Appendix-11.1 Further Improvement Plan of the Iron Ore Handling Equipment

In case of annual throughput 7.5 million tons, required modification for the iron ore handling equipments are already mentioned in Chapter 11 and 13. In future, in case of annual throughput 10 million ton, it is recommended that an additional berth will be required as described in the conclusion in Chapter 7. The plan and cost of the ore handling equipments for the new berth of 100,000 or 150,000 DWT class are discussed in this appendix.

The required shiploading capacities are 8000 t/h for concentrate and 4100 t/h for pellet.

(Shiploader)

For the new 100,000 DWT class berth, boom shuttling type (similar to the existing one) with longer chute stroke shiploader as shown on Figure-A.11.1 is recommendable, considering to the convenience for the operation and maintenance of the machine.

Moreover, in case of 150,000 DWT class berth, it is suggested that boom rotating type shiploader as shown on Figure-A.11.2 is recommendable, because the boom shuttling type shiploader is not suited to cases where much chute travel range is required. As for this type of shiploader an additional transfer conveyor will be required to feed the material from the wharf conveyor which is located in the rain-protecting gallery alongside the berth to the shiploader at the point of the rotating centre.

(Conveyor Lines)

The modification of conveyors for each cases are listed in Table-A.11.1. Modification list of conveyors, and the layout is showing on Figure-A.11.3.

