4-3 Selection of Machines and Equipments for Removal Operation

4-3-1 Comparative study for machines and equipments

(1) Comparision of the lifting capacity of floating crane

In order to remove sunken vessels, there are many types of floating cranes, namely, the lifting capacities of 1,000, 500, 200 tons. However, the lifting capacities of 500 and 200 tons are quite ideal for the mobilization and given comparative study in the following.

1) Technical reason

In general whenever a floating crane may be mobilized to remove any sunken vessel, no floating crane has been mobilized in the past if the lifting capacity should exceed more than 500 tons. As for the major reason,

a) More numbers of sling wire ropes should be employed. This results salvage engineers more troubles on how to bundle the hull or block.

b) It is difficult to hold the balance of chains fixed to the hull or block on how strong the load is devied and/or which one of the chains has more load. If the block should slant to one side, a sling wire rope may be cut and it will cause damages to the floating crane and perhaps to the human beings.

c) If the block should be deformative, it is difficult to ajust the balance of the weight by many sling wire ropes.

d) Since the vessels have sunken for more than 30 years and have been deteriorated by corrosion, they hardly stand the forth from the sling wire of as much as 100 m/m diameter.

e) In consideration to the existing technical level of divers and riggers in Indonesia, it is very difficult for them to take charge of such a large sling wire.

2) Navigational technology

The biggest floating crane in the Republic of Indonesia is of the lifting capacity of 240 tons. Therefore it will be a problem to operate any larger floating crane like 1,000 ton capacity.

a) Difficulties from crews' technical level

If employed, it requires competent experiences and techniques to navigate such a large floating crane, i.e. L X B X D = 80 M X 36 M X 6 M, the sheers = 80 – 100 M.

b) On account of its central remote control system for navigational lift winch, mooring winches, and others in the bridge, the crew's ability should be matched with the high level of techniques.

c) Particularly, the captain shall be competent for all the technical know-hows at work during the performance of navigation and work.

d) In case of this size of the floating crane, she'll be restricted by port regulations to sail and to enter, and also by the capacity of port. Even after having entered port, there frequently cause troubles for radio, air navigation, and others.

e) In order to match with the floating crane, the horse power of a tug boat should be raised.

i) In connection with Surabaya Port, one example will be well explained in the following;

List 4-3-1

	200 ton F.C.	500 ton F.C.	1,000 ton F.C.
Inport	1,000 – 1,500 HP	2,000 – 2,500 HP	3,000 – 4,000 HP
Outport	2,000 – 3,000 HP	3,000 – 4,000 HP	4,500 – 6,000 HP

The larger the floating crane becomes, the stronger the horse power should be installed for the tug boat, which requires the higher knowledge of techniques in navigation and operation.

ii) In case that the floating crane should navigate in the ocean, the sheers should be set down, so that a specially technical preparation will be required.

iii) In case of operation, it is not adequate for the floating crane with the draft of 5 meters to manupulate the work in the shallow waters on account of the restricted scope of work. And it is also very difficult to manupulate her smoothly due to the large volume of hull.

In consideration to the above reason, the floating crane with the lifting capacity of 1,000 tons has been excluded in removal operation.

(2) Lifting method corresponding to the type of floating crane

In case of removing a sunken vessel, there are two types, namely, a floating crane which is to lift a cut-off block and/or a hull itself with a lifting hook (as called hereafter A-type F.C.) and which is to lift it with both a lifting hook and a deck winch (as called hereafter B-type F.C.).

1) Advantage & disadvantage of A-type F.C.

a) Advantage

i) It can freely change the lifting height once it has lifted a block and/or a hull.

ii) It can land a lift block and/or a hull on shore by using the projected sheers within the depth of her draft.

b) Disadvantage

There is no other capacity of lifting substances other than main hook.

2) Advantage & disadvantage of B-type F.C.

a) Advantage

It can lift more than the capacity of main hook, so that a lifting hook is smaller than that of an A-type F.C. since there mounted another lifting unit.

b) Disadvantage

i) It can't lift a block and or a hull out of the sea surface.

ii) Owing to a block and/or a hull, and to the draft depth in the water, it can't deposit it on either any scrap yard and/or surfside.

iii) In lifting, a block and/or a hull may give any damages to the F.C. during the lifting or towing operation.

(3) Comparison between underwater gas cutting & underwater oxy-arc cutting

1) History of underwater cutting

The underwater gas cutting method was implemented in America in 1908 by using a general on-land cutting torch, which was improved later, and actually applied this method to remove the American sunken submarine S-51 for the first time in the history of salvage works. On the other hand, the underwater oxy-arc cutting method was introduced with carbon rod before the World War II, and was not improved much, however, the underwater oxy-hydrogen cutting was commonly used in the underwater cutting work. In 1942, the U.S. Navy

commenced to develop the underwater electric cutting in response to the military demand, improved cutting torch, cutting rod, cutting techniques, and populalized in this field.

During the World War II, an underwater electric cutting was devised out in Japan. After the World War II, some salvage company tried to introduced the underwater cutting method, found it not so efficient in comparison with the underwater oxy-arc cutting method, and also found it difficult technically. Up to the present this method hasn't actually applied in underwater cutting, while the underwater oxy-arc cutting method has been practising up to date.

2) Regarding the underwater gas cutting method

Although the team contact the Indonesian Naval Authority, the related authorities, and salvages companies, no much data and information were available for the volume of gas consumption per one meter (propane and oxygen) in the cutting table and for the calculation bases.

a) Regarding the data

Though the examinations for the written records on the borrowed books from the Government of Indonesia and the purchased ones, were conducted to the underwater gas cutting, nothing much was mentioned regarding the cutting efficiency in details.

3) Cost comparison

The survey team remains the same number, while machines & equipment and the consumerable goods are varied as follows;

Cutting method List 4-3-2

Equipment	Gas cutting	Electric cutting
Cutting torch	Gas cutting torch	Oxy-arc cutting torch
Generator	nil	One set
Compressor	One set	nil
Consumable goods	Propane gas	Cutting rod
	Oxygen	Oxygen
	Light oil for a compressor	Light oil for a generator

a) Consumable volume of propane & oxygen at the time of gas cutting
The rate of consumption is one propane cylinder (45 kg) versus 25 cylinders (6 m^3 each) according to the data in Indonesia.

b) Consumable volume of cutting rod versus oxygen by oxy-arc cutting
Use one oxygen cylinder versus 10 cutting rod (60 – 70 cm long each).

c) Consumable volume per day
Supposed that the diving team which consists of a diver and an assistant, should consume 5 oxygen cylinders per day (4 working hours), the team is to consume 0.2 propane cylinders by gas cutting and 50 cutting rod by oxy-arc cutting.

d) Difference of cost
i) The consumable volume of oxygen is the same.
ii) Costs of propane & cutting sticks
Propane: 0.2 cylinders x R.P. 35,000 = R.P. 7,000
iii) Cutting rod: 50 x= R.P. 700 = R.P. 35,000
Therefore, propane price is cheaper than cutting rod.
R.P. 35,000 – R.P. 7,000 = R.P. 28,000

e) Comparison
On the basis of a tariff table, it costs R.P. 564,000, so that the oxy-arc cutting cost can be calculated as follows:

R.P. 564,000 + R.P. 28,000 = R.P. 593,000

Therefore, if the oxy-arc cutting method is 10% better efficient than the gas cutting one, both costs will be more or less the same.

4-3-2 Calculation for Removal Operation

(1) Conditions of calculation

1) Every mobilized vessel, machines & equipments, and personnel, were calculated to mobilize from Surabaya Port to the site and vice versa.

2) General machines and equipments were purchased in the foreign country, and added the costs to the transportation and the premiums on cargoes.

3) The underwater oxy-arc cutting was calculated to cut seven meters per four (4) working hours a day.

4) The underwater gas cutting was calculated to cut five (5) meters per four (4) working hours a day.

5) A unit price was introduced in the tariff and those which were not available, were calculated to refer to the market prices.

6) Mobilized floating cranes and boats were calculated as they were based in Surabaya Port, provided that the mobilization fees and premiums were added to calculated in case that any boat should be mobilized from any other ports other than Surabaya Port, such as, in Singapore and/or in the foreign country.

7) The scrap yards should be located within the range of 3 miles.

(2) Working flow of sunken vessel and its costing

1) Comparative costing table on the floating cranes by the capacity and the cutting method.

2) Detailed comparative costing for the capacity of floating cranes and cutting methods

3) Costing & work flow of No. 4, 3, 6, & 2 sunken vessels

4) In case that the scrap yard should be in Tanjung Tati, Madura Islands, work flow and costing are as follows;

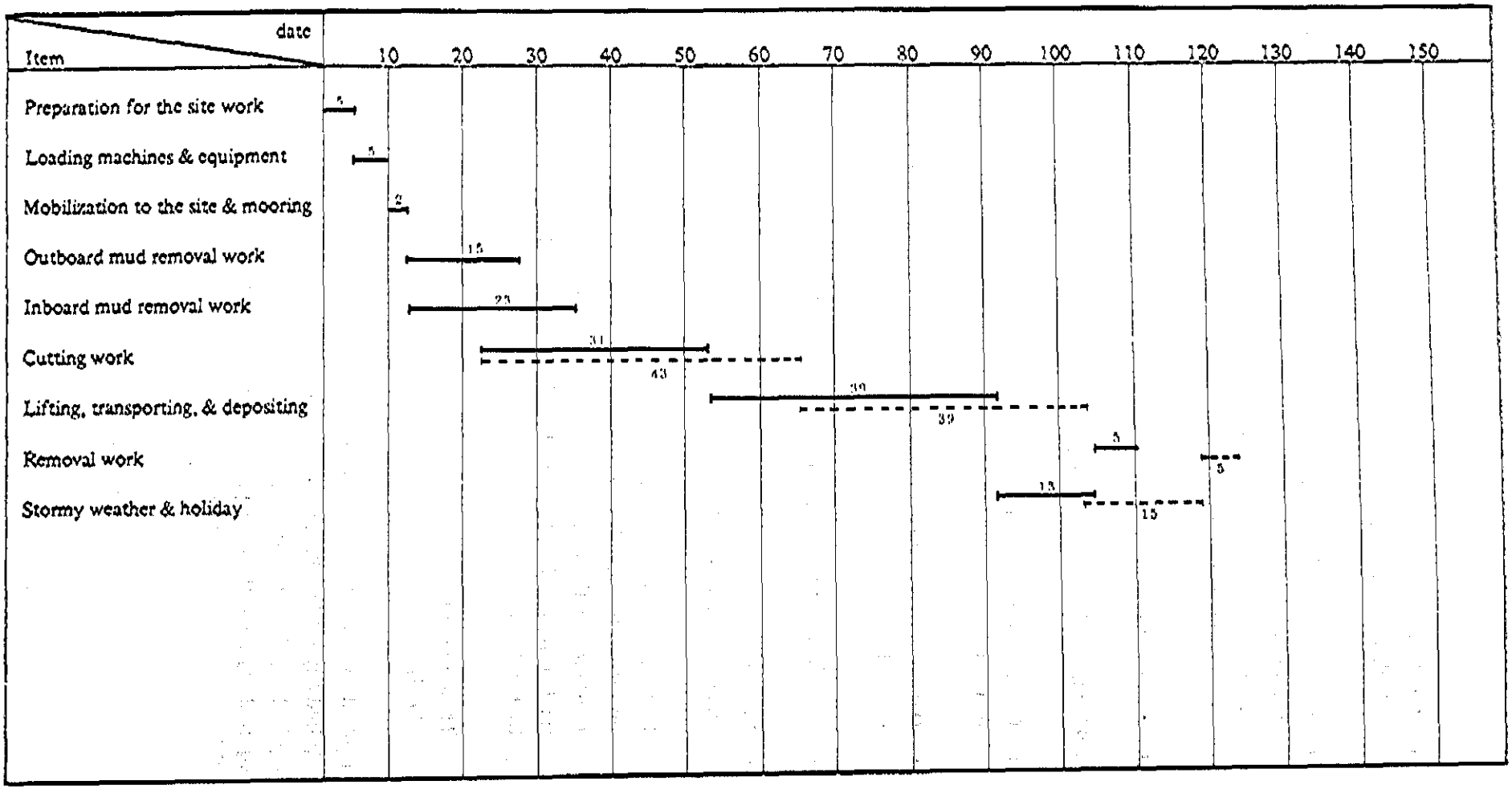
In consideration to the distance of 18 miles off the site, it takes time to transport by lifting. Besides, the floating cranes, a block, and/or a hull would face the water resistance of the tidal current as this navigational route is in the course of rapid tidal current and half of the block is under the water, being lifted and transported by the floating crane.

Therefore, the working days should be more than the case of Karang Jamuang Islands.

Required day from Surabaya Port to the site	one day
Required day for installing sling wire ropes	one day
Required day from the site to Janjung Jati for depositing	one day
Required day from the scrap yard to Surabaya Port	one day
Total:	Four (4) days

Work flow for removal work of No. 4 sunken vessel (in case of 200 ton F.C.

List 4-3-3



List 4-3-4

Costing for removal work of No. 4 sunken vessel (200 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1× 45= 45	RP. 3,000,000	RP.135,000,000	1× 45= 45	RP. 3,000,000	RP. 135,000,000
	Tug boat (1,000 HP)	1× 45= 45	1,000,000	45,000,000	1× 45= 45	1,000,000	45,000,000
	Anchor boat	1×105=105	300,000	31,500,000	1×119=119	300,000	35,000,000
	Small boat	1×100=100	150,000	15,000,000	1×114=114	150,000	17,100,000
	Diving pontoon	2×100=200	150,000	30,000,000	2×114=248	150,000	37,200,000
	Working vessel	1×105=105	1,500,000	157,500,000	1×119=119	1,500,000	178,500,000
	Grab bucket-type dredger	1× 20= 20	1,000,000	20,000,000	1× 20= 20	1,000,000	20,000,000
	Rubber boat with engine	1×100=100	75,000	7,500,000	1×119=119	75,000	8925,000
			Sub-total	441,500,000		Sub-total	476,725,000
Personnel expenses	Project manager	1×110=110	15,000	1,650,000	1×124=124	15,000	1,860,000
	Salvage master	1×110=110	12,000	1320,000	1×124=124	12,000	1488,000
	Assistant salvage master	1×110=110	10,000	1,100,000	1×124=124	10,000	1240,000
	Asst. project manager	1×110=110	5,000	550,000	1×124=124	5,000	624,000
	Diver	8×110=880	8,000	7,040,000	8×124=992	8,000	7,936,000
	Blaster	2×110=220	5,000	1,100,000	2×124=248	5,000	1,240,000
	Rigger	6×110=660	5,000	3300,000	6×124=744	5,000	3,720,000
	Mechanic	5×110=550	5,000	2,750,000	5×124=620	5,000	3,100,000
	Welder	1×110=110	5,000	550,000	1×124=124	5,000	620,000
	Cook	2×110=220	2,000	440,000	2×124=248	2,000	496,000
			Sub-total	19,800,000		Sub-total	22324,000

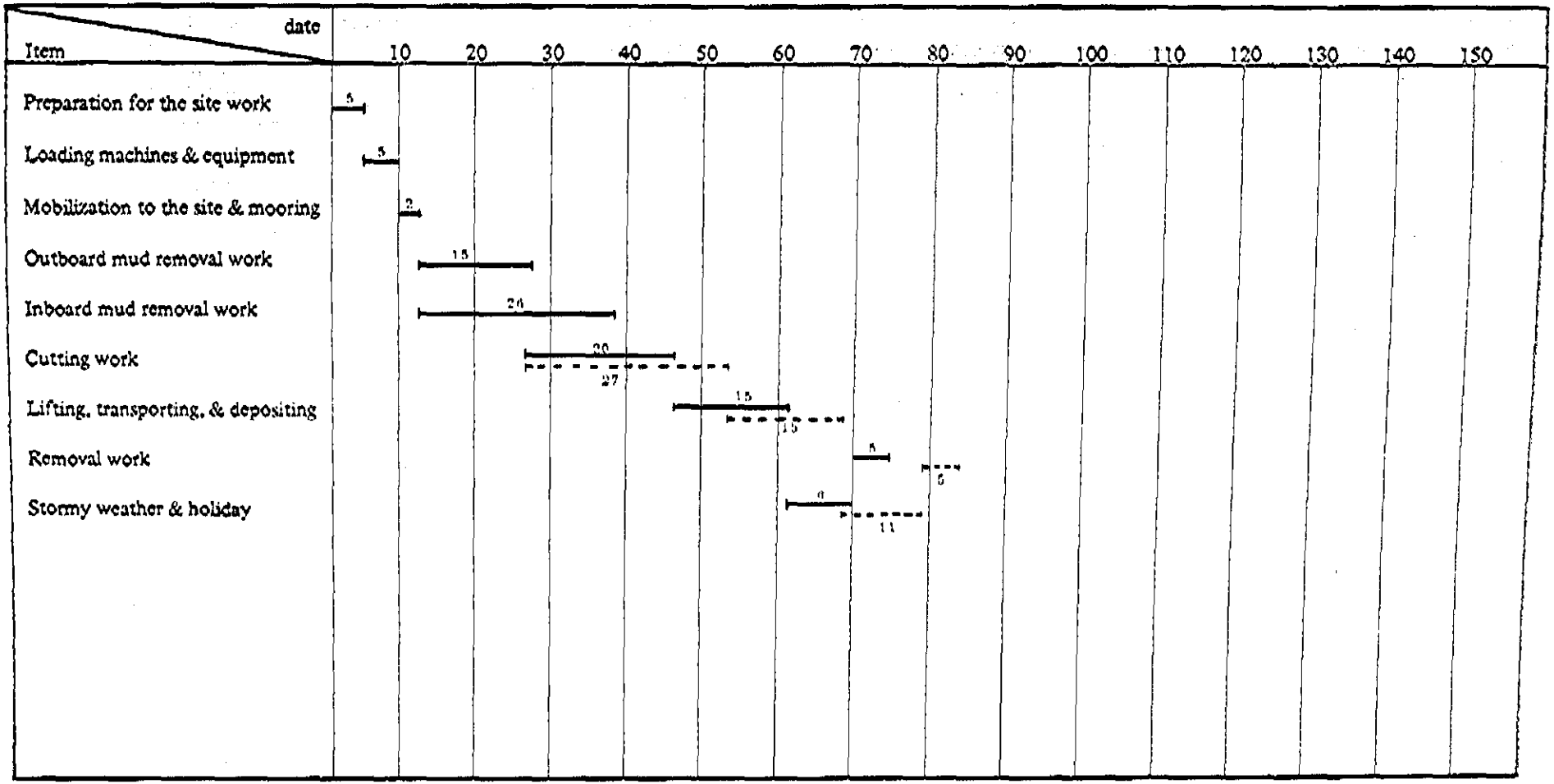
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×105=630	5,000	3,150,000	6×119=714	5,000	3,570,000
	Scuba-type diving equipment	3×105=315	3,000	945,000	3×119=357	3,000	1,071,000
	Wet suit	8×105=840	1,000	840,000	8×119=952	1,000	952,000
	Air hose (K.M.B. 10)	6×105=630	1,000	130,000	6×119=714	1,000	714,000
	Air bombe (spear)	3×105=315	2,000	630,000	3×119=357	2,000	714,000
	High pressure compressor	1×105=105	25,000	2,625,000	1×119=119	25,000	2,975,000
	Low pressure compressor	2×105=210	25,000	5,250,000	2×119=238	25,000	5,950,000
	Underwater cutting torch	4×105=420	6,000	2,520,000			
	Underwater cutting apparatus	4×105=420	5,000	2,100,000			
	Blasting apparatus (full set)	1×105=105	15,000	1,575,000	1×119=119	15,000	1,785,000
	Generator (with a switching board)	1×105=105	50,000	5,250,000	1×119=119	50,000	5,950,000
	Scrapper	2×105=210	500	105,000	2×119=238	500	119,000
	Jet pump	2×105=210	5,000	1,050,000	2×119=238	5,000	1,190,000
	Sand pump (6 inches)	2×105=210	32,500	6,825,000	2×119=238	32,500	7,735,000
	Air lift (6 inches)	2×105=210	12,500	2,625,000	2×119=238	12,500	2,975,000
	Air lift compressor (10 m^3)	1×105=105	45,000	4,725,000	1×119=119	45,000	5,355,000
	Anchor (5 tons)	4×105=420	3,000	1,260,000	4×119=476	3,000	1,428,000
	Anchor (1 ton)	3×105=315	1,000	315,000	3×119=357	1,000	357,000
	Chain (72ϕ × 100M)	3× 45=135	12,500	1,687,500	3× 45=135	12,500	1,687,500
	Transceiver	3×105=315	500	157,500	3×119=357	500	178,500

