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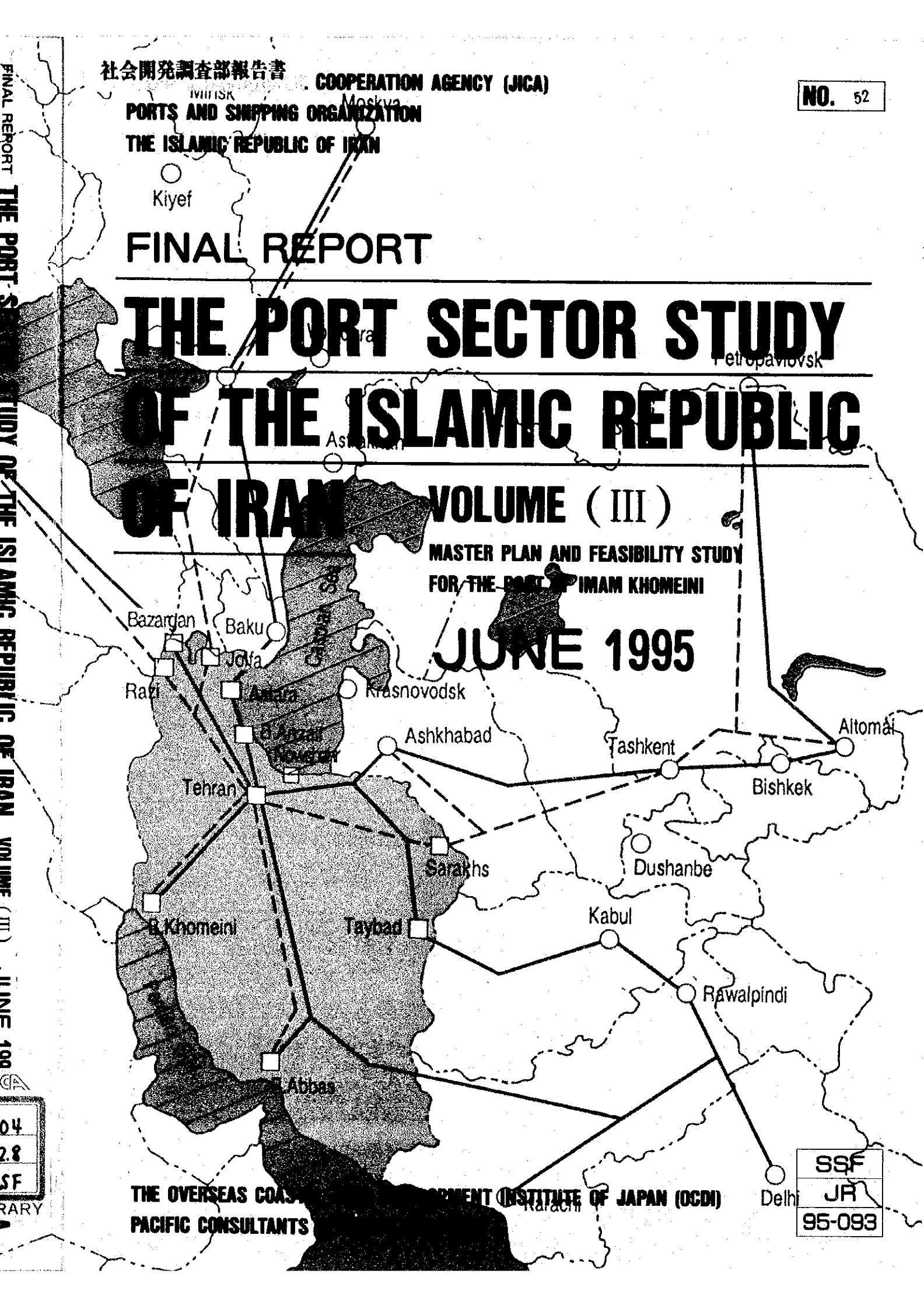
THE PORT SECTOR STUDY OF THE ISLAMIC REPUBLIC OF IRAN

VOLUME (III)

MASTER PLAN AND FEASIBILITY STUDY FOR THE PORT OF IMAM KHOMEINI

JUNE 1995



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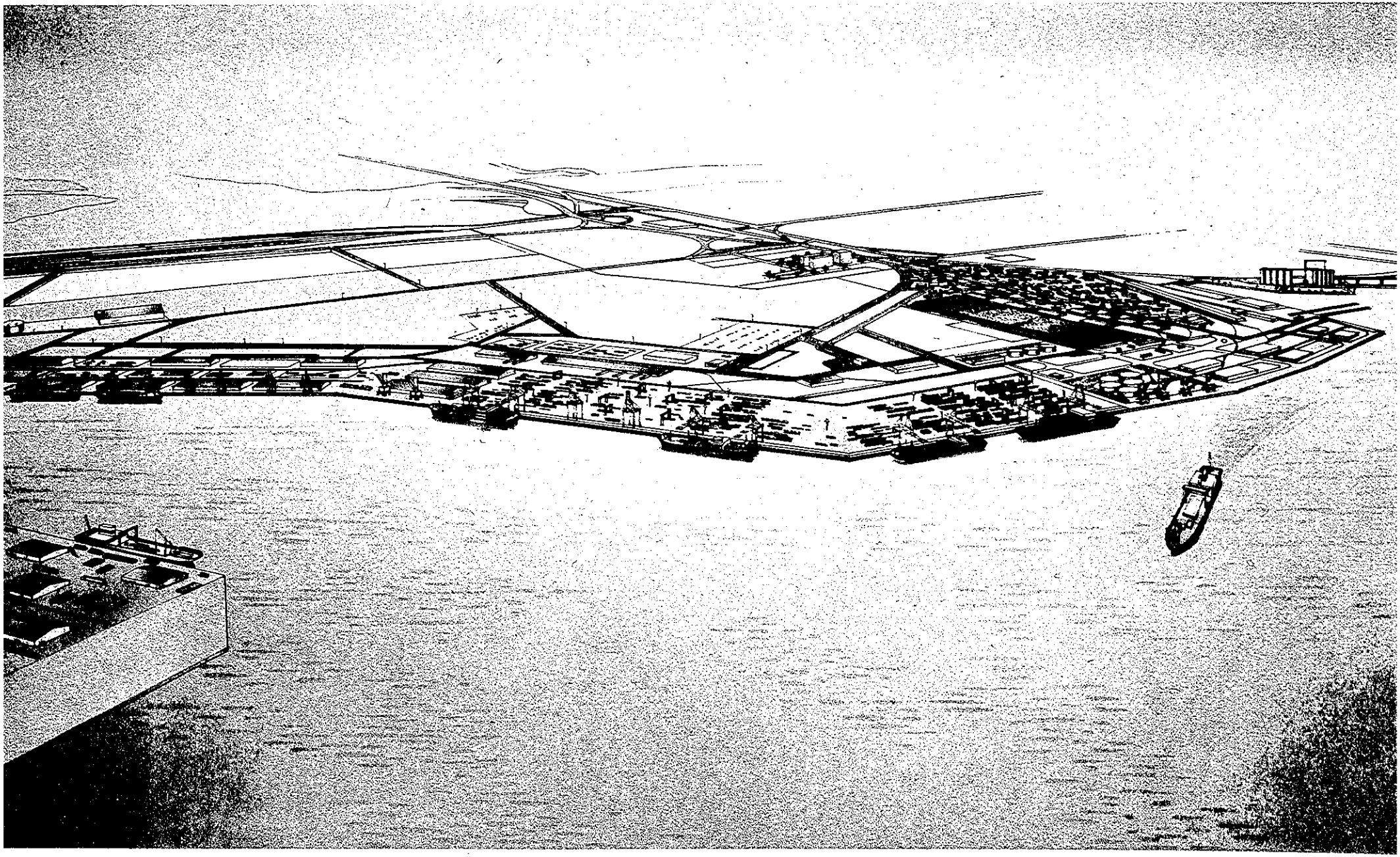
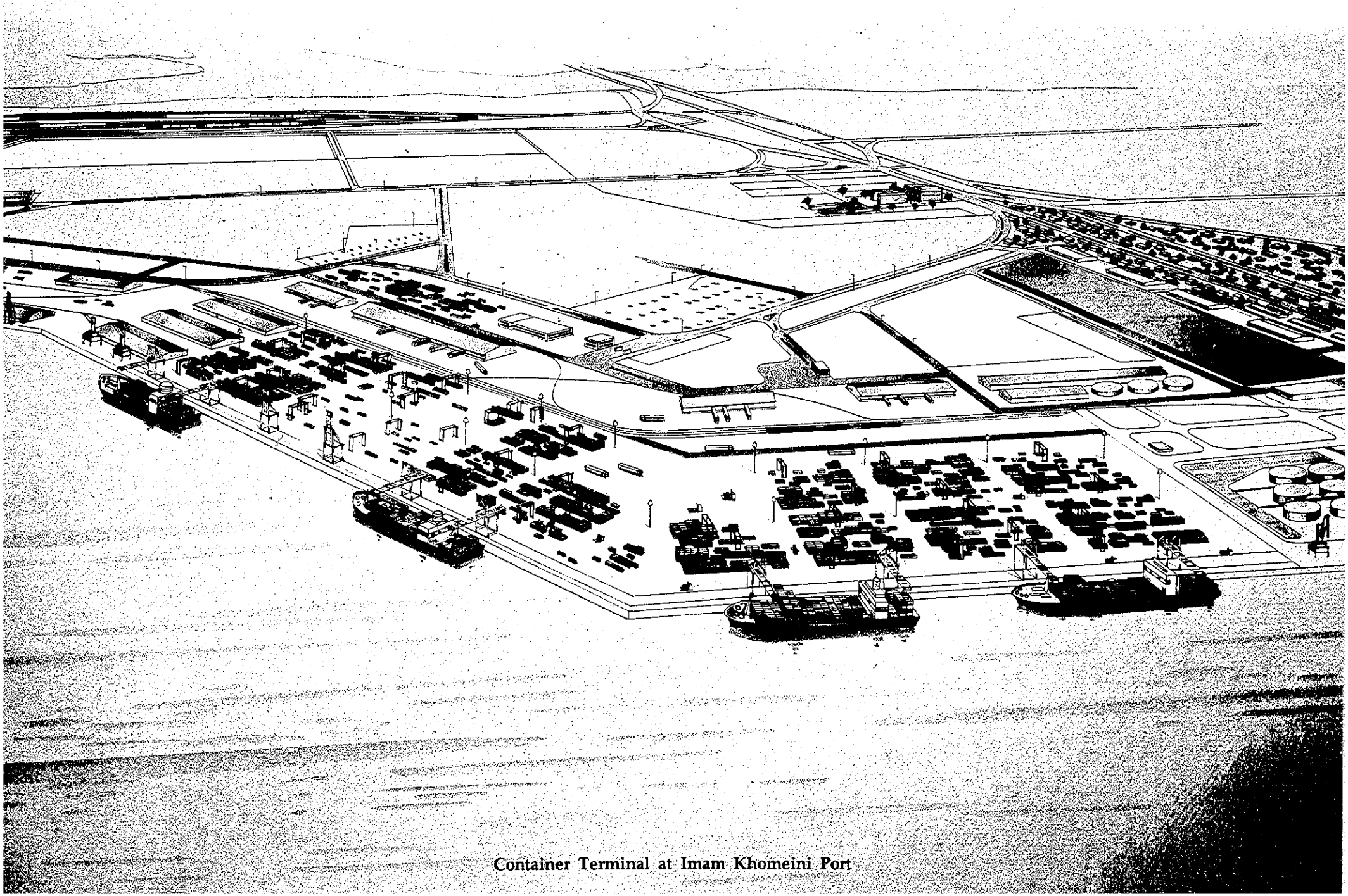


Imam Khomeini Port (2010/11)



Container Terminal at Imam Khomeini Port

THE PORT SECTOR STUDY OF THE ISLAMIC REPUBLIC OF IRAN

VOLUME III

Master Plan for The Imam Khomeini Port

LIST OF CONTENTS

LIST OF TABLES
LIST OF FIGURES
LIST OF ABBREVIATIONS

INTRODUCTION 1

Chapter 1. Development Concept of the Port 3

1.1 Major Roles of The Port in The Iranian Port Network 3
1.2 Location and Hinterland of the Port 4
1.3 Future Pattern of Cargo Flow and Corresponding Function of the Ports ... 5
1.4 Overall Cargo Traffic Demand for Major Iranian Ports 6
1.5 Basic Policy of Port Development 8
1.6 Basic Direction of the Port Planning 8

Chapter 2. Current Situation of the Port 9

2.1 Particulars in Natural Conditions 9
2.2 Port Function and its Activities 27
2.3 Port Management and Operation 39
2.4 Historical Background of Port Construction 48
2.5 Progress of Previous Master Plan Development 53
2.6 Existing Major Port Facilities 57
2.7 Review of Existing Structures 78

Chapter 3. Demand Forecast 99

3.1 Commodity-wise Cargo Traffic Demand for the Port 99
3.2 O/D Analysis of Future Cargo Traffic 106
3.3 Shipload and Number of Ship Call 111

Chapter 4. Functional Allotment and Capacity Evaluation of the Port Activities 125

4.1 Functional Allotment of Port Activities 125
4.2 Basic Concept for Capacity Evaluation 131
4.3 Commodity-wise Standard for Evaluation of Current Cargo Handling Capacity 133

Chapter 5. Potential Cargo Handling Capacity Expected by Improving Existing Facilities and Operation System 137

5.1 Basic Concept of Physical Possible Improvement 137
5.2 Improvement Plans for Cargo Handling System and Cargo Handling Equipment 140
5.3 Commodity-wise Capacity Evaluation 147
5.4 Total Evaluation of Cargo Handling Capacity 153

Chapter 6. Physical Requirements for Future Port Development 155

6.1 Capacity and Functional Requirements for Future Port Related Facilities ... 155

Chapter 7. Alternative Layout Plans of Port Facilities 177

7.1 Basic Policy for Development of Alternative Layout Plans 177
7.2 Access to/from Port 178
7.3 Alternative Layout Plans 183
7.4 Container and Bulk Terminal 193
7.5 Evaluation Indexes for Proposed Alternative Plans 193
7.6 Evaluation and Recommendation 194
7.7 Short Term Development Plan and the Project 203

Chapter 8. Preliminary Design of Port Structures 207

8.1 Scope of Study 207
8.2 Design Basis 207
8.3 Natural Conditions 210
8.4 Material Conditions 214
8.5 Particular Design Criteria 217
8.6 Preliminary Study of Marine Structures 241
8.7 Marginal Wharfs 247
8.8 New Development 257
8.9 Upgrading of Existing Facilities for Alternative Plan-1 and Plan-2 267
8.10 Upgrading of Existing Facilities for Alternative Plan-3 278
8.11 Maintenance and Repair 285
8.12 New Main Access 294
8.13 Changes of Channel Section and Its Influence 298
8.14 Initial Dredging 302
8.15 Maintenance of Channel and Basin 303

Chapter 9. Preliminary Design of Cargo Handling Equipment 313

9.1 Basic Strategy of Preliminary Design of Cargo Handling Equipment 313
9.2 Designs of Cargo Handling Equipment and Related Equipment (For Master Plan) 314
9.3 Designs of Cargo Handling Equipment and Related Equipment (For Short-term Plan) 316

9.4 List of the Total Handling Equipment to Be Required 318
9.5 Preliminary Cost Estimation 320
9.6 Outline of the Large Equipment 320

Chapter 10. Navigation Aides 321

10.1 Navigation Facility 321
10.2 Rehabilitation Plan and Short-term Development Plan 328

Chapter 11. Project Implementation and Stage Development 329

11.1 Basic Strategy 329
11.2 Stage Development 329
11.3 Implementation Schedule 336
11.4 Preliminary Disbursement Schedule 344
11.5 Construction Method 353

Chapter 12. Project Cost Estimation 355

12.1 Basic Arrangement of Project Cost 355
12.2 Application to the Proposed Project Components 358
12.3 Basic Composition of Cost 359
12.4 Basic Condition for Cost Estimation 361
12.5 Phasing of Project Implementation 367
12.6 Summary of Project Cost 370
12.7 New Development 376
12.8 Upgrading of Existing Facilities 378
12.9 Detailed Cost Information of Short-term Development 387
12.10 Rehabilitation of the Existing Facilities 392
12.11 Transitional Use of Existing Jetties 398
12.12 Dredging and Reclamation 400
12.13 On-land Facilities, Buildings and Utilities 407
12.14 New Main Access 408
12.15 Cargo Handling Equipment 410
12.16 Navigation Aides 413
12.17 Alternative Plans for New Development Site Selection 413
12.18 Operation and Maintenance Cost 418

Chapter 13. Management and Operation for the Proposed Port Activities 423

13.1 Overall Administration System 423
13.2 Development of the Port Organization 427
13.3 Financial System and Port Tariff 430
13.4 Cargo Handling Operation 434
13.5 Engineering System 434

Chapter 14. Economic Analysis 439

14.1 Purpose and Methodology of Economic Analysis 439
14.2 "Without" Case and "With" Case 441
14.3 Prerequisites of Economic Analysis 442
14.4 Economic Prices 443
14.5 Costs of the Project 445
14.6 Benefits of the Project 446
14.7 Evaluation and Conclusion 453

Chapter 15. Financial Analysis 459

15.1 Purpose and Methodology of Financial Analysis 459
15.2 Prerequisites of Financial Analysis 460
15.3 Revenue and Expenditure 461
15.4 Sensitivity Analysis 462
15.5 Evaluation and Conclusion 463

Chapter 16. Environmental Assessment 465

16.1 Initial Environmental Assessment 465
16.2 Evaluation of Environmental Assessment 468
16.3 Preventive Measures 469

Chapter 17. Objectives for Successful Utilization of the Plan 471

17.1 Monitoring and Review 471
17.2 Consideration to Better Port Environment 472
17.3 Periodical Maintenance 473
17.4 Training System for Staff 474