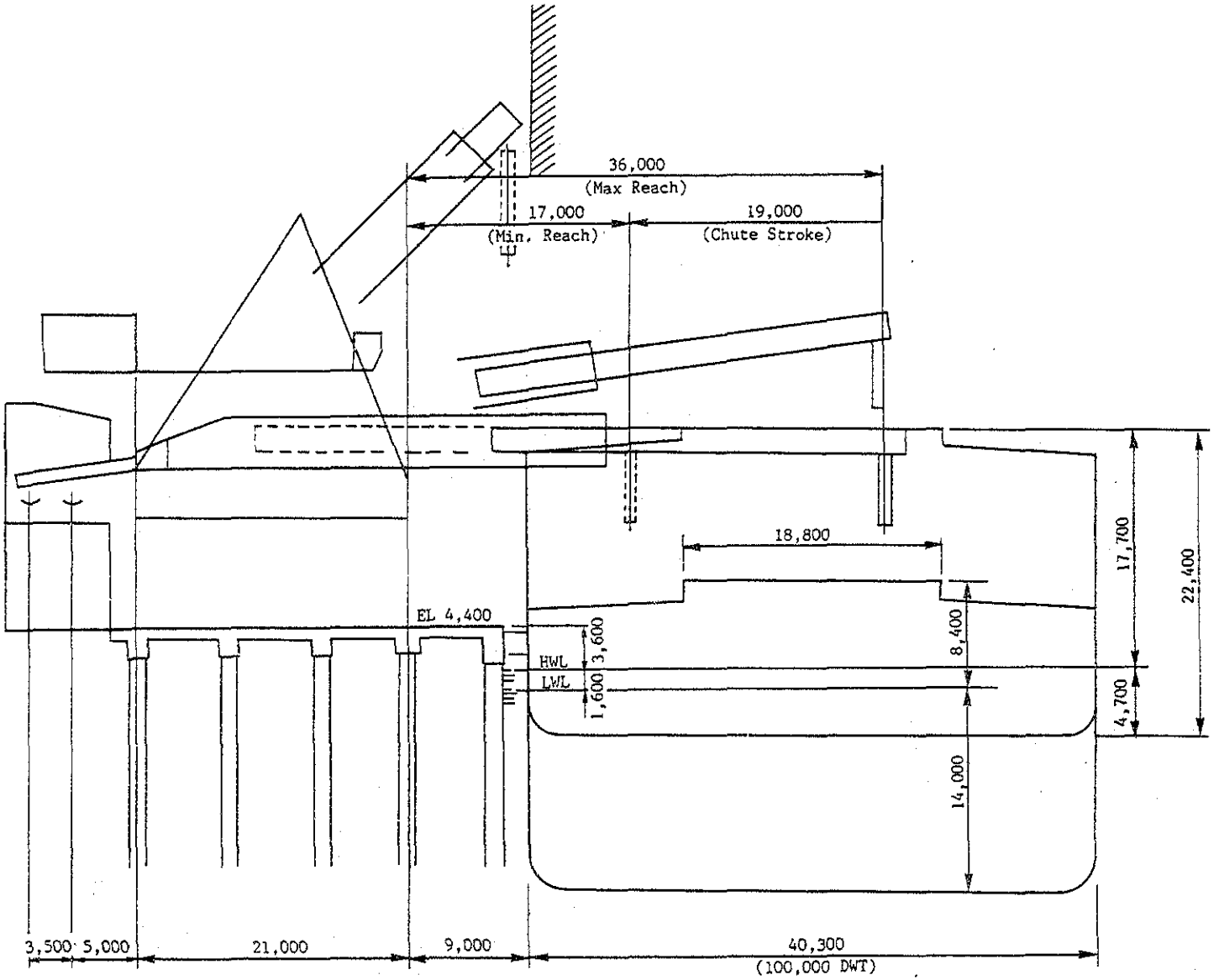

Figure-A.11.1 Boom Shuttling Type Shiploader for 100,000 DWT Vessel

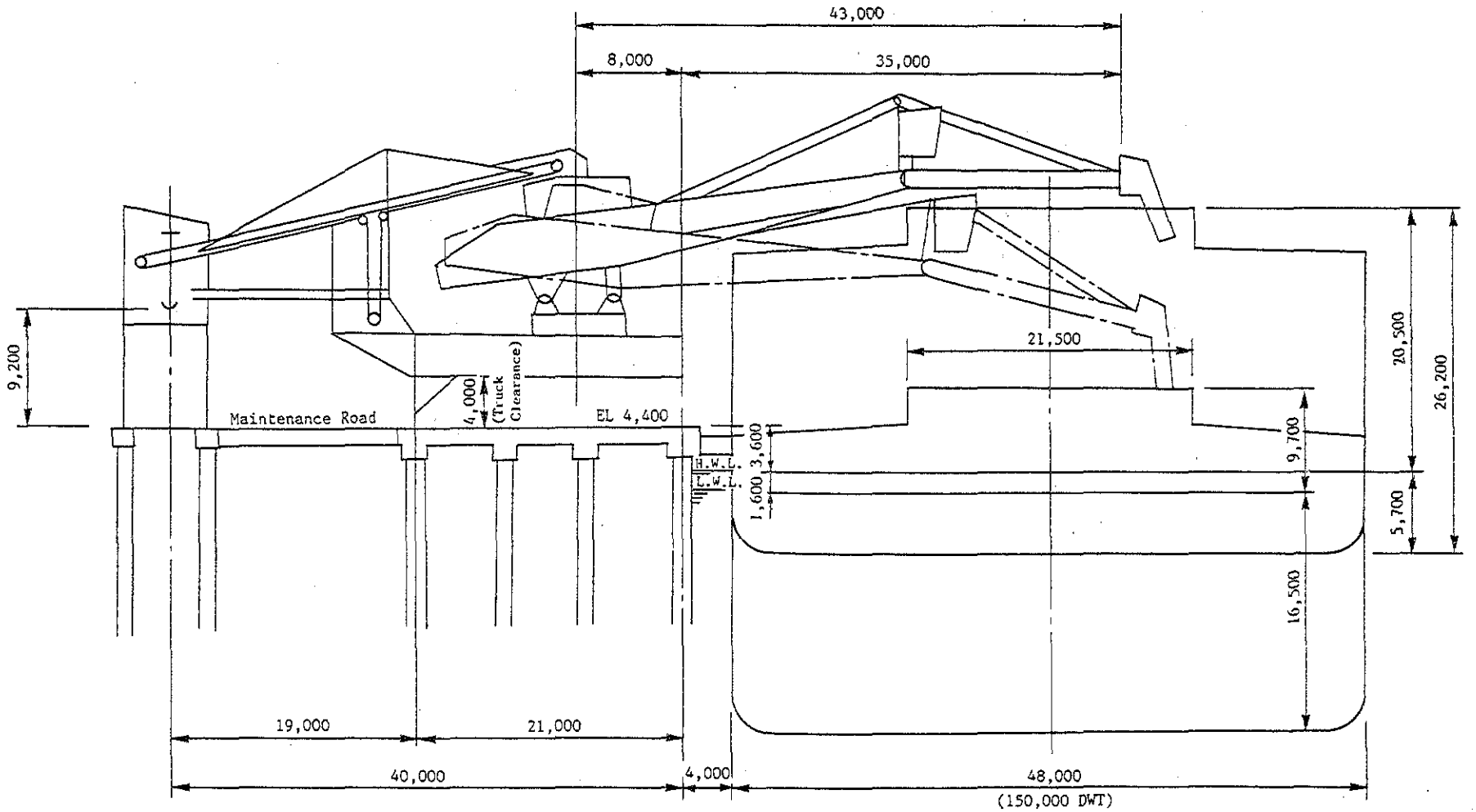

Figure-A.11.2 Boom Rotating Type Shiploader for 150,000 Class Ship

Table-A.11.1 Modification List of Conveyors

Conv. No.	Location		Existing	Modification	Remarks
CB 81 82	Incoming Concent.	Q t/h L m B mm V m/m	1500 370 800 130	2500 740 1000 130	Capacity Up Extension Length Belt Width Up
85 86	Outgoing Concent.	Q L B V	3000 370 1000 150	4250 740 1400 130	Capacity Up Extension Length Belt Width Up Speed Change
89	Cross	Q L B V	6800 330 1400 170	D 8000 330 1400 200	Capacity Up Speed Change
92	Wharf	Q L B V	6800 308 1400 170	D 8000 343 1400 170	Capacity Up Extension Length
433	Incoming Pellet	Q L B V	1500 370 1000 150	2500 740 1200 180	Capacity Up Extension Length Belt Width Up Speed Change
439	Outgoing Pellet	Q L B V	6600 370 1800 190	6600 740 1800 190	 Extension Length

Note, Q : Conveyor Capacity t/h
L : Conveyor Length m
B : Breadth of Conveyor Belt mm
V : Speed of Belt Conveyor m/m
D : Additional Conveyor Line in parallel with the existing one

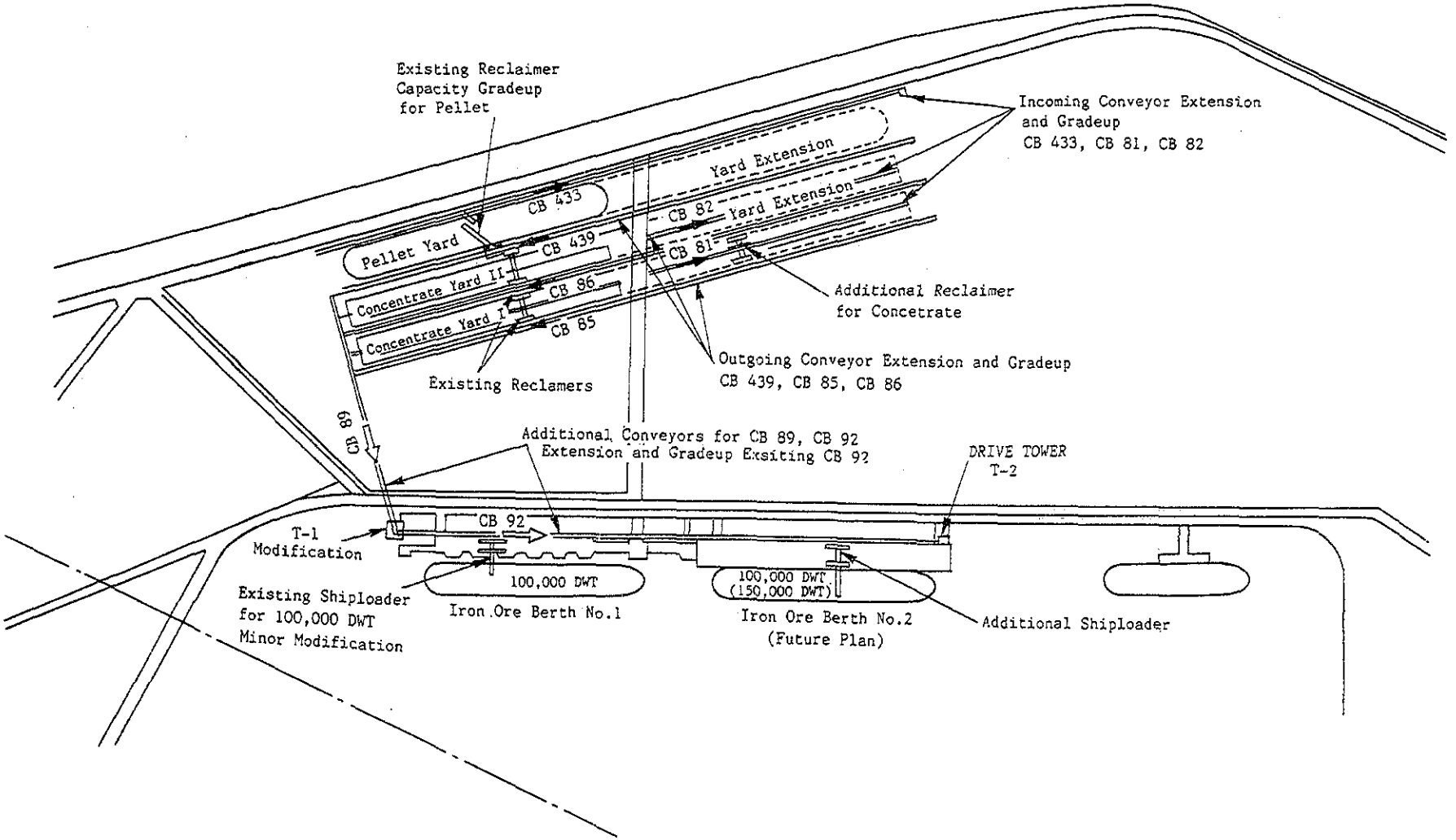

Figure-A.11.3 Case 1 Layout Plan

(Reclaimer)

The required shiploading capacity is 8000 t/h and 4100 t/h for concentrate and pellet, respectively.

Direct loading capacity of concentrate from the filter plant is 1500 t/h and the concentrate supply to palletizing plant is 2000 t/h. Therefore, the required reclaiming capacity for concentrate is,

$$8000 + 2000 - 1500 = 8500 \text{ t/h}$$

Existing capacity is 3500 x 2 = 7000 t/h. Then 8500 - 7000 = 1500 t/h is the required capacity increased. So, one more reclaimer as same capacity to the existing one (3500 t/h) for concentrate shall be recommended.

For pellet reclaimer, it is recommendable to upgrade net capacity to 4,100 t/h. The nominal capacity of the existing pellet reclaimer is 5,000 t/h. If the reclaiming efficiency is 0.7 (applied usually for this type of reclaimer), then the existing net capacity will be 5,000 t/h x 0.7 = 3,500 t/h. So, capacity upgrading rate is 4,100/3,500 = 1.17. This modification will be performed by increasing the bucket wheel rotating speed.

(Stockpile Capacity)

The existing stockyard capacity for concentrate and pellets and recommended extension of the stockyard for annual throughput of 7.5 million tons are explained in Chapter 11.4.5. The recommended extension of the stockyard for annual throughput of 10 million tons is as follows:

It is recommended that the present mean number of staying days remain at least those shown in Table-A.11.2

Table-A.11.2 Required Stockyard Capacity

unit: 10,000 tons

	Annual Throughput (10,000 tons)	1989-90 500	2004-05 1,000
Concentrate	Stockpile Capacity (10,000tons)	2 x 20	2 x 40
	Yard Length (m)	370	740
Pellet	Stockpile Capacity (10,000tons)	15	30
	Yard Length (m)	370	740

Note: The required stockpile capacity are calculated as follows
please refer Chapter 11.4.5 stockpile for calculation;
for concentrate stockyard
(C = m x A/N = 21.6 x 1000/270 = 80 x 10,000t (2004-05)
for pellet stockyard
C = 10 x 590/190 = 31 --- 30 x 10,000t (2004-05)
(m = 10.6 --- 10 days)

(Cost of the Further Improvement of the Equipments)

Total cost of each cases are presented in Table-A.11.3.