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×105=315	1,000	315,000	3×119=357	1,000	357,000
	Schakle	1×105=105	1,000	105,000	1×119=119	1,000	119,000
	Mooring buoy (1 ton)	4× 45=180	2,500	450,000	4×119=476	2,500	1,190,000
	Oxy-acetylen gas cutting apparatus				4×119=476	50,000	23,800,000
			Sub-total	45,135,000		Sub-total	70,172,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	150	7,500	1,125,000	350	7,500	2,625,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	1,500	700	1,050,000			
	Powder	45	2,000	90,000	45	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			300,000			300,000
	Others			200,000			200,000
	Propane				14	35,000	490,000
			Sub-total	7,030,000		Sub-total	7,970,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	5,000	40	200,000	5,000	40	200,000
	Gasoline	1,200	100	120,000	1,200	100	120,000
	Engine oil	50	1,000	50,000	50	1,000	50,000
			Sub-total	370,000		Sub-total	370,000
Site expenses	Food expenses	28×110=3080	1,000	3,080,000	28×124=3472	1,000	3,472,000
	Transport & communication expenses	110	5,000	550,000	124	5,000	620,000
	Office expenses			500,000			500,000
			Sub-total	4,130,000		Sub-total	4592,000
Transportation expenses	Equipment transport expenses			500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	518,665,000		Sub-total	582853,000
General administrative expenses			10%	51,866,500		10%	58,285,300
			Grand total	570,531,500		Grand total	641,138,300

List 4-3-5

Work flow for removal work of No. 4 sunken vessel (in case of 500 ton F.C.



List 4-3-6

Costing for removal work of No. 4 sunken vessel (500 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1×20= 20	RP. 6,000,000	RP.120,000,000	1×20= 20	RP. 6,000,000	RP.120,000,000
	Tug boat (1,000 HP)	1×20= 20	1,500,000	30,000,000	1×20= 20	1,500,000	20,000,000
	Anchor boat	1×70= 70	300,000	21,000,000	1×79= 79	300,000	23,700,000
	Small boat	1×65= 65	150,000	9,750,000	1×74= 74	150,000	11,100,000
	Diving pontoon	2×65=130	150,000	19,500,000	2×74=148	150,000	22,200,000
	Working vessel	1×70= 70	1,500,000	105,000,000	1×79= 79	1,500,000	118,500,000
	Grab bucket-type dredger	1×20= 20	1,000,000	20,000,000	1×70= 70	1,000,000	20,000,000
	Rubber boat with engine	1×65= 65	75,000	4,875,000	1×74= 74	75,000	5,550,000
			Sub-total	330,125,000		Sub-total	351,050,000
Personnel expenses	Project manager	1×75= 75	15,000	1,125,000	1×84= 84	15,000	1,260,000
	Salvage master	1×75= 75	12,000	900,000	1×84= 84	12,000	1,008,000
	Assistant salvage master	1×75= 75	10,000	750,000	1×84= 84	10,000	840,000
	Asst. project manager	1×75= 75	5,000	375,000	1×84= 84	5,000	420,000
	Diver	8×75=600	8,000	4,800,000	8×84=672	8,000	5,376,000
	Blaster	2×75=150	5,000	750,000	2×84=168	5,000	840,000
	Rigger	6×75=450	5,000	2,250,000	6×84=504	5,000	2,570,000
	Mechanic	5×75=375	5,000	1,875,000	5×84=420	5,000	2,100,000
	Welder	1×75= 75	5,000	375,000	1×84= 84	5,000	
	Cook	2×75=150	2,000	300,000	2×84=168	2,000	
			Sub-total	13,500,000		Sub-total	15,120,000

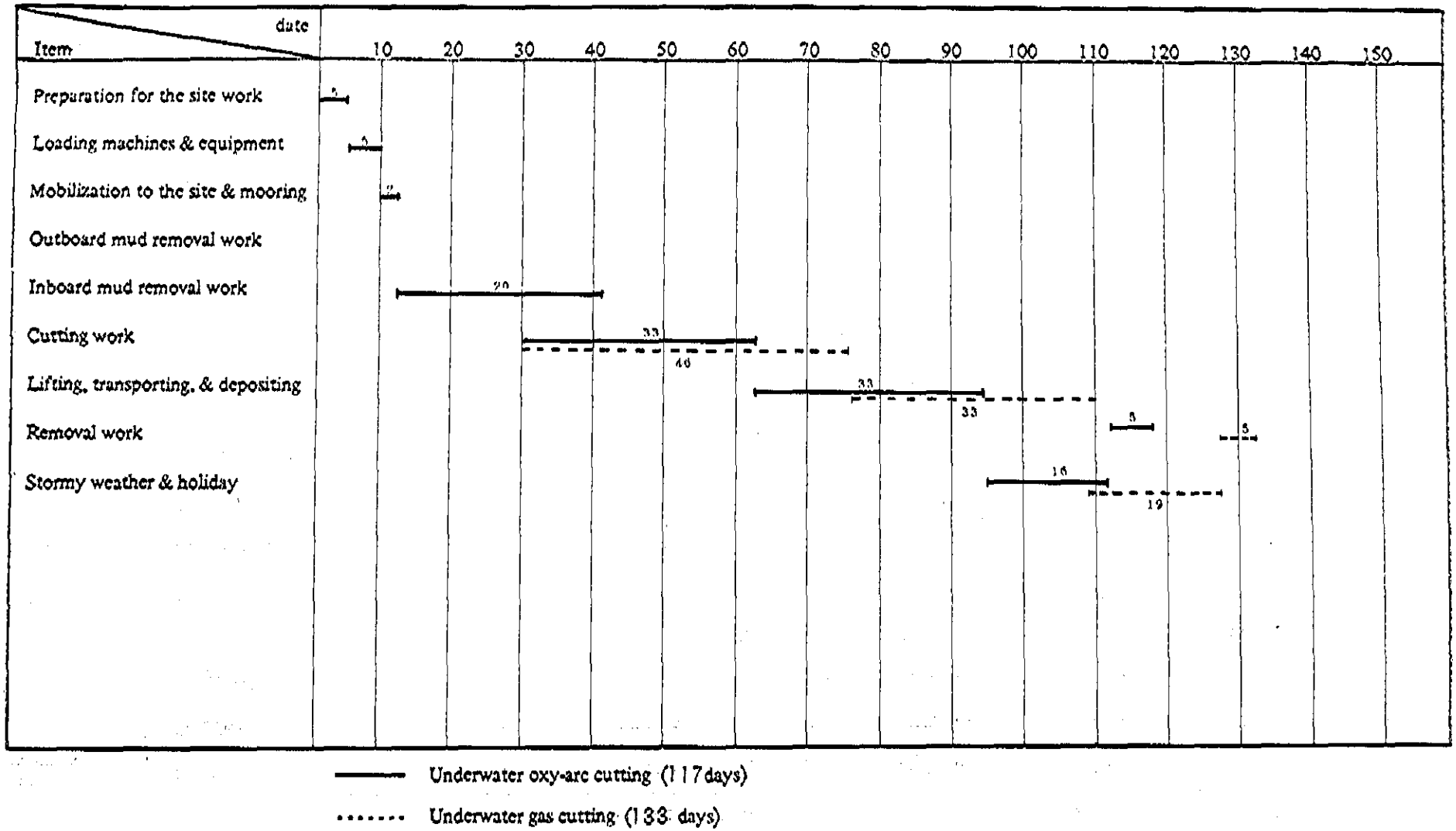
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×70=420	5,000	2,100,000	6×79=474	5,000	2,370,000
	Scuba-type diving equipment	3×70=210	3,000	630,000	3×79=237	3,000	711,000
	Wet suit	8×70=560	1,000	560,000	8×79=632	1,000	632,000
	Air hose (K.M.B. 10)	6×70=420	1,000	420,000	6×79=474	1,000	474,000
	Air bombe (spear)	3×70=210	2,000	420,000	3×79=237	2,000	474,000
	High pressure compressor	1×70= 70	25,000	1,750,000	1×79= 79	25,000	1,975,000
	Low pressure compressor	2×70=140	25,000	3,500,000	2×79=158	25,000	3,950,000
	Underwater cutting torch	4×70=280	6,000	1,680,000			
	Underwater cutting apparatus	4×70=280	5,000	1,400,000			
	Blasting apparatus (full set)	1×70= 70	15,000	1,050,000	1×79= 79	15,000	1,185,000
	Generator (with a switching board)	1×70= 70	50,000	3,500,000	1×79= 79	50,000	3,950,000
	Scrapper	2×70=140	500	70,000	2×79=158	500	79,000
	Jet pump	2×70=140	5,000	700,000	2×79=158	5,000	790,000
	Sand pump (6 inches)	2×70=140	32,500	4,550,000	2×79=158	32,500	5,135,000
	Air lift (6 inches)	2×70=140	12,500	1,750,000	2×79=158	12,500	
	Air lift compressor (10 m^3)	1×70= 70	45,000	3,150,000	1×79= 79	45,000	
	Anchor (5 tons)	4×70=280	3,000	840,000	4×79=316	3,000	948,000
	Anchor (1 ton)	3×70=210	1,000	210,000	3×79=237	1,000	237,000
	Chain (72ϕ x 100M)	3×20= 60	12,500	750,000	3×79= 81	12,500	1,012,500
	Transceiver	3×70=210	500	105,000	3×79=237	500	118,500

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×70=210	1,000	210,000	3×79=237	1,000	237,000
	Schakle	1×70= 70	1,000	70,000	1×79= 79	1,000	79,000
	Mooring buoy (1 ton)	4×70=280	2,500	700,000	4×79=316	2,500	790,000
	Oxy-acetylen gas cutting apparatus				4×79=316	50,000	15,800,000
			Sub-total	30,115,000		Sub-total	46,477,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	80	7,500	600,000	220	7,500	1,650,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	800	700	560,000			
	Powder	45	2,000	90,000	45	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			200,000			200,000
	Others			200,000			200,000
	Propane				9	35,000	315,000
			Sub-total	5,915,000		Sub-total	6,720,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	2,500ℓ	40	100,000	3,000ℓ	40	120,000
	Gasoline	1,200ℓ	100	120,000	1,200ℓ	100	120,000
	Engine oil	30ℓ	1,000	30,000	30ℓ	1,000	30,000
			Sub-total	250,000		Sub-total	270,000
Site expenses	Food expenses	28×75=2,100	1,000	3,100,000	28×84=2,352	1,000	2,352,000
	Transport & communication expenses	75	5,000	375,000	84	5,000	420,000
	Office expenses			500,000			500,000
			Sub-total	2,975,000		Sub-total	3,272,000
Transportation expenses	Equipment transport expenses		10%	500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	383,580,000		Sub-total	423,609,000
General administrative expenses			10%	38,358,000		10%	42,360,900
			Grand total	421,938,000		Grand total	465,969,900

List 4-3-7

Work flow for removal work of No. 3 sunken vessel (in case of 200 ton F.C.



List 4-3-8 Costing for removal work of No. 3 sunken vessel (200 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1× 40= 40	RP. 3.000.000	RP.120,000,000	1× 40= 40	RP. 3,000,000	RP. 120,000,000
	Tug boat (1,000 HP)	1× 40= 40	1,000,000	40,000,000	1× 40= 40	1,000,000	40,000,000
	Anchor boat	1×112=112	300,000	33,600,000	1×128= 128	800,000	38,400,000
	Small boat	1×107=107	150,000	16,050,000	1×123= 123	150,000	18,450,000
	Diving pontoon	2×107=214	150,000	32,100,000	2×123= 246	150,000	36,900,000
	Working vessel	1×112=112	1,500,000	168,000,000	1×128= 128	1,500,000	192,000,000
	Grub bucket-type dredger						
	Rubber boat with engine	1×107=107	75,000	8,025,000	1×123= 123	75,000	9,225,000
			Sub-total	417,775,000		Sub-total	454,975,000
Personnel expenses	Project manager	1×117=117	15,000	1,755,000	1×133= 133	15,000	1,995,000
	Salvage master	1×117=117	12,000	1,404,000	1×133= 133	12,000	1,596,000
	Assistant salvage master	1×117=117	10,000	1,170,000	1×133= 133	10,000	1,330,000
	Asst. project manager	1×117=117	5,000	585,000	1×133= 133	5,000	665,000
	Diver	8×117=936	8,000	7,488,000	8×133=1,064	8,000	8,512,000
	Blaster	2×117=234	5,000	1,170,000	2×133= 266	5,000	1,330,000
	Rigger	6×117=702	5,000	3,510,000	6×133= 798	5,000	3,990,000
	Mechanic	5×117=585	5,000	2,925,000	5×133= 665	5,000	3,325,000
	Welder	1×117=117	5,000	585,000	1×133= 133	5,000	665,000
	Cook	2×117=234	2,000	468,000	2×133= 266	2,000	532,000
			Sub-total	21,060,000		Sub-total	23,940,000

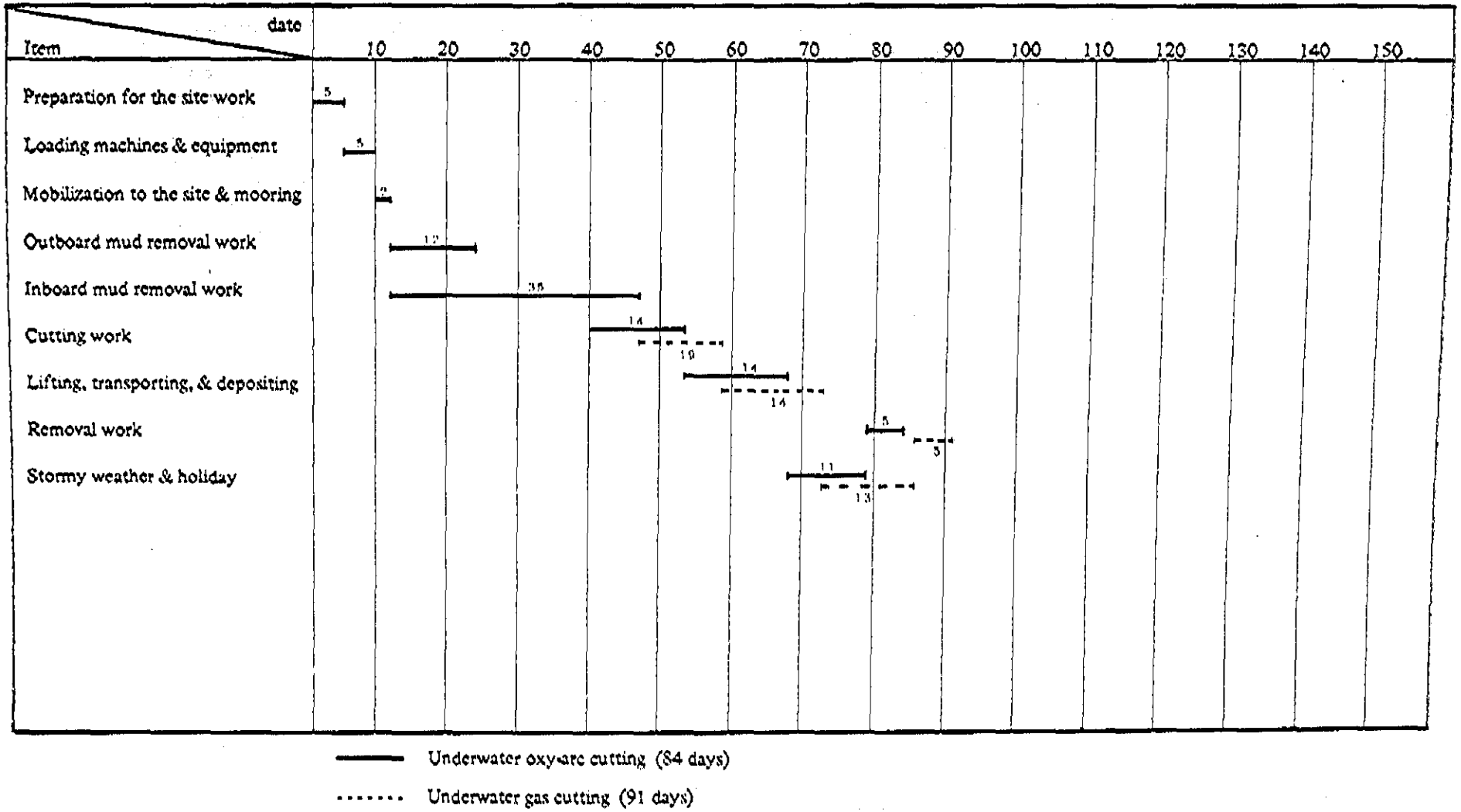
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×112= 672	5,000	3360,000	6×128= 768	5,000	3840,000
	Scuba-type diving equipment	3×112= 336	3,000	1,008,000	3×128= 384	3,000	1,152,000
	Wet suit	8×112= 896	1,000	896,000	8×128=1,024	1,000	1,024,000
	Air hose (K.M.B. 10)	6×112= 672	1,000	672,000	6×128= 768	1,000	768,000
	Air bombe (spear)	3×112= 336	2,000	672,000	3×128= 384	2,000	768,000
	High pressure compressor	1×112= 112	25,000	2800,000	1×128= 128	25,000	3200,000
	Low pressure compressor	2×112= 224	25,000	5,600,000	2×128= 256	25,000	6400,000
	Underwater cutting torch	4×112= 448	6,000	2,688,000	=		
	Underwater cutting apparatus	4×112= 448	5,000	2240,000			
	Blasting apparatus (full set)	1×112= 112	15,000	1,680,000	1×128= 128	15,000	1,920,000
	Generator (with a switching board)	1×112= 112	50,000	5,600,000	1×128= 128	50,000	6400,000
	Scrapper	2×112= 224	500	112,000	2×128= 256	500	128,000
	Jet pump	2×112= 224	5,000	1,120,000	2×128= 256	5,000	1280,000
	Sand pump (6 inches)	2×112= 224	22,500	7,280,000	2×128= 256	32,500	8320,000
	Air lift (6 inches)	2×112= 224	12,500	2800,000	2×128= 256	12,500	3200,000
	Air lift compressor (10 m^3)	1×112= 112	45,000	5040,000	1×128= 128	45,000	5760,000
	Anchor (5 tons)	4×112= 448	3,000	1,344,000	4×128= 512	3,000	1,536,000
	Anchor (1 ton)	3×112= 336	1,000	336,000	3×128= 384	1,000	384,000
	Chain (72ϕ × 100M)	3× 40= 120	12,500	1,500,000	3× 40= 120	12,500	1,500,000
	Transceiver	3×112= 336	500	168,000	3×128= 384	500	192,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×112= 336	1,000	336,000	3×128= 384	1,000	384,000
	Schakle	1×112= 112	1,000	112,000	1×128= 128	1,000	128,000
	Mooring buoy (1 ton)	4× 40= 160	2,500	400,000	4× 40= 160	2,500	400,000
	Oxy-acetylen gas cutting apparatus				4×128= 512	50,000	25,600,000
			Sub-total	47,764,000		Sub-total	74284,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	150	7,500	1,125,000	370	7,500	2,775,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	1500	700	1,050,000			
	Powder	45	2,000	90,000	45	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			400,000			400,000
	Others			200,000			200,000
	Propane				15	35,000	525,000
			Sub-total	7,130,000		Sub-total	8,255,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	5,000	40	200,000	5,000	40	200,000
	Gasoline	1,200	100	120,000	1,200	100	122,000
	Engine oil	50	1,000	50,000	50	1,000	50,000
			Sub-total	370,000		Sub-total	370,000
Site expenses	Food expenses	28×117=3,276	1,000	3276,000	28×133=3,724	1,000	3,724,000
	Transport & communication expenses		5,000	585,000		5,000	665,000
	Office expenses			600,000			600,000
			Sub-total	4461,000		Sub-total	4989,000
Transportation expenses	Equipment transport expenses			500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	499260,000		Sub-total	567,513,000
General administrative expenses			10%	49,926,000		10%	56,751,300
			Grand total	549,186,000		Grand total	624264,300

