130 - Course Outline

A. Bottom Ash Handling and Storage

- o Bottom Ash Hopper
  - Clean Seal Trough
  - Check Refractory
  - Maintain Gate
- o Clinker Grinder - Lubricate and Check Seals
- o Jet Pump - Check Wear
- o Conveying Line - Check Joints for Leaks and Rotate Periodically for Wear
- o Dewatering Bin
  - Check Overflow Trough Piping and Dewatering Element Piping for Leaks
  - Check Dump Gate for Wear
  - Lubricate Operating Cylinder

B. Fly Ash Handling and Storage

- o Check Hopper Outlets and Feeders for Hangups
- o Check Vacuum/Pressure Producing Device for Maintenance Requirements
- o Conveyor Piping - Check Joint for Leaks
- o Storage Silo
  - Vent Filter - Check for Plugging or Leaks
  - Fluidizing Stones - Check for Plugging
- o Unloader
  - Feeder - Check Gate and Fluidizing Stone
  - Blades - Check for Wear and Adjustment
  - Water - Check for Proper Pressure and Flow Check Condition of Wetted Ash

No. 4140 - Flue Gas and Air Quality Control

- o Classroom Training
  - Duration : Short
  - Class size : Medium
- o OJT
  - Duration : Medium - In Country
  - No. of Trainees : Medium
- o Source : Vendor Gilbert/Commonwealth

4140 - Course Outline

A. Precipitator

- o Check Controls
- o Tensioning Weights
- o Hopper Hangup
- o Condition of Wires and Plates

B. Fabric filter

- o Check Controls
- o Dampering Mechanism
- o Hopper Hangup
- o Condition of Bags

C. Dry Scrubbers

- o Controls
- o Mixing, Pumping and Injection of Treatment Liquid
- o Plugging of Scrubber Vessel
- o Hopper Hangup

D. Wet Scrubbers

- o Controls
- o Mills
- o Mixing of Treatment Liquid
- o Pumping Systems
- o Scrubber Vessel Plugging
- o Thickener Hangups
- o Sludge Handling System
- o Vacuum Filters

No. 4141 - Environmental Impact of Coal Firing

o Classroom Training		
- Duration	:	Short
- Class Size	:	Medium
o OJT		Not Required
- Duration	:	N/A
- No. of Trainees	:	N/A
o Source	:	Professional Training Institute Gilbert/Commonwealth

4141 - Course Outline

A. Stack Emissions

- o SO_x
- o NO_x
- o Particulate

B. Noise - Range of Intensity

C. Thermal Pollution

- o Receiving Streams
- o Atmosphere

D. Regulations

No. 4200 - Coal Handling

- o Classroom Training
  - Duration : Short
  - Class Size : Medium
- o OJT
  - Duration : Long - In Country
  - No. of Trainees : Medium
- o Source : Vendor Gilbert/Commonwealth

4200 - Course Outline

A. Receiving

- o Track - Check Condition
- o Unloader
  - Controls
  - Lubrication
  - Operation

B. Transporting

- o Apron Feeder - Operation and Lubrication
- o Conveyor Belt(s)
  - Condition of Belt and Roller
  - Lubrication
  - Check Shutdown Control
  - Belt Tensioning
- o Tripper Belt
  - Operation
  - Lubrication
  - Wear

C. Storage

- o Stacker - By Bulldozing
  - Controls
  - Operation
  - Lubrication
- o Compacting Equipment

D. Reclaim

- o Reclaim Equipment
- o Conveyor Belts and Towers
  - Condition of Belt and Roller
  - Lubrication
  - Check Shutdown Control
  - Belt Tensioning
  - Coal Preparation - Crusher
    - o Wear
    - o Lubrication
  - Weighing - While Being Conveyed
  - Sampling - From Belt
  - Dust Mitigation - Supression System
  - Fires and Explosions - Causes and Preventative Measures

APPENDIX 7.2

EXTRACT FROM USAID

PARTICIPANT TRAINING PLANS

APPENDIX 7.2

Extract from USAID Participant Training Plans (LAKHRA); FY-1985
Coal Power Station Proposal Training Fields

Training Field	No. of Participants Offered	Duration (Month) Proposed by USAID	Duration (Month) Recommended by WAPDA	Preliminary Training Plan Identification
Coal Supply Contracting	4	4	4	1005
Environmental Protection	3	6	3	2151
Coal Generation Planning		6	3	1006
Engineering and Design/ Technical Internship to Lignite Burning US Electric Utility Covering Coal Handling, Coal Combustion, Boiler Operation, Ash Handling and Pollution Control	1	12	6	2000
Coal-Fired Plant Availability, Reliability and Combustion Testing	1	8	4	3003
Plant Operation and Maintenance, Boiler/Coal Yard Equipment, Stack Gas Cleaning and Handling Equipment	1	8	4	3210,3150 4210,4150
Coal Analysis and Sampling	1	6	4	3211
Coal Handling	3	6	4	3210