Table-A.11.3 Total Cost of Equipments

unit: ¥1,000,000

Ship Size (DWT)	100,000	150,000
Shiploader	1005	1265
Conveyor	2970	
Reclaimer (Concentrate)	410	
Reclaimer (Pellet)	Negligible	
Stockpile Shed	935	
Total Cost	5320	5580
Crore (Rs.)	61.22	64.21

Appendix-13.1 Analysis of Daily Reports of Capital Dredging at Kudremukh Development Scheme

Period		1978.11-1979.3		1979.5-6	
Dredger		MOT VIII		MOT VIII	
	Unit	Lagoon	Channel	Lagoon	Channel
Total Nos. of Cycle		331	332	155	185
Av. Dredging Time	(min.)	62.2	53.8	50.3	47.9
Av. Sailing Time (Going)	(min.)	30.3	26.0	42.4	31.1
Av. Dumping Time	(min.)	5.0	5.0	5.0	5.0
Av. Sailing Time (Returning)	(min.)	37.6	31.3	45.1	36.9
Working Time per Cycle	(min.)	135.1	116.1	142.8	120.8
Total Working Time	(hrs.)	745.2	642.4	368.8	372.6
Total Working Days		31.0	26.8	15.4	15.5
Mechanical Trouble	(hrs.)	39.9		30.1	
Fresh Water Supply	(hrs.)	0.0		6.0	
Routine Maintenance	(hrs.)	296.8		183.7	
Major Repairs	(hrs.)	192.4		0.0	
Bad Whether	(hrs.)	1.0		5.9	
Mob./Demobilization	(hrs.)	0.0		1.6	
Others	(hrs.)	661.3		327.3	
Total Intermission Time	(hrs.)	1,191.4		554.6	
Total Intermission Days		49.6		23.1	
Dredger Staying Days		127		54	
Total Dredging Volume	(m3)	1,050,478	1,528,940	530,929	521,670
Dredging Volume per Cycle	(m3)	3,174	4,605	3,425	2,820
Dredging Volume per Day	(m3)	33,833	57,120	34,548	33,603

Appendix-14.1 Maintenance of Navigational Aids

1. Maintenance of Buoys of Buoy Base

Complete sets of buoys will be taken out of the water and thoroughly checked at the buoy base. Damaged and worn parts will be replaced by new ones and the buoys will be prepared for return to the water during the next rotation of the buoy loading. Fig-A.14.1 show the process of the buoy maintenance works.

(1) Buoy Body

The light and power devices and other parts should be dismantled and if necessary, the tower should also be removed.

All damaged, worn and malfunctioning parts should be repaired or replaced. Rust should be removed by sand blasting and the buoys should be repainted thereafter.

The buoys should be carefully painted including anti-rust primer coats according to the pre-established buoy painting procedures concerning the number of coats the drying period, etc.

For day marks, the buoys' forthcoming location in the water should be taken into account.

(2) Mooring

All damaged and worn parts should be repaired or replaced, and the necessary quantity of chains should be prepared.

(3) Sinker

All damaged and worn parts should be repaired or replaced.

(4) Light Device

Inspection, adjustment and performance tests should be carried out, and necessary repairs should be made.

(5) Power Source

Batteries, acetylene and propane gas and cylinders should be checked.

(6) Top Mark

Repairs should be made as necessary.

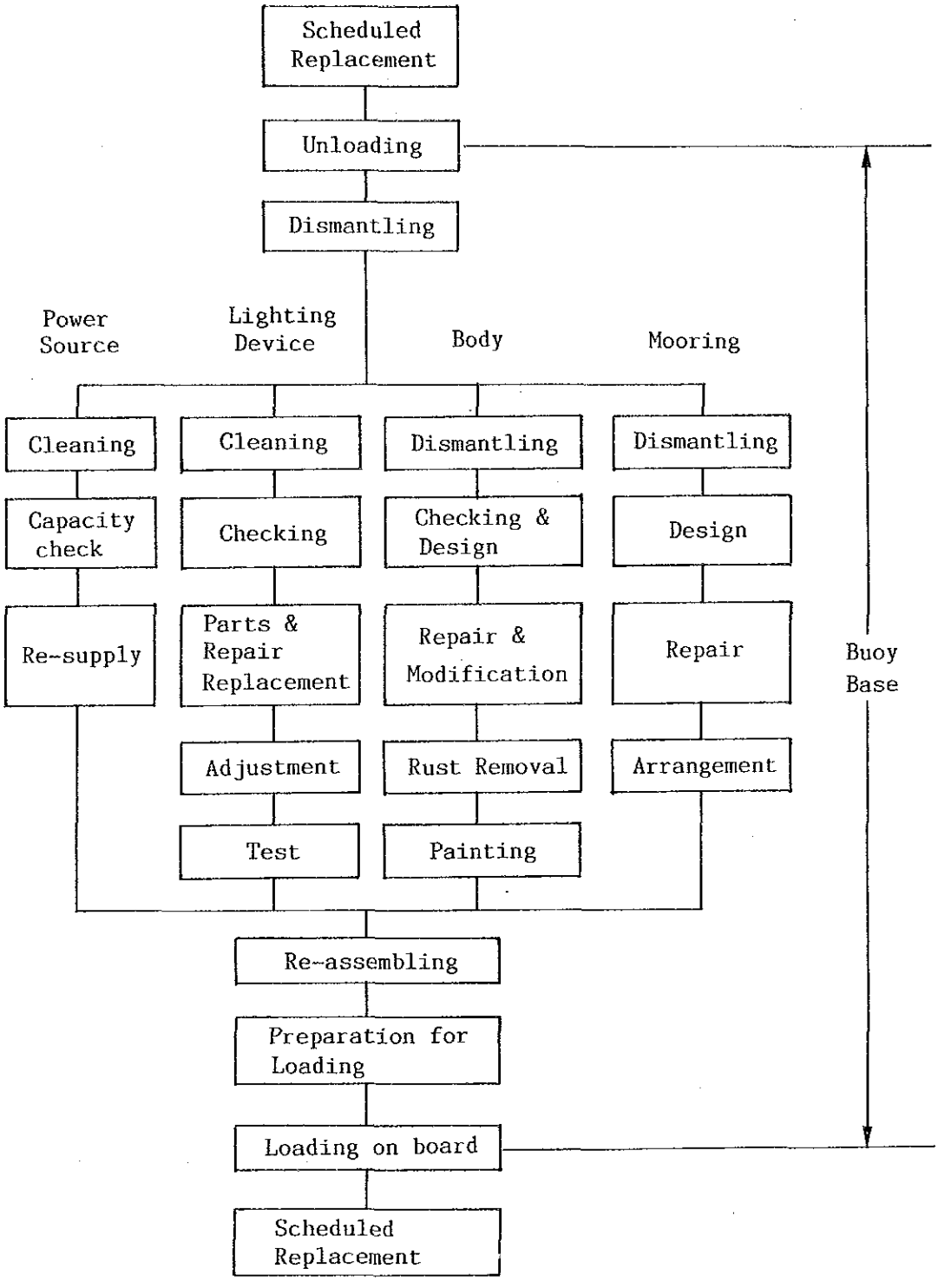

Fig-A.14.1 Process of Buoy Maintenance Works

2. Facilities

The necessary maintenance and repairs described above are to be carried out at the buoy base. The facilities to be installed at the buoy base are described below, and an outline is presented in Fig-A.14.2.

(1) Office

The office should be located on the second floor to have an overall view of the entire base, and the first floor space should be used as a garage.

(2) Power Supply Room

This room will supply power for machinery, cranes offices, etc., and also for battery charging.

(3) Workshop

Production and repairs of structural parts of buoy bodies are to be made using necessary machines and tools.

(4) Equipment Test Room

Performance tests and adjustment of light devices, etc. shall be carried out here.

(5) Storage

Materials and parts other than item placed in the open storage areas are to be kept here, and gas cylinders will also be stored in sectioned areas.

(6) Jib Crane

The crane is to be used for loading and unloading of buoys to and from the buoy tender.

(7) Open Workshop for Buoys

Outdoor inspections and repairs are including rest removal, painting and other necessary works shall be carried out here.