List 4-3-9

Work flow for removal work of No. 3 sunken vessel (in case of 500 ton F.C.



List 4-3-10

Costing for removal work of No. 3 sunken vessel (500 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1×20= 20	RP. 6.000.000	RP.120.000.000	1×20= 20	RP. 6.000.000	RP.120.000.000
	Tug boat (1,000 HP)	1×20= 20	1.500.000	30.000.000	1×20= 20	1,500.000	30.000.000
	Anchor boat	1×79= 79	300.000	23.700.000	1×86= 86	300.000	25.800.000
	Small boat	1×74= 74	150.000	11.100.000	1×81= 81	150.000	12.150.000
	Diving pontoon	2×74=148	150.000	22.200.000	2×81=162	150.000	24.300.000
	Working vessel	1×79= 79	1.500.000	118.500.000	1×86= 86	1.500.000	129.000.000
	Grab bucket-type dredger	1×15= 15	1.000.000	15.000.000	1×15= 15	1,000.000	15.000.000
	Rubber boat with engine	1×74= 74	75.000	5.550.000	1×81= 81	75.000	6.075.000
			Sub-total	346.050.000		Sub-total	362.325.000
Personnel expenses	Project manager	1×84= 84	15.000	1.260.000	1×91= 91	15.000	1.365.000
	Salvage master	1×84= 84	12.000	1.008.000	1×91= 91	12.000	1.092.000
	Assistant salvage master	1×84= 84	10.000	840.000	1×91= 91	10.000	910.000
	Asst. project manager	1×84= 84	5.000	420.000	1×91= 91	5.000	455.000
	Diver	8×84=177	8.000	5.376.000	8×91=728	8.000	5.824.000
	Blaster	2×84=168	5.000	840.000	2×91=182	5.000	910.000
	Rigger	6×84=504	5.000	2.520.000	6×91=546	5.000	2.730.000
	Mechanic	5×84=420	5.000	2.100.000	5×91=455	5.000	2.275.000
	Welder	1×84= 84	5.000	420.000	1×91= 91	5.000	455.000
	Cook	2×84=168	2.000	336.000	2×91=182	2.000	364.000
			Sub-total	15.120.000		Sub-total	16.380.000

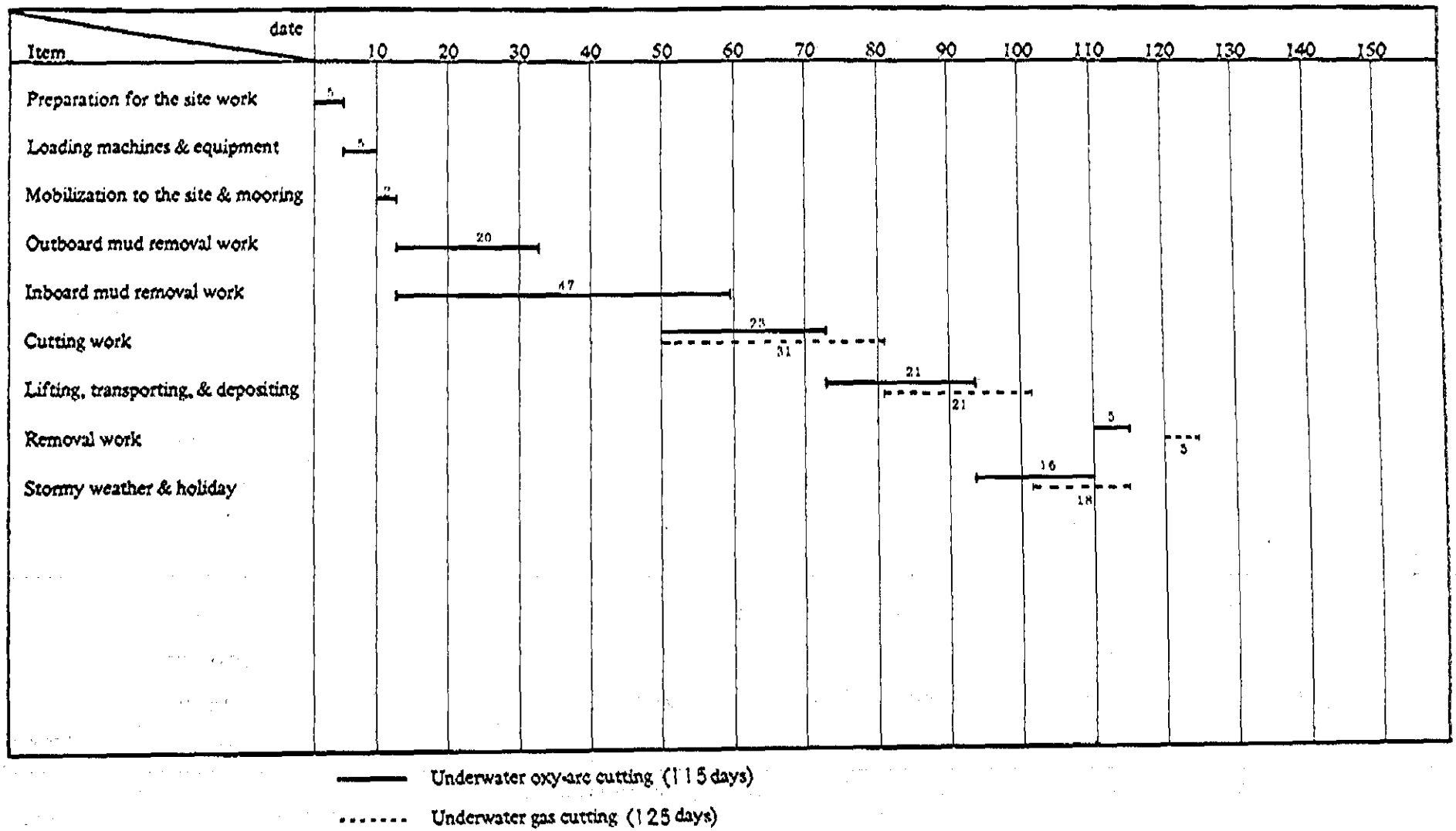
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×79=474	5,000	2,370,000	6×86=516	5,000	2,580,000
	Scuba-type diving equipment	3×79=237	3,000	711,000	3×86=258	3,000	774,000
	Wet suit	8×79=632	1,000	632,000	8×86=688	1,000	688,000
	Air hose (K.M.B. 10)	6×79=474	1,000	474,000	6×86=516	1,000	516,000
	Air bombe (spear)	3×79=237	2,000	474,000	3×86=258	2,000	516,000
	High pressure compressor	1×79= 79	25,000	1,975,000	1×86= 86	25,000	2,150,000
	Low pressure compressor	2×79=158	25,000	3,950,000	2×86=172	25,000	4,300,000
	Underwater cutting torch	4×79=316	6,000	1,896,000			
	Underwater cutting apparatus	4×79=316	5,000	1,580,000			
	Blasting apparatus (full set)	1×79= 79	15,000	1,185,000	1×86= 86	15,000	1,290,000
	Generator (with a switching board)	1×79= 79	50,000	3,750,000	1×86= 86	50,000	4,300,000
	Scrapper	2×79=158	500	79,000	2×86=172	500	86,000
	Jet pump	2×79=158	5,000	790,000	2×86=172	5,000	860,000
	Sand pump (6 inches)	2×79=158	32,500	5,135,000	2×86=172	32,500	5,590,000
	Air lift (6 inches)	2×79=158	12,500	1,975,000	2×86=172	12,500	2,150,000
	Air lift compressor (10 m^3)	1×79= 79	45,000	3,555,000	1×86= 86	45,000	3,870,000
	Anchor (5 tons)	4×79=316	3,000	948,000	4×86=344	3,000	1,032,000
	Anchor (1 ton)	3×79=237	1,000	237,000	3×86=258	1,000	258,000
	Chain (72ϕ x 100M)	3×20= 60	12,500	750,000	3×20= 60	12,500	750,000
	Transceiver	3×79=237	500	118,500	3×86=258	500	129,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×79=237	1,000	237,000	3×86=258	1,000	258,000
	Schakle	1×79= 79	1,000	79,000	1×86= 86	1,000	86,000
	Mooring buoy (1 ton)	4×79=316	2,500	790,000	4×86=344	2,500	860,000
	Oxy-acetylen gas cutting apparatus			790,000	4×86=344	50,000	17,200,000
			Sub-total	33,890,500		Sub-total	50,243,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	60	7,500	450,000	150	7,500	1,125,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	600	700	420,000			
	Powder	45kg	2,000	90,000	45kg	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			300,000			300,000
	Others			200,000			200,000
	Propane				7	35,000	245,000
			Sub-total	5,725,000		Sub-total	6,225,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	4,000ℓ	40	160,000	4,000ℓ	40	160,000
	Gasoline	1,200ℓ	100	120,000	1,200ℓ	100	120,000
	Engine oil	40ℓ	1,000	40,000	40ℓ	1,000	40,000
			Sub-total	320,000		Sub-total	320,000
Site expenses	Food expenses	28×84=2,352	1,000	2,352,000	28×91=2,548	1,000	2,548,000
	Transport & communication expenses	84	5,000	420,000	91	5,000	455,000
	Office expenses			500,000			500,000
			Sub-total	3,772,000		Sub-total	3,503,000
Transportation expenses	Equipment transport expenses			500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	405,077,500		Sub-total	439,376,000
General administrative expenses			10%	40,507,750		10%	43,937,600
			Grand total	445,585,250		Grand total	483,313,600

List 4-3-11

Work flow for removal work of No. 6 sunken vessel (in case of 200 ton F.C.



List 4-3-12

Costing for removal work of No. 6 sunken vessel (200 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200-ton F.C.	1× 27= 27	RP. 3,000,000	RP.81,000,000	1× 27= 27	RP. 3,000,000	RP. 81,000,000
	Tug boat (1,000 HP)	1× 27= 27	1,000,000	27,000,000	1× 27= 27	1,000,000	27,000,000
	Anchor boat	1×110=110	300,000	33,000,000	1×120=120	300,000	36,000,000
	Small boat	1×105=105	150,000	15,750,000	1×115=115	150,000	17,250,000
	Diving pontoon	2×105=210	150,000	31,500,000	2×115=230	150,000	34,500,000
	Working vessel	1×110=110	1,500,000	165,000,000	1×120=120	150,000	180,000,000
	Grab bucket-type dredger	1× 25= 25	1,000,000	25,000,000	1× 25= 25	1,000,000	25,000,000
	Rubber boat with engine	1×105=105	75,000	7,875,000	1×115=115	75,000	8,625,000
			Sub-total	386,125,000		Sub-total	409,375,000
Personnel expenses	Project manager	1×115=115	16,000	1,725,000	1×125=125	15,000	1,875,000
	Salvage master	1×115=115	12,000	1,380,000	1×125=125	12,000	1,500,000
	Assistant salvage master	1×115=115	10,000	1,150,000	1×125=125	10,000	1,250,000
	Asst. project manager	1×115=115	5,000	575,000	1×125=125	5,000	625,000
	Diver	8×115=920	8,000	7,360,000	8×125=1000	8,000	8,000,000
	Blaster	2×115=230	5,000	1,150,000	2×125=250	5,000	1,250,000
	Rigger	6×115=690	5,000	3,450,000	6×125=750	5,000	3,750,000
	Mechanic	5×115=575	5,000	2,875,000	5×125=625	5,000	3,125,000
	Welder	1×115=115	5,000	575,000	1×125=125	5,000	625,000
	Cook	2×115=230	2,000	460,000	2×125=250	2,000	500,000
			Sub-total	20,700,000		Sub-total	27,500,000

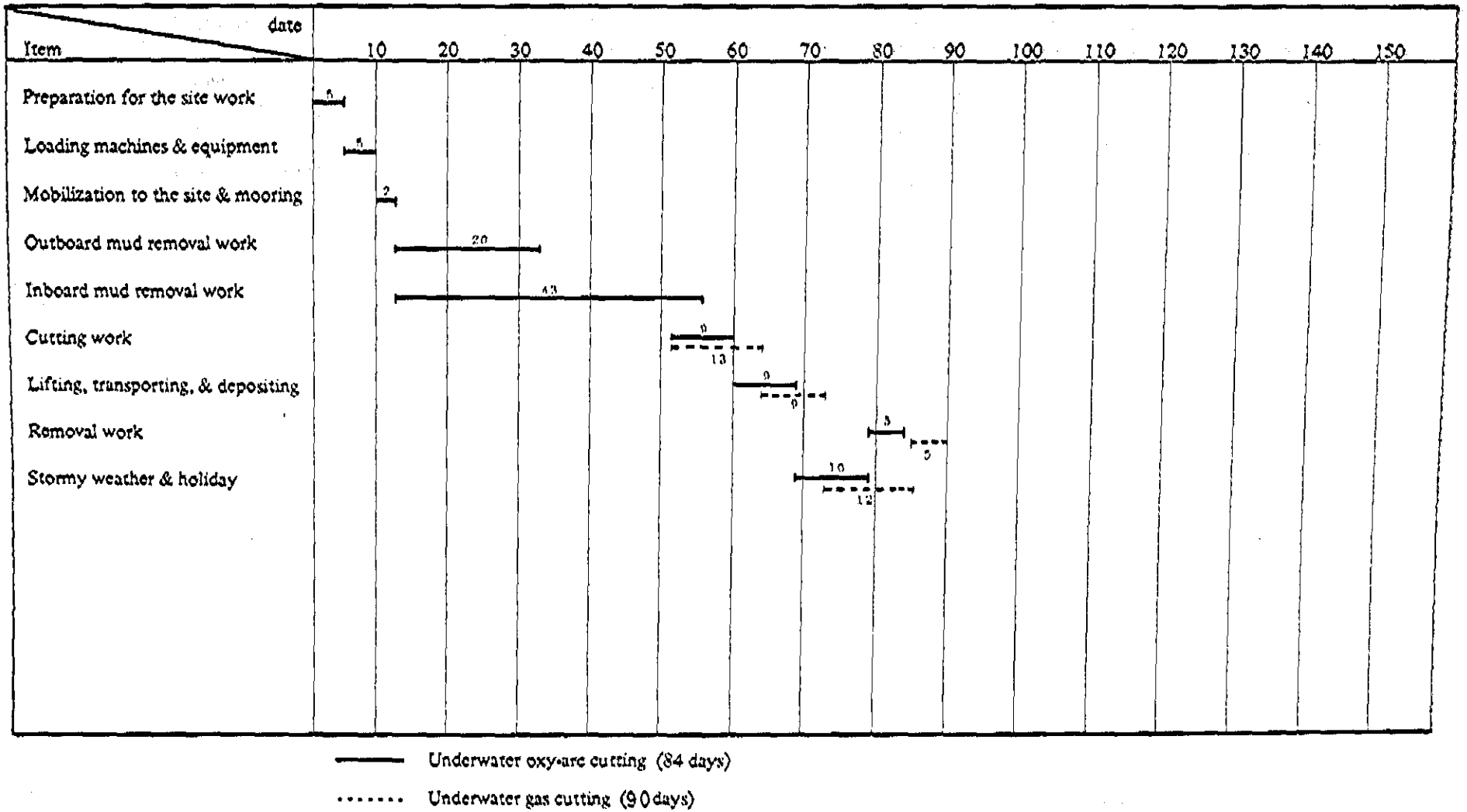
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×110=660	5,000	3,300,000	6×120=720	5,000	3,600,000
	Scuba-type diving equipment	3×110=330	3,000	990,000	3×120=360	3,000	1,680,000
	Wet suit	8×110=880	1,000	880,000	8×120=960	1,000	960,000
	Air hose (K.M.B. 10)	6×110=660	1,000	660,000	6×120=720	1,000	720,000
	Air bombe (spear)	3×110=330	2,000	660,000	3×120=360	2,000	720,000
	High pressure compressor	1×110=110	25,000	2,750,000	1×120=120	25,000	3,000,000
	Low pressure compressor	2×110=220	25,000	5,500,000	2×120=240	25,000	6,000,000
	Underwater cutting torch	4×110=440	6,000	2,640,000	4×120=480	6,000	2,880,000
	Underwater cutting apparatus	4×110=440	5,000	2,200,000			
	Blasting apparatus (full set)	1×110=110	15,000	1,650,000			
	Generator (with a switching board)	1×110=110	50,000	5,500,000	1×120=120	50,000	6,000,000
	Scrapper	2×110=220	500	110,000	2×120=240	500	120,000
	Jet pump	2×110=220	5,000	1,100,000	2×120=240	5,000	1,200,000
	Sand pump (6 inches)	2×110=220	32,500	7,150,000	2×120=240	32,500	7,800,000
	Air lift (6 inches)	2×110=220	12,500	2,750,000	2×120=240	12,500	3,000,000
	Air lift compressor (10 m^3)	1×110=110	45,000	9,900,000	1×120=120	45,000	5,400,000
	Anchor (5 tons)	4×110=440	3,000	1,320,000	4×120=480	3,000	1,440,000
	Anchor (1 ton)	3×110=330	1,000	330,000	3×120=360	1,000	360,000
	Chain (72ϕ × 100M)	3× 27= 81	12,500	1,012,500	3× 27= 81	12,500	1,012,500
	Transceiver	3×110=330	500	165,000	3×120=360	500	180,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×110=330	1,000	330,000	3×120=360	1,000	360,000
	Schakle	1×110=110	1,000	110,000	1×120=120	1,000	120,000
	Mooring buoy (1 ton)	4×110=440	2,500	1,100,000	4×120=480	2,500	1,200,000
	Oxy-acetylen gas cutting apparatus				4×120=480	50,000	24,000,000
			Sub-total	52,107,500		Sub-total	71,152,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	100	7,500	750,000	250	7,500	1,875,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	1,000	700	700,000			
	Powder	45kg	2,000	90,000	45kg	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			400,000			400,000
	Others			200,000			200,000
	Propane				10	35,000	350,000
			Sub-total	6,403,000		Sub-total	7,180,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	5,000ℓ	40	200,000	5,000ℓ	40	200,000
	Gasoline	1,200ℓ	100	120,000	1,200ℓ	100	120,000
	Engine oil	50ℓ	1,000	50,000	50ℓ	1,000	50,000
			Sub-total	370,000		Sub-total	370,000
Site expenses	Food expenses	28×115=3,220	1,000	3,220,000	28×125=3,500	1,000	3,500,000
	Transport & communication expenses	115	5,000	575,000	125	5,000	625,000
	Office expenses			600,000			600,000
			Sub-total	4,395,000		Sub-total	4,725,000
Transportation expenses	Equipment transport expenses			500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	470,802,500		Sub-total	515,002,000
General administrative expenses			10%	47,080,250		10%	51,600,200
			Grand total	517,882,750		Grand total	567,602,200