List of Tables

Table 1.2.2.1	Hinterlands of Ports	5
Table 1.4.1.1	Total Forecast Commodity-wise Volume at Each Study Ports	7
Table 2.1.2.1	Tide Data (K-11 and A-H Datum)	15
Table 2.1.2.2	Musa Channel Tidal Characteristics	16
Table 2.1.4.1	Range of Wave Height Imam Khomeini Port	17
Table 2.1.9.1	Recommended Design Soil Parameters Former Four Berths Extension (Imam Khomeini Port)	22
Table 2.1.9.2	Soil Parameters (1/2) (Upper Layer) Ten Berths Extension (Imam Khomeini Port)	24
Table 2.1.9.3	Soil Parameters (2/2) (Lower Residual Stratum) Ten Berths Extension (Imam Khomeini Port)	26
Table 2.2.1.1	Commodities and Share of Handling Cargo	27
Table 2.2.1.2	Transportation Mode	29
Table 2.2.2.1(1)	List of Cargo Handling Equipment Imam Khomeini Port	30
Table 2.2.2.1(2)	List of Cargo Handling Equipment Imam Khomeini Port	31
Table 2.2.2.1(3)	List of Cargo Handling Equipment Imam Khomeini Port	32
Table 2.2.2.2	Distance of main cities from Imam Khomeini Port by road	33
Table 2.2.2.3	Distance of Tehran from Persian Gulf Port by road	34
Table 2.2.2.4	Railway Network around Imam Khomeini Port	34
Table 2.2.2.5	International railway networks	34
Table 2.2.2.6	Major Industries near Khomeini Port	35
Table 2.3.1.1	Number of PSO Employees by Age Group (in 1993)	41
Table 2.3.4.1	Income Statement of the PSO Special Account	43
Table 2.3.4.2	Income & Expenditure of Imam Khomeini Por	44
Table 2.3.4.3	Main Tariff of PSO (In Jun. 1994)	46
Table 2.3.4.4	Main Tariff of PSO (Container) (In Jun. 1994)	47
Table 2.3.4.5	Tariff for Container Storage (In Jun. 1994)	47
Table 2.4.1.1	Major Waterfront development history, Imam Khomeini Port	48
Table 2.4.1.2	History of Port Construction and Extension: Imam Khomeini Port 1/2	49
Table 2.4.1.2	History of Port Construction and Extension: Imam Khomeini Port 2/2	50
Table 2.5.1.1	Project Cost Summary Previous Project Cost	55
Table 2.6.3.1	Existing Cargo Berth: Imam Khomeini Port	62
Table 2.6.12.1	Present Condition of Transit Shed ad Warehouse of Berth No.16-No.20	74
Table 2.6.13.1	Present Condition of transit shed and warehouses of Berths No.21-No.34	76
Table 2.7.2.1	Fender Numbers Appropriated to Each Berth	81
Table 2.7.2.2	Selected Berths for Visual Observation	83
Table 2.7.2.3	Location of Concrete Core Samples (CCS)	84
Table 2.7.2.4	Location of Electric Potential Tests (EPT)	84
Table 2.7.3.1	Summary of Damaged Structures, Berth No.11-34	87
Table 2.7.4.1	Damage Grade (D.G)	89

Table 2.7.6.1	Concrete Compressive Strength by Core Test	95
Table 2.7.6.2	Schmidt Hammer Test Results	96
Table 2.7.7.1	Electric Potential Test Results	97
Table 2.7.8.1	Chemical Content Test Results	98
Table 3.1.1.1	Total Cargo Volume at Imam Khomeini Port	100
Table 3.1.1.2	Import Cargo Volume at Imam Khomeini Port	101
Table 3.1.1.3	Export Cargo Volume at Imam Khomeini Port	102
Table 3.1.2.1	Forecasted Cargo Handling Volume	103
Table 3.1.2.2	Annual Growth Rate	103
Table 3.1.2.3	Forecasted Import & Export Cargo Handling Volume	104
Table 3.2.2.1	Ports and their Hinterlands	107
Table 3.2.2.2	Calculation of Transportation Cost	109
Table 3.2.2.3	Calculation of 1/Kt:1/Kr:1/At:1/Ar	109
Table 3.2.2.4	Share of Cargo Volume at Each Port	109
Table 3.2.2.5	Share of Cargo Volume in Each Port	110
Table 3.2.2.6	Share of Cargo Volume at Imam Khomeini Port & Abbas Port	110
Table 3.2.2.7	Comparison of Share of Cargo Volume	111
Table 3.3.1.1	Total Calling vessel at Imam Khomeini Port	111
Table 3.3.1.2	Average Vessel-size & Imported Cargo at Imam Khomeini Port	112
Table 3.3.1.3	Distribution of Calling Vessels	113
Table 3.3.1.4	Distribution of Calling Vessel	113
Table 3.3.1.5	Distribution of Calling Vessel	114
Table 3.3.1.6	Distribution of Calling Vessel	114
Table 3.3.1.7	Distribution of Calling Vessel	115
Table 3.3.1.8	Distribution of Calling Vessel	115
Table 3.3.1.9	Distribution of Calling Vessel	116
Table 3.3.1.10	DWT and Vessel Length	117
Table 3.3.2.1	Future Average Vessel-size	118
Table 3.3.2.2	Cargo Loading Ratio	118
Table 3.3.2.3	Distribution of Calling Vessel for Dry Bulk Cargo	119
Table 3.3.2.4	Distribution of Calling Vessel for Bagged Cargo	119
Table 3.3.2.5	Distribution of Calling Vessel for Container Cargo	120
Table 3.3.2.6	Distribution of Calling Vessel for Refrigerated Cargo	120
Table 3.3.2.7	Distribution of Calling Vessel for Steel Product	121
Table 3.3.2.8	Distribution of Calling Vessel for Mineral (bulk)	121
Table 3.3.2.9	Distribution of Calling Vessel for General Cargo	122
Table 3.3.2.10	Distribution of Calling Vessel	122
Table 4.1.1.1	Share of Cargo Volume among Four Ports (2010)	125
Table 4.3.4.1	Distance between Cities and Khomeini Port by Road	135
Table 4.3.4.2	Main Railway Section around Khomeini Port	135
Table 5.2.10.1	Comparison of Handling Systems	144
Table 5.3.1.1	Cargo Handling Capacity of Two Facilities	150
Table 5.3.2.1	Cargo Volume and Numbers of Vessels (1992)	151
Table 5.3.2.2	Existing Numbers of Conventional Cargo Berths (1993)	151
Table 5.4.1.1	Potential Cargo Handling Capacity of Existing Port Facility Improvement in Imam Khomeini Port	154
Table 6.1.1.1	Required Number of Berth in 2000 and 2010 by Berth Length	156

Table 6.1.1.2	Required Number of Berths in 2000 and 2010 by Berth Length	158
Table 6.1.1.3	Required Number of Berth in 2000 and 2010 by Berth Length	159
Table 6.1.1.4	Required Berth Number and Length	159
Table 6.1.1.5	Future Port Facilities	160
Table 6.1.2.1	Vessel Size	161
Table 6.1.2.2	Volume of Container Cargo	162
Table 6.1.2.3	Required Number of Container Berths	162
Table 6.1.2.4	Required Storage Capacity in Container Yard 2000/01	163
Table 6.1.2.5	Required Storage Capacity in Container Yard 2010/11	163
Table 6.1.2.6	Required Area of Container Freight Station	164
Table 6.1.2.7	Required Number of Truck Lanes	165
Table 6.1.4.1	Share of Direct Delivery	168
Table 6.1.4.2	Cargo in Storage Facilities	168
Table 6.1.4.3	Required Area of Storage Facilities in 2000/01	168
Table 6.1.4.4	Required Area of Storage Facilities in 2010/11	169
Table 6.1.11.1	Planning of Service Craft Facilities	175
Table 7.6.4.1	Evaluation of Alternatives for the Master Plan of Imam Khomeini Port	202
Table 8.2.3.1	Service Life of Structures	208
Table 8.2.4.1	Land Use: Imam Khomeini Port	209
Table 8.3.2.1	Tide Levels	211
Table 8.3.2.2	Range of Wave Height Imam Khomeini Port	212
Table 8.4.1.1	Concrete Classification	214
Table 8.4.2.1	Reinforcement Specification	214
Table 8.4.3.1	Minimum Concrete Cover for Common Works	215
Table 8.4.3.2	Minimum Concrete Cover for Marine Works	215
Table 8.4.4.1	Structural Steel Specification	215
Table 8.4.5.1	Corrosion Rates of Steel Exposed Surface	216
Table 8.4.6.1	Unit Weight of Common Materials	217
Table 8.5.1.1	Safety Factor for Bearing Piles	220
Table 8.5.1.2	Safety Factor for Pulling Resistance	221
Table 8.5.1.3	Allowable Stress of Steel Piles	222
Table 8.5.1.4	Safety Factors on Structure Analysis	223
Table 8.5.1.5	Safety Factor on Circular Failure	223
Table 8.5.2.1	Dimension of Objective Vessels	226
Table 8.5.2.2	Tractive Forces of Ships	231
Table 8.5.2.3	Arrangement of Bollard	231
Table 8.5.5.1	Interior Illumination Requirement	239
Table 8.5.5.2	Exterior Lighting Requirement	239
Table 8.6.1.1	Berth Arrangement Both Present and Alternative Plan 1	243
Table 8.7.2.1	Summary of Wharf Structural Comparison	251
Table 8.7.2.2	Construction Cost, DL -14.0m Wharf	252
Table 8.8.1.1	Faceline Arrangement of West Harbor, Plan-1	258
Table 8.8.1.2	Land Use of New Development; Dorag West Bank in Alternative Plan-1	258
Table 8.8.1.3	Faceline Arrangement of Zangi South Bank, Plan-2	260
Table 8.8.1.4	Land Use of New Development: Zangi South Bank in Alternative	

	Plan-2	260
Table 8.8.1.5	Faceline Arrangement of West Harbor, Plan-3	262
Table 8.8.1.6	Land Use of New Development: Dorag West Bank in Alternative Plan-3	263
Table 8.9.2.1	Faceline Arrangement, Eastern Jetty to Existing Berth No.10: LTD	270
Table 8.9.2.2	Land Use of Existing Facilities (1), in Alternative Plan-1 and Plan-2	271
Table 8.9.4.1	Faceline Arrangement, Former Ten Berth Extension Area: LTD	274
Table 8.9.4.2	Land Use of Existing Facilities (2) in Alternative Plan-1 and Plan-2	275
Table 8.9.6.1	Faceline Arrangement, Former Fourteen Berth Extension Area: LTD	277
Table 8.10.2.1	Land Use of Existing Facilities (1) in Alternative Plan-3	281
Table 8.10.4.1	Land Use of Existing Facilities (2) in Alternative Plan-3	284
Table 8.11.4.1	Standard Values of Covering for Reinforcing Steel Bars	290
Table 9.4.1.1	List of Equipment	319
Table 11.3.1.1	Major Work Components by Project Groups	337
Table 11.3.1.2	Master Schedule	340
Table 11.3.1.3	Outline Schedule	341
Table 11.3.1.4	Basic Investment Schedule	342
Table 11.3.1.5	Construction Schedule; Imam Khomeini Port - Alternative Plan 1	343
Table 11.4.1.1	Preliminary Disbursement Schedule (1/3), Total Costs	345
Table 11.4.1.2	Preliminary Disbursement Schedule (2/3), Construction and Procurement	346
Table 11.4.1.3	Preliminary Disbursement Schedule (3/3), Physical Contingency and Engineering Fee	347
Table 11.4.2.1	Disbursement, Total Construction and Procurement	348
Table 11.4.2.2	Disbursement, Construction and Procurement in Short-term Development	349
Table 11.4.2.3	Disbursement, Total Construction and Procurement in Long Term Development	350
Table 11.4.2.4	Disbursement, Construction and Procurement in Long-term Development at the Existing Facilities	351
Table 11.4.2.5	Disbursement, Construction and Procurement in Long-term Development at the New Development	352
Table 12.4.3.1	Typical Cost Components; New Development at Dorag Bank	363
Table 12.4.3.2	Applied Cost Components Ratio by Type of Works	366
Table 12.5.1.1	Outline Schedule	368
Table 12.5.1.2	Basic Investment Schedule	369
Table 12.6.1.1	Initial Investment Cost Summary of Master Plan Alternatives	371
Table 12.6.1.2	Cost Summary of Master Plan Alternatives by Access Route	374
Table 12.6.2.1	Cost Summary of Master Plan Alternatives by Development Stage	375
Table 12.6.3.1	Cost Summary of Short-term Development by Currency Portion	376
Table 12.7.1.1	Cost Summary of New Development	377
Table 12.7.2.1	Cost Summary of New Development (LTD) by Major Work Categories	378

Table 12.8.1.1 Cost Summary for Upgrading of Existing Facilities 379
Table 12.8.2.1 Cost Summary of Existing Facility Upgrading by Major Work Categories 380
Table 12.8.2.2 Cost Summary of Existing Facility Upgrading by Port Area (Plan 1 or Plan 2, LTD) 381
Table 12.8.2.3 Cost Summary of Existing Facility Upgrading by Port Area (Plan 3, LTD) 382
Table 12.8.2.4 Cost Summary of Existing Facility Upgrading by Port Area (Plan 1, Plan 2 and Plan 3, STD) 383
Table 12.8.2.5 Cost for Rehabilitation of Existing Facility by Work 385
Table 12.8.2.6 Cost Breakdown of Existing Facility Upgrading by Work 386
Table 12.9.1.1 Summary Cost Information of Short-term Development 387
Table 12.9.2.1 Cost Information, Short-term Development Construction Works 390
Table 12.9.2.2 Applied Standard Factors for Cost Subdivision 391
Table 12.9.3.1 Summary Cost Information for Short-term Development for Disbursement Schedule 392
Table 12.12.1.1 Summary of Dredging and Reclamation Works 401
Table 12.12.2.1 Dredging and Reclamation, Plan 1 402
Table 12.12.3.1 Dredging and Reclamation, Plan 2 403
Table 12.12.4.1 Dredging and Reclamation, Plan 3 404
Table 12.12.4.2 East Musa Channel Summary 405
Table 12.12.4.3 Dorag Channel Summary 405
Table 12.12.4.4 West Musa Channel Summary 406
Table 12.12.4.5 Zangi Channel Summary 406
Table 12.14.2.1 Cost Summary of Main Access and Utility Mains 410
Table 12.15.1.1 Number of Equipment by Stage 411
Table 12.15.3.1 Summary of Cargo Handling Equipment Costs 412
Table 12.17.2.1 Preliminary Cost Study for New Development Site 416
Table 12.17.2.2 Soil Balance in Alternative Blocks 417
Table 12.18.2.1 Proposed Rates of Annual Maintenance Cost to Investment Cost 419
Table 12.18.2.2 Investment Cost for Existing Facilities 419
Table 12.18.2.3 Estimated Annual Maintenance Cost 421
Table 13.2.1.1 Alternatives of Terminal Operation 428
Table 13.3.1.1 Methods to Raise Investment Funds 431
Table 13.3.2.1 Tariff Comparison 433
Table 14.2.1.1 Berth Condition of "Without" Case 441
Table 14.2.1.2 Cargo Handling Conditions 441
Table 14.2.2.1 Berth Condition of "With" Case 442
Table 14.2.2.2 Cargo Handling Conditions (2000) 442
Table 14.4.2.1 Standard Conversion Factor (SCF) 444
Table 14.4.2.2 The Conversion Factor for Consumption (CFC) 445
Table 14.5.1.1 Investment Cost in Economic Prices (Imam Khomeini Port) 447
Table 14.5.1.2 Total Costs in Economic Prices (Imam Khomeini Port) 448
Table 14.6.2.1 Calculation for Saving Ships' Staying Costs 450
Table 14.6.2.2 Calculation for Saving Ships' Staying Costs 450
Table 14.6.2.3 Calculation for Saving Interest of Cargo Costs 452
Table 14.7.1.1 Calculation of EIRR for Short-term Plan (Imam Khomeini Port) 454

Table 14.7.2.1 Calculation of EIRR for Short-term Plan Case A (Imam Khomeini Port) 455
Table 14.7.2.2 Calculation of EIRR for Short-term Plan Case B (Imam Khomeini Port) 456
Table 14.7.2.3 Calculation of EIRR for Short-term Plan Case C (Imam Khomeini Port) 457
Table 15.5.1.1 Result of FIRR Calculation 463
Table 17.4.1.1 The Number of Educated Staff at the Port A 476
Table 17.4.3.1 Training Program for All Staff 478
Table 17.4.3.2 Training Program for Secretaries and Engineers 478
Table 17.4.3.3 Training Program for Operators 479

List of Figures

Figure 1.1.1.1	Shares of the Total Cargo Volume at Each Port	3
Figure 2.1.1.1	Wind Characteristics, Mahshahr Port (Bandar Mahshahr)	11
Figure 2.1.1.2	Iran Rainfall Distribution	13
Figure 2.1.2.1	Tidal Datum (K-11 Datum and A-H Datum)	15
Figure 2.2.2.1	Major Industries in Iran	37
Figure 2.3.1.1	Organization Chart of Imam Khomeini Port Authority	40
Figure 2.7.2.1	Location Map of Structural Survey, Imam Khomeini Port	80
Figure 2.7.4.1	Existing Wharf Deck Elements (1/2)	90
Figure 2.7.4.2	Existing Wharf Deck Elements (2/2)	91
Figure 2.7.4.3	Typical Beam Damage	92
Figure 2.7.5.1	Damage Records of Existing 24 Wharves Rate of Damage Occurrence at Damage Grade 3 or worse	94
Figure 3.1.1.1	Total Cargo Traffic Movement at Imam Khomeini Port	100
Figure 3.1.1.2	Import Cargo Traffic Movement at Imam Khomeini Port	101
Figure 3.1.1.3	Export Cargo Traffic Movement at Imam Khomeini Port	102
Figure 3.1.2.1	Forecast Total Cargo Traffic Movement	104
Figure 3.1.2.2	Forecast Import Cargo Traffic Movement	105
Figure 3.1.2.3	Forecast Export Cargo Traffic Movement	105
Figure 3.2.2.1	Ports and their Hinterland	108
Figure 3.3.1.1	Yearly Transition of Calling Vessel	113
Figure 3.3.1.2	Yearly Transition of Calling Vessel	113
Figure 3.3.1.3	Yearly Transition of Calling Vessel	114
Figure 3.3.1.4	Yearly Transition of Calling Vessel	114
Figure 3.3.1.5	Yearly Transition of Calling Vessel	115
Figure 3.3.1.6	Yearly Transition of Calling Vessel	115
Figure 3.3.1.7	Yearly Transition of Calling Vessel	116
Figure 3.3.1.8	Correlation with Vessel Length and DWT	116
Figure 3.3.2.1	Flow Chart of Forecast for Ship Type and Number of Ship Call in Future	117
Figure 3.3.2.2	Transition of Calling Vessel	123
Figure 4.1.2.1	Cargo Volume by Berth (1992)	129
Figure 5.2.10.1	Transfer Crane System Recommended System	146
Figure 5.2.10.2	Straddle Carrier System	146
Figure 5.2.10.3	Chassis System	146
Figure 5.3.1.1	Cargo Volume and Cargo Handling Capacity	150
Figure 5.3.2.1	Conventional Cargo Volume and Handling Capacity	152
Figure 6.1.1.1	Flow Chart for Determining Number of Berths	155
Figure 6.1.6.1	Traffic Volume (2000/2010)	171
Figure 7.2.1.1	Road Network Plan around Imam Khomeini Port	179
Figure 7.2.1.2	Outer Main Access Imam Khomeini Port Alternative Plans 1 and 3	181
Figure 7.3.1.1	Iran Ports Master Plan, Alternative-1	187
Figure 7.3.2.1	Iran Ports Master Plan, Alternative-2	189
Figure 7.3.3.1	Iran Ports Master Plan, Alternative-3	191