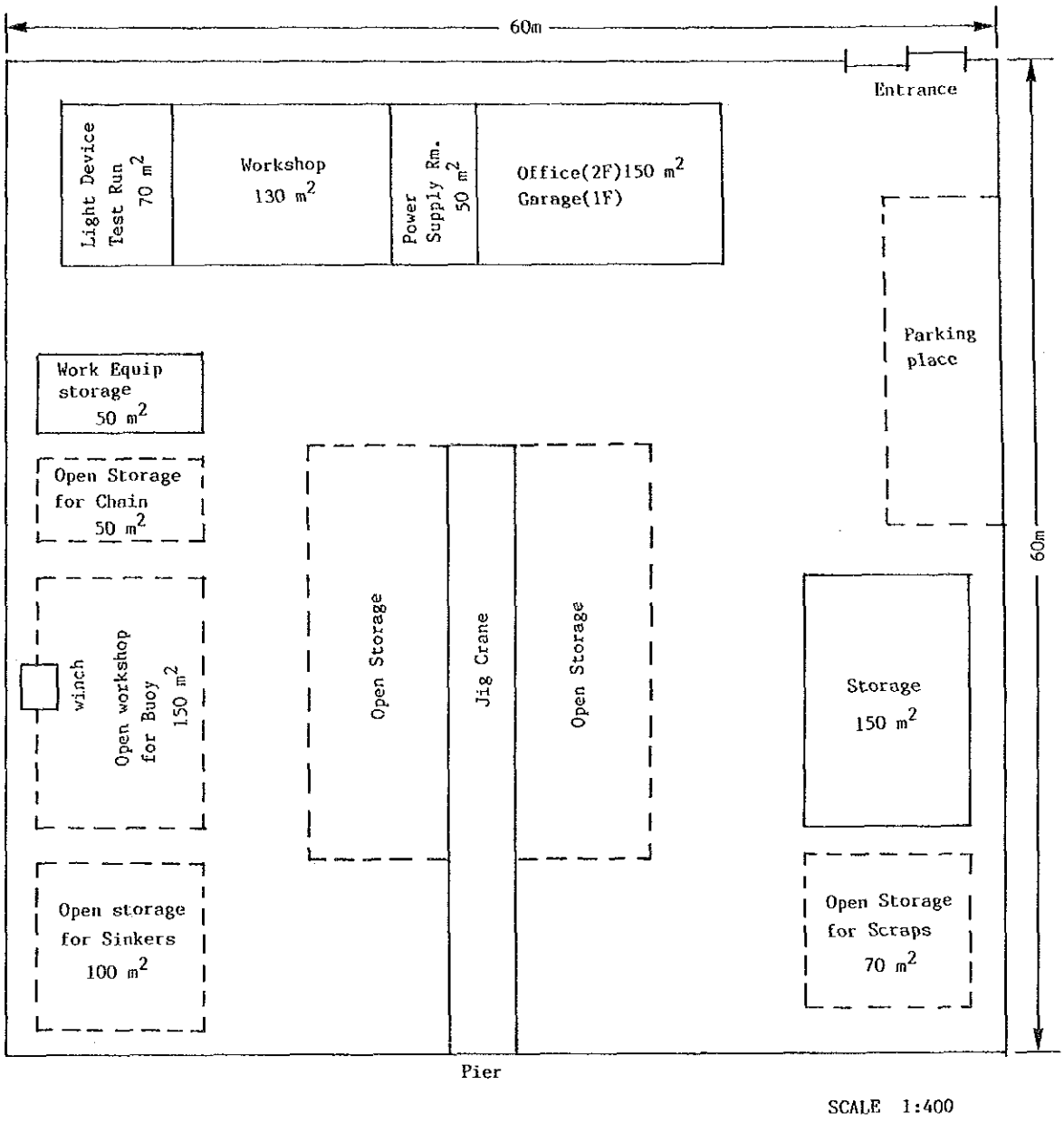

Fig-A.14.2 Site Plan for Buoy Base

(8) Work Equipment Storage

Equipment for maintenance and repairs of buoys and chains are to be stored here.

(9) Heavy Items

Truck cranes, forklift and other heavy machines are to be used for carriage of heavy items like sinkers.

(10) Winches

Winched are to be used for stretching chairs out for inspection at the open storage area.

3. Radar Beacon Station

Regular inspection and maintenance of rader beacon stations are vitally required to prevent of possible malfunctioning and to maintain the operational performance and reliability of the stations.

However, it will still be necessary in case of a sudden malfunction. It is also necessary to properly train to carry out the repairs. Following is an outlines of the periodic inspection and maintenance works for radar beacon stations.

(1) Inspections

(a) On-board inspection will be carried out to confirm the operational status of racons within the coverage area through reception of the signals on PPI.

(b) The operational status of racons will also be checked by reading each of the built-in will be checked meters.

(c) Finally, each facility will be checked to see whether there are any abnormalities.

(2) Maintenance

Radar beacons are normally situated at remote areas such as isolated islands reefs, capes and so on, and accordingly it is difficult to carry out various measurement tests and adequate maintenance as required for Maintaining the equipment.

For this reason, a unit replacement system will be applied for the

main units. These units will then be services at workshops on shore.

4. Spare Buoys and Materials and Required Quantity

In order to achieve a regular rotation of buoy replacement and to properly repair and maintain the buoys, spare buoys and materials will be required. The spare buoys should be completed including body, light device, power source, mooring and sinker. In addition to these, spare parts and other materials should also be prepared.

The required quantity of each item should be specified in accordance with the number of days required for maintenance and repairs, annual rotation requirements, capability of buoy tender, lifetime, etc.

(1) Quantity

The quantity of spares is specified and estimated as given below according to the base, type of buoy and classification of use.

For rotation : Spares required for regular replacement

For emergency : Spares required for accidents

For adjustment : Spares for efficient and smooth operation of spare rotation considering the lifetime of the buoys

(a) Quantity for Rotation

Number of buoys for rotation

= (Number of buoys installed within the covering area) x 1/(Rotation Period) ..... (A)

(A) above applies to "Once-per-year" service, and in case of "twice-per-year" service, (A) is given as (A) x 1/2.

If the rotation services were carried out frequently, the rotation would depend on the period required for buoy maintenance and repairs at the base.

Assuming that the period required for maintenance and repairs is 3 months per buoy,

Rotation rate:

12 month/Period required for Maintenance and Repairs = 12 months/3 months = 4

Accordingly,

Quantity required for rotation

= (Number of buoys installed within the covering area)
x 1 (Rotation Period of Year) x 1/(Rotation rate) or
Quantity for Rotation x 1/(Number of services to be provided)

(b) The number of buoys prepared for emergency use is to be 2% of the number installed.

(c) The number of buoys prepared for adjustment is assumed to be 2% of the number installed. Otherwise, a total of 7% will be prepared for emergency and adjustment. The individual number required is calculated by multiplying the number of buoys installed by the above percentage, and any fractions are disregarded.

Total number of spares
= (Rotation Qty) + (Emergency Qty) + (Adjustment Qty)

It should be noted that the spares all consist of complete sets.

(2) Other Spares and their Quantity

In addition to complete sets of spare buoys, other spare parts should be prepared according to the types, specifications and classifications of the buoys installed.

The actual allocation will be made to the bases and other Districts of Navigation.

Spare Item	Qty (Equivalent to following)
(a) Lanterns	7 % of the total number of buoys installed
(b) Flashers	7 % "
(c) Batteries*	10 % "
(d) Gas Cylinders*	7 % "
(e) Chains Plate	10 % "
(f) Three Eye Plate	10 % "
(g) Swivel Pieces	10 % "
(h) Joining Shackles	25 % "
(i) Sinkers	5 % "
(j) Others	

Note: * Calculation should be made on the basis of their consumption and rotation intervals

5. Advantages of the Total Replacement System for Buoys

(1) Under the total replacement system,whereby complete buoy sets are replaced, the buoys can be precisely inspected and maintained at the buoys base. This type of inspection and maintenance cannot be performed satisfactorily onboard while at sea. Especially, prolongation of the lifetime of the buoy body will be possible through rest removal followed of primer coats and paint, the current lifetime of the buoys may be doubled.

(2) Thorough inspection of the moorings and the associated parts and precise measurement of their tear and wear will be carried out at the base together with necessary repair and replacement of parts.

(3) The total replacement system reduces the working hours spent handling heavy materials on board ship under rolling and pitching conditions. This is an important factor from the view-point of safe operation.

(4) Quantity of buoys

(a) For rotation = 2

(b) For emergency = 1

(c) For adjustment = 1

Total = 4

(d) Number of other spares

Appendix-15.1 Economic Benefits

Economic benefits are defined mainly in terms of Gross Domestic Product (GDP); from this point of view, the impact of the project on goods and services produced and/or saved in the country is emphasized. The effects of the project on employment and foreign exchange earnings and/or savings are sometimes also identified and quantified as constituting economic benefits of the project.

The economic benefits of a project are generally divided into two broad categories : "direct" and "indirect" benefits. The practice has been to quantify, as far as practicable, the direct benefits derived from the end-product of a project and to use this as a basis for the estimation of EIRR. Some attention has also been paid to indirect benefits, but these are stated only in qualitative terms.