List 4-3-13

Work flow for removal work of No. 6 sunken vessel (in case of 500 ton F.C.



List 4-3-14

Costing for removal work of No. 6 sunken vessel (500 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1×14= 14	RP. 6,000,000	RP. 84,000,000	1×14= 14	RP. 6,000,000	RP. 84,000,000
	Tug boat (1,000 HP)	1×14= 14	1,500,000	21,000,000	1×14= 14	1,500,000	21,000,000
	Anchor boat	1×79= 79	300,000	23,000,000	1×85= 85	300,000	25,500,000
	Small boat	1×74= 74	150,000	11,100,000	1×80= 80	150,000	12,000,000
	Diving pontoon	2×74=148	150,000	22,200,000	2×80=160	150,000	24,000,000
	Working vessel	1×79= 79	1,500,000	118,500,000	1×85= 85	1,500,000	127,500,000
	Grab bucket-type dredger	1×23= 23	1,000,000	23,000,000	1×23= 23	1,000,000	23,000,000
	Rubber boat with engine	1×74= 74	75,000	5,550,000	1×80= 80	75,000	6,000,000
			Sub-total	309,050,000		Sub-total	323,000,000
Personnel expenses	Project manager	1×84= 84	15,000	1,260,000	1×90= 90	15,000	1,350,000
	Salvage master	1×84= 84	12,000	1,008,000	1×90= 90	12,000	1,080,000
	Assistant salvage master	1×84= 84	10,000	840,000	1×90= 90	10,000	900,000
	Asst. project manager	1×84= 84	5,000	420,000	1×90= 90	5,000	450,000
	Diver	8×84=672	8,000	5,376,000	8×90=720	8,000	5,760,000
	Blaster	2×84=168	5,000	840,000	2×90=180	5,000	900,000
	Rigger	6×84=504	5,000	2,520,000	6×90=540	5,000	2,700,000
	Mechanic	5×84=420	5,000	2,100,000	5×90=450	5,000	2,250,000
	Welder	1×84= 84	5,000	420,000	1×90= 90	5,000	450,000
	Cook	2×84=168	2,000	336,000	2×90=180	2,000	360,000
			Sub-total	15,120,000		Sub-total	16,200,000

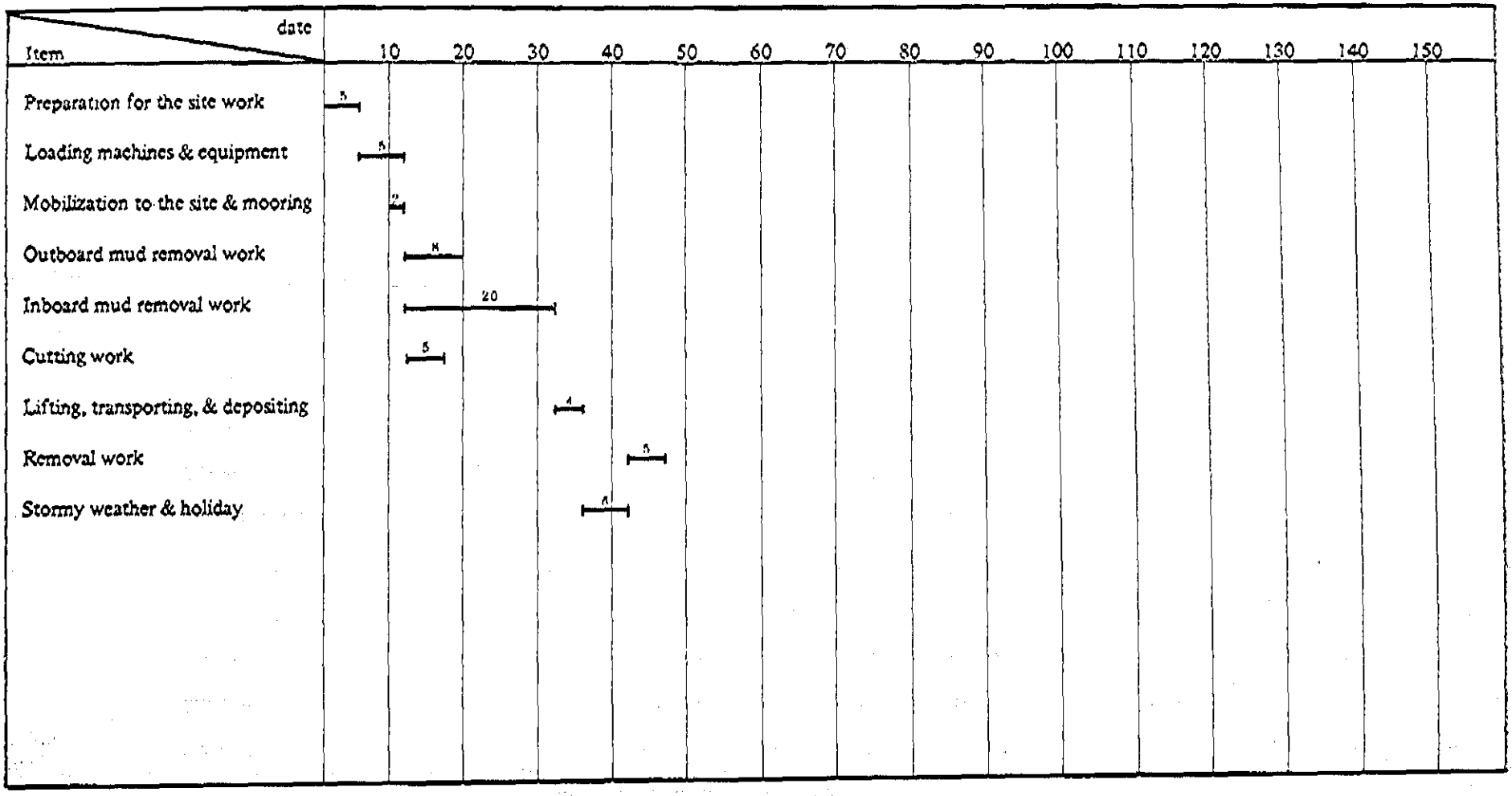
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×79=474	5,000	2,370,000	6×85=510	5,000	2,550,000
	Scuba-type diving equipment	3×79=237	3,000	711,000	3×85=255	3,000	765,000
	Wet suit	8×79=632	1,000	632,000	8×85=680	1,000	680,000
	Air hose (K.M.B. 10)	6×79=474	1,000	474,000	6×85=510	1,000	510,000
	Air bombe (spear)	3×79=237	2,000	474,000	3×85=255	2,000	510,000
	High pressure compressor	1×79= 79	25,000	1,975,000	1×85= 85	25,000	2,125,000
	Low pressure compressor	2×79=158	25,000	3,950,000	2×85=170	25,000	4,250,000
	Underwater cutting torch	4×79=316	6,000	1,896,000			
	Underwater cutting apparatus	4×79=316	5,000	1,580,000			
	Blasting apparatus (full set)	1×79= 79	15,000	1,185,000	1×85= 85	15,000	1,275,000
	Generator (with a switching board)	1×79= 79	50,000	3,950,000	1×85= 85	50,000	12,750,000
	Scrapper	2×79=158	500	79,000	2×85=170	500	85,000
	Jet pump	2×79=158	5,000	790,000	2×85=170	5,000	850,000
	Sand pump (6 inches)	2×79=158	32,500	5,135,000	2×85=170	32,500	5,525,000
	Air lift (6 inches)	2×79=158	12,500	1,975,000	2×85=170	12,500	2,125,000
	Air lift compressor (10 m³)	1×79= 79	45,000	3,555,000	1×85= 85	45,000	3,825,000
	Anchor (5 tons)	4×79=316	3,000	948,000	4×85=340	3,000	1,020,000
	Anchor (1 ton)	3×79=237	1,000	237,000	3×85=255	1,000	255,000
	Chain (72φ × 100M)	3×27= 81	12,500	1,012,500	3×27= 81	12,500	1,012,500
	Transceiver	3×79=237	500	118,500	3×85=255	500	127,500

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×79=237	1,000	237,000	3×85=255	1,000	255,000
	Schakle	1×79= 79	1,000	79,000	1×85= 85	1,000	85,000
	Mooring buoy (1 ton)	4×79=316	2,500	790,000	4×85=340	2,500	850,000
	Oxy-acetylen gas cutting apparatus				4×85=340	50,000	17,000,000
			Sub-total	34,153,000		Sub-total	58,430,000
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			2,000,000
	Kuremona rope (12φ ~ 42φ)			2,000,000			2,000,000
	Mooring buoy (rescue type)			100,000			100,000
	Oxygen	40	7,500	300,000	90	7,500	675,000
	Acetylane	5	15,000	75,000	5	15,000	75,000
	Cutting stick	400	700	280,000			
	Powder	45kg	2,000	90,000	45kg	2,000	90,000
	Percussion cap	60	1,500	90,000	60	1,500	90,000
	Graves & tape, etc.			300,000			300,000
	Others						200,000
	Propane				4	35,000	140,000
			Sub-total	5,435,000		Sub-total	5,670,000

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	4,000ℓ	40	160,000	4,000ℓ	40	160,000
	Gasoline	1,200ℓ	100	120,000	1,200ℓ	100	120,000
	Engine oil	40ℓ	1,000	40,000	40ℓ	1,000	40,000
			Sub-total	320,000		Sub-total	320,000
Site expenses	Food expenses	28×84=2,352	1,000	2,352,000	28×90=2,520	1,000	2,520,000
	Transport & communication expenses	84	5,000	420,000	90	5,000	450,000
	Office expenses			500,000			500,000
			Sub-total	3,272,000		Sub-total	3,470,000
Transportation expenses	Equipment transport expenses			500,000			500,000
Premium	Cargo premium for equipment transport			200,000			200,000
			Sub-total	368,050,000		Sub-total	407,790,000
General administrative expenses			10%	36,805,000		10%	40,779,000
			Grand total	404,855,000		Grand total	448,569,000

List 4-3-15

Work flow for removal work of No. 2 sunken vessel (in case of 500 ton F.C.



List 4-3-16

Costing for removal work of No. 2 sunken vessel (500 ton F.C.)

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Vessel expenses	200 ton F.C.	1× 7= 7	RP. 6,000,000	RP. 42,000,000		RP.	RP.
	Tug boat (1,000 HP)	1× 7= 7	1,500,000	10,500,000			
	Anchor boat	1×42= 42	300,000	12,600,000			
	Small boat	1×37= 37	150,000	5,550,000			
	Diving pontoon	2×37= 74	150,000	11,100,000			
	Working vessel	1×42= 42	1,500,000	63,000,000			
	Grab bucket-type dredger	1× 9= 9	1,000,000	9,000,000			
	Rubber boat with engine	1×37= 37	75,000	2,775,000			
			Sub-total	156,525,000		Sub-total	
Personnel expenses	Project manager	1×47= 47	15,000	705,000			
	Salvage master	1×47= 47	12,000	564,000			
	Assistant salvage master	1×47= 47	10,000	470,000			
	Asst. project manager	1×47= 47	5,000	235,000			
	Diver	8×47=376	8,000	3,008,000			
	Blaster	2×47= 94	5,000	470,000			
	Rigger	6×47=282	5,000	1,410,000			
	Mechanic	5×47=235	5,000	1,175,000			
	Welder	1×47= 47	5,000	235,000			
	Cook	2×47= 94	2,000	188,000			
			Sub-total	8,460,000		Sub-total	

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Equipment expenses	K. M. B. 10	6×42=252	5,000	1,260,000			
	Scuba-type diving equipment	3×42=126	3,000	378,000			
	Wet suit	8×42=336	1,000	336,000			
	Air hose (K.M.B. 10)	6×42=252	1,000	252,000			
	Air bombe (spear)	3×42=126	2,000	252,000			
	High pressure compressor	1×42= 42	25,000	1,050,000			
	Low pressure compressor	2×42= 84	25,000	2,100,000			
	Underwater cutting torch	4×42=168	6,000	1,008,000			
	Underwater cutting apparatus	4×42=168	5,000	840,000			
	Blasting apparatus (full set)	1×42= 42	15,000	630,000			
	Generator (with a switching board)	1×42= 42	50,000	2,100,000			
	Scrapper	2×42= 84	500	42,000			
	Jet pump	2×42= 84	5,000	420,000			
	Sand pump (6 inches)	2×42= 84	32,500	2,730,000			
	Air lift (6 inches)	2×42= 84	12,500	1,050,000			
	Air lift compressor (10 m^3)	1×42= 42	45,000	1,890,000			
	Anchor (5 tons)	4×42=168	3,000	504,000			
	Anchor (1 ton)	3×42=126	1,000	126,000			
	Chain (72ϕ × 100M)	3× 7= 21	12,500	262,500			
	Transceiver	3×42=126	500	63,000			

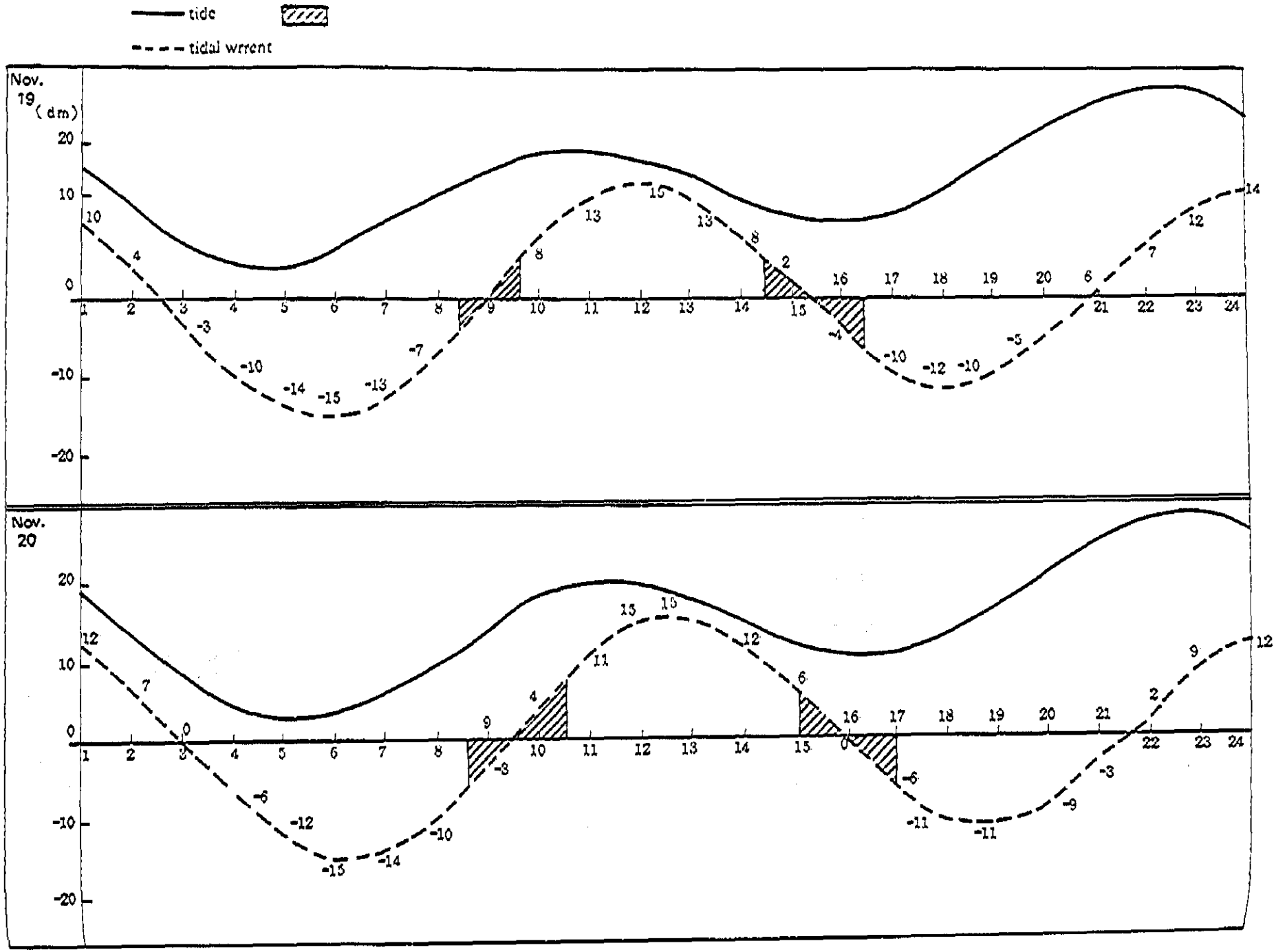
Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
	Underwater communication system	3×42=126	1,000	126,000			
	Schakle	1×42= 42	1,000	42,000			
	Mooring buoy (1 ton)	4×42=168	2,500	420,000			
	Oxy-acetylen gas cutting apparatus		2,500				
			Sub-total	17,881,500		Sub-total	
Consumable expenses	Wire rope (12φ ~ 32φ)			2,000,000			
	Kuremona rope (12φ ~ 42φ)			2,000,000			
	Mooring buoy (rescue type)			100,000			
	Oxygen	10	7,500	75,000			
	Acetylane	5	15,000	75,000			
	Cutting stick	100	700	70,000			
	Powder	20kg	2,000	40,000			
	Percussion cap	30	1,500	45,000			
	Graves & tape, etc.			200,000			
	Others			200,000			
	Propane						
			Sub-total	4,805,000		Sub-total	