Figure 7.4.1.1	Iran Ports Master Plan, Alternative 1.2. Container Terminal Plan A	195
Figure 7.4.1.2	Iran Ports Master Plan, Alternative 3. Container Terminal Plan B	197
Figure 8.7.1.1	Standard Section, Open Structure, Deep Berth by Three Meter	248
Figure 8.7.2.1	Standard Section, Open Structure, New Development	253
Figure 8.7.2.2	Wharf Structural Alternative-2, Caisson Box Wall	254
Figure 8.7.2.3	Wharf Structural Alternative-3, Steel Sheet Pile Wall	255
Figure 8.7.2.4	Typical Section of Concrete Block Wall	256
Figure 8.8.1.1	Alternative Plan-1	264
Figure 8.8.1.2	Alternative Plan-2	265
Figure 8.8.1.3	Alternative Plan-3	266
Figure 8.9.2.1	Grain Terminal Extension Plan	269
Figure 8.12.2.1	Main Access for Plan-1 and Plan-3	296
Figure 8.12.2.2	Main Access for Plan-2	297
Figure 8.13.1.1	Change of Channel Section	300
Figure 8.15.4.1	Original Maintenance Dredging	307
Figure 8.15.4.2	Advance Maintenance Dredging	310
Figure 8.15.4.3	Siltation Study Graph	311
Figure 10.1.1.1	The Channel Marking	326
Figure 10.1.1.2	Positions of lights	327
Figure 12.1.1.1	Various Countermeasures to Existing Facility	356
Figure 12.17.2.1	Preliminary Arrangement of New Site Selection Study	415
Figure 14.1.1.1	Flow Chart of Economic Analysis	440
Figure 16.1.1	Procedure of the Environmental Consideration	465
Figure 16.1.1.1	Location Map of Environmental Study at Imam Khomeini Port	466

List of Abbreviations

CIS	:	Commonwealth of Independent States
EIRR	:	Economic Internal Rate Return
EIA	:	Environmental Impact Assessment
PSO	:	Ports and Shipping Organization
IIRR	:	Islamic Iranian Republic Railways
DCDR	:	Deputy for Construction and Development of Railway Network
METRA	:	Railway Developing Consulting Engineers IRAN
DOE	:	Department of the Environment
STD	:	Short Term Development
LTD	:	Long Term Development
CIF	:	Cost, Insurance, and Freight
FOB	:	Free on Board
SCF	:	Standard Conversion Factor
CFC	:	Conversion Factor for Consumption
PES	:	Preliminary Environmental Survey
IEE	:	Initial Environmental Examination
FIRR	:	Financial Infernal Rate of Return
DWT	:	Dead Weight Tonnage
MRT	:	Ministry of Roads and Transportation
PBO	:	Planning and Budget Organization
G.T.	:	Gross Tons

SYMBOLS

Negligible fraction	-
Figures not available	?
Statistic data unavailable	***

Introduction

The PSO last formulated the Master Plan of the Iranian Ports in 1974, though various short term plans and rehabilitation plans have been conducted in the interim. Construction of port facilities has at each port has been completed in accordance with the said Master Plan.

At this time, a new port master plan that includes a cargo demand forecast for the coming century is required.

This volume presents the Master Plan and Feasibility Study for Imam Khomeini port. The Plan reflects the requirements of the commercial port in 2010/11.

Before 2010/11, Imam Khomeini port should be expanded to accommodate larger vessels and to modernize the cargo handling system. Development plans of the container and steel port are included in the Plan.

The cargo demand forecast of Iranian port and functional allotment of each port are already presented. The transhipment cargo volume was also forecasted based on the information available at the time of study.

The volume should be read in conjunction with The Volume II, which presents the general considerations for port planning and development.

Chapter 1

Development Concept of the Port

Chapter 1 Development Concept of the Port

1.1 Major Roles of the Port in the Iranian Port Network

Importance of the port sector as the sea-borne cargo traffic center in total foreign trade, as the cargo distribution center, as the transition point of transport mode and as the industrial and commercial service center was already described in the Volume II.

In this section, the role as transition point of the major Iranian port network is illustrated with considering the cargo throughput.

The share of total cargo volume handled in the two major ports (Imam Khomeini and Bandar Abbas) in the Persian Gulf increased from 88% to 94% during the last 5 years. The share will exceed 89% in 2000, and 92% in 2010 according to the forecast of the Study. The average annual growth rate of cargo throughput from 1989 to 1993 at Imam Khomeuni port is 15.5% while it is 20.0% at Bandar Abbas port. The cargo volume at these ports contributed to this high rate. In particular, the cargo volume significantly increased at Bandar Abbas port.

Bushehr and Chabahar port will serve as regional and sub-ports because of the inadequate inland transportation system.

Figure 1.1.1.1 show past and future shares of the total cargo volume at each port.

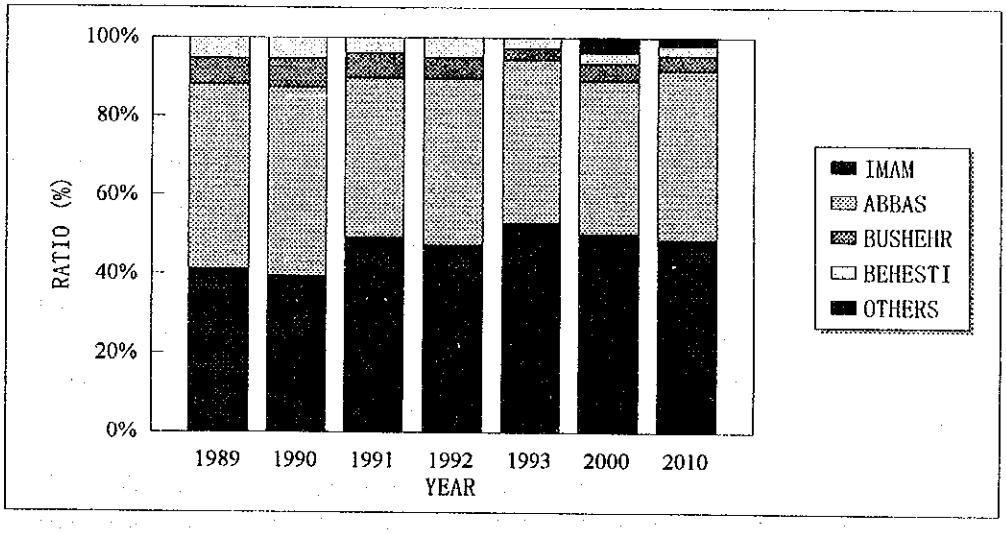


Figure 1.1.1.1 Shares of the Total Cargo Volume at Each Port

1.2 Location and Hinterland of the Port

1.2.1 Location

Vessels calling to the Persian Gulf ports come from all over the whole world. Main sea routes are through the Suez Canal for vessels from Europe and America and through the Indian Sea via Singapore for vessels from Asia.

Chabahar port is the most advantageously positioned from the shippers point of view. However, this port is very far from the consumption and production center. The other three other ports in the Persian Gulf (Imam Khomeini, Bandar Abbas, Bushehr) are located in the depth of the Persian Gulf have disadvantages in terms of ship cost and transport time.

Inland transportation influences cargo flows and port activities. Considering the distance from the port to the destination, Abbas port is located far from the gravity center of consumption and production. However, the rail way from this port will be connected to Tehran soon.

It is well known that Imam Khomeini port is near Teheran compairing with other major ports along the Persian Gulf coast. The two gateway ports, Imam Komeini port and Abbas port, will compete with one another once the railway is completed at Abbas port.

1.2.2 Hinterland

The area of consumption and production in Iran is closely related to the population distribution. The volume of cargo that flows to/from ports is related to the regional population.

For the ports in the Persian Gulf, the surrounding land is separated into eight areas considering transportation infrastructure, road and railway. Cargo volume of ports to/from area related to the population is shown in Table 1.2.2.1.

Similarly, the hinterland of each port is assumed. And to check the cargo volume share of each port (which has been obtained by the micro cargo demand forecast) in the Persian Gulf, the transportation cost and time to/from the hinterland is calculated. (Details are given in Section 3.2 of Chapter 3).

For the ports in the Caspian Sea, since the existing two ports (Anzali port and NowShahr port) are near Tehran and each other, their hinterlands are considered to be identical. To check the cargo volume share of each port in the Caspian Sea, a cost analysis is not employed because the actual share is determined by many factors, not simply the transportation cost to/from the ports.

Table 1.2.2.1 Hinterlands of Ports

Area	Province	Population Share	Port
Tehran	Tehran,Zanjan,Seman,Gilan Mazandaran,East Azerbayejan West Azerbayejan	0.450	Imam Khomeini Abbas
Esfahan	Esfahan	0.067	Imam Khomeini Abbas
Ahvaz	Khuzestan,Kohgiluye & Boyer-Ahmad,Chaharmahal & Bakhtiyari	0.075	Imam Khomeini Abbas,Bushehr
Arak	Markazi,Bakhtaran,Kordestan Hamadan,Lorestan,Ilam	0.140	Imam Khomeini Abbas
Shiraz	Fars,Bushehr	0.077	Imam Khomeini Abbas,Bushehr
Yazd	Yazd	0.012	Imam Khomeini Abbas, Behesti
Kerman	Kerman,Sisten & Baluchestan Hormozgan	0.072	Abbas,Bushehr Behesti
Mashhad	Khorasan	0.107	Imam Khomeini Abbas,Behesti

1.3 Future Pattern of Cargo Flow and Corresponding Function of the Ports

The following are possible changes in cargo flow pattern in and around the country qualitatively predicted on the basis of perspective on future state of the various relevant factors.

(1) International transshipment cargoes, including land bridge cargo, may increase depending on the relevant factors including availability of services to be provided by the competing foreign transportation system

(2) The scale of sea-borne cargo flow through the Caspian Sea ports will increase steadily in the long term basis according to the economic development of CIS Republics.

(3) Export cargo volume will increase steadily in line with the governments policy to seek a balanced trade that is not dependent on oil.

(4) Substantial increase in cargo traffic through Bandar Abbas area can be expected due to active improvement of port facilities and its accessibility together with

development of free trade area.

(5) Composition of cargo commodities will be diversified according to growth of economic activities and close relations with neighboring countries.

(6) Domestic sea-borne cargo flow will considerably increase according to progress of local port and coastal area development.

(7) Total in/out flow of international trading cargoes through road or rail directly to/from the neighboring countries (overland cargo flow) will increase its share of the cargo traffic through the ports (sea-borne cargo flow).

(8) Grain bulk cargo will still be imported from foreign countries although domestic production will increase to meet the consumption needs of a growing population.

(9) Oil products cargo will decrease as self-sufficiency is gradually attained.

1.4 Overall Cargo Traffic Demand for Major Iranian Ports

In Chapter 3 of Final Report(II), commodity-wise cargo handling volume at each study port in the target years 2000/01 and 2010/11 was forecasted as shown in Table 1.4.1.1).
From the perspective of future cargo traffic demand, the following assumptions have been applied to determine commodity-wise cargo handling volume at each study port in the target years.

(1) Present commodity shares of handling cargo at each study port are expected to be basically maintained in the target years 2000/01 and 2010/11.

(2) Containerization ratio of total cargo (import and export) in Iranian ports will be 18.4% in the year 2000/01 and 53% in the year 2010/11.

(3) Container cargo volume at Imam Khomeini port in the year 2010/11 will have grown to the same level as that of Abbas port.

(4) The cargo handling volume of the ports currently under construction, Amir Abad and Fereydunkenar port, is estimated to be 400,000 tons and 800,000 tons respectively in the target year 2010/11. The share of import/export cargo volume and commodity-wise cargo is considered to be the same as Nowshahr port.

(5) The cargo handling volumes of the newly opened ports of Khorramshahr and Abadan port are estimated to be 1,000,000 tons and 200,000 tons in the target years 2000/01 and 2010/11 respectively. The share of import/export cargo volume will be two to one. General cargo and container cargo are the main commodities to be handled at these ports.

Table 1.4.1.1 Total Forecast Commodity-wise Volume at Each Study Ports

Import & Export Cargo of North Ports

Unit: 1,000 tons

	Anzali				Noshahr				Amir Abad				Fereydunkener				Total	
	2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01	2010/11
Dry Bulk	222	14.4%	444	10.1%	56	10.0%	136	8.6%	25	9.8%	33	8.4%	36	9.8%	67	8.4%	339	680
Bag Cargo	49	3.2%	131	3.0%	97	17.5%	299	19.3%	44	17.0%	74	18.5%	63	17.0%	148	18.5%	253	651
Container	86	5.6%	1,159	26.3%	7	1.3%	120	7.8%	3	1.3%	29	7.2%	5	1.3%	58	7.2%	101	1,366
Refrigerated	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
Steel	218	14.2%	575	13.1%	46	8.2%	144	9.3%	21	8.0%	36	8.9%	30	8.0%	71	8.9%	314	826
Mineral	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0
General Cargo	162	10.6%	563	12.8%	53	9.5%	159	10.3%	31	11.8%	59	14.7%	43	11.8%	117	14.6%	289	897
Total	736		2,872		258		857		125		231		177		461		1,297	4,421

Import & Export Cargo of South Ports

Unit: 1,000 tons

	Imam				Rajaee				Bahonar				Bushehr				Behesti				Khorramshahr				Abadan				Total	
	2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01		2010/11		2000/01	2010/11
Dry Bulk	3,711	23.7%	4,505	15.0%	2,478	17.6%	3,037	10.8%	16	0.4%	20	0.4%	194	9.2%	252	7.7%	407	34.9%	591	29.8%	79	7.9%	103	10.3%	0	0.0%	0	0.0%	6,884	8,508
Bag Cargo	3,375	21.5%	5,405	18.1%	1,202	8.5%	2,121	7.6%	213	4.8%	206	3.7%	149	7.1%	187	5.8%	157	13.4%	219	11.1%	22	2.2%	10	1.0%	6	3.2%	4	2.0%	5,124	8,152
Container	914	5.8%	8,167	27.3%	975	6.9%	8,386	29.9%	0	0.0%	0	0.0%	6	0.3%	35	1.1%	30	2.6%	214	10.8%	130	13.0%	293	29.3%	0	0.0%	0	0.0%	2,055	17,095
Refrigerated	219	1.4%	410	1.4%	49	0.4%	87	0.3%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	268	497
Steel	4,434	28.3%	6,650	22.2%	1,507	10.7%	2,975	10.6%	61	1.4%	98	1.8%	291	13.8%	472	14.5%	71	6.1%	135	6.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	6,365	10,330
Mineral	99	0.6%	133	0.4%	302	2.1%	432	1.5%	653	14.8%	701	12.6%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1,053	1,265
General Cargo	2,762	17.6%	4,473	14.9%	2,744	19.5%	5,389	19.2%	1,876	42.4%	2,996	54.0%	789	37.3%	1,506	46.3%	121	10.4%	302	15.2%	769	76.9%	595	59.5%	194	96.8%	196	98.0%	9,254	15,458
Total	15,513		29,743		9,256		22,428		2,819		4,021		1,429		2,453		785		1,461		1,000		1,000		200		200		31,003	61,305

	Anzali Port						Imam Khomeini					
	1993/94		2000/01		2010/11		1993/94		2000/01		2010/11	
Dry Bulk	0	0.0%	222	14.4%	444	10.1%	2,071	20.6%	3,711	23.7%	4,505	15.0%
Bag Cargo	41	3.8%	49	3.2%	131	3.0%	2,661	26.5%	3,375	21.5%	5,405	18.1%
Container	46	4.3%	86	5.6%	1,159	26.3%	38	0.4%	914	5.8%	8,167	27.3%
Refrigerated	0	0.0%	0	0.0%	0	0.0%	66	0.7%	219	1.4%	410	1.4%
Steel	266	24.7%	218	14.2%	575	13.1%	3,679	36.6%	4,434	28.3%	6,650	22.2%
Mineral	0	0.0%	0	0.0%	0	0.0%	0	0.0%	99	0.6%	133	0.4%
General Cargo	148	13.7%	162	10.6%	563	12.8%	1,463	14.6%	2,762	17.6%	4,473	14.9%
Total	501		736		2,872		9,978		15,513		29,743	

1.5 Basic Policy of Port Development

Future port development and planning should be based on the following five subjects.

(1) To assist smooth trading in Iran, especially the land bridge cargo and increasing export cargo
(2) To support industrial/commercial development and free trade area activities
(3) To cope with the growing trend of containerization
(4) To maintain efficiency with regards to port operation and management
(5) To offer good service to port users

While considering the port development, it is also important to consider the environment surrounding the port, as well as economic and financial issues.