Appendix-15.2 Calculation of Economic Internal Rate of Return

Project Name : New Mangalore (Case 1)

E.I.R.R. (%) : 22.9

(Unit : Million Rupees)

No.	Year	Cost	Benefit	Bnft.-Cost	P. Cost	P. Bnft	P.Value
1	1990	68.90	0.00	-68.90	68.90	0.00	-68.90
2	1991	367.80	0.00	-367.80	299.33	0.00	-299.33
3	1992	363.30	0.00	-363.30	240.62	0.00	-240.62
4	1993	391.60	0.00	-391.60	211.08	0.00	-211.08
5	1994	22.20	383.80	361.60	9.74	168.36	158.62
6	1995	34.20	383.80	349.60	12.21	137.02	124.81
7	1996	34.20	383.80	349.60	9.94	111.51	101.57
8	1997	34.20	383.80	349.60	8.09	90.75	82.66
9	1998	34.20	383.80	349.60	6.58	73.85	67.27
10	1999	34.20	383.80	349.60	5.36	60.11	54.75
11	2000	34.20	383.80	349.60	4.36	48.92	44.56
12	2001	66.00	383.80	317.80	6.85	39.81	32.96
13	2002	34.20	383.80	349.60	2.89	32.40	29.51
14	2003	34.20	383.80	349.60	2.35	26.37	24.02
15	2004	34.20	383.80	349.60	1.91	21.46	19.55
16	2005	34.20	383.80	349.60	1.56	17.46	15.91
17	2006	34.20	383.80	349.60	1.27	14.21	12.95
18	2007	34.20	383.80	349.60	1.03	11.57	10.54
19	2008	34.20	383.80	349.60	0.84	9.41	8.57
20	2009	66.00	383.80	317.80	1.32	7.66	6.34
21	2010	34.20	383.80	349.60	0.56	6.23	5.68
22	2012	34.20	383.80	349.60	0.45	5.07	4.62
23	2013	34.20	383.80	349.60	0.37	4.13	3.76
24	2014	166.10	383.80	217.70	1.45	3.36	1.91
25	2015	34.20	383.80	349.60	0.24	2.73	2.49
26	2016	34.20	383.80	349.60	0.20	2.23	2.03
27	2017	34.20	383.80	349.60	0.16	1.81	1.65
28	2018	66.00	383.80	317.80	0.25	1.47	1.22
29	2019	34.20	383.80	349.60	0.11	1.20	1.09
30	2020	34.20	383.80	349.60	0.09	0.98	0.89
Total		2296.10	9978.80	7682.70	900.08	900.08	-0.00

Note : P.Cost .. Present Value of Costs

: P.Bnft .. Present Value of Benefit

Appendix-15.3 Viability of Project by EIRR

The economic viability of a project is judged by the EIRR (Economic Internal Rate of Return) estimated on the basis of the economic benefits and costs of the project, as identified and valued. The project is generally considered to be economically viable if the estimated EIRR exceeds the opportunity cost of capital (OCC), in the country concerned. The estimation of the OCC, however, cannot be very precise. This is not only because the OCC may change from time to time but also because the lack of data makes such estimation difficult. Based on the information available, it has generally been assumed that OCC in developing countries is most likely to be within the range of 8 to 12 percent. Therefore the following guidelines are used for the economic viability of project:

If EIRR < 8%, it is almost certain that the project is not justified.

If 8% < EIRR < 12%, the project is probably not justified unless there are major benefits which could not be quantifies and which are clearly larger than unquantifies costs.

If EIRR > 12%, the project is viable and does not require further justification.

Appendix-15.4 EIRR of Other Cases

Four alternative master plans are formulated in Chapter 7, then the optimum plan has been selected. Here, we set short-term plans for other alternations which were not selected and show E.I.R.R. of the each plan. Figure-A.15.1 -and Table-A.15.1, show the short-term plans, and whose E.I.R.R. are calculated as shown in Table-A15.2.

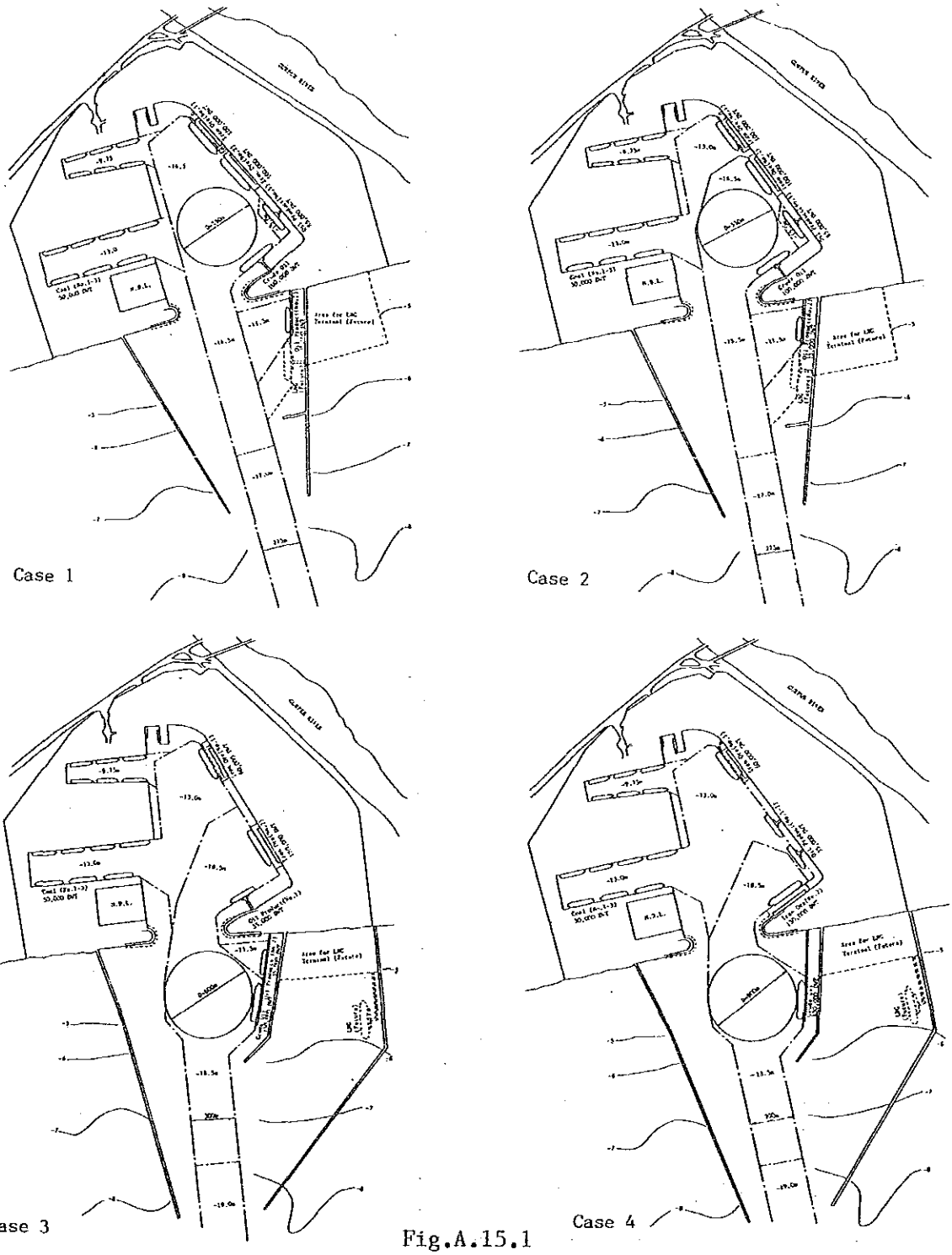

Fig.A.15.1

Table-A.15.1 Facilities Involved in The Each Alternative

Item	Case 1	Case 2	Case 3	Case 4
Raising Existing Breakwater	840m	840m	840m	840m
South Breakwater	930m	930m	2,270m	2,270m
North Breakwater	930m	930m	1,430m	1,430m
Iron Ore Berth	100,000 DWT (Improvement existing one)	100,000 DWT	150,000 DWT	150,000 DWT
Crude Oil Berth	100,000 DWT (Reconstruction, existing one)	100,000 DWT (Reconstruction, existing one)	150,000 DWT (Outer Area)	150,000 DWT (Outer Area)
Product Oil Berth	85,000 DWT	85,000 DWT	35,000 DWT	35,000 DWT