Item	Contents	Underwater oxy-arc cutting			Underwater gas cutting		
		No. of mobilization	Unit price	Amount	No. of mobilization	Unit price	Amount
Fuel expenses	Light oil	2,000ℓ	40	80,000			
	Gasoline	1,200ℓ	100	120,000			
	Engine oil	20ℓ	1,000	20,000			
			Sub-total	220,000		Sub-total	
Site expenses	Food expenses	.28×47=13.16	1,000	1,316,000			
	Transport & communication expenses	47	5,000	235,000			
	Office expenses						
			Sub-total	1,551,000		Sub-total	
Transportation expenses	Equipment transport expenses			500,000			
Premium	Cargo premium for equipment transport			200,000			
			Sub-total	190,142,500		Sub-total	
General administrative expenses			10%	19,014,250			
			Grand total	209,156,750		Grand total	

SURABAYA PORT

(Tidal Current Table & Tide Table)

Plan 4-3-1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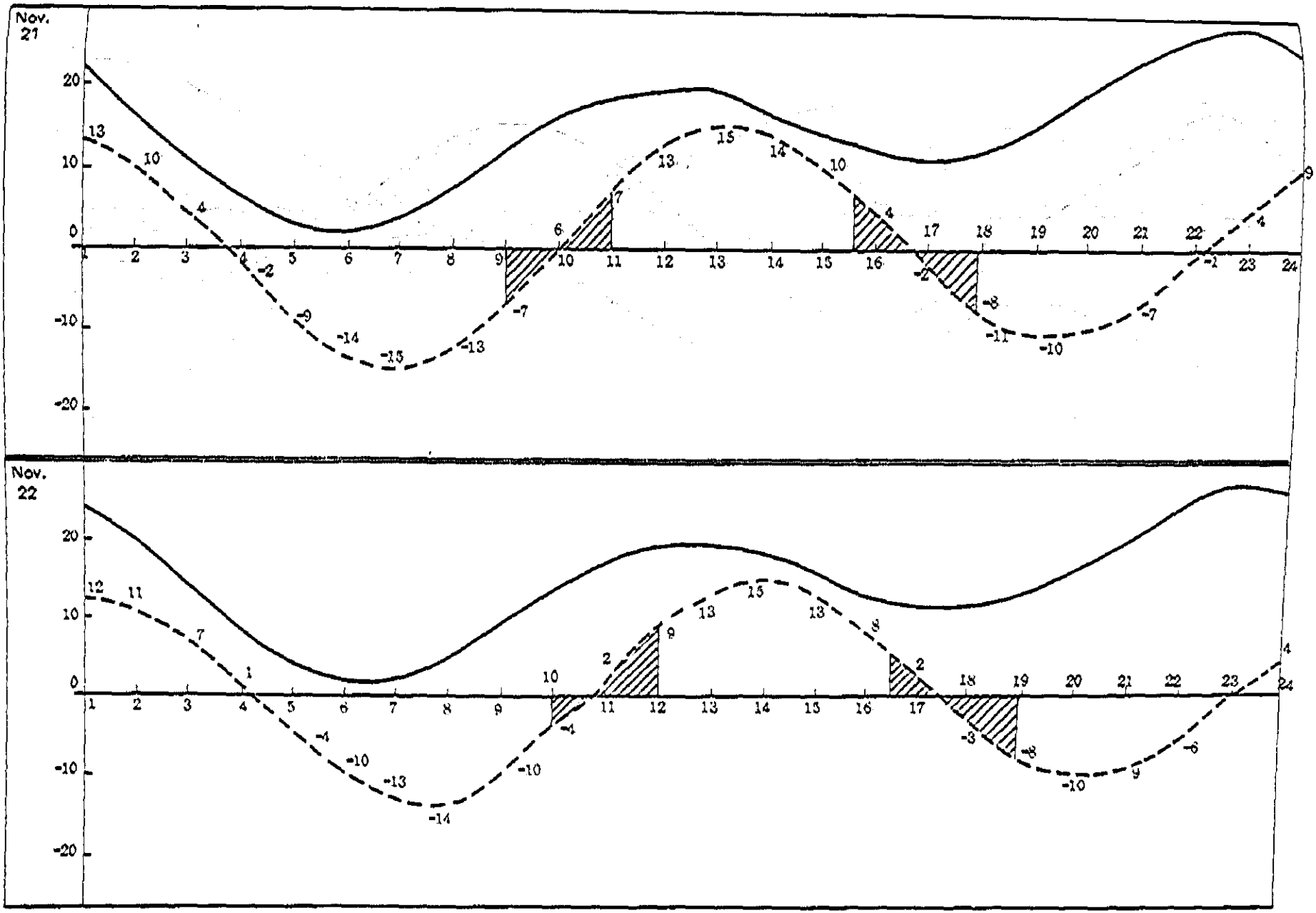
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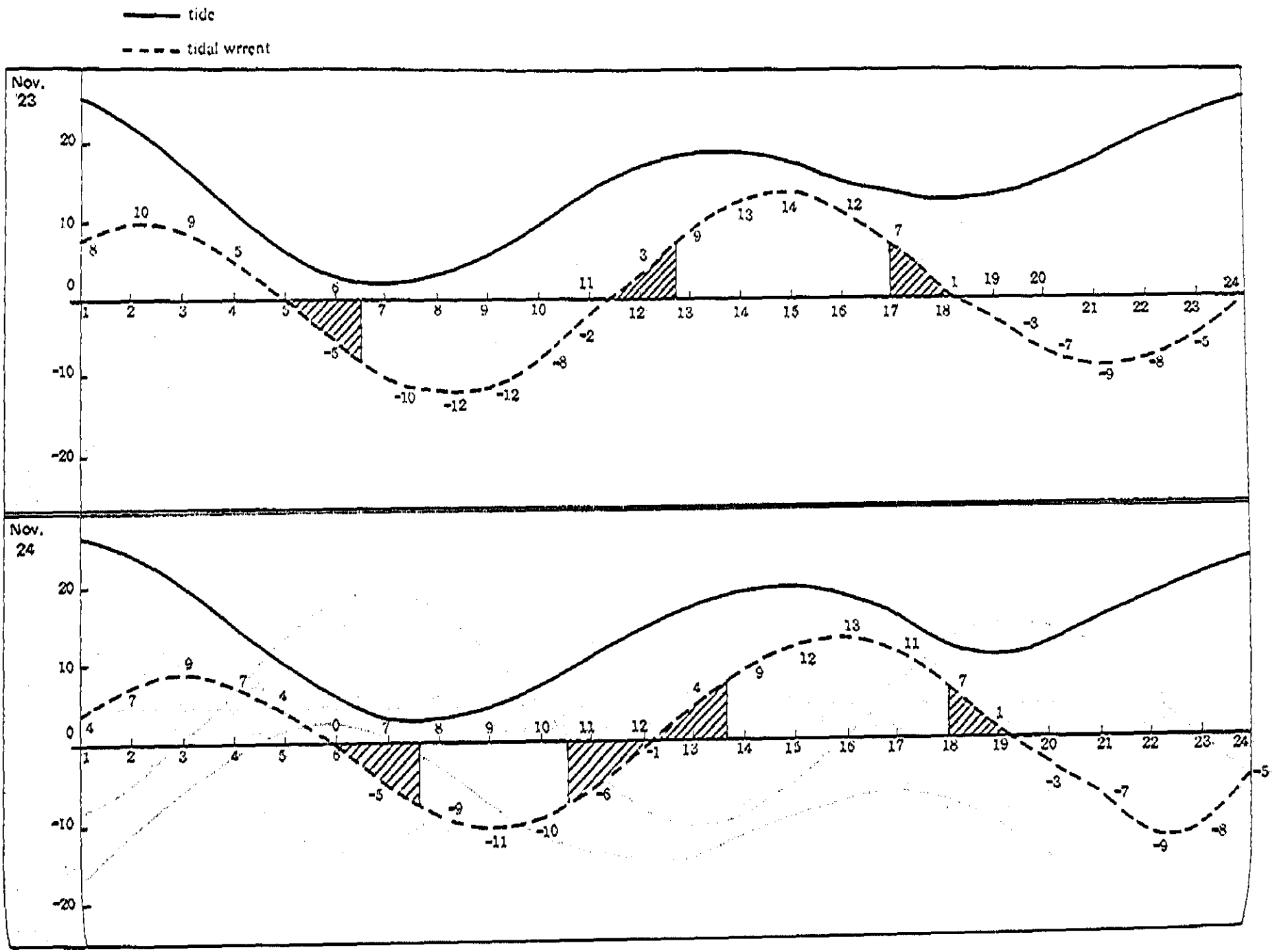