1.6 Basic Direction of the Ports Planning

1.6.1 Ports Planning Policy

Some subjects are described as follows;

(1) Upgrading of the existing port facilities including wharf, channel, basin, yard and cargo handling equipment
(2) Construction of the new port facilities
(3) Keeping sufficient land for long term development
(4) Promoting privatization with regards to port operation and management

1.6.2 Present Problems and Other Issues

In Imam Khomeini port, followings are present problems.

(1) Shallow water depth of wharf
(2) Shortage of cargo handling equipment
(3) Aged structures at the old port area

Details are described in section 2.6.

Chapter 2

Current Situation of the Port

Chapter 2 Current Situation of the Port

2.1 Particulars in Natural Conditions

This subsection deals with the natural condition of Imam Khomeini Port and its surroundings. The items described here cover the meteorological condition, oceanographic condition, topographic condition, bathymetric condition, geotechnical condition, and sedimentation.

Besides these items, environmental condition was studied together with sampling and tests for sea water quality and seabed material contents. However, these will be described separately in Chapter 11.

The Study Team collected various data, main sources of which can be classified as follows:

(1) Data provided by PSO

(2) Data provided by the other organization through PSO

Among these, most valuable sources were the Iran Ports Master Plan in 1974 (hereinafter referred to as MP-74), other survey reports at that time and investigation reports showing recent study results.

The primary aim of the study on natural conditions is to arrange original information and to gather them into data files taking the required engineering studies to come into consideration. Preparation of a port master plan and feasibility study should be based on the precise technical backgrounds as possible.

For improving these data the Study Team conducted hard investigation at the site namely an environmental survey bathymetric survey and structural observation.

It is to be noted that main source of data is consequently the Master Plan Report by Adibi-Harris in 1974.

2.1.1 General Climate Around Imam Khomeini Port

(1) Summary

The Imam Khomeini climate, like that of Khorramshahr, is subtropical, hot and dry, with few clouds for most of the year.

Temperature is the highest degree in July with a daily average of about 35°C, and an average maximum of about 43°C. The lowest temperature is in January with a daily average of about 12°C, and an average minimum of about 7°C. Extreme temperature may reach about 50°C in July and drop to about 1°C in December - January. Sun temperature may reach 75°C.

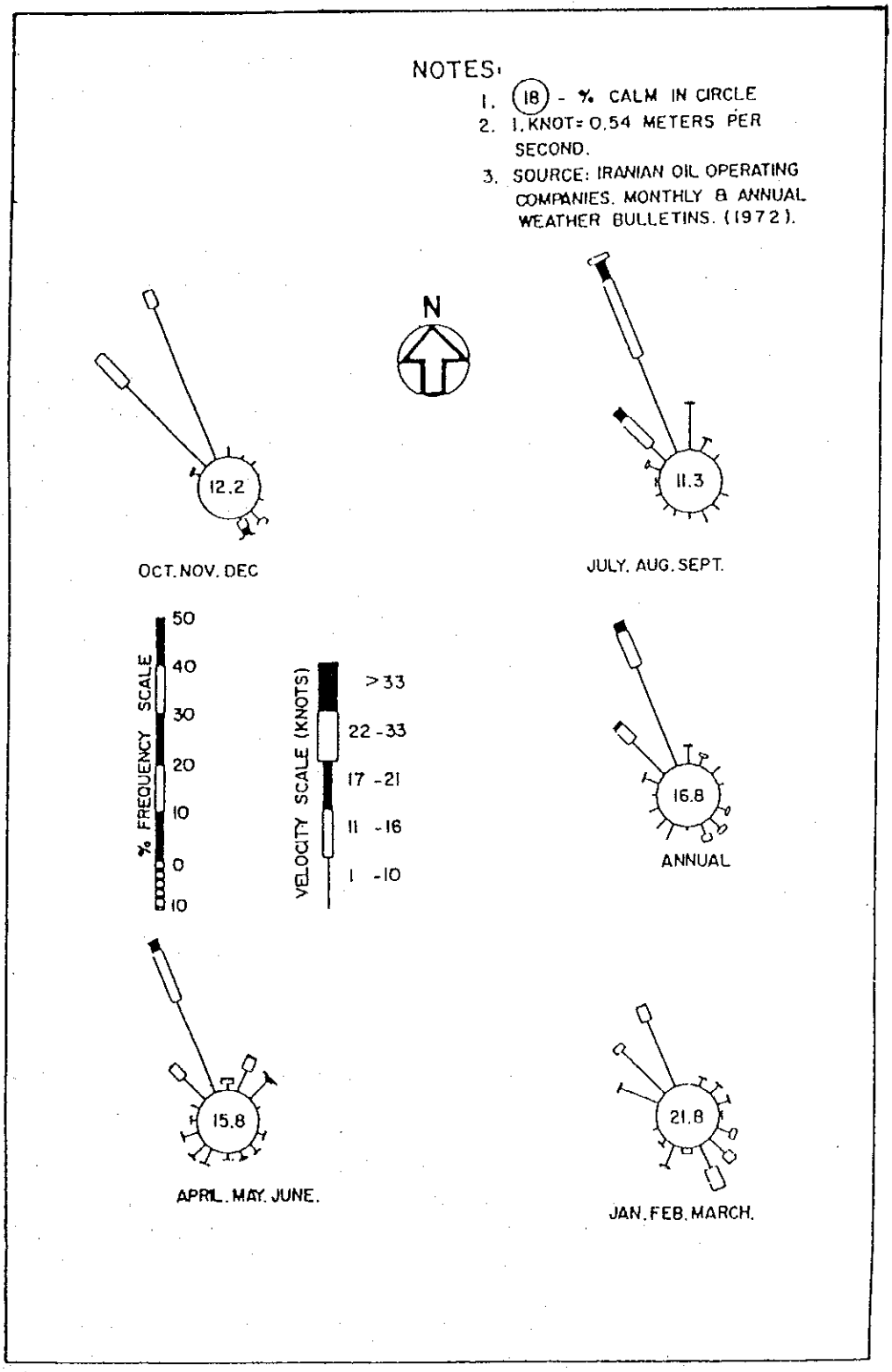
Rainfall is sparse, but the intensity may be considerable. There is normally no rainfall from May to October. Rain occurs mainly in the months of November to February. The total yearly rainfall varies from 100 mm to 300 mm. Daily precipitation of 45 mm is not uncommon and the maximum daily is around 80 mm.

Wind characteristics recorded at nearby Mahshar are illustrated in Figure 2.1.1.1. The most common wind is the "Shama" from between W.N.W. and N.N.W. The "Shama" seldom reaches Beaufort force 6 (11 - 14 m/sec) and Beaufort force 8 (17 - 21 m/sec) has been observed on only in a few occasion. The average wind speed is 2 to 5 in Beaufort force, corresponding to about 1 to 2.6 m/sec.

Dust storm usually occur in the project site during August and September and may reduce visibility to 1 km. The dust comes from the deserts of Iran or the Arabian Peninsula and is particularly small particles and damaging to all kinds of mechanical equipment not especially protected.

The salt content of the air is high thus required countermeasures must be given of the steel parts and mechanical equipment in order to protect them from corrosion.

Fog may occur during November, December and January.



Note: Master Plan in 1974 by PSO

Figure 2.1.1.1 Wind Characteristics, Mahshahr Port (Bandar Mahshahr)

(2) Characteristics of Atmospheric Pressure Fluctuation

All these regions show a large seasonal fluctuation of barometric pressure, being highest in winter and lowest in summer. For example at Abadan, the mean monthly atmospheric pressure is 1,019 mb. in December and 997 mb. in July.

(3) Offshore Winds - Persian Gulf

The winds offshore in the Persian Gulf west of 60°E are summarized as followings. They are dominantly between west and north throughout the year and are known locally as "Shaman".

The south-easterly wind commonly lasts for one to three days and then, within an hour or so it is replaced by the shaman. The veer to north-west is often accompanied by a squall which may occasionally reach gale force. The onset of the shaman is sometimes extremely abrupt. Violent squalls have been known to occur with a rising barometer wherein the wind changed almost immediately from south-south-west at 7 knots to west-north-west at 30 knots.

Winds between south and east are known as Sharqi. They are commonly hot and humid and are sometimes accompanied by cloudy weather. They rarely exceed 24 knots and are usually less strong than the following shaman. (Mariners know the Sharqi by the name of Kaus).

(4) Coastal Winds

Within about 30 km of the coast, winds become progressively modified by coastal effects, especially in the absence of strong pressure gradients. Normally the temperature difference between land and sea gives rise to a sea breeze by day and land breeze at night. When there is a general wind blowing, this effect will tend to add an onshore component to the wind by day and an offshore component by night.

(5) Precipitation

The desert character of much of Iran's south coast indicates the general lack of adequate rainfall as shown on Figure 2.1.1.2

Most of the coast experiences a mean annual rainfall between 100 to 200 mm, which exceeded only along about 100km of coast around Bushehr where the amount increases to 200 - 300 mm. There is falls in the winter months. From May to October there is less than 10 mm of rain.

As is common in regions of low rainfall, the amounts vary considerably from year to year. Thus Pasni averages 127 mm but has had as much as 376 mm and as little as 35 mm per year. Maximum falls in 24 hours can be quite large. Up to 140 mm has been recorded at Bushehr, but most places is never exceeded more than 80 mm. Thunderstorms are relatively infrequent. The average annual frequency of days with

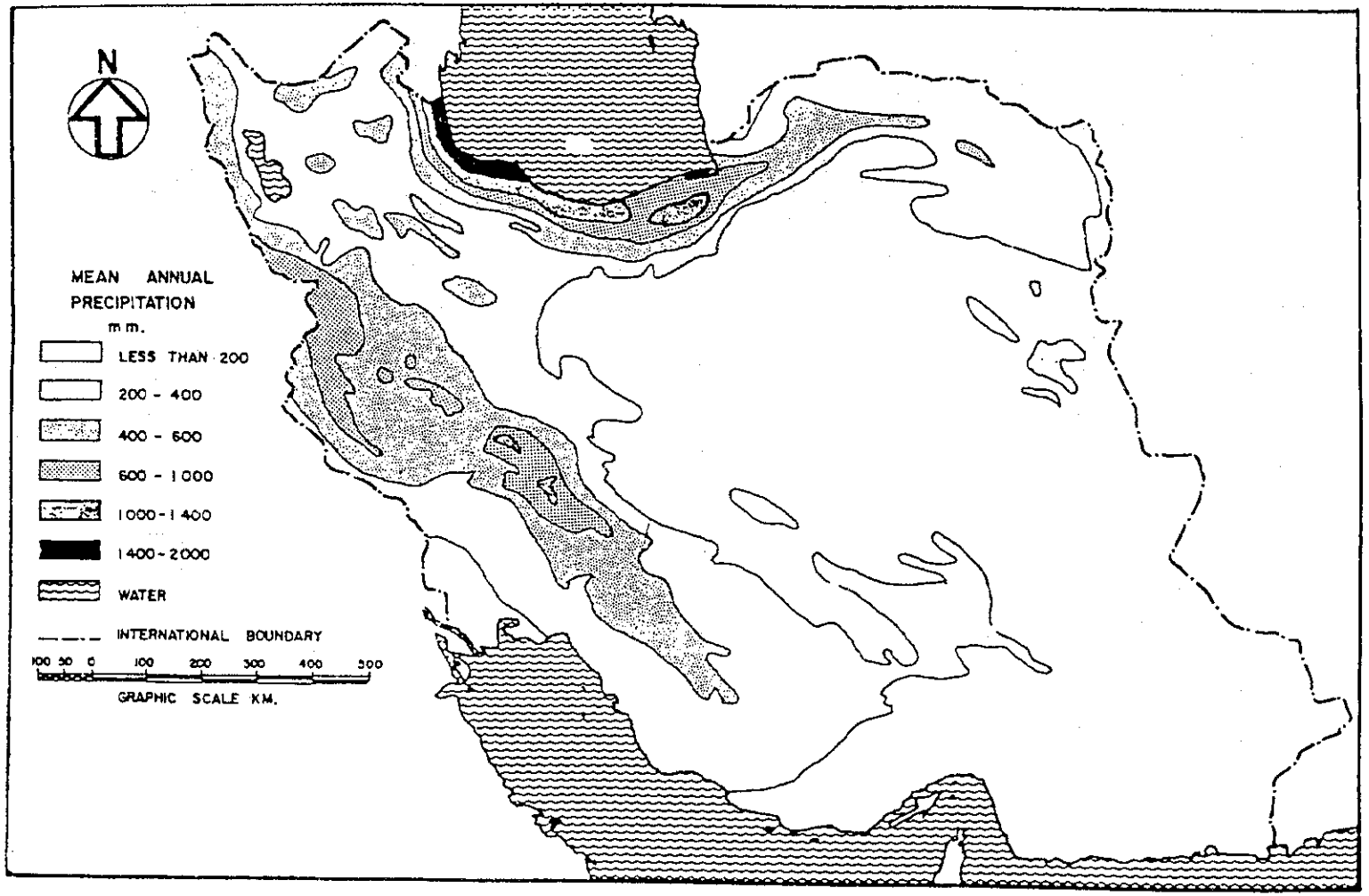


Figure 2.1.1.2 Iran Rainfall Distribution

thunderstorms is between 5 and 10 on the Persian Gulf coast.

(6) Visibility

Fog, visibility less than 1 km due to water droplets in suspension, is very rarely observed in the open Gulf, as compared to along the shore. Haze, visibility less than 8km, due mainly to dust particles in suspension, is considerably more frequent, particularly in summer. Haze, occur less than 5 percent of the time in November and December but ranges from 20 - 30 percent in April to 60 - 70 percent in July, decreasing to less than 30 percent in August.

Fog is occasionally reported near the coast normally in the early morning. It may be dense, but is usually very local and short-lived.

(7) Air Temperature and Relative Humidity

The region of the Persian Gulf is very hot in summer, but comparatively cool in winter because of the predominance of north-westerly winds blowing from the cool continents in the latter season. Average air temperatures over the sea are as low as 16°C in the north-west of Persian Gulf in January and February, increasing gradually to about 21°C in the Hormuz Strait and to about 22°C still further to the south-east.

By May the air temperature in the west of the Persian Gulf has risen to about 28°C. In July the average air temperature reaches its highest value of 33°C in the southern-most part of the Persian Gulf. The port areas experience more extreme temperature ranges especially notable at Abadan, due to its distance from the sea.

Relative humidity varies considerably according to the time of day, being usually highest when the temperature is lowest, around dawn and lowest when the temperature is highest, in the early afternoon.

In many places this daily variation is greater than the seasonal variation. Thus, at Bushehr, the relative humidity in July varies from 76 percent at 0630 to 48 percent at 1230. The greatest variation between the values at 0630 in the various months of the year that is from the March minimum of 72 percent to the December maximum of 84 percent is only 12 percent.

2.1.2 Oceanographic Condition: Tide

There are two tidal systems in Imam Khomeini Port, namely Kampsax K-11 Datum and Adibi-harris (a-H Datum). Table 2.1.2.1 indicates both data.

Table 2.1.2.1 Tide Data (K-11 and A-H Datum) Unit: m

Tidal Characteristics		K-11	A-H	Difference
Extreme High Water	EHW	+3.80	+6.40	2.6
Highest Astronomical Tide	HAT	+3.10	-	-
Mean Higher High Water	MHHW	+2.30	+5.00	2.7
Mean Sea Level	MSL	+0.50	+3.10	2.6
Mean Lower Low Water	MLLW	-2.00	+0.90	2.9
Lowest Astronomical Tide	LAT	-2.80	±0.00	2.8
Extreme Low Water	ELW	-2.90	-0.10	2.8

Difference between two systems are also shown in Figure 2.1.2.1
Application of these two datum is currently employed as follows:

a. Chart Datum	A-H
b. Sounding Data	K-11 and A-H
c. Datum for Construction	K-11
d. Topographic Survey	K-11
e. Drawings by Iran-Kampsax	K-11

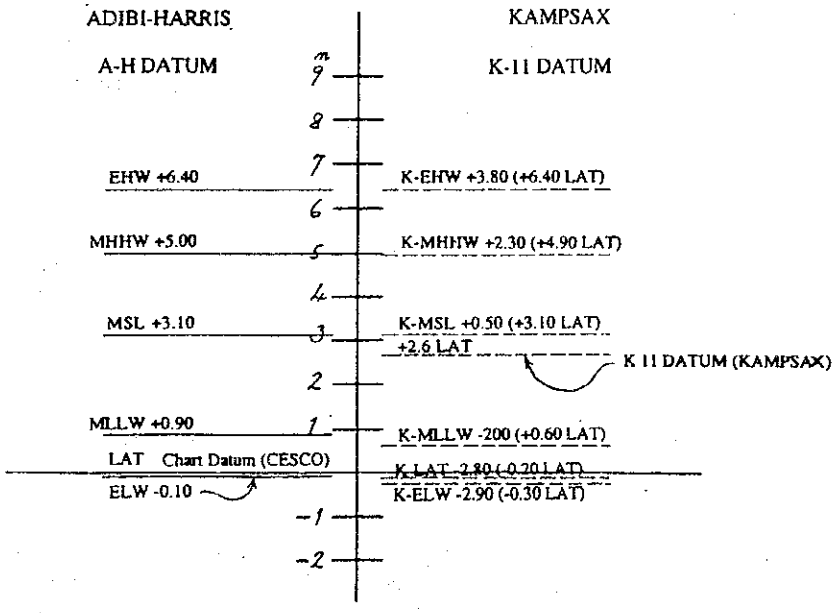


Figure 2.1.2.1 Tidal Datum (K-11 Datum and A-H Datum)

Elevation showing on the Master Plan 1974 by ADIBI-HARRIS is not only A-H Datum but also K-11. In order to avoid confusion description in this report will be made based on the A-H Datum.

Tides at the bar and in the Estuary of Musa Channel are of mixed characteristics. Mean tidal implied at the bar is 3.5 meters at springs and 2.9 meters at napes. Maximum spring tide amplitudes at Imam Khomeini Port are estimated to be about 6.0 meters. Tidal characteristics are summarized in Table 2.1.2.2.