Table-A.15.2 E.I.R.R. for the Alternatives

(%)

Item	Case 1	Case 2	Case 3	Case 4
Base Case	22.9	15.7	16.7	17.5
Sensitivity Analysis				
(A) Increase in Costs by 10%	20.7	14.0	15.0	15.7
(B) Decrease in Benefits by 10%	20.3	13.8	14.8	15.5
(c) Increase in Costs by 10% and decrease in Benefits by 10%	18.3	12.3	13.2	13.8

Case a: No. Tariff Increase

FIRR CALCULATION

FIRR= 0.0863941

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,160	0	2,160	-2,160	0	0	2,160	-2,160
1991	0	409,690	0	409,690	-409,690	1	0	377,110	-377,110
1992	0	368,130	0	368,130	-368,130	2	0	311,908	-311,908
1993	0	351,600	0	351,600	-351,600	3	0	274,212	-274,212
1994	153,073	0	28,000	28,000	125,073	4	109,888	20,101	89,787
1995	153,073	0	37,700	37,700	115,373	5	101,149	24,912	76,237
1996	153,073	0	37,700	37,700	115,373	6	93,105	22,931	70,175
1997	153,073	0	37,700	37,700	115,373	7	85,701	21,107	64,594
1998	153,073	0	37,700	37,700	115,373	8	78,886	19,429	59,457
1999	153,073	0	37,700	37,700	115,373	9	72,613	17,884	54,729
2000	153,073	0	37,700	37,700	115,373	10	66,838	16,461	50,377
2001	153,073	31,800	37,700	69,500	83,573	11	61,523	27,933	33,590
2002	153,073	0	37,700	37,700	115,373	12	56,630	13,947	42,683
2003	153,073	0	37,700	37,700	115,373	13	52,127	12,838	39,289
2004	153,073	0	37,700	37,700	115,373	14	47,982	11,817	36,164
2005	153,073	0	37,700	37,700	115,373	15	44,166	10,878	33,288
2006	153,073	0	37,700	37,700	115,373	16	40,654	10,013	30,641
2007	153,073	0	37,700	37,700	115,373	17	37,421	9,216	28,204
2008	153,073	0	37,700	37,700	115,373	18	34,445	8,483	25,962
2009	153,073	31,800	37,700	69,500	83,573	19	31,706	14,395	17,310
2010	153,073	0	37,700	37,700	115,373	20	29,184	7,188	21,997
2011	153,073	0	37,700	37,700	115,373	21	26,864	6,616	20,247
2012	153,073	0	37,700	37,700	115,373	22	24,727	6,090	18,637
2013	153,073	0	37,700	37,700	115,373	23	22,761	5,606	17,155
2014	153,073	0	37,700	37,700	115,373	24	20,951	5,160	15,791
2015	153,073	0	37,700	37,700	115,373	25	19,285	4,750	14,535
2016	153,073	0	37,700	37,700	115,373	26	17,751	4,372	13,379
2017	153,073	0	37,700	37,700	115,373	27	16,340	4,024	12,315
2018	153,073	31,800	37,700	69,500	83,573	28	15,040	6,829	8,211
2019	153,073	-665,621	37,700	-627,921	780,994	29	13,844	-56,790	70,634
TOTAL	153,073	561,359	37,000	1,531,859	2,448,039	435	1,221,579	1,221,579	0

Case b: 10% Tariff Increase from 1994/95

FIRR CALCULATION

FIRR= 0.1251658

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,160	0	2,160	-2,160	0	0	2,160	-2,160
1991	0	409,690	0	409,690	-409,690	1	0	364,115	-364,115
1992	0	368,130	0	368,130	-368,130	2	0	290,782	-290,782
1993	0	351,600	0	351,600	-351,600	3	0	246,831	-246,831
1994	204,007	0	28,000	28,000	176,007	4	127,286	17,470	109,816
1995	204,007	0	37,700	37,700	166,307	5	113,126	20,905	92,221
1996	204,007	0	37,700	37,700	166,307	6	100,542	18,580	81,962
1997	204,007	0	37,700	37,700	166,307	7	89,357	16,513	72,844
1998	204,007	0	37,700	37,700	166,307	8	79,417	14,676	64,741
1999	204,007	0	37,700	37,700	166,307	9	70,582	13,043	57,539
2000	204,007	0	37,700	37,700	166,307	10	62,731	11,592	51,138
2001	204,007	31,800	37,700	69,500	134,507	11	55,752	18,993	36,759
2002	204,007	0	37,700	37,700	166,307	12	49,550	9,157	40,394
2003	204,007	0	37,700	37,700	166,307	13	44,038	8,138	35,900
2004	204,007	0	37,700	37,700	166,307	14	39,139	7,233	31,907
2005	204,007	0	37,700	37,700	166,307	15	34,785	6,428	28,357
2006	204,007	0	37,700	37,700	166,307	16	30,916	5,713	25,203
2007	204,007	0	37,700	37,700	166,307	17	27,477	5,078	22,399
2008	204,007	0	37,700	37,700	166,307	18	24,420	4,513	19,907
2009	204,007	31,800	37,700	69,500	134,507	19	21,704	7,394	14,310
2010	204,007	0	37,700	37,700	166,307	20	19,289	3,565	15,725
2011	204,007	0	37,700	37,700	166,307	21	17,143	3,168	13,975
2012	204,007	0	37,700	37,700	166,307	22	15,236	2,816	12,421
2013	204,007	0	37,700	37,700	166,307	23	13,541	2,502	11,039
2014	204,007	0	37,700	37,700	166,307	24	12,035	2,224	9,811
2015	204,007	0	37,700	37,700	166,307	25	10,696	1,977	8,720
2016	204,007	0	37,700	37,700	166,307	26	9,506	1,757	7,750
2017	204,007	0	37,700	37,700	166,307	27	8,449	1,561	6,888
2018	204,007	31,800	37,700	69,500	134,507	28	7,509	2,558	4,951
2019	204,007	-665,621	37,700	-627,921	831,928	29	6,674	-20,541	27,215
TOTAL	153,073	561,359	37,000	1,531,859	3,772,323	435	1,090,902	1,090,902	0

FIRR CALCULATION

Case c: 20% Tariff Increase from 2000/01

FIRR= 0.12312869

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,160	0	2,160	-2,160	0	0	2,160	-2,160
1991	0	409,690	0	409,690	-409,690	1	0	364,776	-364,776
1992	0	368,130	0	368,130	-368,130	2	0	291,838	-291,838
1993	0	351,600	0	351,600	-351,600	3	0	248,176	-248,176
1994	153,073	0	28,000	28,000	125,073	4	96,201	17,597	78,604
1995	153,073	0	37,700	37,700	115,373	5	85,655	21,096	64,559
1996	153,073	0	37,700	37,700	115,373	6	76,264	18,783	57,481
1997	153,073	0	37,700	37,700	115,373	7	67,903	16,724	51,180
1998	153,073	0	37,700	37,700	115,373	8	60,459	14,890	45,569
1999	153,073	0	37,700	37,700	115,373	9	53,831	13,258	40,573
2000	254,941	0	37,700	37,700	217,241	10	79,826	11,804	68,022
2001	254,941	31,800	37,700	69,500	185,441	11	71,075	19,376	51,699
2002	254,941	0	37,700	37,700	217,241	12	63,283	9,358	53,925
2003	254,941	0	37,700	37,700	217,241	13	56,345	8,332	48,013
2004	254,941	0	37,700	37,700	217,241	14	50,168	7,419	42,749
2005	254,941	0	37,700	37,700	217,241	15	44,668	6,605	38,063
2006	254,941	0	37,700	37,700	217,241	16	39,771	5,881	33,890
2007	254,941	0	37,700	37,700	217,241	17	35,411	5,236	30,174
2008	254,941	0	37,700	37,700	217,241	18	31,529	4,662	26,866
2009	254,941	31,800	37,700	69,500	185,441	19	28,072	7,653	20,419
2010	254,941	0	37,700	37,700	217,241	20	24,995	3,696	21,299
2011	254,941	0	37,700	37,700	217,241	21	22,255	3,291	18,964
2012	254,941	0	37,700	37,700	217,241	22	19,815	2,930	16,885
2013	254,941	0	37,700	37,700	217,241	23	17,643	2,609	15,034
2014	254,941	0	37,700	37,700	217,241	24	15,708	2,323	13,385
2015	254,941	0	37,700	37,700	217,241	25	13,986	2,068	11,918
2016	254,941	0	37,700	37,700	217,241	26	12,453	1,842	10,611
2017	254,941	0	37,700	37,700	217,241	27	11,088	1,640	9,448
2018	254,941	31,800	37,700	69,500	185,441	28	9,872	2,691	7,181
2019	254,941	-665,621	37,700	-627,921	882,862	29	8,790	-21,650	30,439
TOTAL	153,073	561,359	37,000	1,531,859	4,485,399	435	1,097,066	1,097,066	0