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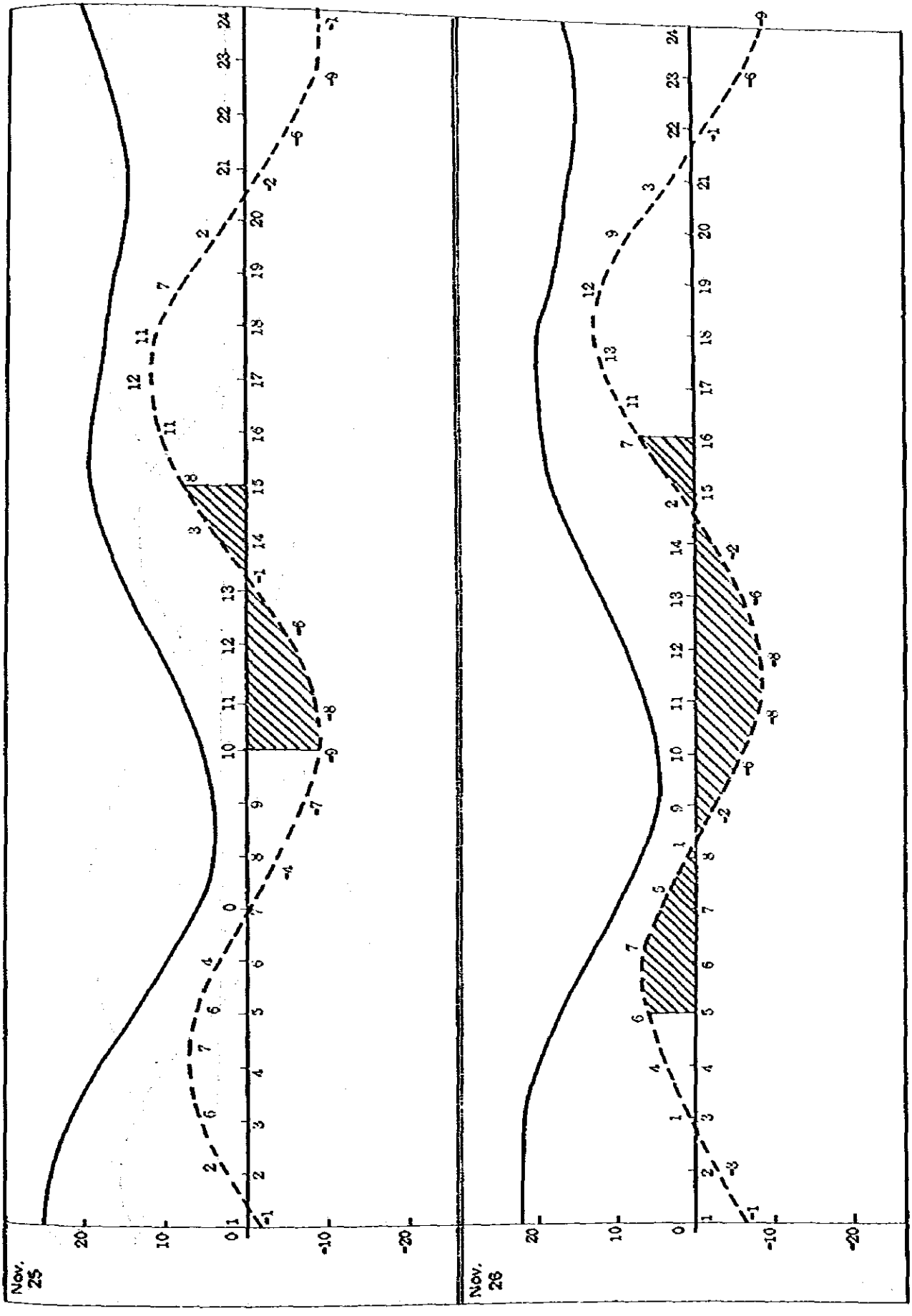
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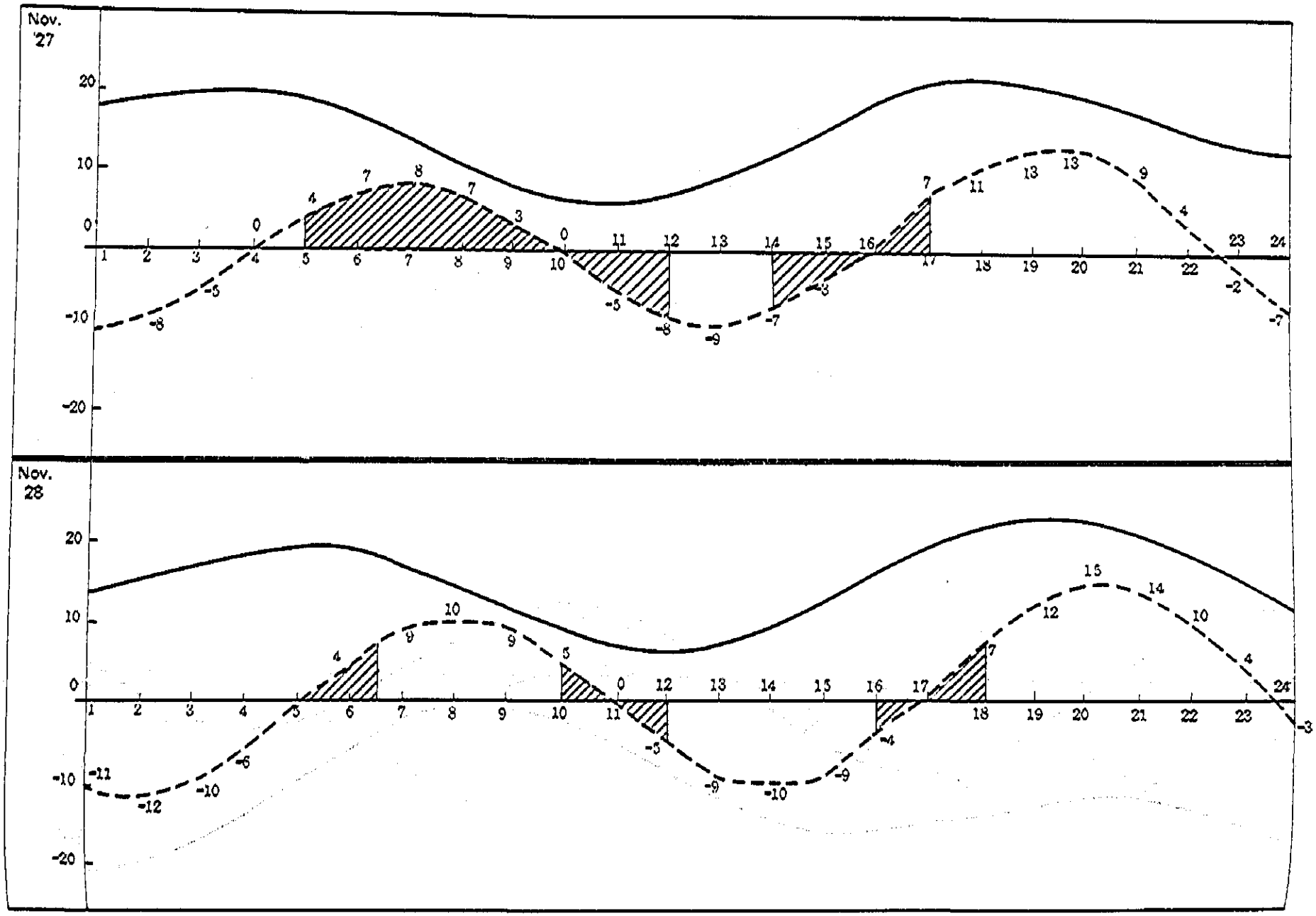
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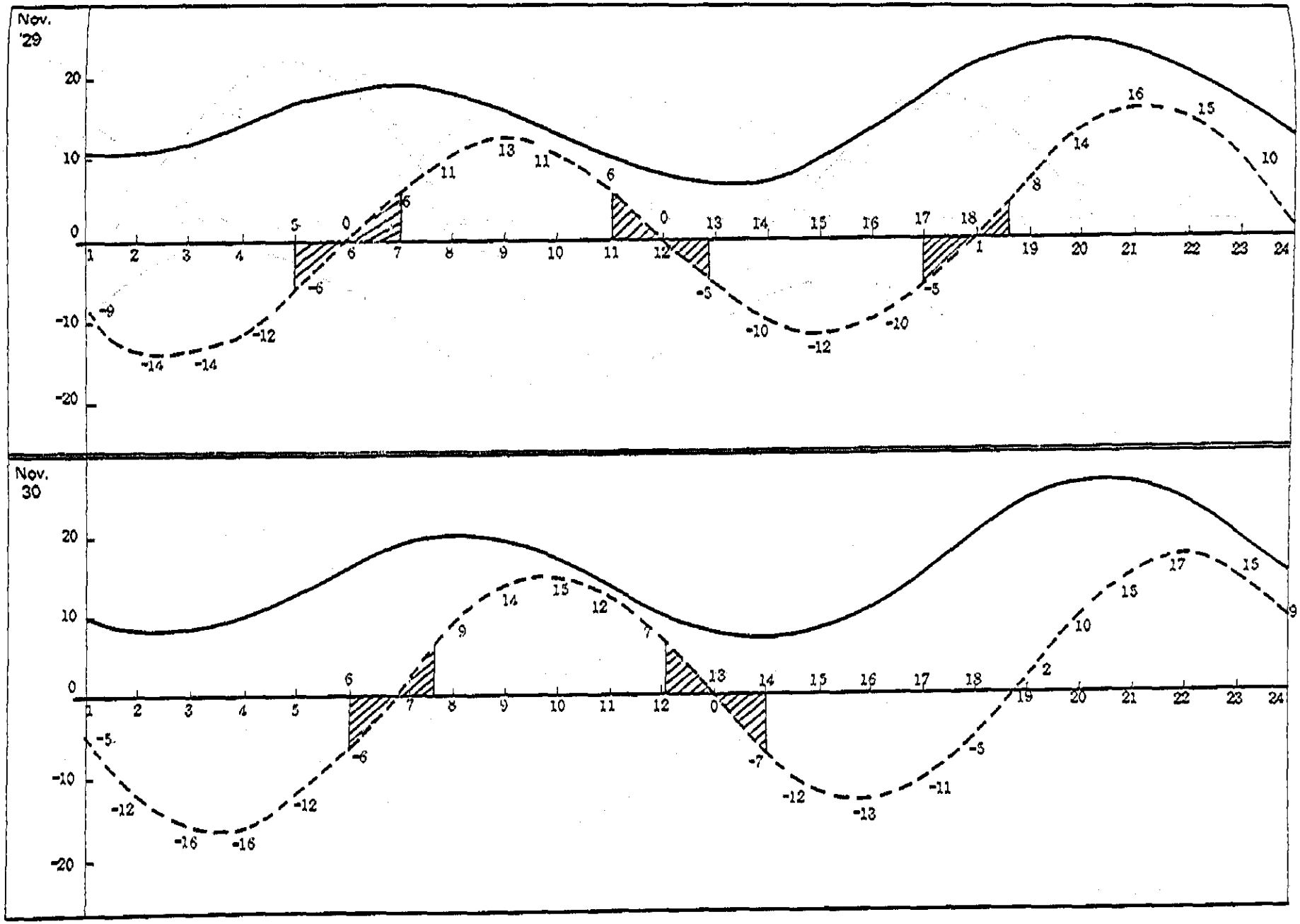
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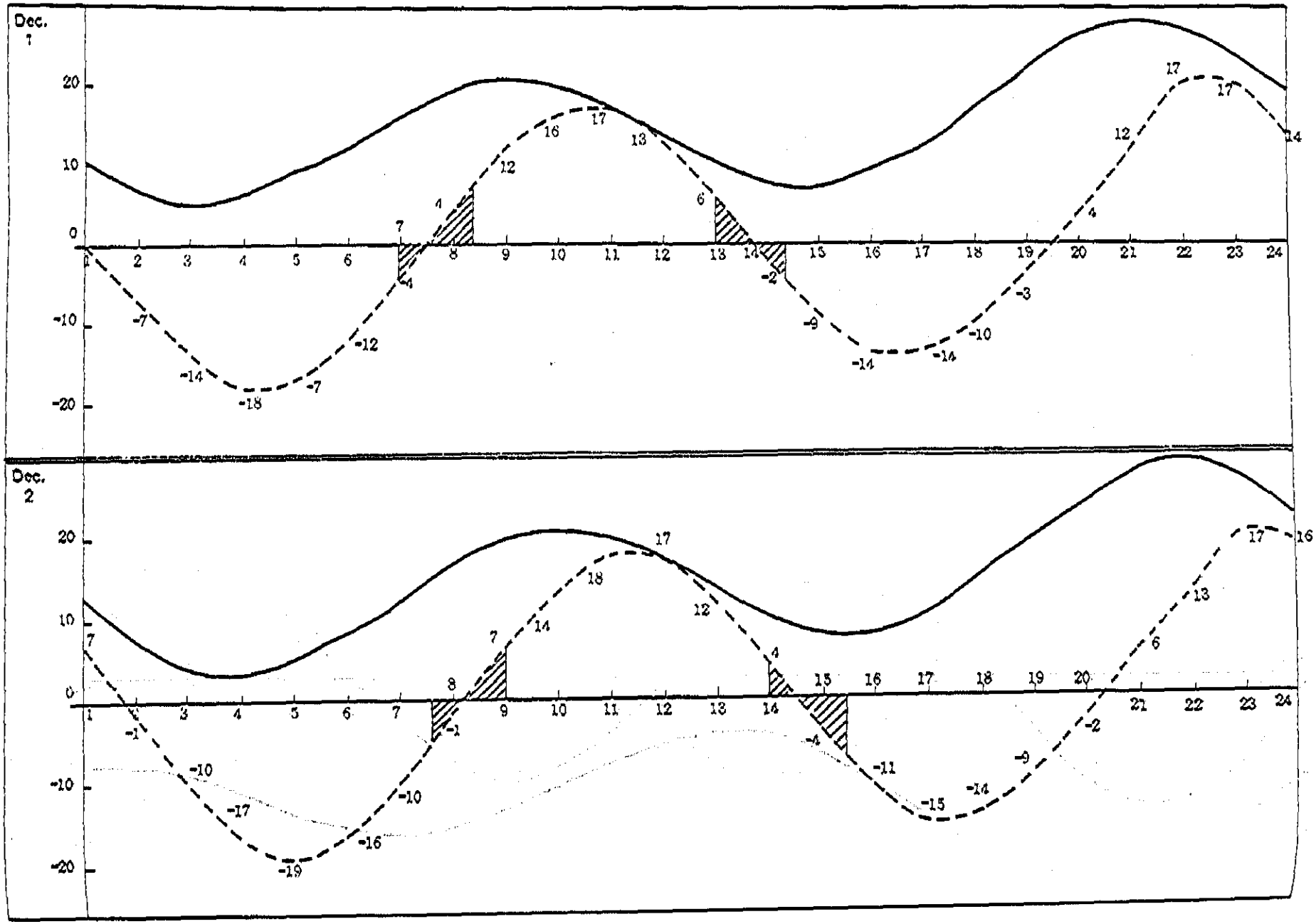
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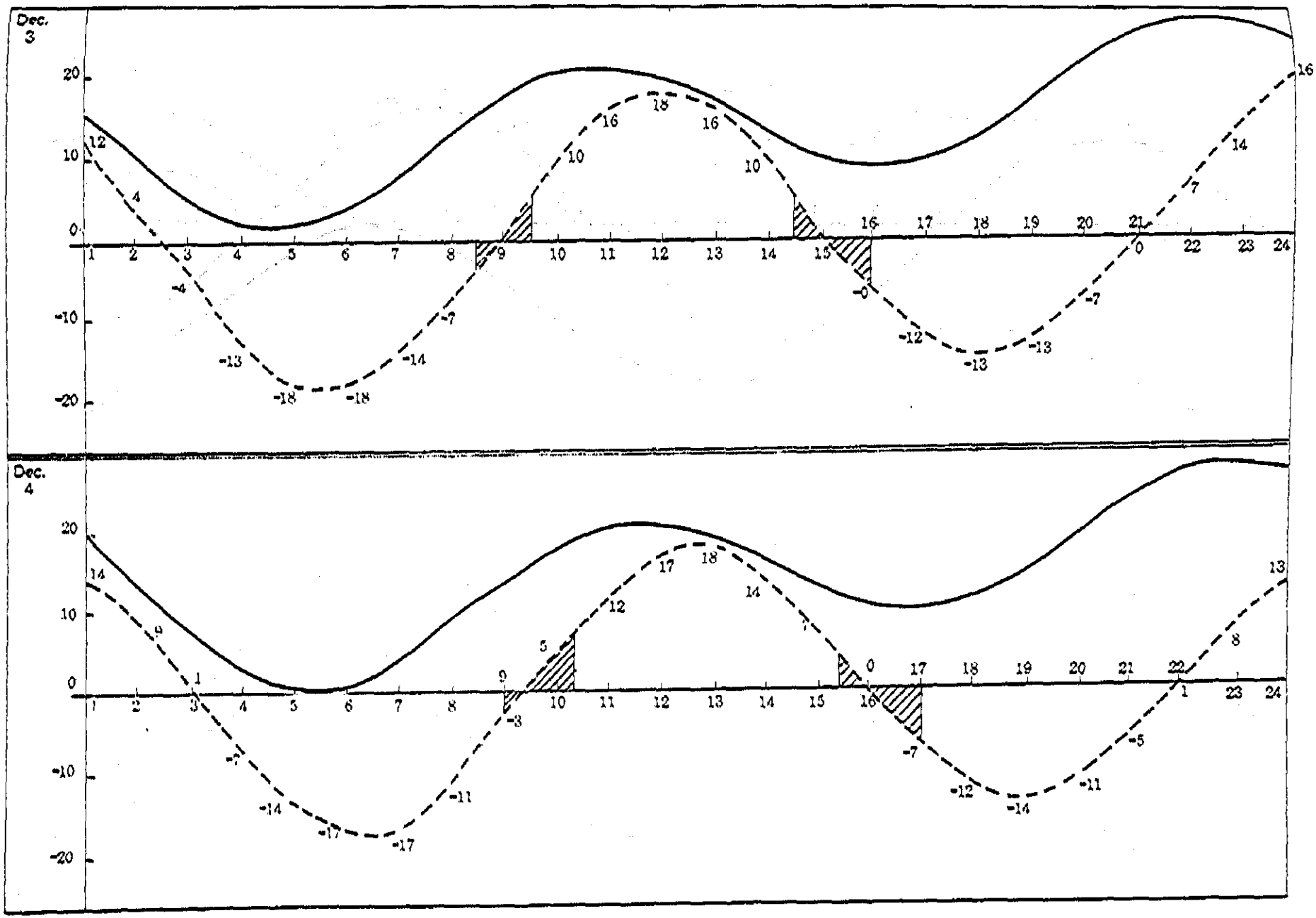
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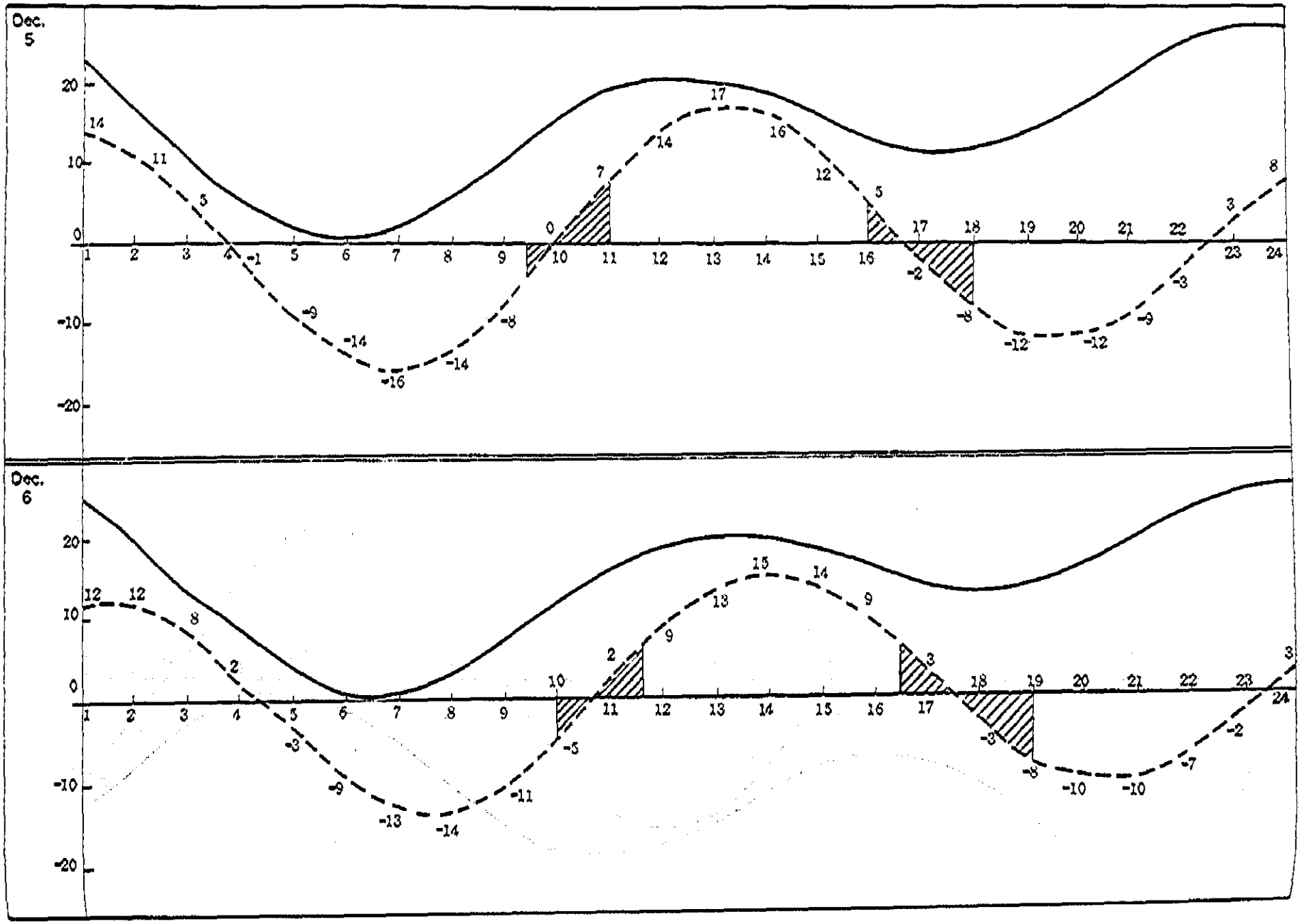
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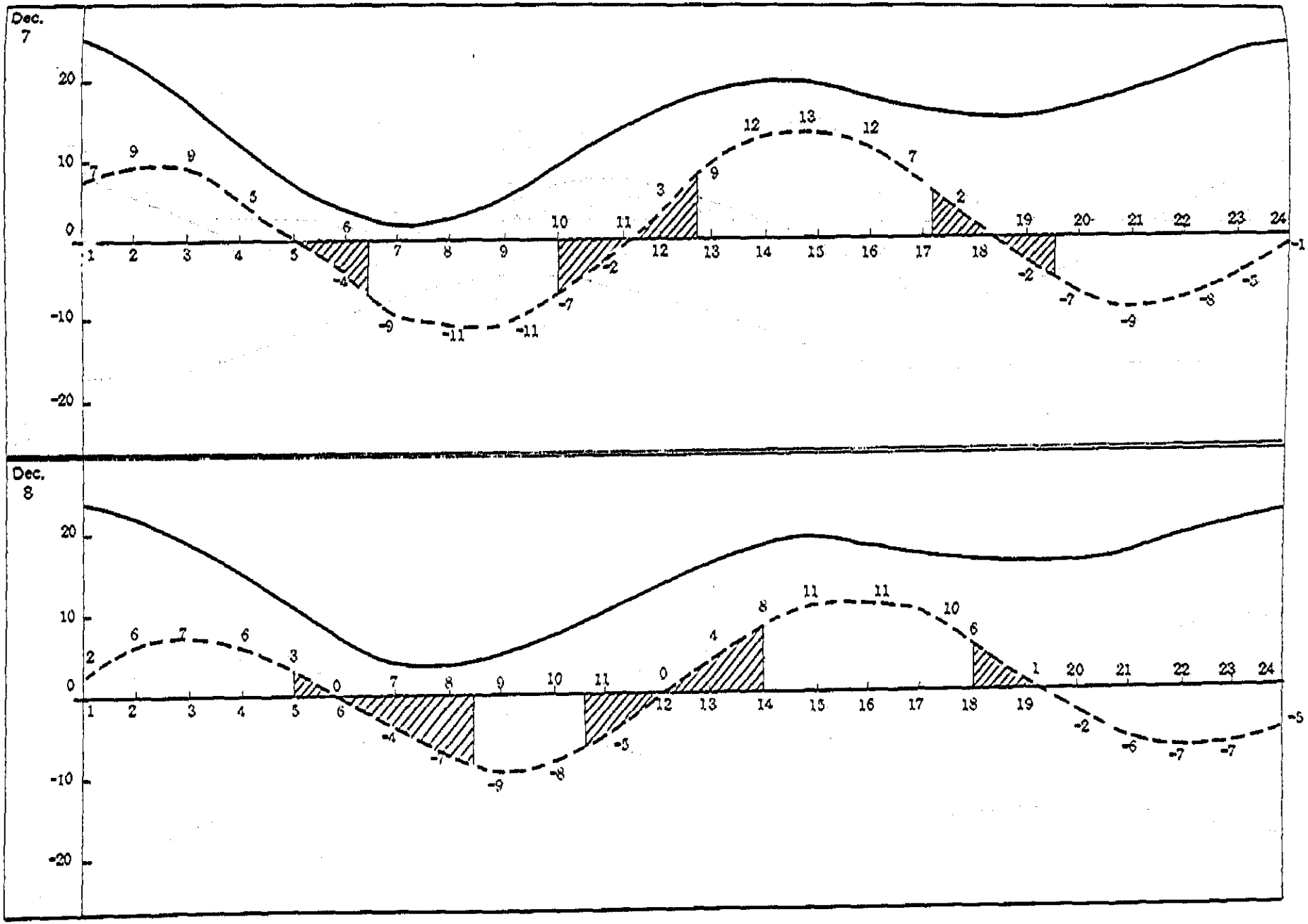
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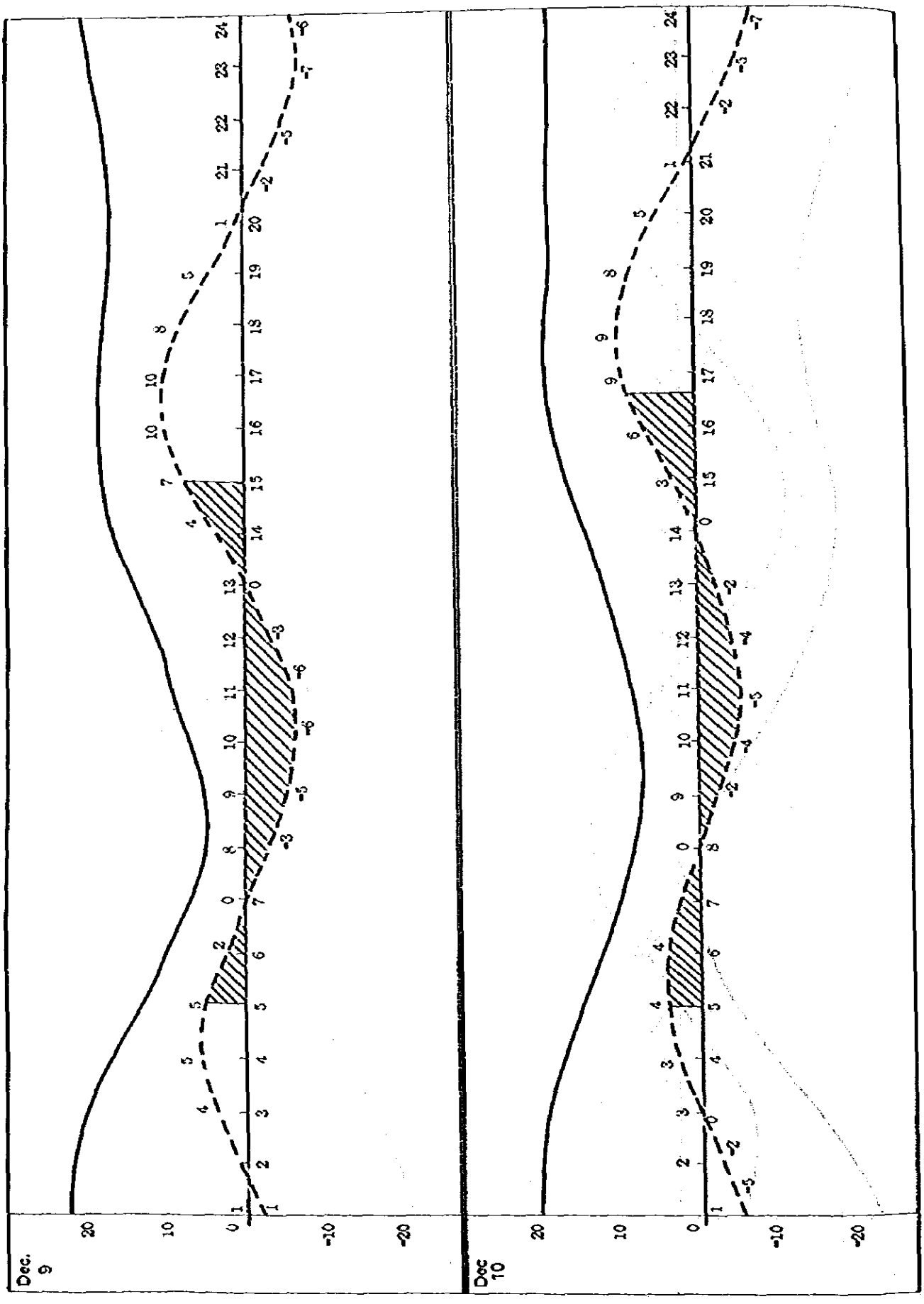
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Detailed comparative costing by the capacity of floating crane and cutting method