APPENDIX 7.3

EXTRACT FROM PC-II 1985

FOREIGN TRAINING REQUIREMENTS

OF GENERATION

APPENDIX 7.3

EXTRACT FROM PC-II 1985

FOREIGN TRAINING REQUIREMENTS OF GENERATION

Sr. No.	Specialised field of training abroad	Number of facilities and fields of training required during the next 5 years		Proposed period of training	Country where training facility is available
(1)	(2)	(3)		(4)	(5)
1.	Chemist in Thermal Power Stations	3	Thermal Power Station	6 months	Australia Canada U.K U.S.A
2.	Training in the manufacture shop for high pressure/Temp. gas & coal fired water tube boilers and their auxillary and ancillary equipment(Fans pumps valves & gauages etc).	3	Thermal Power Station	6 months	Canada U.S.A. U.K
3.	Factory & shop training for manufacture of modern turbines their auxilliries and ancillaries and inspection and testing of the entire equipment involved.	4	Thermal Power Station	6 months	U.S.A. U.K.
4.	Designing & manufacture of water cooled and air cooled Condensers	4	Thermal Power Station	3 months	W/Germany U.SA. Hungary
5.	Manufacture and rewinding of Generators and Motors of 6 & 11 KV	4	Thermal & Hydel Power Stations	3 months	Switzerland U.S.A U.K. W.Germany France
6.	Operation & Maintenance of water treatment plants both with Zeolite and deminerlizing equipment	3	Thermal Power Station	3 months	Australia W/Germany U.K. U.S.A.
7.	Erection, Operation & Maintenance of Steam Boilers and restoration of worn out valves.	4	Thermal Power Station	6 months	Canada Denmark U.S.A. U.K.
8.	Operation, maintenance and overhauling of Steam Turbines with & without reheat cycles	4	Thermal Power Station	6 months	Canada Denmark U.S.A. U.K.

(1)	(2)	(3)	(4)	(5)
9.	Operation & maintenance of high tension and low tension switchgears Air Blast Circuit Breakers.	4 Hydel Power Station	6 months	Germany France Austria U.S.A. U.K.
10.	Operation & maintenance of various instruments and relays employed in hydel and thermal power Stations	4 Thermal and Hydel Power Station	6 months	Switzerland Italy Yogosolavia Denmark U.S.A. U.K.
11.	Training of high pressure Welders from Pakistan in high pressure parts and tubes of boilers plus pipelines and fittings carrying high pressure steam or water.	4 Thermal Power Station	6 months	Germany Italy Japan U.S.A U.K.
12.	Manufacture, Assembly and testing of water turbine, Governers & auxiliary equipment	3 Hydel Power	6 months	Japan Canada Newzealand U.S.A. U.K.
13.	Manufacture,Assembly testing of Hydro-Generators,excitation system and auxiliary equipment	3 Hydel Power Station	6 months	Japan Canada U.S.A. U.K.
14.	Overhauling of large Steam Turbo Sets of 65 to 200 MW capacity.	3 Thermal Power Station	6 months	Japan France U.S.A. U.K.
15.	Inspection technique of boilers upto 1500 Lbs. pressure, 950°p 250 ton/hour rating	3 Thermal Power Station	3 months	Japan France U.S.A. U.K.
16.	Non-destructive tests technique viz.dye penetration,zyglo ultrasonic,magnetic, particles and radiation technique for crack detection.	3 Thermal Power Station	3 months	Japan France U.S.A. U.K.
17.	Welding technique of Super Alloys as used in Gas Turbine with Inlet temp. of 950°F viz. Argon gas welding plasma spray welding, also building of worn parts-blades,diaphrams,shafts etc.	3 Thermal Power Station	3 months	Japan France U.S.A. U.K.

Cont'd.....P/10

(1)	(2)	(3)	(4)	(5)
18.	Rehabbiting of white metal bearings	3 Thermal & Hydel Power Station	3 months	Japan France U.S.A. U.K.
19.	Cleaning techniques of dirty plant components viz blasting, chemical and ultrasonic cleaning etc.	3 Thermal Power Station	3 months	France Japan U.S.A. U.K.
20.	Chemical cleaning of boiler plants	3 Thermal Power Station	3 months	Japan France U.S.A. U.K.
21.	Training of teaching staff employed in Training Institutes of Thermal/Hydel Stations	3 Thermal & Hydel Power Station	6 months	U.S.A. U.K. Canada Australia Newzealand
22.	Balancing of large machines "Statically and Dynamically".	3 Thermal & Hydel Power Station	3 months	Japan France U.S.A. U.K.
23.	Efficiency & performance control of boiler, steam turbines, heat exchanger, pumps; cooling towers, condensers gasturbines, generators, transformers etc.	3 Thermal Power Station	6 months	Japan France U.S.A. U.K.
24.	Maintenance of automatic combustion control equipment, steam turbine governing and protection system pressure, temperature and flow recorders ecentricity differential expansion, vibration recorders etc.	3 Thermal Power Station	6 months	Japan France U.S.A. U.K.
25.	Training in the maintenance and trouble shooting of speedtronic system for the starting operation and stopping of modern and gas turbines.	3 Thermal & Gas Turbine Power Station	6 months	Japan France U.S.A. U.K.
26.	Operation & maintenance of power station with a gas turbine rating of 100 MW	3 Thermal & Gas Turbine Power Station	3 months	Japan U.S.A. U.K.

Cont'd....P/11

(1)	(2)	(3)	(4)	(5)
27.	Operation & maintenance of combined cycle units upto 300/450 MW capacity.	4 Thermal/Steam & Gas Turbine Power Station	6 months	Japan U.S.A. U.K.
28.	Power system Load Flow studies	3 Load Despatch Centre	6 months	Japan U.S.A. U.K.
29.	Optimal Despatch Energy	3 Load Despatch Centre	6 months	Japan U.S.A. U.K.

BREAKDOWN

Grade 17	50	Total No. of Trainees = 96
Grade 18	40	
Grade 19	6	

Cont'd....P/12