Case a: Increase in Costs by 10%

FIRR CALCULATION

FIRR= 0.11399338

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,376	0	2,376	-2,376	0	0	2,376	-2,376
1991	0	450,659	0	450,659	-450,659	1	0	404,544	-404,544
1992	0	404,943	0	404,943	-404,943	2	0	326,309	-326,309
1993	0	386,760	0	386,760	-386,760	3	0	279,765	-279,765
1994	204,007	0	28,000	28,000	176,007	4	132,469	18,181	114,288
1995	204,007	0	37,700	37,700	166,307	5	118,914	21,975	96,939
1996	204,007	0	37,700	37,700	166,307	6	106,745	19,726	87,019
1997	204,007	0	37,700	37,700	166,307	7	95,822	17,708	78,115
1998	204,007	0	37,700	37,700	166,307	8	86,017	15,896	70,121
1999	204,007	0	37,700	37,700	166,307	9	77,215	14,269	62,946
2000	204,007	0	37,700	37,700	166,307	10	69,314	12,809	56,505
2001	204,007	34,980	37,700	72,680	131,327	11	62,221	22,167	40,054
2002	204,007	0	37,700	37,700	166,307	12	55,854	10,322	45,532
2003	204,007	0	37,700	37,700	166,307	13	50,138	9,265	40,873
2004	204,007	0	37,700	37,700	166,307	14	45,008	8,317	36,691
2005	204,007	0	37,700	37,700	166,307	15	40,402	7,466	32,936
2006	204,007	0	37,700	37,700	166,307	16	36,268	6,702	29,566
2007	204,007	0	37,700	37,700	166,307	17	32,557	6,016	26,540
2008	204,007	0	37,700	37,700	166,307	18	29,225	5,401	23,824
2009	204,007	34,980	37,700	72,680	131,327	19	26,235	9,346	16,888
2010	204,007	0	37,700	37,700	166,307	20	23,550	4,352	19,198
2011	204,007	0	37,700	37,700	166,307	21	21,140	3,907	17,234
2012	204,007	0	37,700	37,700	166,307	22	18,977	3,507	15,470
2013	204,007	0	37,700	37,700	166,307	23	17,035	3,148	13,887
2014	204,007	0	37,700	37,700	166,307	24	15,292	2,826	12,466
2015	204,007	0	37,700	37,700	166,307	25	13,727	2,537	11,190
2016	204,007	0	37,700	37,700	166,307	26	12,322	2,277	10,045
2017	204,007	0	37,700	37,700	166,307	27	11,062	2,044	9,017
2018	204,007	34,980	37,700	72,680	131,327	28	9,930	3,538	6,392
2019	204,007	-732,183	37,700	-694,483	898,490	29	8,914	-30,344	39,257
TOTAL	153,073	617,495	37,000	1,587,995	3,716,187	435	1,216,353	1,216,353	0

Case b: Decrease in Benefits by 10%

FIRR CALCULATION

FIRR= 0.11011103

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,160	0	2,160	-2,160	0	0	2,160	-2,160
1991	0	409,690	0	409,690	-409,690	1	0	369,053	-369,053
1992	0	368,130	0	368,130	-368,130	2	0	298,723	-298,723
1993	0	351,600	0	351,600	-351,600	3	0	257,010	-257,010
1994	183,606	0	28,000	28,000	155,606	4	120,899	18,437	102,461
1995	183,606	0	37,700	37,700	145,906	5	108,907	22,362	86,545
1996	183,606	0	37,700	37,700	145,906	6	98,104	20,144	77,961
1997	183,606	0	37,700	37,700	145,906	7	88,373	18,146	70,228
1998	183,606	0	37,700	37,700	145,906	8	79,608	16,346	63,262
1999	183,606	0	37,700	37,700	145,906	9	71,712	14,725	56,987
2000	183,606	0	37,700	37,700	145,906	10	64,599	13,264	51,334
2001	183,606	31,800	37,700	69,500	114,106	11	58,191	22,027	36,164
2002	183,606	0	37,700	37,700	145,906	12	52,419	10,763	41,656
2003	183,606	0	37,700	37,700	145,906	13	47,220	9,696	37,524
2004	183,606	0	37,700	37,700	145,906	14	42,536	8,734	33,802
2005	183,606	0	37,700	37,700	145,906	15	38,317	7,868	30,449
2006	183,606	0	37,700	37,700	145,906	16	34,516	7,087	27,429
2007	183,606	0	37,700	37,700	145,906	17	31,093	6,384	24,708
2008	183,606	0	37,700	37,700	145,906	18	28,009	5,751	22,258
2009	183,606	31,800	37,700	69,500	114,106	19	25,230	9,550	15,680
2010	183,606	0	37,700	37,700	145,906	20	22,728	4,667	18,061
2011	183,606	0	37,700	37,700	145,906	21	20,474	4,204	16,270
2012	183,606	0	37,700	37,700	145,906	22	18,443	3,787	14,656
2013	183,606	0	37,700	37,700	145,906	23	16,613	3,411	13,202
2014	183,606	0	37,700	37,700	145,906	24	14,966	3,073	11,893
2015	183,606	0	37,700	37,700	145,906	25	13,481	2,768	10,713
2016	183,606	0	37,700	37,700	145,906	26	12,144	2,494	9,650
2017	183,606	0	37,700	37,700	145,906	27	10,939	2,246	8,693
2018	183,606	31,800	37,700	69,500	114,106	28	9,854	3,730	6,124
2019	183,606	-665,621	37,700	-627,921	811,527	29	8,877	-30,358	39,235
TOTAL	153,073	561,359	37,000	1,531,859	3,241,897	435	1,138,251	1,138,251	0

Case c: Increase in Costs by 10% and Decrease in Benefits by 10%

FIRR CALCULATION

FIRR= 0.09992888

(UNIT:1,000Rs.)

YEAR	REVENUE	COST			REVENUE-COST		PRESENT VALUE IN 1990		
		INVESTMENT	EXPENSE	TOTAL			REVENUE	COST	DIFFERENCE
1990		2,376	0	2,376	-2,376	0	0	2,376	-2,376
1991	0	450,659	0	450,659	-450,659	1	0	409,716	-409,716
1992	0	404,943	0	404,943	-404,943	2	0	334,707	-334,707
1993	0	386,760	0	386,760	-386,760	3	0	290,635	-290,635
1994	183,606	0	28,000	28,000	155,606	4	125,438	19,129	106,308
1995	183,606	0	37,700	37,700	145,906	5	114,042	23,416	90,625
1996	183,606	0	37,700	37,700	145,906	6	103,681	21,289	82,392
1997	183,606	0	37,700	37,700	145,906	7	94,262	19,355	74,907
1998	183,606	0	37,700	37,700	145,906	8	85,698	17,596	68,101
1999	183,606	0	37,700	37,700	145,906	9	77,912	15,998	61,914
2000	183,606	0	37,700	37,700	145,906	10	70,834	14,544	56,289
2001	183,606	34,980	37,700	72,680	110,926	11	64,399	25,492	38,907
2002	183,606	0	37,700	37,700	145,906	12	58,548	12,022	46,526
2003	183,606	0	37,700	37,700	145,906	13	53,229	10,930	42,299
2004	183,606	0	37,700	37,700	145,906	14	48,393	9,937	38,456
2005	183,606	0	37,700	37,700	145,906	15	43,996	9,034	34,963
2006	183,606	0	37,700	37,700	145,906	16	39,999	8,213	31,786
2007	183,606	0	37,700	37,700	145,906	17	36,365	7,467	28,898
2008	183,606	0	37,700	37,700	145,906	18	33,062	6,789	26,273
2009	183,606	34,980	37,700	72,680	110,926	19	30,058	11,898	18,160
2010	183,606	0	37,700	37,700	145,906	20	27,327	5,611	21,716
2011	183,606	0	37,700	37,700	145,906	21	24,844	5,101	19,743
2012	183,606	0	37,700	37,700	145,906	22	22,587	4,638	17,949
2013	183,606	0	37,700	37,700	145,906	23	20,535	4,217	16,319
2014	183,606	0	37,700	37,700	145,906	24	18,670	3,833	14,836
2015	183,606	0	37,700	37,700	145,906	25	16,974	3,485	13,488
2016	183,606	0	37,700	37,700	145,906	26	15,431	3,169	12,263
2017	183,606	0	37,700	37,700	145,906	27	14,030	2,881	11,149
2018	183,606	34,980	37,700	72,680	110,926	28	12,755	5,049	7,706
2019	183,606	-732,183	37,700	-694,483	878,089	29	11,596	-43,862	55,458
TOTAL	153,073	617,495	37,000	1,587,995	3,185,761	435	1,264,665	1,264,665	0

Appendix-16.3 FIRR of Other Cases

Four alternative master plans are formulated in Chapter 7, then the optimum plan has been selected. Here, we set short-term plans for other alternations which were not selected and show F.I.R.R. of the each plan. Figure-A.15.1 - and Table-A.15.1 show the short-term plans, and whose F.I.R.R. are calculated as shown in Table-A.16.1.