List 4-3-17

Item		Sunken vessel	No. 4	No. 3	No. 6	No. 2
200 ton floating crane	Under water oxy-arc cutting	Vessel expenses	77.38%	76.07%	74.56%	
		Personnel expenses	3.47	3.83	3.99	
		Equipment expenses	7.91	8.70	10.06	
		Consumable expenses	1.30	1.37	1.31	
		Site expenses	0.85	0.94	0.98	
		General expenses	9.09	9.09	9.09	
	Under water gas cutting	Vessel expenses	74.36%	72.88%	72.12%	
		Personnel expenses	3.48	3.83	3.96	
		Equipment expenses	10.94	11.90	12.54	
		Consumable expenses	1.30	1.38	1.33	
		Site expenses	0.83	0.91	0.96	
		General expenses	9.09	9.09	9.09	

Item		Sunken vessel	No. 4	No. 3	No. 6	No. 2
500 ton floating crane	Under water oxy-arc cutting	Vessel expenses	78.24%	77.66%	76.34%	74.84%
		Personnel expenses	3.20	3.39	3.73	4.04
		Equipment expenses	7.14	7.61	8.44	8.55
		Consumable expenses	1.46	1.36	1.42	2.40
		Site expenses	0.87	0.89	0.98	1.08
		General expenses	9.09	9.09	9.09	9.09
	Under water gas cutting	Vessel expenses	75.34%	74.97%	72.01%	
		Personnel expenses	3.24	3.39	3.61	
		Equipment expenses	9.97	10.40	13.03	
		Consumable expenses	1.50	1.35	1.34	
		Site expenses	0.85	0.87	0.93	
		General expenses	9.09	9.09	9.09	

Detailed comparative costing table by the capacity of floating crane and cutting method

List 4-3-18

Item \ Sunken Vessel			No. 4	No. 3	No. 6	No. 2
200 ton floating crane	Number of cut block		13	11	7	
	Cut length (M)		±430	±460	±310	
	Under water oxy-arc cutting	Period (day)	110	117	115	
		No. of mobilization (man, day)	3080	3276	3220	
		Cost (R.P.)	570,531,500	549,186,000	517,882,750	
	Under water gas cutting	Period (day)	124	133	125	
		No. of mobilization (man, day)	3472	3724	3500	
		Cost (R.P.)	641,138,300	624,264,300	567,602,200	

Item \ Sunken Vessel			No. 4	No. 3	No. 6	No. 2
500 ton floating crane	Number of cut block		5	4	3	1
	Cut length (M)		±270	±190	±114	0
	Under water oxy-arc cutting	Period (day)	75	84	84	47
		No. of mobilization (man, day)	2100	2352	2352	1316
		Cost (R.P.)	421,938,000	445,585,250	404,855,000	209,156,750
	Under water gas cutting	Period (day)	84	91	90	
		No. of mobilization (man, day)	2352	2548	2520	
		Cost (R.P.)	465,969,900	483,313,600	448,569,000	

List 4-3-19 Additional Cost in case that a scrap yard is provided at T.G. Jati

(1) Mobilization of 200 ton F.C.

sunken vessel	No. 4	No. 3	No. 6	No. 2
Additional working days	13 days	11 days	7 days	
Additional cost	R.P. 57,200,000	R.P. 48,400,000	R.P. 30,800,000	

(2) Mobilization of 500 F.C.

sunken vessel	No. 4	No. 3	No. 6	No. 2
Additional working days	5 days	4 days	3 days	1 day
Additional cost	R.P. 41,250,000	R.P. 33,000,000	R.P. 24,750,000	R.P. 8,250,000

Only for reference

Steel Weight per Gross Tonnage

Kind of Vessel	Steel Weight
Cargo Vessel (large)	0.51 %
(small)	0.47
Passenger Vessel	0.49
Tanker	0.46
High Speed Cargo Vessel (flat deck type)	0.49
High Speed Cargo Vessel (three island type)	0.52
Cargo Vessel	0.47

Weight of Various Materials

Kind of Vessel		Cargo Vessel	Cargo Vessel	Cargo Vessel	Tanker
Type of Vessel		Three Island	Three Island	Shelter Deck	Long Poop
Dimension (M)		L x B x D	L x B x D	L x B x D	L x B x D
		83.5 x 12.7 x 6.93	99.1 x 14.0 x 8.23	108 x 14.8 x 10	140 x 18.7 x 11.4
Gross tonnage (T)		2085	3150	4270	8674
Steel	pipe	22 T	27	46	40
	plate	650	918	1239	2924
	angle	254	340	453	996
	Total	926	1285	1738	3960
Casting Forging	Forging	32	39	67	80
	casting	70	88	119	119
	Total	102	127	186	199
Cupper	gun metal	5	6	8	7
	cupper	2	3	4	6
	Total	7	9	12	13
Grand Total		1035 T	1421 T	1986 T	4172 T

Example of Steam Reciprocating Engine

	L x B x D	G/T	Type of engine	I.H.P Apro.
E	123. x 16.3 x 9.4	5,618	600 x 730 x 1700	2750 / 3371
F	100.58 x 14.33 x 7.12	3,291	500 x 770 x 1400	1,550 / 2278
G	80.00 x 11.6 x 6.1	1,805	400 x 620 x 1130	1,000 / 1,257

Weight

		E	F	G
1.	Main engine	135.1	81.	44.1
2.	Shafting	62.5	33.5	17.5
3.	Ex. Turbine	9.7	8.1	1
4.	Aut. Mach.	26.9	19.2	16.6
5.	Boiler	179.4	119.1	85.
6.	Piping	23.5	23.8	11.2
7.	Valve	17.5	13.8	11.0
8.	Spare Gear	14.1	9.1	2.7
9.	Elect. Plant	9.0	6.9	5.3
10.	Floor	20.3	16.2	12.6
11.	Miscellarous	23.0	16.5	7.4
12.	Donky Boiler	1	1	1
	Total	521.4 t	346.1 t	213.4 t

Engine Weight

Kind of Engine	Reciprocasing engine				Turbine		
H. P.	160 HP	770	2,880	5,500	2,100	3,000	
Main engine	4.88 T	25. T	111.6 T	175.	53.5	81.6	
Shaft	1.22 T	11.2	52.5 T	48.2	31.1	50.0	
Auxiliary machine	1.12 T	6.2	12.3	28.5	21.4	22.7	
Boiler	12.9	45.5	98.7	231.0	90.8	177.5	
Funnel	0.94	3.4	21.4	49.	32.3	41.5	
Piping	1.73	5.2	23.4	47.8	34.0	26.	
Etc.	1.12	6.7	17.5	45.8	29.5	40.	
Total	23.27 T	103.1	337.4	625.3	292.6	439.3	

5. MOST ADEQUATE METHOD AND EXPENSES

Historical Background of Salvage

The salvage service is a relatively new enterprise where professional salvors began emerging in and after 19th century. Historically, during the age of marine transportation mainly by wooden ships which were fragile in quality of wood and structure, the ships, with the exception of cargo, were not considered as objects of salvage because the hull sustained nearly a complete damage when a ship met with a disaster at sea. However, after the Industrial Revolution, the rate of total loss even to ships encountering disasters at sea was reduced by emergence of iron ships, and as a result, the salvage service for those ships developed into a profession.

In addition, the advance of science prompted appearance of professional enterprises equipped with necessary personnel including diving experts, or having materials and equipment with salvage boats suitable for salvage operation. In the mid-nineteenth century, with the emergence of helmet-type diving equipment capable of long diving operation, which was completed in England, the salvage service began settling as part of maritime affairs industry.

Also, the international need for legal control aimed at reasonable adjustment of the interests of the interested parties of different nationalities concerning maritime accidents in the sea, which is a world's commonplace, led to the adoption by the International Diplomatic Conference of Brussels in 1910 of the International convention for the unification of certain rules of law respecting assistance and salvage at sea. Ratification of the agreement and enactment of the respective national laws by the countries concerned (Japan made a partial amendment of the Commercial Code in 1911, enacted the current 4th Edition, Chapter 5 "Salvage and Rescue", and ratified the agreement in 1913). Practically, The Salvage Law thus enacted, taking a positive position of encouraging salvage, has been reputed to be a world law.

Since then, quick reporting and disposition of maritime disasters have been made possible by invention and development of radio communications, and the salvage service, similar to fire stations on land, takes standby positions, constantly maintaining a full scope of salvage functions.

Although the removal operation of sunken ships is regarded as part of salvage service, most of the objects are not in urgent demand for the operation, such as a wrecked ship for which emergency damage control has been neglected for economic, technical or social reasons, or suspended to abandon the ship for certain reasons. This kind of ship, known as total loss in insurance, can be divided into two kinds. One is that the shipowner is apparent and the removal operation is carried out on owner's responsibility. The other

is that because of uncertainty in shipowner due to lapse of time or ownerless by renouncement of ownership, the sunken ship belongs legally to the administrator (country, etc.) of the sea area where the sunken ship is located.

With regard to the former, the shipowners' mutual protection and indemnity association (generally called P & I) to which the shipowner belongs is usually entrusted by the owner to conduct the removal operation or sometimes the shipowner himself does the work, using the P & I. But, in the case of the latter, as it is a national property, disposition of the sunken ship is done on national responsibility.

5-1 Ordinary Operation Process for Removal

5-1-1 Survey and operation process

It is evident that decision of an operation process depends on the results of the preliminary survey, as observed in Chapter 4 "Model Case." This paragraph outlines the overall operation process for removal operation of a sunken ship in ordinary cases.

Items in the overall operation process will be as follows:

(1) Confirmation of Location of Sunken Ship (Search)

(2) Grasp of Present Situation . . . Diving Survey

(3) Formation of Removal Plan . . . Operation process, Materials and Equipment, Calculation of Expenses

(4) Contract . . . Bidding

(5) Implementation of Removal Plan

(6) Disposal of Hull

After this, the final inspection of the removal operation will follow, besides collection of necessary data as reference and clarification of points of reflection for the future. Each of the above items will be explained below.

(1) Confirmation of Location of Sunken Ship (Search)

Confirmation of a sunken ship with an installation of buoys for marking the submersion can be made without rather difficulties since the search is limited within a certain area of the waters, and in addition, because of the presence of the targets. On the other hand, search for a sunken ship shown on the chart or reported only with its location has to be conducted by survey boats, etc.

With regard to searching methods, search for the former is carried out by dredging using primitive wire rope or small anchor, or with echo sounder. But, in the case of the latter, an estimated position is tentatively decided based on target bearing and distance, etc. from the shore. Then, after installing temporary buoys at the position, confirmation of the sunken ship is conducted by the above-mentioned method, or with side scan sonnar.

In case that a sunken ship has not spent much time after submersion, its location may be confirmed by spotting floating fuel and ships stores. In a shallow sea, possibly a sunken ship can be confirmed by observing a variation of tidal current affecting the surface of the sea, or even by the naked eye. It is also often heard that fishermen have their nets caught on a sunken ship, or recognize it as a fish shelter.

(2) Grasp of present situation . . . Diving Survey

1) After completing confirmation of the location of a sunken ship, in succession, diving survey is carried out in order to grasp present situation. This survey will cover not only the sunken ship itself but also surrounding natural as well as even social conditions.

Based on the results of the surveys made on one item to the other, concrete items in conducting removal operation of the sunken ship are studied; namely, necessary procedure, and decision of operation process and basic principle for expenses calculation. In view of the fact that the surveys here will tackle with important points, in principle, well-experienced veterans should be chosen for engineers and the rest of members, and diving experts expected to be engaged in the removal operation are nominated.

2) Necessary Personnel, Materials and Equipment for Survey

The number of personnel necessary for survey, whose quality is mentioned above, varies with extent in grasping external conditions of a sunken ship. One team may be composed of 2 to 3 people, and the other 7 to 8, etc. Besides survey ships, materials and equipment necessary for survey are diving equipment, echo sounders, current meters, and side scan sonnar, etc.

3) Items of Survey

Items to be covered by the above-mentioned personnel, materials and equipment are divided roughly into the following three.

a. Particulars of Sunken Ship
b. Existing Conditions of Sunken Ship
c. Environment and Social Conditions

Details of the above each item are given below.

a) Particulars of Sunken Ship

Kind and Name of Ship, Gross Tonnage (or Displacement Tonnage), Main Dimension, Type, Owner (Charterer), Insurance Company, Value of Hull/Cargo, General Arrangement and Construction, Kind and Horse Power of Main Engine, Date of Building, Name of Builder, Kind and Quantity of Cargo, Cause for Submersion, Conditions at the time of Submersion, Estimated Position of Ship, Fuel remaining, etc.

Concerning the above items, it is advised to hear relevant information from the shipowner and the crew, to obtain the sea protest, and to receive from the builder the plans mentioned below.

* General Arrangement Plan
* Measurement Plan
* Construction Plan on Steel Materials, etc.
* Pipe Arrangement
* Lines
* Midship Section
* Stern Material
* Inside Arrangement of Engine Room
* Graphs on Displacement, etc.
* Weight, Center of Gravity, Calculation Sheet of Floatation

(When cargo and fuel exist, relevant stowage plans are also needed.)

b) Existing Conditions of Sunken Ship

Location of Sunken Ship, Depth of Water, Ship's Head, Degree of Inclination, Trim, Residual Cargo, Conditions of Residual Fuel, Bottom Section Contact and Buried Conditions, Situation of Cargo Hold, Corrosion Degree of Outer Plate and Deck, Conditions of Sea Growth, Draft, Distance between Water Surface and Hull, Underwater Visibility, Quality and Conditions of Sea-Bed.

These are details to be covered by diving experts.

c) Environment and Social Conditions

Tidal Difference, Direction and Velocity of Tidal Current, Depth of Water around Ship, Distance to Shore, Conditions of Neighboring Waters, Administrator, Conditions of Permit for Operation, Nearest Base for Operation Ship, Facilities for Communications and Lodging, Data of Weather and Sea Phenomenon.

This paragraph deals with conditions and environment relating to implementing actual operations. The tidal current, even in the same waters, varies in flow with every location of a sunken ship, and this variation again becomes different between periods of spring tide and neap tide. In view of this particular situation, the actual time to enable diving should be accurately grasped.

Conditions of neighboring waters mean general existing conditions, such as whether the sunken ship is in or out of harbor area, degree of congestion of ships at sea, distance from routes, disposition of mines, and fishing activities, etc.

The items described between a) and c) are fundamentals. Besides them, if there are other items necessary for implementing the operation, naturally survey has to be conducted. With regard to those matters, please refer to the Model Case in Chapter 4.

(3) Formation of a Plan for Removal of Sunken Ships

1) Priority of Removal

The priority of removal of sunken ships under planning is determined in accordance with the method of deciding priority of removal of sunken ships described in Chapter 3. In case of the equal priority, decision may be made from political viewpoints, taking into account such factors as expenses involved.

2) Study of Operation Process

The operation process is studied with due consideration to materials and equipment to be used for the operation, necessary personnel and capacities of available crane ships, etc. in addition to existing conditions of the sunken ship, environment and social conditions. The following methods are considered as actual operation process at present.