Table 2.1.2.2 Musa Channel Tidal Characteristics

Tidal Characteristics	Khor Musa Bar	Imam Khomeini Port	Mahshar Port
Mean Higher High Water	3.5	5.1	5.2
Mean Sea Level	2.3	3.3	-
Mean Lower Low Water	0.9	0.8	0.9
Lowest Astronomical Tide	-	±0.0	-

Note: CESCO carried out various oceanographic survey and used LAT as the datum. The Study Team adopted this datum instead of K-II datum which is LAT +2.6 employed by Iran-Kampsax. Thus, in the hydrographic data surveyed by the Study Team DL equals to CESCO datum.

The effect of the deep tidal estuary on the propagation of the tidal wave is to amplify the amplitudes contrary to the effect of large river. Without wind effect the daily higher high water occurs about 1 hour 35 minutes later at Imam Khomeini Port than at the bar while the lower low water occurs about 15 minutes earlier at Imam Khomeini Port.

Wind has generally an effect on tide level and time of high and low water but it provides somewhat less affection due to the greater depths of the Musa Channel. As there is no significant fresh water inflow to the estuary, there is no tidal correction for seasonal variation at Imam Khomeini port and Mahshar port.

2.1.3 Oceanographic Condition: Tidal Current

Currents were measured for velocity and direction at 9 locations in the Khor Dorag and Khor Musa in 1973 by CESCO B.V. A continuous reading water-level gauge was used to relate current velocity and direction to the variation in water level.

The current measurements were intended primarily to identify possible navigational problems associated with the layouts and designs of port facilities.

Maximum currents of 0.8 m/sec were measured for both ebb and flood flows. Directions were sometimes contrast to what could be expected according the shape of channel, however, this is at least partly due to the extremely irregular bottom configuration at the locations of the measurement stations. Maximum currents at some stations were observed to be almost perpendicular to the channel axis.

Tidal currents in the lower part of the Khor Musa set N.N.W. and S.S.W., turning at about the time of high water and low water respectively. The greatest rate was recorded at 1.5 knots in February. At the bar, spring tides produce average 4 knots ebb currents and 3 knots flood currents. Current direction through the bar is generally parallel to the channel axis. Strongest tides within the estuary are 4.5 knots during maximum ebb and 3.5 knots during maximum flood, which were found near

beacon No.18 about 15 km west of the Western Jetty. Currents in front of the existing jetties may occur with rates of 3.0 knots at maximum ebb and up to 2.3 knots at maximum flood.

2.1.4 Oceanographic Condition: Waves

(1) Waves at Port Basin

There are two goals about waves data collection.

1) To know the wave characteristics at the possible approaching channel and anchorage for new wharf faceline arrangement.

2) To know the wave calmness at the proposed berths in order to ensure that the counted operatable days are going to be more than an acceptable figures.

Design wave height will also be assumed through obtained wave data in order to design the seawall or other heavy waterfront structures. Waves in the shallow water may change their energy into coastal current which will enhance the littoral drift and sedimentation.

The project site is protected well against the offshore wave attack by narrow and bended channels, thus the wave intensity in front of proposed quaywall is the main target to be evaluated.

It is reported that wave intensity at the port basin are relatively moderate since the limited fetch length. The length should be measured on the free straight line without any obstacles on the wave generation. The fetch length of Imam Khomeini port can be measured on the free water surface of channel. Thanks to the natural shape of them, the fetch line on the free water is so limited. Possible wave height generating in front of the Berth No.11 was roughly estimated using the S-M-B method.

Table 2.1.4.1 Range of Wave Height Imam Khomeini Port

Wind Speed m/sec	Fetch Length F(km)	Height H1/3(m)	Length Lo (m)	Period To(sec)
10	10	0.7	12.5	2.8
15	10	0.9	17.0	3.3
20	10	1.4	22.5	3.8
25	10	1.8	27.5	4.2
30	10	2.2	31.5	4.5

Note: Wave height (H1/3) is a significant wave. Significant wave is an average wave of highest one-third of the wave group observed.

(2) Waves in Persian Gulf

All together, calm or moderate seas (less than one meter high) prevail more than 75 percent of the time in the Persian Gulf and the Oman Sea. However, rate of happening of rough-through-high seas, 1.6 m and higher, share 5 or 6 percent of the time throughout these areas, which have maximum occurrence during autumn and winter and minimum occurrence during spring and summer.

Swells greater than 3.5 m occur less than one percent of the time throughout the year in both the Persian Gulf and Oman Sea. Swells of over 1.8 m occur with an average frequency of 9 percent with little variation throughout the year.

At the head of the Persian Gulf, low and moderate swells from the south and southwest occur with significant frequency only in the winter months. High swell is rare in any seasons. The central part of the Persian Gulf has swells from the west and northwest 30 percent of the time in spring and 40 to 45 percent of the time during all other seasons.

2.1.5 Topographic Condition

The Karun River once discharged through the present Khor Musa Channel. Virtually the entire area south of the 100 km Abadan-Imam Khomeini highway and some area to the north are salty marsh. The 300 m contour is almost 100 km distance but the mountains rise steeply after that.

The existing map shows that the location of the present port is built on an artificial land, which was reclaimed about 60 years ago on swampy land. It was located approximately 8 km from the firm high ground but served by an excellent channel.

2.1.6 Hydrology

Karun River is the largest one among the major watersheds and rivers draining into the Persian Gulf. Most of the rivers are essentially seasonal and highly subject to temporary torrential flooding carrying large amounts of brown mud, gravel, sand and boulders.

Because of the occurrence of salt formations in the coastal areas, the rivers are frequently of brackish water. In essentially flat regions where the groundwater table is high considerable evaporation takes place resulting in relatively high concentration of salt in the ground water.
Many of the small rivers do not reach the coast as the water is absorbed in alluvial plains, a portion of which subsequently flows into the Persian Gulf as groundwater. Formation of deltas are observed in most major rivers. Tidal influence is frequently measurable far inland due to the very porous calcareous soil.

Basic discharge data of Karun River for the years of 1967 - 1970 is as follows:

Observation at	Ahwaz
Average annual discharge volume	21,300m3
Peak flow	6,460 m/sec
Suspended sediment flow (1969~1970)	4,500,000 ton

2.1.7 Bathymetric Condition

This part deals with the bathymetric condition of existing channel and port basin. All necessary discussions will be made based on the survey results in the previous works. MP-74 and CESCO B.V. etc., were added to the survey by the Study Team in June 1994.

(1) General Background Information: Hydrographic Data

While the Karun must be responsible for the poor site conditions at Imam Khomeini, it contributed to the formation of the Khor Musa, the finest natural channel to a protected harbor in Iran.

The Khor Musa Bar was formed evidently as a function of the tidal flows in the estuary producing equilibrium with the sediment, which was carried by the Karun River, before it was diverted from the estuary. The waters of the Khor Musa estuary are separated from the open Persian Gulf by this bar, which is approximately 8 km in length. The 50 km approach to the bar from seaward has a depth of 12 to 18 meters. From the bar to Imam Khomeini is about 63 km.

The Khor Musa Bar has two sections of relatively shallow water each 2.5 km in length separated by 3 km with depth of 11 to 15 meters.

At the outer bar 350,000 m^3 of material was dredged in the past in order to increase the depth from a natural minimum of 7.4 meters to a minimum of 9 meters over a 150 meters width. Since this dredging, scour has occurred to create an irregular channel of 9.8 meters minimum depth over a width of 60 to 100 meters.

Within Khor Musa estuary the channel is of exceptional depths, averaging 20 to 45 meters for the 55 km channel extending from the bar to Imam Khomeini port. These favorable depths also will be extended into the Khor Dorag and Khor Zangi.

The seabed in the upper of estuary is mainly of soft mud and fine silt.

(2) Previous Survey Records, MP-74/CESCO Survey

A hydrographic survey was performed by CESCO B.V. in 1973 in the Khor Dorag and Khor Zangi.

Horizontal control was affected by a means of a continuous reading tide gauge at the entrance to Khor Kushi on the Khor Dorag, which is approximately in the center of the survey area. M.S.L. was established and related to deck elevation and the

Kampsax K II land datum elevation at the port. Chart datum was established at 3.1 m below M.S.L. or 2.6 m below K II datum.

The survey area begins from the Khor Dorag near the Khor Kushi with a 15 m depth channel continuing to the North-West and deepening to over 40 m at the junction with Khor Zangi.

Depths are generally greater to the outside of bends, as is normal to narrow waterways. Then the Khor Zangi branches to the east with depths rapidly decreasing to about minimum 4 m and then increasing to over 30 m at its eastern extremity due to the turbulence, which was caused by the sharp bend to the north.

Depths in the Khor Zangi diminish to the north, and a centerline profile in the continuation of the Khor Zangi through the Khor Temur to the west and returning to the south generally showed water depth above datum elevation.

The Khor Dorag continues to the west of the junction with the Khor Zangi with depths increasing from 13 m to 30 m at its junction with Khor Temur. A centerline profile down the Khor Kushi showed shallow waters of 1 to 3 m L.A.T. depths.

2.1.8 Littoral Drift and Siltation

The interplay of tides, currents, waves and salinity bears on sedimentation.

Measurements in 1972 indicate that salinity in the Khor Musa is higher than Persian Gulf, as would be expected for an estuary with very limited fresh water inflow and a high rate of evaporation. Analysis showed the value of 4.3 % to 4.45 % with no observable gradation from seabed to the surface in the period of measurement.

By calculation, wave heights at Imam Khomeini port may often reach 0.6 m, but in an extraordinary cases with strong winds from the south or southwest, 1.0 and even 1.5 m height may occur.

Suspended sediment concentrations were measured during 12 months of 1972/73 as part of PM-74 study on siltation. Indications are that silt concentrations are generally low and that sedimentation rates should be low. The silt are fine, relatively uniformly distribute vertically and concentration does not greatly vary during a tidal cycle. However, sediment concentration increases with tidal amplitude.

The coarser sediments move close to an along the seabed; that concentration is directly related to current velocity. As the seabed is generally composed of these coarse sediments, siltation is expected to result principally from movement of this material. Turbulence of tidal flows, except a closed basin, will prevent most of the finer silt from settling out.

2.1.9 Geotechnical Conditions

Geotechnical condition of the site is one of the most important items with respect of design of port facility. Existence of thick soft layer generally will be increased construction costs of wharf and pavement. Dredging cost of rock layer is so expensive that port layout is frequently forced to modify into new layout in order to avoid any such work.

According to the geological maps the general condition at site is basically categorized as residual stratum to alluvial soil group. It is understood that the soil composition in this area consist of two layers.

First layer : Alluvial soil, sedimentation
Second layer : Residual Stratum

Combination of these layers varies place by place.

(1) Soil Investigation in 1967

This investigation can be summarized as follows:

a. Purpose of this investigation was to survey the geotechnical data for the Four Berths Extension together with a possible further port development.
b. Soil investigation was carried out in summer of 1967/1968.
c. Soil samples were tested at the technical and soils laboratories of the Plan Organization of Iran.
   Supplemental laboratory tests were conducted at the head office of Kampsax.
d. Supervision of this investigation was carried out by Hamker-Kampsax, Consulting Engineers.
e. 19 boreholes were tested in depth between 25 m and 47 m.Undisturbed samples were taken every two meters by 54 mm diameter piston samplers, 40 mm samplers were employed together with auger cutting.A vane sounding was also carried out adjacent to each borehole by Danish and Swedish Vane tests.
f. Detailed design and construction recommendations were performed on the Four Berths Extension and layout of further port extension.

For the engineering purpose, the soil can be categorized into two basic strata as follows.

<u>The Surficial Deposit</u>
A soft to fine silty clay with silt and fine sand stratifications.
This clay is slightly over-consolidated (3.0 t/m2).

<u>The Lower Deposit</u>
A hard lightly cemented silty clay.

This layer is under a heavy consolidation and forms a hard bottom for the purpose

of settlement calculation. Hard clay stratum lays at least 40 m below the datum.

The Survey Report gave its descriptions on these two strata as follows:

The surficial deposit is a soft to fine silty clay with many silt and fine sand stratifications. The clay is slightly over consolidated, equivalent to an approximate previous ground level of +2 meters. The frequent occurrence of sand seams enables excess pore pressures, which are set up by shear stresses or increases in vertical stress to eliminate rapidly.

Table 2.1.9.1 gives the recommended design parameters for the surficial silty clay stratum, based both on the laboratory testing and on previous experience in the area.

The lower deposit encountered in the boring is a hard and lightly cemented silty clay which is probably also heavily over consolidated. This stratum can be considered as hard bottom for the purpose of settlement calculations.

The mean ground water level has been taken as +0.5 meters in the clay, with a water table at elevation +2.0 m, in the fill.

Table 2.1.9.1 Recommended Design Soil Parameters Former Four Berths Extension (Imam Khomeini Port)

Parameter		Design Value
Wet unit weight		1.97 t/m^3
Undrained Shear Strength for stability analysis		-
* at elevation	- 5m	1.0 t/m^2
* at elevation for bearing capacity of piles	-15m	2.5 t/m^2
* at elevation	- 5m	2.3 t/m^2
* at elevation	-15m	5.0 t/m^2
Over consolidation pressure, δc-δo		3.0 t/m^2
Consolidation ratio, $C_C/1 + eo$		0.11 m^2/t
$C_R/1 + eo$		0.01 m^2/t
Effective Shear Strength Parameters		0
Ø		34°

Source; Soil Investigation Report, Volume 3B January 1969, prepared by Iran-Kampsax

(2) Soil Investigation in 1972

Outline of this survey is summarized below:

a. The main purpose of the investigation was checking the soil for the Ten Berths Extension together with the future reclamation of hinterland area.
b. Soil investigation was conducted from September 1972 to March 1973.
c. A field laboratory at the site was established for the investigation.

d. Iran-Kampsax was selected by PSO for this services.
e. A total number of boreholes were 20, a total length of them were 613 m. The boring depth was changed between 14.1 m to 42.5 m. Continuous undisturbed samples were taken by Norwegian 54 mm thin-walled piston samplers in depth from 10 m to 17 m. In addition, 13 vane tests were carried out by Swedish Vane apparatus.
f. Structural alternatives were evaluated using of obtained geotechnical conditions.
g. It was recommended to make a series of settlement measurement including with pieozometors.
h. Borrow material tests were also conducted in order to confirm the chemical characteristics of earth for reclamation.
i. Soil investigation was also performed along the road between Imam Khomeini Port and Sar Bandar Town.

For the engineering purpose, the soil can be divided into two types, namely the upper Estuarine and Deltaic Deposit and the Lower Residual Stratum.

Upper Estuarine and Deltaic Deposits

The upper stratum is an estuarine or deltaic deposit of alternating clays, silts and sands. The presence of shells indicates that the sediments to have been laid down in a marine environment. Sand layers, in places with several meters thick, indicate the sediments to have been deposited in shoals.

It is unlikely that this deposit as a whole has undergone any significant preloading. However, it is probable that, during sediment- ing, the sea level varied considerably. Such variation would cause erosion-sediment cycles. In some of the boring such evidence is found at the bottom of the stratum, that a layer of very stiff silty clay was encountered. This material was found to be similar to the main sediment but it has a lower moisture content, a higher unit weight and a higher vane shear strength. This is probably the results from preloading in excess of that of the overlying clay.

Table 2.1.9.2 shows soil characteristics of this upper layer.

Table 2.1.9.2 Soil Parameters (1/2) (Upper Layer) Ten Berths Extension (Iman Khomeini Port)

Mean Values					
Layer	a	b	c	d	e
Water content %	29	33	24	27	28
Unit weight t/m^3	2.00	1.90	2.00	2.00	1.97/2.02
Clay content %	18	32	--	20	36
Liquid limit %	30	35	--	30	30
Plastic limit %	20	22	--	18	18
Plasticity index %	10	13	--	12	12
Untrained shear strength t/m^2	2-8	2-3	--	4-20	8-40
Sensitivity	2-4	2-3	--	2-3	2-3
Preconsolidation pressure Pc-Po t/m^2	4-6	2-4	--	--	2
Consolidation ratios:					
$Cc/1 + e_o$	0.14	0.12	--	0.10	0.13
$C_R/1 + e_o$	0.01	0.02	--	0.015	0.02
Effective friction angle ϕ'	-31	31	30-33	27	33
Effective cohesion C' t/m^2	-1.0	1.0	~0	0	0

Source: Iran-Kampsax Report, 1973

Classification of soil in the table is as follows:

Mark (a) Soft to medium silty clay and clayey silt
Mark (b) Very soft to soft silty clay
Mark (c) Fine silty sand coarse silt
Mark (d) Fine silty sand and coarse silt
Mark (e) Silt clay
Mark (f) Sand and silt
Mark (g) Clay and silt

The Lower Residual Stratum

A very stiff to hard slightly cemented clay under heavy preconsolidation.

This layer is a hard bottom for purpose of settlement calculation. There is a dense to very dense sand or residual clays starting from -30 m to -40 m.

Following descriptions are an excerpt from the survey report 1973.

The previous development is to be sited on the North Bank of the Khor Dorag. The ground consists of tidal deltas and tidal mud flats, flooded at high tide, which slope gently from elevation +2 to +3 m to the south and west. The banks themselves are relatively steeper, having natural slope of up to 2.5 horizontal of 1 vertical.

The site is intersected by several 5 to 10 m wide channels (Khors) and separated from the Four Berths Extension site by a 30 m wide channel, the Khor Zaid, the banks of which are about 6 m high and stand as steeply as 1 to 1 in some places. Since there are many sand layers in the underlaying clay stratum, it is considered that the groundwater level within the clay stratum follows the sea level closely. A mean groundwater level at elevation +0.5 m has been assumed in all calculations for boring having a ground level of +2.0 m or less. For boring having a ground level of more than +2.0 m, a mean groundwater level at 1.5 m depth is assumed.

The soil state encountered in the boreholes can be classified in two main geological categories:

Table 2.1.9.3 shows soil characteristics of this lower layer.

(3) Chemical Test on Soils

Followings are excerpt from the report:

The chemical tests were carried out by the Institute of Technical Geology at the Technical University of Denmark.