Table-A.16.1 F.I.R.R. for the Alternatives

(%)

C A S E	1	2	3	4
Base Case	12.5	12.2	5.6	6.7
Sensitivity Analysis				
(A) Increase in Costs by 10%	11.4	11.1	4.9	6.0
(B) Decrease i Benefits by 10%	11.0	10.7	4.5	5.6
(C) Increase in Costs by 10% and Decrease in Benefits by 10%	10.0	9.7	3.9	4.9

Appendix-16.4 Financing Arrangements for Port Development in Japan

Port development in Japan is carried out as part of general public works with government grants and subsidies, whereby ports are not expected to fully recover development costs through their operations alone. This policy is significantly different from the widely accepted concept that ports should in principle be managed like a commercial entity. In other words, the theory that ports should be financially self-supporting by earning sufficient revenues from their operations. Financing for port development in Japan, however, is justified on the basis of its contribution to the social and economic development of the region rather than on the basis of a direct financial return from port operations. Consequently, Japanese port development relies on a substantial amount of funds from the national and local governments. Not just port users but the entire hinterland communities, financially support the development of ports in Japan.

Construction and improvement works of public port facilities are financed based on annual government budgets in accordance with long-term port plans as well as five-year port improvement plans. Port facilities for private use are entirely financed by private users, except for container terminals which are owned by public corporations and leaned out to private parties. In general, the construction costs of public port facilities are shared by the central government and the port management body. The cost-sharing scheme used at present is shown in Table A.16.2.

Regarding the construction works of basic port facilities such as channels, breakwaters, mooring facilities and port roads, the central government bears up to 75% of the total cost for specially designated major ports, which means major ports that are of special importance for the promotion of foreign trade and designated as such by government ordinance: and 50% for major ports, which means those ports that are specified by government ordinance as having great importance to the national interest. Development and maintenance works of waterways outside port areas are financed entirely by the central government.

Regarding back-up facilities such as cargo handling equipment and transit sheds, port management bodies secure funds by issuing local government bonds. Their interest and principal are repaid by the port management bodies through collecting user charges from the new facilities.

Regarding environmental facility works such as waterfront parks and waste disposal facilities, port management bodies have primary responsibility for constructing and improving these facilities, receiving subsidies of varying rates from the central government.

In addition, there are several other schemes that must meet various special requirements. "Specially designated port facility works" are a form of construction undertaken by the central government in major ports in which specially designated major ports are included to develop specialized terminals for bulk cargoes such as timber, coal, ore and so on. With this arrangements, investments are made more efficiently and works are accelerated through a sharing of the costs between the central government, port management bodies and beneficiaries.

Table A.16.2 Share of Construction Cost Borne by Central Government

(1) Basic port Facilities

		Water facilities	Protective facilities	Mooring facilities	Waterfront traffic facilities	Land for port and harbor facilities	Remarks
Port classification (Mainland)	Specially designated major ports	5/10-10/10	5/10-10/10	5/10-7.5/10	-7.5/10	-	
	Major ports	5/10	5/10	5/10	-5/10	-	
	Minor ports	4/10	4/10	4/10	4/10	-	
	Harbors of refuge	7.5/10	7.5/10	-	-	-	
Special Zones	Hokkaido	9.5/10	9.5/10	7.5/10*	7.5/10*	7.5/10	*Excluding mooring and port traffic facilities for harbors of refuge. **Excluding port traffic facilities for harbors of refuge.
	Okinawa	10/10	10/10	10/10*	10/10*	10/10*	
	Remote islands	9.5/10	9.5/10	7.5/10	7.5/10**	-	
	Ogasawara islands	10/10	10/10	7.5/10	7.5/10	-	
	Amami Islands	9.5/10	9.5/10	9/10	9/10	9/10	
Specially designated port facilities work	Specialized cargo piers (Mainland)	4/10(2/10)	4/10	4/10(2/10)	-	-	The figures in parentheses indicate shares paid by beneficiaries
	(Hokkaido)	8.55/10(1/10)	8.55/10(1/10)	6.75/10(1/10)	-	-	
	Energy, iron and steel ports	-2.5/10(5/10-)	2.5/10(5/10)				
Industry-related projects	(Mainland)	2.5/10(5/10)	2.5/10(5/10)	-	-	-	
	(Minor ports)	5/10(5/10	2/10(5/10)	-	-	-	

(2) Container Terminals

National interest-free loans	Interest-free loans by Municipal government	Treasury investments & loans	Private capital
1/10	1/10	4/10	4/10

Appendix-16.5 An Experimental FIRR calculation for 150,000 DWT Development Case

According to Appendix-16.3, despites a 10-percent raising of the port tariff at New Mangalore Port, FIRRs for 150,000 DWT development cases are far lower than the criterion: 12%. While the port trust has a financial difficulty, buyers can enjoy a cheaper transportation cost by using larger iron ore carriers. Theoretically, the port trust who invests to the port expansion and KIOCL who invests to the handling equipment improvement are entitled to enjoy this savings in freight cost. Therefore, this savings can be shared between three parties, that is, buyers, the port trust and KIOCL by raising the port tariff and FOB price of iron ore. Practically, if buyers do not necessarily need to buy iron ore from KIOCL, buyers would avoid higher port tariff and iron ore price and change a mining and a loading port, and even if buyers want to buy the iron ore after expansion, FOB price would depend on a contract talk between KIOCL and the buyers and it would not be clear whether KIOCL could raise the price.

For oil transportation, situation is a little different. The price of oil products would be directly affected by tariff and/or FOB price raising. since success of the oil refinery plant would depend upon whether the plant could produce products cheaper than imported products, the possibility of the tariff and FOB price raising would need to be considered from this point. However, no information about this point is available at present.

Anyway, these uncertainty is completely neglected here, and only experimental study is done.

Table-A.16.1 Costs for Short-term Plan (Case-3)

(Million Rs)

Item	Cost				
	1990/91	91/92	92/93	93/94	94/95
Capital Costs	2.37	426.68	544.17	1,268.60	0
Maintenance Costs	91.52	22.32	22.32	22.32	35.93

Table-A.16.2 Revenue of the New Mangalore Port Trust (Case-3)

(Million Rs)

Fiscal Year	1990-93	1994-98
Port Operation Charge in Present Tariff		1,607
Revenue Adding 1/3 of Savings in Freight Costs of Iron Ore Transportation (150,000/60,000 DWT)	0	1,053
1/3 of Savings in Freight Costs of Oil Transportation (150,000/35,000 DWT)	0	634.0

Savings in Freight Costs are calculated on assumption that annual iron ore exports and crude oil import are as follows:

Year	94	95	96	97	98	99-
Iron Ore Export (Million Tons)	7.5	8.0	8.5	9.0	9.5	10.0
Crude Oil Import (Million Tons)	3.0	3.0	3.0	3.0	3.0	6.0

Table-A.16. shows the results that by adding the part(1/3) of savings in freight costs, FIRR for the port trust would go up to 10%. If this revenue up is obtained by tariff raising, the raising rate would be 105% and such a high raising would not be practical because of severe competition with other ports.

Table-A.16.3 FIRR of the Experimental FIRR Study (Case-3)

Revenue Adding	FIRR(%)
1/3 of Savings in Freight Costs of Iron Ore Transportation (150,000/60,000 DWT)	10.4
PLUS 1/3 of Savings in Freight Costs of Oil Transportation (150,000/35,000 DWT)	13.5
(Tariff Raising)	105.0