The content of calcite ($CaCO_3$) was determined on basis of the amount of CO_2 set free by treatment of the sample with acid. The content of organic matter in the soil was determined by combustion analyses. The content of sulphur in the soil was determined as soluble sulphate (SO_3) in % of dry soil, and the content in g per 1 pore water was calculated from initial water content.

The chlorinity of the pore water was determined as the amount of Cl per gram of dry soil by a volumetric analysis. After determination of water content of the sample, the chlorinity and salt content (NaCl) in pore water were calculated in g per 1 pore water. The value of PH was determined on a sample of 10 g air dried soil suspended in 25 ml water.

Table 2.1.9.3 Soil Parameters (2/2) (Lower Residual Stratum)
Ten Berths Extension (Iman Khomeini Port)

Mean Values				
Layer	f1	f2	g1	g2
Water content %	22	22	21	21
Unit weight t/m^3	2.05	2.00	2.10	2.00
Clay content %	--	--	45	20
Liquid limit %	--	--	38	28
Plastic limit %	--	--	20	17
Plasticity index %	--	--	18	11
Untrained shear strength t/m^2	--	--	>30	>30
Sensitivity	--	--	-2-3	-2-3
Preconsolidation pressure Pc-Po t/m^2	--	--	--	--
Consolidation ratios:				
$Cc/1 + e_o$	--	--	0.11	0.11
$C_R/1 + e_o$	--	--	0.02	0.02
Effective friction angle ø'	-37	-38	--	--
Effective cohesion C' t/m^2	-0	-0	--	--

Source: Iran-Kampsax Report, 1973

2.2 Port Function and its Activities

2.2.1 Cargo Handling Activities

(1) General

Total cargo volume handled at Imam Khomeini port reached 9.978 million tons in 1993/94. Commodities and share of handling cargo in 1993/94 are shown in following Table 2.2.1.1.

Table 2.2.1.1 Commodities and Share of Handling Cargo

Commodities	Volume (x1,000 tons)	Share (%)
Dry bulk cargo	2,071	20.7
:Barely, Wheat, Corn	-	-
Bagged cargo	2,661	26.6
:Fertilizer, Sugar, Rice, Soy bean, Chemical material	-	-
Refrigerated cargo	66	0.7
:Meat	-	-
Metallic products	3,679	36.9
:Steel products, Steel Ingot, Zinc	-	-
General cargo	1,463	14.7
Container	38	0.4
Total	9,978	100.0

Major handling equipment for loading/unloading are pneumatic unloaders at exclusive berth (grain terminal), floating unloaders for mineral goods between The Eastern and Western Jetties, container cranes at container Berth (One of the two cranes is out of service.), tire-mounted pneumatic unloaders for dry bulk cargo at Berth No.15 and mobile cranes. Six (6) portal jib cranes are installed at from berth No.16 to No.19.

(2) Cargo Handling Operation by Commodity

1) Dry bulk cargo at exclusive berth (Grain Terminal)

The exclusive berth is located at the east side of the port. Dry bulk cargo is discharged by pneumatic unloader from vessel and then transferred to silo by belt conveyers. Cargo stored in silo is transported out of the port (to consignee or cargo's owner) by trucks.

2) Dry bulk cargo at general berth

Tire-mounted pneumatic unloader is used for discharging dry bulk cargo at Berth No.14 and No.15. Cargo to be discharged by pneumatic unloader is loaded to truck

through hopper at apron and then transported out of the port directly. This direct delivery system sometimes causes a long line of trucks due to long loading time. At this time, some of the cargo spills onto the apron or into the sea causing pollution.

3) Bagged cargo

Bagged cargo is discharged by ship gear or mobile crane or a combination of both with sling system instead of pallet system. Some of the cargo is conveyed to the transit shed located behind the apron by tractor with flat bed chassis. Remaining cargo is transported out of the port by truck directly.

4) Metallic products

Metallic products are discharged by ship gear, mobile crane or combination of both with sling system. Metallic products generally are stored in the open yard. Forklift truck and mobile crane are used for handling in the open yard.

5) Refrigerated cargo

There is no facility for refrigerated cargo in port area. Prior to arrival of refrigerated cargo at the port, consignee or cargo owner arranges reefer container box at ship side (apron) for transportation. Refrigerated cargo is discharged from ship to apron by ship gear or mobile crane or a combination of both, and is then stuffed into reefer container box directly at the apron. Direct stuffing work takes long time.

6) General cargo

Normally, general cargo is discharged by ship gear, mobile crane or a combination of both. Six (6) portal jib cranes are installed at existing Berth No.16 to No.19 for loading and unloading of light cargo.

7) Container cargo

There are two (2) container cranes at container berths (existing Berth No.11 and No.12) and two (2) transfer cranes in the container yard. However, one (1) container crane has been out of service for about five years following a collision caused by strong winds. It has not been repaired yet. Normally container cargo is unloaded from ship by container crane, mobile crane, ship gear or a combination of them. In the container yard, containers are handled by transfer crane and forklift truck (top lifter).

(3) Direct delivery

Ratios of direct delivery are shown in Table 2.2.1.2.

Table 2.2.1.2 Transportation Mode (x1,000 ton)

Year	Direct Delivery	Through Storage Facilities	Total
1991/2	3,860 (50.1%)	3,851 (49.9%)	7,711
1992/3	3,674 (49.5%)	3,752 (50.5%)	7,426

Source: PSO/Imam Khomeini port

2.2.2 Port related Facilities and its Condition

(1) Basic Facilities

Port basic facilities contain roads, yard, stormwater drainage, buildings, transit sheds, warehouse, jetties, piers, wharfs and others.

All these facilities are ordinary condition except followings.

- Old jetties, Western Jetty and Eastern Jetty
- Land use of the old port area

Some basic facilities proposed in the previous master plan in 1974 are still under construction. However after they are completed, port facilities will provide port users with more ordinary services.

(2) Cargo handling equipment

1) Existing cargo handling equipment

The existing cargo handling equipment at the port are shown in Table 2.2.2.1. There are many kinds of cranes and most of them are tire mounted except container cranes, portal jib cranes and continuous mechanical unloaders. Furthermore there are two (2) unique handling system. one is floating unloaders with double link level luffing crane for ore. Another one is hopper which are shiftable from dolphin to jetty for alminus powder.

2) Principal Problem

Lack of recognition to cargo handling equipment which are installed at quay. Two(2) container cranes have been installed at container berth in 1997. However, one container crane has been out of order from some years ago and it is not repaired yet.
The purpose of cargo handling equipment installed at quayside is to get quick dispatch of the ship and to reduce the total transportation cost but it is not to reduce the handling cost at the port.

Table 2.2.2.1(1) List of Cargo Handling Equipment Iman Khomeini Port

Type	Location (No of Berth)	Capacity	Produced		No of Equipment			Remarks
			Year	Age	Total	Good	Bad	
Container Crane	11-14	40 t	1977		2	1	1	
Portal Jib crane	16-19	6tx25m 15tx15m 15tx8		0	6			For general cargo
Tyre mounted Hopper	6	500t/h			2			For aluniniun s powder
Tyre mounted continous mechanical unloader	5	300 t/h		20	1		1	For Grain
Floating unloader (Double-links level luffing type)	between 3 and 4	1000 t/h 25tx36m 50tx20m			2	1	1	For ore
Continous mechanical unloader with pneumatic unloader	Grain jetty	H1000 t/h Pn 250 t/hx2			2			For Grain
Grain loader	"	1000 t/h			1			" "
Tyre mounted pneumatic unloader		280 t/h	1989		2	2		at berth No. 14
Transfer crane		40 t			2			
Mobile crane		550	1993		1	1	0	
		90	1973		1	1	0	K.L.B
		60	1993		2	2	0	
		50	1970		1	0	1	
		475	1993		1	1	0	K.L.B
		40	1992		2	2	0	
		35	1991		1	1	0	
		35	1973		5	0	5	
		275	1992		2	2	0	PSO1

Table 2.2.2.1(2) List of Cargo Handling Equipment Iman Khomeini Port

Type	Location (No of Berth)	Capacity	Produced		No of Equipment			Remarks
			Year	Age	Total	Good	Bad	
		25	1993		4	4	0	
		20	1991		5	0	5	
		15	1973		6	0	6	
		15	1971		4	0	4	
		10	1956		2	1	1	
		8	1983		2	0	2	
		8	1973		6	2	4	
		8	1972		1	0	1	
		6	1959		1	0	1	
Fork-lift Truck (top lifter)		40			5			For container
Fork-lift Truck		15	1993		1	1	0	
			1991		1	1	0	
			1983		2	1	1	
		13.5	1982		3	1	2	
		10	1993		5	5	0	
			1991		5	5	0	
			1981		1	0	1	
			1980		2	0	2	
			1979		2	0	2	
		7	1993		2	2	0	
			1991		2	2	0	
			1982		4	2	2	
		5	1991		8	8	0	

Table 2.2.2.1(3) List of Cargo Handling Equipmetn Iman Khomeini Port

Type	Location (No of Berth)	Capacity	Produced		No of Equipment			Remarks
			Year	Age	Total	Good	Bad	
			1984		1	1	0	
		4.5	1993		9	9	0	
		2.5	1993		1	1	0	
Tractor			1992		5	5	0	
			1991		32	32	0	
			1988		12	12	0	
			1986		1	0	1	
			1982		5	0	5	
			1981		3	0	3	
			1980		9	0	9	
			1979		12	0	12	
			1978		2	0	2	
			1977		4	0	4	
Push Truck			1993		6	6		
Raily Road Crane		20	1994		1			
		10	1994		3			

3) Problems at present

There are some very old equipment and their age is not evened.
Procurement and disposal shall be carried out on schedule.
In order to keep each piece of equipment in a safety and to make the most of its original function display, maintenance especially preventive maintenance is indispensable. Then effective maintenance system shall be established.

(3) Utilities

Utilities in Imam Khomeini port include water supply sewerage system, power supply, telecommunication and others.

For the time being these system can maintain ordinary port operation, since the present traffic demands are much lower than its capacity. Thus the existing ones are not fully utilized of their own capacity. However, proportionally to concentration of port activities, high demands of the utilities may happen.

It is assumed that present utility systems are generally within an acceptable level, if the systems, which were proposed by the previous port study, are completed.

(4) Access Road and Railways

1) Road networks around Imam Khomeini port

The mountains of the Zagros Range run from north-west to south-east in the western part of Iran. Route of Tehran-Imam Khomeini port confronts the Zagros Range, requiring many bridges and tunnels. Route of Tehran-Abbas port passes through the desert region where weather conditions are very severe.

Concerning road networks in the north and south direction, Tehran-Esfahan-Shiraz route is the most important route running north and south.

Table 2.2.2.2 Distance of main cities from Imam Khomeini Port by road

Route	Distance	Remark
Khomeini---- Tehran	1,030 km	-
Khomeini---- Qom	870 km	Two-lane Main road
Qom--------- Tehran	160 km	Four-lane Expressway
Khomeini---- Ahvaz	156 km	Two-lane Main road
Khomeini---- Arak	737 km	Two-lane Main road
Khomeini---- Esfahan	940 km	Two-lane Main road

Note

Freeway : Six-lanes road with fence on sides and without traffic signal
Expressway : Four-lanes road
Main road : The total width is 11.0m-13.3m and includes 1.85m-2.0m on each side (shoulder)

International road networks

Persian Gulf ports offer links to other countries and thus good networks are vital to support the flow of goods between Central Asia and Eastern Europe.

Table 2.2.2.3 Distance of Tehran from Persian Gulf Port by road

Persian Gulf port---Tehran					Total distances
Khomeini--	Ahvaz------	Khorramabad--	Arak-------	Tehran	1,030 km
Bushehr----	Shiraz-------	Esfahan----------		Tehran	1,228 km
Abbas------	Sirjan--------	Shahrebabak----------		Tehran	1,334 km
Chahbahar-	Iranshahr--	Kerman----------	Yazd-------	Tehran	1,961 km

2) Railway Network around Imam Khomeini port

There is a railway stretching 928 km from Imam Khomeini port to Tehran. The present network comprises a single track line (Ahvaz-Tehran) and a double track line (Khomeini port-Ahvaz).

Table 2.2.2.4 Railway Network around Imam Khomeini Port

main section		distance	operation year
Tehran---	Khomeini port	928 km	1938
Ahvaz---	Khoramshahr	121 km	1942

International railway networks

Borders from where the goods are transported by railways are covered in the present network. Imam Khomeini port is connected to Turkey and Central Asia by railway

Table 2.2.2.5 International railway networks

Khomeini---	Tehran---	Sarakhs---	(Turkmenistan)
Khomeini---	Tehran---	Razi------	(Turkey)
Khomeini---	Tehran---	Julfa-----	(Azerbaijan)

(5) Industrial and Commercial Entities

Oilfield are mainly located in the south-west part of Iran. There are many oil related industries in this areas, such as oil refineries, natural liquid gas plant and petrochemical plant. There are two big industrial steel projects in this area.
Ahvaz and Esfahan are important for their steel production industries.

Table 2.2.2.6 Major Industries near Khomeini Port

	Khomeini	Abadan	Ahvaz	Esfahan
Distance	0	100km	156km	940km
Power Station		Thermal 1 Water 2	Thermal 1 Water 1	Thermal 1
Oil Refinery		Abadan 1		Esfahan 1
Petro -chemical	Khomeini 3	Abadan 1		Esfahan 1
Gas Plant	Khomeini 3			
Steel Plant			Ahvaz 2	Esfahan 2

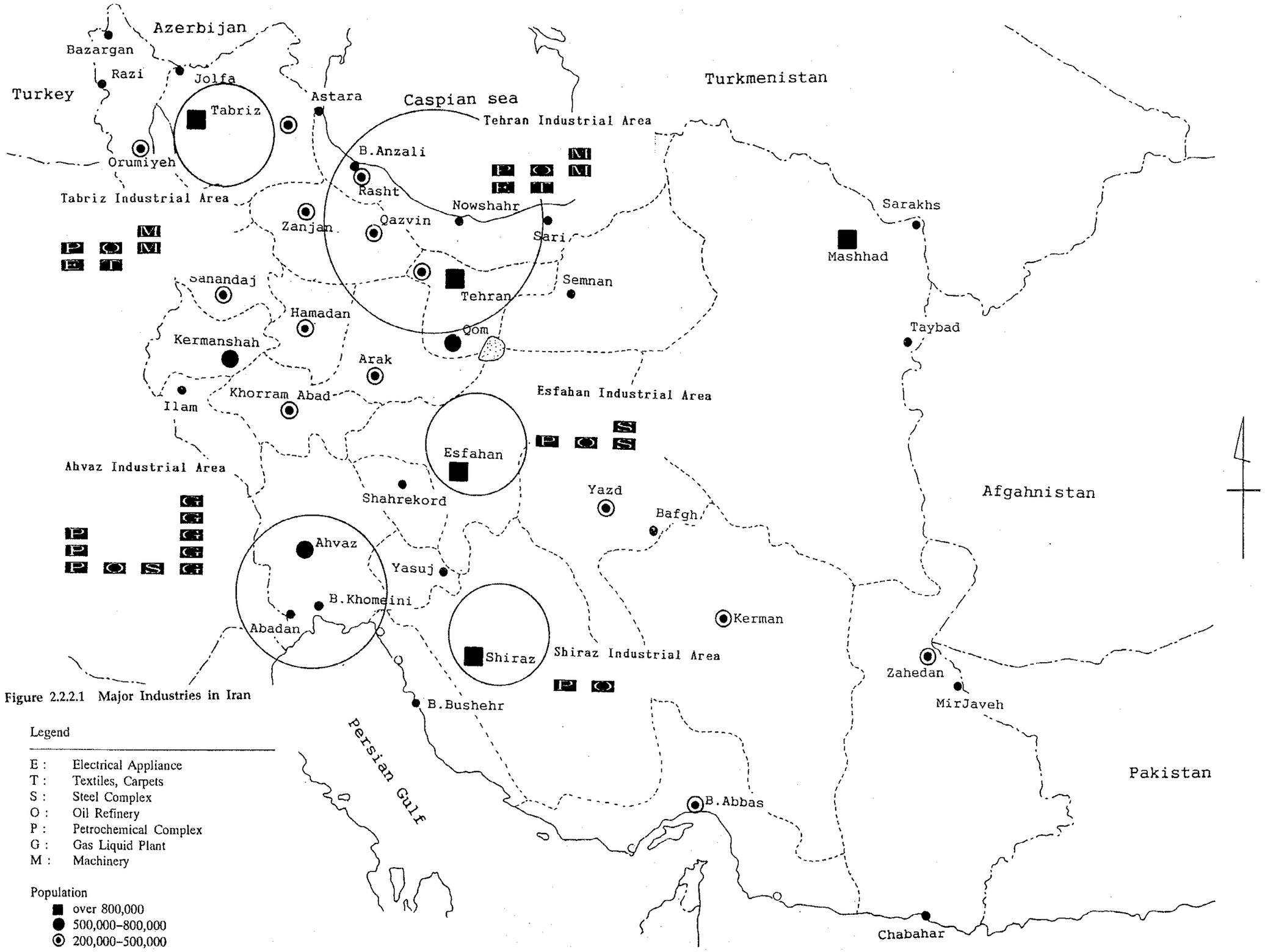


Figure 2.2.2.1 Major Industries in Iran

Legend

E :	Electrical Appliance
T :	Textiles, Carpets
S :	Steel Complex
O :	Oil Refinery
P :	Petrochemical Complex
G :	Gas Liquid Plant
M :	Machinery

Population

- over 800,000
- 500,000–800,000
- 200,000–500,000
- under 200,000

2.3 Port Management and Operation

2.3.1 Port Management

(1) Imam Khomeini Port Authority (IKPA)

As shown in Figure 2.3.1.1, Port Director holds the highest position. Under the Port Director, some offices are established such as Public Relations Office, Program and Planning Center, Port Guard Office, Security and Legal Adviser.
In addition, four main departments, namely Finance and Administration Department, Technical Department, Civil Engineering Department and Operation Department, are established and they are headed by the four Deputy Port Directors.

1) The Finance and Administration Department has four divisions related to general administration matters and financial and fiscal matters. The Service Division is in charge of providing miscellaneous services to the internal personnel such as cleaning service of the office buildings and commuter bus service. The Financial Division is in charge of financial matters including invoices of port charges to shipping agencies. The Logistics Division oversees procurement procedures.

2) The Technical Department has three divisions which are in charge of maintenance and repair of marine equipments and on land cargo handling equipment.

3) The Civil Engineering Department has four divisions related to construction works in the port.
The Construction Division is in charge of the investment plan of the ports which is under the jurisdiction of the port authority. This division drafts the annual budget and five-year plans and submits them to PSO head office. In addition, this division conducts demand forecast for large scale port development plans. This division is also responsible for the introduction of an information system.

4) The Operation Department has three divisions related to provision of marine service and cargo handling service including tallying. At Imam Khomeini port, cargo handling service, excluding on the ship, is provided by the port authority personnel, who belong to the Port Operation Division. Pilotage, towage and line handling services are provided by the Marine Operation Division.

Table 2.3.1.1 shows the number of PSO head office and IKPA employees by age in 1993. IKPA has 1,872 personnel which is about 31% of the total PSO personnel, the largest number of personnel in the port authorities in Iran. This is because it administrates comparative large-scale ports and employs its own personnel to conduct cargo handling service by itself.

As shown in the Table 2.3.1.1, 71% of the employees at IKPA are age 41 and over. The same age group represents 64% of the total at PSO head office. Compared to PSO head office, employees of IKPA thought to be older. Increase of young employees is necessary.

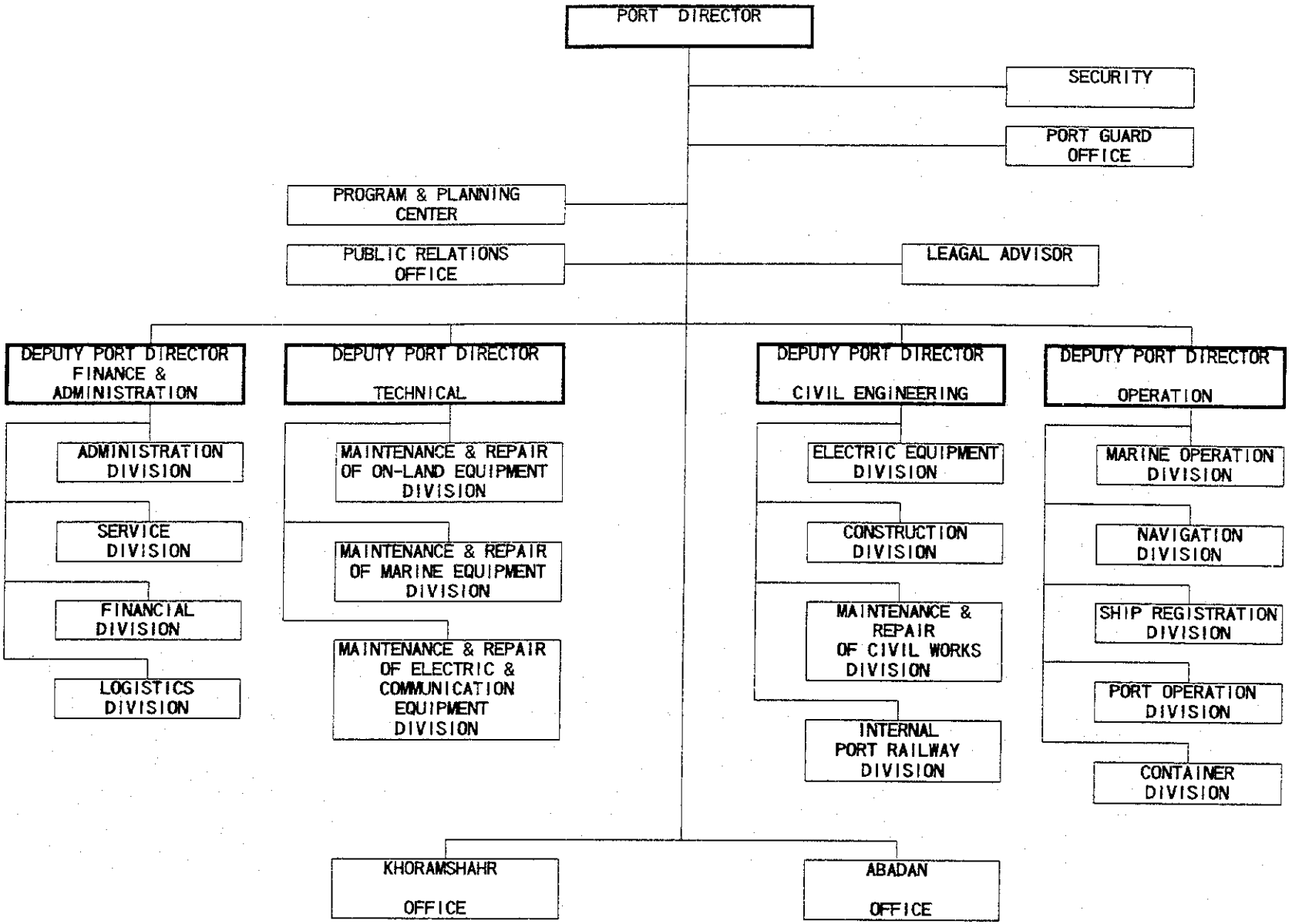


Figure 2.3.1.1 Organization Chart of Imam Khomeini Port Authority

Table 2.3.1.1 Number of PSO Employees by Age Group (in 1993)

	Total	Years Old				
		-30	31-40	41-50	51-60	61-
PSO Central Office	382	57	81	180	58	6
share(%)	100.0%	14.9%	21.2%	47.1%	15.2%	1.6%
Imam Khomeiini Port	1872	165	375	709	523	100
share(%)	100.0%	8.8%	20.0%	37.9%	27.9%	5.3%
PSO TOTAL	5992	503	1348	2697	1234	210
share(%)	100.0%	8.4%	22.5%	45.0%	20.6%	3.5%

Source: PSO

2.3.2 Port Operation

(1) Berth Allotment

At Imam Khomeini port, berth allotment is generally on a first come first serve basis. Container vessels without crane are given priority, however, at the container berths which have gantry cranes.
The Marine Operation Division of IKPA is in charge of berth allotment.
A shipping agent which wants to use the berth has to inform the port authority of the Estimate Time of Arrival (ETA) 48 hours prior to port entry. The Marine Operation Division of IKPA checks that the agency paid the port charge and then has a meeting with the agency to decide the berth. The Marine Operation Division allots the berth taking into consideration the dimensions of the ship (length and draft of the ship), type of cargo, location of the shed or open area to be used. As there is currently no congestion at the ports, it has not been necessary for plural shipping agents to hold meetings to coordinate berthing places.

(2) Cargo Handling Service

At Imam Khomeini Port, private entities provide cargo handling service on ships in principal, and IKPA conducts cargo handling, stowage and cargo transport in the port area. Most berths of this port are general cargo berths. This port also has four container berths (Berth No 11 ~ No 15) and two container gantry cranes. PSO stuff operate the gantry cranes. One of them is out of service at present. A regular container service line, however, does not call this terminal.
A ship unloader and belt conveyers for aluminum powder is installed at Berth No 5. Open storage yard for aluminum is behind the Berth No 5. An private company rent the land from PSO, and installed facilities for aluminum. This terminal is a unique one in this port.
Between Berth No 3 and No 4, a floating crane for iron powder is moored, which is operated by PSO.
This port has a grain terminal with one jetty, two ship unloaders, conveyer and silo. The grain terminal is located at the western side of Berth No 1 beyond a basin for small ships. The grain facilities are also owned and operated by PSO. Ships used to be able to use both sides of the jetty, depth on the western side of the jetty became

shallow, and now ships can berth only no one side.
A chemical factory and petro chemical factory are located on the western side of the grain terminal. These factories are not included in the port area. Thus, they have jetties, which are operated by the factories. However, since vessels which enter these factories must use the access channel for Imam Khomeini port, they take a PSO pilot on board at the entrance of the access channel.

(3) Mooring, Water Supply and Bunkering

At the major ports, each port authority provides mooring and water supply services. At Imam Khomeini port, the Maritime Operation Division of IKPA is in charge of these services, which are undertaken by their own force.
Bunkering service is carried out by private companies.

(4) Introduction of Information System at IKPA

IKPA has started to introduce information systems. It uses personal computers for some items such as statistics, salary calculation, personnel record management. Only one semi-expert has been hired.

2.3.3 Procurement System

In the past, PSO head office was totally in charge of procurement procedures and conducted all paper work. A procurement request would be first submitted from each division of IKPA to the Technical Logistics Division of PSO head office. This division conducted all procurement procedures.
The system has changed. At present, IKPA can procure necessary items whose prices are lower than 2,000,000 RLs and within its budget.
The Logistics Division of IKPA is in charge of the procurement procedure. It directly enters contracts with foreign companies to procure something which is not available in Iran. The change has meant that necessary items such as parts for cargo handling equipment can be procured more easily and quickly.

PSO head office, however, still conducts procurement procedure for large size cargo handling equipment because the permitted limit is still low, and there are some port authorities which do not have enough experience in such procurement procedures. In this case, each port authority submits a list of necessary equipment to the Operation Division of PSO head office. The Port Operation Division collects and submits the lists to the Board of Directors. After approval of the board, the Equipment and Maintenance Division technically examines them, and the Technical Logistics Division conducts procurement procedures.

2.3.4 Financial Condition and Port Tariff

(1) Financial Condition

PSO receives a subsidy from Government. In this context, PSO is not financially

independent from Government. Table 2.3.4.1 shows the financial condition of the PSO special account over a recent six-year period.

According to this Table, PSO was able to make a profit. This is mainly because the amount of cargo handling revenue is large, and large scale investment is done by the general account of Government.

The working ratio of port operation[1], however, was around 70% over a recent six-year period (1987-1992). This figure should be lower than normal ratios of 50-60% if an entity is to be able to invest in port development. Therefore, the financial condition of PSO is not sound enough to allow for investment in large scale port development.

Table 2.3.4.1 Income Statement of the PSO Special Account

(Mn. RLs)

	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
Operating Revenue	24,416	24,507	28,789	46,380	61,210	71,615
-Terminals & Marine Operational Income	9,664	8,774	8,838	9,754	12,290	14,379
-Port Operation Income	215	243	261	397	601	703
-Loading and Unloading Income	13,988	14,931	18,999	35,380	46,924	54,901
-Others	549	559	691	849	1,395	1,632
Operation Expense	21,363	19,402	23,110	35,476	47,220	54,615
-Personnel Expense	9,562	10,152	12,167	14,901	20,426	23,694
-Contract Services	2,086	2,374	3,290	6,963	9,747	11,306
-Fuel & Electricity	380	510	613	709	1,370	1,589
-Maintenance	1,582	3,004	3,811	7,784	11,482	13,319
-General Expenses	1,450	1,722	1,556	3,290	2,527	2,931
-Others	175	200	235	261	168	195
-Depreciation	6,128	1,440	1,438	1,568	1,500	1,581
Operating Income	3,053	5,105	5,679	10,904	13,990	17,000
Non-Operating Revenue	0	0	0	0	0	0
	-	-	-	-	-	-
Non-Operating Expense	0	0	0	3,176	1,798	1,000
-Interest	0	0	0	0	0	0
-Taxes	0	0	0	0	0	0
-Provision Years Lost Claims	0	0	0	3,176	1,798	1,000
Non-Operating Income	0	0	0	-3,176	-1,798	-1,000
Surplus or Deficit	3,053	5,105	5,679	7,728	12,192	16,000
Working Ratio(*)	62.4%	73.3%	75.3%	73.1%	74.7%	74.1%

*Note: (1)Working Ratio:(Operation Expense-Depreciation)/Operation Revenue*100 (%)*
Source: PSO

There is no financial statement by each port. At Imam Khomeini port, however, a balance sheet of incomes and expenses is prepared as shown in table 2.3.4.2.
Both income and expenses of IKPA have been increasing since 1991/92, the balance has been in black. By tariff revise in 1993/94, income has increased drastically. However, on the basis of conference with PSO head office, net income is returned to PSO head office, therefore, it isn't available to IKPA. The amount of net income decreased drastically in 1992 because of increasing personnel expenses and general expenses.

Table 2.3.4.2 Income & Expenditure of Imam Khomeini Port

Khomeini

Income Title	Amount (Mn. RLs)		
	1991/92	1992/93	1993/94
Marine and Terminal Operations Income	3,502.6	4,575.4	47,114.7
Port Operations Income	70.9	98.8	358.1
Loading/Unloading Operations Income	17,616.1	17,691.5	15,250.4
Equipment Service Income	73.7	134.6	410.4
Miscellaneous Income	364.5	495.4	966.8
Income Total (1)	21,627.8	22,995.7	64,100.4
Expenditure Title			
Salary and Benefits paid to Employees Expenses	4,204.3	5,866.1	5,684.8
Other Personnel Expenses	1,480.0	2,045.2	2,603.1
Contractual Services Expenses	4,978.0	4,638.9	3,555.6
Repair and Maintenance Expenses	3,537.1	3,048.1	3,708.1
Fuel Expenses	66.9	86.4	94.4
Services Expenses	139.4	219.6	402.7
Wages Expenses	1,342.4	1,932.8	2,399.6
General Expenses	541.5	3,720.3	1,201.6
Contingency Expenses	32.1	46.7	17.2
Depreciation Expenses	103.5	764.8	874.0
Expenditure Total (2)	16,425.2	22,368.9	20,541.1
Balance (1)-(2)	5,202.6	626.8	43,559.3

Source: PSO

(2) Port Tariff

The main tariff of PSO (June 1994) is shown in Table 2.3.4.3, Table 2.3.4.4 and Table 2.3.4.5.
As shown in the Table, cargo handling charges are levied because PSO provides a part of cargo handling service in the ports. Cargo handling charges for container are defined in RLs. PSO does not have a special tariff for container transhipment cargo. As shown below, there are two ways(one for shipping companies, and another for cargo owners) to collect the charges.

1) The charges which shipping companies should pay such as port entry charge and pilotage are paid by shipping agencies. The Financial Division of port authorities issues the bills to the shipping agencies. The shipping agencies pay the charge to the banks.
These kinds of charges are defined in dollars in principal, and are decided on the

basis of operational cost of PSO taking into consideration the tariffs of neighboring countries such as the U.A.E., Kuwait, Bahrain, Saudi Arabia. The Supreme Council has authority to revise these charges.

2) The charges which consignees of cargo should pay such as cargo handling charge in the yard are paid to the Customs office with customs duties by the consignees. The Customs office deposits the charges into the special account of PSO. These kinds of charges are defined in RLs in principle. These have not been changed for a long time.

The Supreme Council has authority to revise almost all charges. Permission of the parliament, however, is necessary to change seven items when the level is to be increased by more than 30% (see Table 2.3.4.3). PSO does not have a designated division for the preparation of the tariff. Instead, each division of the Operation Department of PSO head office prepares the draft, and the Financial Division is in charge of compiling them.

These had been also defined in RLs in the past. The foreign shipping companies had to pay after exchanging foreign currency at the official fixed rate of the Iranian Central Bank (one dollar = 70 RLs). Therefore, the foreign shipping companies received handicapped treatment because the official rate was different from the actual value.

The fixed rate was abandoned at the beginning of the fiscal year 1993', the tariff for the foreign shipping companies began to be calculated in dollars, while domestic shipping companies began to have to pay the same value RLs with the tariff for the foreign shipping companies. The exchange rate, determined on the basis of the rate on the last day in each month, is announced by port authorities. Hence the problem with the tariff was solved partly. The new tariff in dollars, however, was calculated by using the old rate (one dollar = 70 RLs), therefore the tariff is still comparatively high.

Table 2.3.4.3 Main Tariff of PSO (In Jun. 1994)

Item		Tariff
		(Cent)
For ships	Entering the port entrance (*)	6 / GRT
	Entering the port (*)	10 / GRT
	Pilotage	40 / GRT
	For dredging	41 / GRT
	Loading and Discharging (*)	
	a) At berth	22 / GRT
	b) At ancharage	11 / GRT
	Side wharfage	10 / GRT / day
	For Lighthouses, signs (*)	4 / GRT
	Gabage colletion	3 / GRT
		(Rial)
Berth charge on cargo	Unloading	180 / ton
	Loading	95 / ton
Dues on cargo	Inward (*)	40 / ton
	Outward (*)	10 / ton
	Quarantine duties under control of the Ministry of Pulic Healthe (*)	10/ton
Cargo handling charge on land	Inward cargo (not direct delivery, by PSO worker)	1,650 / ton
	Outward cargo (not direct delivery, by PSO worker)	412 / ton
	Inward cargo (direct delivery, by consignee worker)	330 / ton
	Inward cargo (direct delivery, by PSO worker)	660 / ton
	Outward cargo (direct delivery, by consignee worke	83 / ton
	Outard cargo (direct delivery, by PSO worker)	165 / ton
	Stacking on truck and wagon	412 / ton
Loading and unloading charge	Unloading from ship by port crane	380 / ton
	Loading to ship by port crane	95 / ton
Warehousing	Warehousing	
	untill 15 days	0.05 / day / 10 kg
	16 ~ 30	0.10 / day / 10 kg
	31 ~ 45	0.40 / day / 10 kg
	46 ~ 60	0.60 / day / 10 kg
	61 ~ 90	1 / day / 10 kg
	more days	2 / day / 10 kg

Note: (*)Permission is necessary for raises of more than 30%

: Charge for towage differs by each tug boat. This will be unified.

Source: PSO

Table 2.3.4.4 Main Tariff of PSO (Container) (In Jun. 1994)

(Rial / Unit)

Item	~20 ft		~40 ft	
	Full	Empty	Full	Empty
Unloading by port crane	22,000	10,000	28,000	12,000
Loading by port crane	22,000	10,000	28,000	12,000
Unloading by ship crane	20,000	8,000	26,000	10,000
Loading by ship crane	20,000	8,000	26,000	10,000
Unloading (Ro Ro)	20,000	10,000	26,000	10,000
Loading (Ro Ro)	20,000	10,000	26,000	10,000
Unloading by port crane (direct delivery)	6,500	5,000	10,000	8,000
Loading by port crane (direct delivery)	6,500	5,000	10,000	8,000
Supervision of container handling				
Unloading (Ro Ro)	4,500	4,500	8,000	8,000
Loading (Ro Ro)	4,500	4,500	8,000	8,000
Unloading by ship crane	4,500	4,500	8,000	8,000
Loading by ship crane	4,500	4,500	8,000	8,000
Shift inside ship hold (without using yard)	4,000	4,000	6,000	6,000
Shift inside ship hold (using yard)	7,000	7,000	10,000	10,000
Shift from ship to ship (without using yard)	7,000	7,000	10,000	10,000
Shift from ship to ship (using yard)	16,000	12,000	20,000	16,000
Container movement in yard	3,000	3,000	4,500	4,500
Unloading or Loading from track or wagon	3,500	2,500	4,500	3,500
Unstuffing	1,000			
Stuffing	1,000			
Open or close hachcover	4,000			
Container Creaning	4,000		6,000	
Lashing and unlashing	400			

Source: PSO

Table 2.3.4.5 Tariff for Container Storage (In Jun. 1994)

Item	20 ft		40 ft	
	Without shassis	On shassis	Without shassis	On shassis
1 ~ 15 days	300	400	400	800
16 ~ 30 days	400	800	800	1,600
31 ~ 45 days	600	1,200	1,200	2,400
46 ~ 60 days	800	1,600	1,600	3,200
more than 60 days	1,000	2,000	2,000	4,000

Source: PSO

2.4 Historical Background of Port Construction

2.4.1 General History of Port Construction and Their Improvement

It took 43 years before starting the extension of 24 berths, since the year 1931 (1310) when this great port historicaly commenced it's activities. Although with some delay, all general cargo berths in MP-74 have been constructed having both transit sheds and warehouses.

Refer to the table 2.4.1.1 for the major topics in waterfront development at Imam Khomeini port. Table 2.4.1.2 also provides more detailed information about development since 1972 (1351). It should be noted that these tables may show only the significant ones.

PSO was and is still conducting the necessary repair works on the damaged parts of structure by means of collective measures.

It should be noted that the existing approach channel and port basin are well maintained as natural waterways and anchorages except, shellow water by sedimentation.

Refer to section 2.6 for the progress of works at present. Refer to section 2.8 for the existing port facilities.

Table 2.4.1.1 Major Waterfront development history, Imam Khomeini Port

No.	Major Waterfront Development	Iranian	Gregorian
1.	Start of port construction The first berth, (Eastern Jetty)	1310	1931
2.	Second berth (Eastern Jetty) for Ocean-going vessel	1318	1939
3.	Western Jetty (Three berths for ocean-going vessels) Note: At that moment, the port handled cargo overflow from Khorramshahr.	1320s	1940s
4.	Start of four berths extension (Berths No.7-No.10)	1350	1971
5.	Start of ten berth extension (Berths No.11-No.20)	1353	1974
6.	Start of fourteen berth extension (Berths No.21-No.34)	1353	1974

Source: PSO and MP-74

Table 2.4.1.2 History of Port Construction and Extension: Imam Khomeini Port 1/2

Project	Stage	Name of Companies	Iranian	Gregorian
1)Ten Berth Ext.				
a. wharves				
	(D)	Iran-Kampsax	1351	1972
	(S)	Iran-Kampsax	1354	1975
	(C)	DHH, Dames (F) Hamoun (I), Nadish (I)	1353	1974
b. Road & Utility	(C)	Kaminous a Portus (S)	1356	1977
c. Transit sheds	(S)	Iran - kampsax	1357	1978
	(C)	(not completed due to the revolution)	1357	1978
2)Fourteen Berth Ext.				
a. Wharves	(D)	Iran-Kampsax	1354	1975
	(S)	Iran-Kampsax	1353	1974
	(C)	Sherkat JV Sherkat (I), Stakhtemny (I), Bandar Iran (I), Adrian Volker (N), Zoublin (G)	1353	1974
b. Yard Pavement for storage area	(C)	Same JV shown above	1353	1974
c. Road & Utility		N.A	N.A	N.A
d. Transit sheds	(C)	(Not completed due to the revolution)	1357	1978
3)Iron Ore Jetty				
a. Ext. of Jetty	(C)	TOA Harbor (J)	1354	1975
b. Equipment	(S)	Iran-Kampsax	1355	1975
4)Grain Silo				
a. Silo Jetty	(D)	N.A	N.A	N.A
	(S)	N.A	N.A	N.A
	(C)	JV of Radjianeh (I), Neyer Pars (I)	1353	1974
b. Silo & civil works	(D)	Sano (I)	1359	1980
	(S)	Sano (I)	1359	1980
c. Electric & Equipment	(D)	Itsem (I)	1359	1980
	(S)	Itsem (I)	N.A	N.A

Table 2.4.1.2 History of Port Construction and Extension: Imam Khomeini Port 2/2

Project	Stage	Name of Companies	Iranian	Gregorian
5)Barge Harbor				
a. Wharf	(D)	Iran-Kampsax	1354	1975
	(S)	Iran-Kampsax	1354	1975
	(C)	Setcontrantsimex (R)	1354	1975
b. Dredging	(S)	Iran-Kampsax	1355	1976
	(C)	Adrian Volker (N) Sherkat Layroub (I)	1355	1976
6)Western Jetty				
a. Repair Works	(D)	N.A	N.A	N.A
	(S)	N.A	N.A	N.A
	(C)	TOA Harbor (N) (two months before the revolution)	1357	1978
7)Dredging Works				
a. Dredging with Bouy setting	(S)	Iran-Kampsax	1354	1975
	(C)	Adrian Volker (N)	1353	1974
b. Dredging at Khore Zangi	(C)	Iran Dredging	1359	1978
8)Utility				
a. High voltage	(S)	Iran-Kampsax	1355	1976
	(C)	ISCO Iran (I)	N.A	N.A
b. High voltage	(S)	Iran-Kampsax	1357	1978
	(C)	N.A	N.A	N.A
9)Railway Extension				
a. Line	(S)	Iran-Kampsax	1355	1976
	(C)	Batiman Anfal		
10)Transit sheds & Warehouses				
a. Transit sheds	(S)	Iran-Kampsax	1357	1978
	(C)	N.A	N.A	N.A
b. 18 Transit sheds	(S)	Tehran Barkley (I)	1361	1982
& Warehouses	(C)	Moghak	1361	1982
11)Sar Bandar PSO Housing	(D)	N.A	1363	1984
	(S)	N.A		
	(C)	Grafus Company	1363	1984

Note: (D); Design (S); Construction Supervision (C); Construction Name of Company, (F); Netherland (G); German (J); Japan (R); Romania

2.4.2 Records of Design and Construction Conducted before 1970

Only limited detailed records are facilities implemented before 1970. According to the ovallathe records, the basic structural type of wharf and jetty constructed before 1970 are as follows:

(1) Steel Frame supported by H-shaped Steel Poles.
This type of open structure appears in Eastern Jetty and Western Jetty. They are suitable in case of;

- Bearing stratum (hard soil) exists deep under the seabed, thus gravity construction
- Quick construction by light construction plant.

However, steel materials have a physical week point that is corrosion by seawater.

Superstructure in the original construction consists of timber slab supported by steel frame.

(2) Concrete Deck Supported by Concrete Piles

There is no case of this structure.

2.4.3 Records of Design and Construction Performed After 1971

Detailed design records and limited construction data are available on the port facilities executed after 1974. Iran-Kampsax is the most contributing consultant both to design and provision of construction supervision. This consultant has participated in various consultancy services since 1972 (1351) as follows:

(1) Ten Berth Extension	1972
(2) Fourteen Berth Extension	1975
(3) Barge Harbor	1975
(4) Dredging works	1975
(5) Utilities	1976
(6) Railway Extension	1976
(7) Transit sheds and warehouses	1978

Recently an Iranian consultant, "Tehran Berkeley Engineers" was appointed as the leading consultant mainly for the construction supervision of transit sheds, warehouses and yard pavement.

They periodically prepare the monthly progress report to indicate the present situation, rate (or delay) of progress and other necessary services to construct facilities.

There are few steel works in the marine construction carried out after 1974. All the berths are typical marginal wharves by concrete open structure.

All 26 berths, No.7 - No.34, consist of reinforced concrete decks supported by concrete piles. These facilities are expected to last long due to high resistance of concrete against seawater corrosion than those of steel materials.

Transit sheds and warehouse are standardized as follows:

(1) Same size, 60m x 150m = 9,000 m^2
(2) Same quality (lighting, inner office, fire Fighting etc.)
(3) Wall construction (prefabricated reinforced concrete planks)
(4) Concrete foundation piles. Seaward wall of transit shed rests on the concrete deck.

This standardization might contribute not only to the cost aspect but also to the quality aspect.

2.5 Progress of Previous Master Plan Development

This subsection deals with the major port facilities and its condition. Issues and problems will also be provided.

2.5.1 Port related Facilities and its Conditions

As the largest multi-purpose commercial port in Iran, Imam Khomeini port has various port facilities. It contains the followings.

- Barge harbor
- Ship repair facility
- One loading system
- Grain unloading terminal
- General cargo berths
- Container berths
- and others

Since its opening, the major investment for the port were carried out in the two phases as follows.

Phase one: for old port

- Eastern and Western Jetties
- Railway system
- Ship repair facility
- and others

Phase two: for the recent development after 1974

- Barge harbor
- Grain terminal
- Four berth extension
- Ten berth extension
- Fourteen berth extension
- Others

According to the study report of the Fourteen Berths Extension project in 1974, the total amount for the development was estimated as 481 million US$ or current equivalent 803 million US$.

Conversion rate from the 1973 price to 1994 price is assumed 1.67 based on the actual price increase of wharf and transit shed.

In the original schedule, this investment would have been carried out by 1980, however its completion was delayed and it is estimated that the current progress of works is 660 million US$ in current price or 82% completion. It is expected that

remaining investment will be made within the short period. Table 2.5.1.1 shows these records.

As shown in the table, contracts for the major works were conducted before 1976 and it is assumed that about 70% of contracts of completed by 1979. This means the average age of phase two facilities is 15 years.

Since the life of ordinary port facilities except cargo handling equipment is more than 30 years, it can be said that these facilities whould be are capable structurally for future utilization more than 15 years.

(1) Structures

Major port structures except the phase one elements are generally enough healthy to be used for their remaining life periods. On the other hand, the design depth of wharf structures are basically less than present needs mainly due to increase of large vessels calling.

Transit sheds and warehouses are well designed and enough durable to provide port uses with the wide storage rooms.

(2) Port back-up service facilities

For the time being, water supply, power supply, storm water drainage and other ordinary utility provide the port with sufficient provisions.

Table 2.5.1.1 Project Cost Summary Previous Project Cost

No.	Works and Components	Previous Contract Year						Amount	%	Equivalent	%	1973 Price		1994 Price (x 1.67)		
		72	73	74	75	76	NA	M. Rials		M. US Dollar		Progress M. US Dollar	Remaining M. US Dollar	Total M. US Dollar	Progress M. US Dollar	Remaining M. US Dollar
1	4 Berth Extension															
1a	Earthworks	72						384.7	24.8	6.41	100	6.41	0	10.70	10.70	0
1b	Marine Works		73					860.0	55.3	14.33	60	8.60	5.73	23.93	14.36	9.57
1c	Works on Land		73					310.0	19.9	5.17	70	3.62	1.55	8.64	6.05	2.59
	Subtotal							1,554.7	100.0	25.91	72	18.63	7.28	43.27	31.11	12.16
2.	10 Berth Extension															
2a	Earthworks		73					1,171.0	14.1	19.52	95	18.54	0.98	32.60	30.96	1.64
2b	Marine Works			74				4,158.0	50.0	69.30	100	69.30	0	115.73	115.73	0
2c	Roads & Utilities 1						-	1,504.6	18.0	25.08	70	17.56	7.52	41.89	29.33	12.56
2d	Buildings Contract 1						-	725.0	8.7	12.08	75	9.06	3.02	20.20	15.13	5.07
2e	Container Cranes						-	761.6	9.2	12.69	100	12.69	0	21.32	21.32	0
	Subtotal							8,320.2	100.0	138.67	92	127.15	11.52	231.74	212.47	19.27
3.	14 Berths Extension															
3a	Earthworks			74				1,896.9	14.0	31.62	100	31.62	0	52.81	52.81	0
3b	Marine Works			74				4,875.0	36.1	81.25	100	81.25	0	135.69	135.69	0
3c	Roads & Utilities						-	2,180.0	16.1	36.33	60	21.80	14.53	60.68	36.41	24.27
3d	Buildings Contract						-	3,474.5	25.7	57.91	60	34.75	23.16	96.71	58.03	38.68
3e	West Camp					76		117.5	0.9	1.96	100	1.96	0	3.27	3.27	0
3f	Bldgs for Private Enter						-	611.2	4.6	10.19	0	0	10.19	17.02	0	17.02
3g	Flyover Bridges						-	352.2	2.6	5.87	0	0	5.87	9.80	0	9.80
	Subtotal							13,507.3		225.13	76	171.38	53.73	375.98	286.21	89.77
4.	Barge Harbour															
4a	Earthworks			74	75			169.7	10.6	2.83	100	2.83	0	4.73	4.73	0
4b	Marine Works			74				897.2	55.8	14.95	100	14.95	0	24.97	24.97	0
4c	Works on Land						-	290.0	18.0	4.83	100	4.83	0	8.07	8.07	0
4d	Quay Portal Cranes						-	250.0	15.6	4.17	100	4.17	0	6.96	6.96	0
	Subtotal							1,606.9	100.0	26.78	100	26.78	0	44.73	44.73	0
5.	ORE Import Facility															
5a	Marine Works				75			325.0	20.1	5.42	100	5.42	0	9.05	9.05	0
5b	Mechanical Equipment				75			544.9	33.7	9.08	100	9.08	0	15.16	15.16	0
5c	Floating Cranes			74				744.7	46.2	12.41	100	12.41	0	20.72	20.72	0
	Subtotal							1,614.6	100.0	26.91	100	26.91	0	44.93	44.93	0
1~5	Total (1 ~ 5)															
a.	Earthworks	72			75			3,622.3	13.6	60.37	98	59.40	0.97	100.82	99.20	1.62
b.	Marine Works		73		75			11,115.2	41.8	185.25	97	179.52	5.73	309.37	299.80	9.57
c.	Road & Utilities							4,636.8	17.4	77.28	62	47.81	29.47	129.05	79.84	49.21
d.	Building							4,199.5	15.8	69.99	63	43.81	26.18	116.88	73.16	43.72
e.	Equipment							2,301.2	8.6	38.35	100	38.35	0	64.04	64.04	0
f.	Privates and Others							728.7	2.8	12.15	16	1.96	10.19	20.29	3.27	17.02
	Total							26,603.7	100.0	443.39	84	370.85	72.54	740.45	619.31	121.14
7.	General Port Works															
7a	Khor Musa Bar			74				571.0	25.6	9.52	100	9.52	0	15.90	15.90	0
7b	Railway Works						-	1,502.9	67.3	25.05	50	12.53	12.52	41.84	20.93	20.91
7c	High Tension Equip.						-	110.0	4.9	1.83	100	1.83	0	3.06	3.06	0
7d	Telephone Installation						-	50.0	2.2	0.83	60	0.50	0.33	1.39	0.84	0.55
	Subtotal							2,233.9	100.0	37.23	65	24.38	12.85	62.19	40.73	21.46
1~7	Total (1 ~ 7)															
a.	Earthworks							3,622.3	12.6	60.37	98	59.40	0.97	100.82	99.20	1.62
b.	Khor Musa Bar							571.0	2.0	9.52	100	9.52	0	15.90	15.90	0
c.	Marine Works							11,115.2	38.5	185.25	97	179.52	5.73	309.37	299.80	9.57
d.	Road & Utilities							4,796.8	16.6	79.95	62	50.14	29.81	133.51	83.73	49.78
e.	Railway Works							1,502.9	5.2	25.05	50	12.53	12.52	41.84	20.93	20.91
f.	Building							4,199.5	14.6	69.99	63	43.81	26.18	116.88	73.16	43.72
g.	Equipment							2,301.2	8.0	38.35	100	38.35	0	64.04	64.04	0
h.	Others							728.7	2.5	12.15	16	1.96	10.19	20.29	3.27	17.02
	Grand total							28,837.6	100.0	480.63	82	395.23	85.40	802.65	660.03	142.62

Source: Study Report for Fourteen Berth Extension, by Iran - Kampsak

2.5.2 Issues and Problems

From the engineering point of view, general evaluations on the existing port facilities was conducted. discussions will be made both the advantages and present issues of Imam Khomeini port.

(1) Advantages of the port

- Existing port facilities constructed after 1974 are basically of good condition.
- Musa Channel and Dorag Channel provide the port with calm, deep and wide enough approaching waterways and berthing space.
- Port has wide unused areas behind the port activity zone.
- Port area is also surrounded by flat and open lands without any particular use. Thus there is a big room to make extension for the future requirements.
- There are various connecting access to Tehran which is the largest cargo origin and destination to the port.

(2) Issues and Problems of the port

- Shallow depth of wharf to the current vessel size
- Siltation is generally slight, however it happens at the closed basin like the barge harbor and the dead water space of the channels by low current velocity.
- Old waterfront facilities require urgent rehabilitation represented by the jetties.
- Narrow space in the old port area which is divided by the old railway yard.
- Low utilization of the barge harbor
- Vehicle parking space is so limited and the existing traffic circulation method is rather complicated.
- Old railway siding yard occupies the most useful area in respect of traffic circulation.
- Water depth at Musa Channel entrance is rather shallow which forces large vessels in the full loaded condition waiting for the high tide before approaching to the inner channel.
- There are some wrecked vessels and obstacles for ship manoeuvering.
- Environmental condition is becoming worse due to contaminated effluent and air pollution generated from the neighboring chemical plants.
- Maintenance and repair efforts by PSO is not sufficient.
- Cargo handling equipment should be improved.

All these facts should be improved and upgrades as much as possible.
Imam Khomeini port has a large potential in port capacity, if it is properly organized.