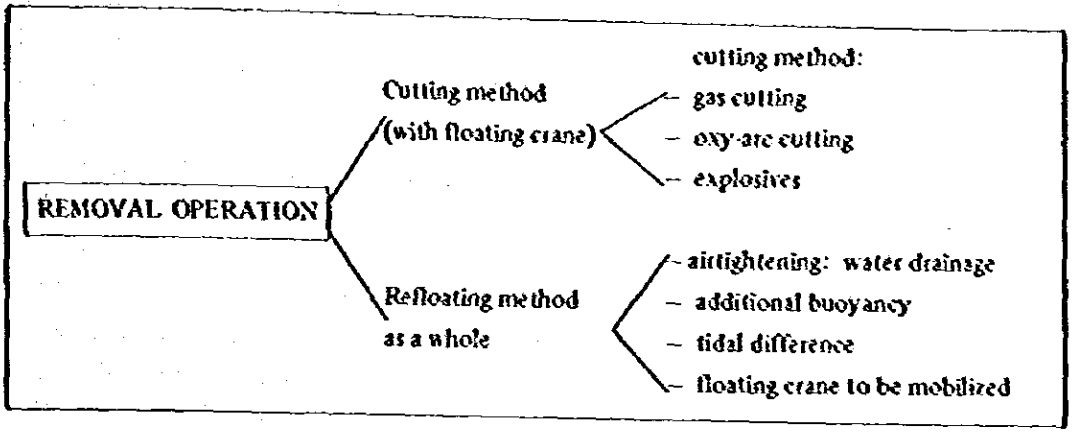
a-1) Cutting a sunken ship into proper pieces to move them with a crane. . . .
Cutting System
(In case of a small ship, sometimes cutting is not necessary.)

a-2) Part of a sunken ship is cut underwater and remove it with a grab backet.

b-1) To refloat the sunken vessel as a whole by giving the buoyancy to the hull
. . . Refloating method as a whole

b-2) To fix buoyancy tanks etc. to the hull for removal operation

c) Combined method of the above two



The major points are explained in the following.

a-1) The following methods are generally applied for underwater cutting.

List 5-1-1

Name	consumable goods	method
gas cutting method (propane)	propane gas oxygen gas	To burn propane gas in the water
hydrogen gas cutting method	hydrogen gas oxygen gas	To burn hydrogen gas in the water
Oxy-arc cutting method	cutting rod oxygen gas	To use electric arc with direct current
Explosives cutting method	dynamite	To blast explosives

a-2) Although there is a method to cut a part of the sunken vessel in the water and to hold it with a grab, it is not suitable to remove the buried hull, and it's not possible to remove it even if the underwater cutting should be appropriate to implement to the hull out of the sea bed, so that it lacks reliability in operation and doesn't have to examine in this topics. Some salvor employs a method to cut the hull vertically like a chain saw after putting chains under the sunken hull double bottom and charging the load to the anchor chains.

b-1) Additional buoyancy

Although it depends on the depth of water and the degree of damages to the sunken vessels, it is possible to add the buoyancy by discharging water and air-tightening after the water tight work to the part of the inboard subdivisions. Even if it is impossible to refloat as a whole, the hull weight in the water relatively decreases as much as more buoyancy tanks are added, and the removal operation gets much easier. It is each tank that is easy to add buoyancy. All the pipes which are air-tightened connecting to the engine room and to the decks, i.e. air pipes, sounding pipes, etc., are formed to an independent compartment, which helps a salvor easy to refloat. What can be considered next, is a large section like the cargo hold or the engine room. This may be considered as the object of examinations in case that the sunken vessel lies upright and the main deck is very close to the water surface, for the strength of the deck is structurally lower than the shell plating and the hull bottom plate. When the hull is slanted more than 90°, it is not so big a problem to send air to the shell plating and the hull bottom from the viewpoint of the strength, and there are some cases to remove the sunken vessel actually by refloating the hull up to the sea surface. Additional buoyancy method to refloat by sending air inboard, shall be implemented through sufficient examinations for various factors in relation to the strength of each section, hull trimming, slanting, volume of air to be sent in, and many others.

b-2) Application of buoyancy tanks, etc.

In order to refloat the hull out of the sea bed, in case that the buoyancy is not sufficient enough to refloat by sending air and draining water so as to reduce the hull weight as much as possible, there are some cases to fix buoyancy tanks, air-balloons, and to send styrofoam into inboard compartments. However, these methods are few cases to employ whenever a floating crane can be easily mobilized and easy to calculate the lifting capacity.

c) Utilization of tidal range

There is a method to remove the sunken vessel at high tide by utilizing tidal range, mooring a flatbarge above the sunken vessel, connecting the both with tackles and wire ropes, and tightening them at low tide and automatically the sunken vessel is to be removed in coming up tide. However, it is a necessary condition to find an adequate depth of water and the tidal range of about 3 meters.

As for the similar method as mentioned above, the sunken vessel is lifted up by providing two flat barges which are sandwiched right above her.

The above mentioned are commonly adopted in removal operation and what method is to be decided, is up to the site conditions.

Once the removal operation method is decided, the work specification is to be completed by covering a list of machines and equipments and personnel, an entire removal operation plan, a work flow, a working hour based on tidal current, etc.

(4) Bidding contract

Apart from a general salvage, a bidding system is often employed as there are plenty of time to remove sunken vessels. In this case it is usually nominated an experienced salvage company on the condition that tenderers should be well aware of specialities in underwater operation. It is sometimes seen a case to assign a salvor with a free contract owing to the area of a sunken vessel, machines and equipments, and a connection so far involved with him. It remains quite a day till the date of tendering usually, so that those who have much interest in, conduct a diving survey at their own cost, and calculate the costing corresponding to the operation method to be employed. Although a bidding offer is often requested to offer tenterers to estimate expenses, a rough removal operation method, required days, and others, they'll have to fill the designated items requested by an orderer.

A contracter is usually responsible for legal procedures regarding a work permit, licence from authorized governments, maritime administrators, etc., and for the contents of legal forms on what to fill them in. Regarding the work permit, it is a case to report the following items daily regarding the items related to the sunken vessel, size, horse power, mooring method, the location, the direction of anchor chains, its size of a flat barge, notices in operation including diving operation, safety measures pertaining to vessels passing in the vicinity, work days, the method of urgent communication, mobilization date of floating crane, and many others.

(5) Implemention of removal operation (in case of cutting method)

The general process of operation is as follows:

1) Assignment of personnel, selection & provision of machines & equipment
2) Loading machines and equipment onto the diving pontoon
3) Mobilization to the site
4) Mooring a diving pontoon
5) Removing dangerous goods, fuel, and loaded cargoes
6) Removing sandy mud from the vessel, and under the hull bottom
7) Removing attached articles & sea growth from sections to be cut

8) Underwater cutting
9) Underwater rigging
10) Operation on the floating crane
11) Shifting & depositing to the scrap yard

An explanation is given for an outline of each item in the following;

1) Assignment of personnel, selection & provision of machines & equipment

a) Assignment of personnel, selection & provision of machines & equipment

The personnel for the removal operation are in the following;

Project manager, assistant project manager
Salvage master
Assistant salvage master
Salvage engineer
Diving officer
Diver
Mechanic
Rigger
Explosive expert
Carpenter
Cook
Crew for a rescue boat
Crew for a floating crane
Crew for a tug boat

b) Machines and equipment will be devided and examined into two categories, namely, for the vessels, and for general machines and equipment.

i) Vessels

The types of vesses for the removal operation of sunken vessels are as follows;

Survey boat
Work boat
Floating crane
Tug boat
Diving pontoon
Transport boat

Dredger
Small boat

ii) General machines and equipment

Diving:
Diving apparatus, compressor, recompression chamber, diving bell, underwater communication system, etc.

Drainage of water and sandy mud:
Draining pump, oil pump, submersible pump of sandy mud, compressed-air lifting unit, etc.

Airtightening, watertightening, & cutting:
Oxy-acetylene gas cutting, welders, underwater welding and cutting machines, wood working machines, blacksmith tools, etc.

Mooring vessels, & lifting:
Anchor, anchorchain, sling wire ropes, hawers, schackles, strop chain, marking buoy, etc.

Others:

iii) Consumable goods

Fuel oil, oxygen, propane, acetylene gas, steel meterial, wood plates, rectanglar lumber, explosives, cap, bamboo, small size ropes, chemical cement, water, provisions, etc.

An adequate number of personnel, machines and equipment, and consumable goods will be arranged according to the work scale, operational method. In regard to the personnel and machines & equipment, please refer to the model cases in Chapter 4.

2) Loading machines and equipments onto diving poontoon or work-boat

The inboard loading arrangement has been decided to place them in the thorough consideration to the mutual inter-relationship among engine unit, underwater diving stage, dangerous articles, such as, oxygen, gas, fuel oil, etc., and the living quarters. Machines and equipment are installed by bolts or fixed by welding electrode.

3)

3) Mobilization to the site

In case that the base port of the diving poontoon (flat barge) is distant from the site, she will be mobilized to the site. Regarding the towing service, since the diving poontoon is usually non-self-propelled and required to be towed, the capacity of a tug boat to be mobilized, is much depended upon a horse power and a wire rope of the tug boat in due considerations to the meteorological, oceanographic conditions and weather forecasting reports, etc. Upon drafting the towing plan, it is quite common that the flat barge should be reinforced upon a request, and be insured by the insurance underwriters, for a boat surveyor would come to inspect her and recommend the operator for the towing preparations.

4) Mooring

The work boat will be moored with anchors and fixed an additional wire rope to a sunken vessel at the site as scheduled. Since the flat barge that is not self-propelled, easily influenced by a tidal current and the like, and stationed for a long time, the mooring wire ropes should be safer than what they'd customarily employ, namely, bigger and much reliable. In an event that the work boat should leave the site due to the stormy weather, it is often employed that mooring wire ropes are connected to the mooring buoys to secure them stationary.

5) Removing dangerous articles, fuel, and loaded cargoes

Prior to the removal operation, explosive specialist will usually dispose any dangerous articles, i.e. gunpowder, cannon balls, and others not only the inboard of a sunken vessel but also the outboard together with the seabed nearby. In case that there remains fuel oil inboard, the removal operation of fuel oil can be practised by oil suction pumps, and or compressed air by boosting fuel out of the sea surface, and/or by replacing fuel oil with water. With respect to the loaded cargoes, sand suction pumps are employed to get rid of cargoes, specially, coal powder, and similar goods, while steel materials concerned are stevedored underwater.

6) Removing sandy mud inboard and under the hull bottom

Sandy mud can be removed by air-lifting, sand suction pumps, backet grabbing, etc.

7) Removing attached articles and sea growth at cutting sections

They can be removed by a hand scrapper, hydraulic scrappers or occasionally by a small volume of dynamite.

8) Underwater cutting

Hull is cut down as per the method already described. It is a principle that length of the underwater cutting is made as short as posible, and intricated structure such as accomodation, engine room, insulation parts are not to be cut from the viewpoint of an efficiency. The weight of cutting parts will be limited to 80% of the capacity of floating crane. Cutting parts are decided taking rigging work, shape of the block, etc. into consideration.

9) Instollation of sling wire

Reinforced structure is to be selected for the instollation. Therefore, one way is to bundle the hull and another way is to install at the sheer strake with web-frame. Anchor chaine and pendant wire are usually employed for setting on shell plate. Therefore, two slings must have adequate safety factor against the weight of blocks. Center of gravity of block and length of pendant wire are also studied in consideration of depth of sea and hoisting angle.

10) Crane Operation

11) Shifting to disposal yard

Regarding the aboved two items, please refer to the model case studied in chapter 4. Various standards and manual for a floating crane are established in respective company in consideration of sea condition and wind force etc.

5-1-2 Problems

Regarding the survey and the removal operation method for sunken vessels as mentioned before, there are some problems to be cleared as follows:

(1) Diving Survey

Regarding the on-shore survey, the surveyors of various fields engage in measuring from every angle using various types of equipments and level up the quality of the survey, while regarding the preliminary survey for sunken vessels, a limited number of divers avail themselves of only the information obtained by their work.

The divers in the water are always subject to the constant water pressure and the threat

from any unexpected accidents and their movement is so restricted that they cannot enter the confined spots. In case where the visibility is poor, their own fingers are not visible right in front of their nose. And yet they have to survey the hull of the length exceeding 100 meters, degree of the submergence and the situation of outside and inside of the sunken vessel. The diving survey can be incredible to those who inhabit on land. The survey always lasts for quite a long time. Neverless errors can creep in. The vessels sunk in water are always subject to change, so it must be born in mind that the condition of the vessel at the time of the removal operation could be different from that of the survey.

(2) Diving Work

The main function is the underwater operation of divers. For safety, the diving operation should be made during day time. Subject to the depth of water, one day's underwater working hours are restricted in view of the diver's health. Under the strong water pressure, divers in water exhaust a lot of energy. Therefore, the actual work hours is, in most cases, less than the regulations and manuals. The worsened visibility causes the loss time. The diving operation cannot be performed in stormy weather, so there will be many cases in which working hours cannot be calculated in advance.

(3) Personnel, machines and equipments for removal operation

As was referred to in the introductory article, the condition of the sunken vessels varies from case to case and the removal operation for sunken vessels is carried out at the specific location or on the sea, and so the work should be assigned to the experts who were trained as salvors. In order to train them, it requires a long period of training. The divers work only for diving works and not capable of being engaged in other line of business. Therefore, salvage companies are refraining from training juniors much more than that as scheduled. On the other hands, the removal operation for sunken vessels is invited irregularly unlike the other general enterprises, so the long-term plan is difficult to draft. If they should engage in the other type of business, they will find themselves short of salvors when the actual operation required for. Therefore, the business is of the nature that the averaged volume of the work is very difficult to be figured out. It is the same with machines and equipments. Even if it's clear that some of machines and equipments are required for removal operation, a large sum of the investment won't pay in view of the above situation. Such being the case, salvage companies tend to do by their existing machines and equipments, or by those temporarily switched from the other quarters, or by lease. This is the general features of the salvage companies, and this is their fundamental attitude for survival.

(4) Operation contract and cost

It is quite natural that shipowners or charterers are bound responsible for the removal of sunken vessels in case that the Government should place an order to remove them. In this case, the removal operation contract is concluded between a shipowner and a salvage company, and the operation is implemented according to the prescription. In an event that shipowner is not known, or the sunken vessel is abandaned to belong to the Government, some problem will occur as regard the contract and expenses.

5-1-3 Problems Solving

(To be prescribed on the basis of the present situation in Indonesia)

(1) Diving survey

As mentioned before, the survey operation depends much on a diver's individual view and his technical competence, which won't be objectively assessed. As a result, there is no denying that the survey might be made somewhat errornessly. In order to cope with the situation, development of a new type of measuring unit is earnestly desired. However, we, for the time being, have to bring up the experienced and capable divers. There is no other way than that the diver's quality should be improved. In Indonesia, the party who orders the removal operation for sunken vessels is DMS, who has 8 divers and surveying machines and equipments (please refer to Chapter 5-2) and conducts a preliminary diving survey by himself. However, the divers have a poor experience in survey and the survey report does not go beyond the "Matsukura Report."

(2) Diving Operation

Although modern science continues its remarkable progress, an underwater operation, though restricted by cost, even ten meters below the surface of the sea being totally a different world is obliged to rely on man-power operations. In addition, being underwater, even such simple operations as removal of sandy mud, underwater cutting, or rigging and the like which cause almost no problems on land are limited to certain operators. Furthermore, because of slow progress of mechanization, and demand for special knowhow including operations disposable only by mannual operations due to hull structures, like or dislike, diving operations are considered indispensable. Regarding how to reduce diving operations, no good ideas have been devised although various researches are being carried out by those concerned. Accordingly, going forward step by step seems to be the only way to cope with the problem at this moment.

In highly dangerous operation such as removal operation of sunken vessels, it is natural that directions and supervision even from the surface of the water should be based on a precise grasp of the movements of underwater divers through full face-mask com-

munication apparatus. Also, a complete grasp and utilization of world trends, such as development of new machines and equipment are indispensable from efficiency and safety viewpoint.

(3) Required Personnel, Machines and Equipments

As mentioned earlier, the training of personnel required for removal operations takes time and possibly quite costly for salvage enterprise. Furthermore, the enterprise can hardly proceed with investment in machines and equipments without actual results or a fair prospect for the future, so as to put it on a commercially profitable basis. Consequently, the enterprise is inclined to deal with only such an immediate problem as use or lease of machines and equipments currently in its possession. Approach must be different in the case of State enterprises. However, in view of the fact that at present, removal operations in Indonesia are conducted based on bidding by private enterprisers, this paragraph is obliged to concentrate on private salvage companies.

The question of personnel, machines and equipments is, in another words, a problem of salvage enterprise. The enterprise is doing business for making profit, but it is hoped that the activity conform to national interest. The salvage service is rated as a nonproductive, passive enterprise aimed at arresting economic loss to minimum, with many human factors similar to tertiary industry. In addition, its operation sites, sea and ocean, are characterized by dependence on natural conditions and that its acceptance of orders for operations is accidental, not on a long-term basis.

At present, the number of those who call themselves professional salvage enterprisers in various countries of the world is quite small in comparison with other industries and furthermore, it is the existing reality that their business activities are centered on ocean tag service, maritime engineering works, loading and unloading at harbors and repairs of hull, etc., as their major revenue sources. In the case of salvage enterprisers in Indonesia, more than half of their work load is relying on the Indonesia's national policy on removal operation of sunken vessels. In view of this situation, the Government may also be requested to tackle the following questions.

1) Future plan of removal operation of sunken vessels in Indonesia.
2) Lease of major machines and equipment by Government.
3) Strengthening of salvage enterprise.

(4) Contract of Operation, and Expenses

Generally "No Cure, No Pay" and a fixed amount are basic principles of contracts for removal operations of sunken vessels. This is why the enterpriser decides an estimate of expenses after a thorough analysis of risks involved in his operation, and by addition

of the respective calculations. In addition, there is another practice in which orderers (shipowner, charterer or insurance company) evaluate salvage enterprisers and collect a deposit. As this is all on private level, the Government does not have a direct part in it.

2) When the sunken vessel is owned by the Government, priority degree, operation process and expenses, etc. of the removal operation must be examined on governmental basis. Two methods can be considered for the operation.

a) The Government directly carries out the removal operation.

b) The Government becomes an orderer, and entrusts the operation to private enterprises.

In either methods, operation process and expenses should be carefully studied and that necessary expenses must be given approval as a national budget, otherwise it will be impossible to proceed to the actual operation.

In the case of b), the following items must be sufficiently examined in connection with contracts between government and private enterprisers.

i. Period of operation and total amount.
ii. Guarantee fee.
iii. Method of payment.
iv. Clause of claims (in case of breach of contract).

5-1-4 Cost analysis

(1) It is a general way of thinking that an settlement for the expenses incurred by a maritime accident and rescue, shall be based on "FAIRNESS & JUSTICE," and shall be given preferential treatment to a salvage company who has adjusted the interests among parties concerned rather than what he shall not be assessed the actual expenses as a remuneration for labours, machines & equipment. In reality, the removal operation for sunken vessels is one of the fields in a salvage enterprise and few cases are required urgently to undertake an urgent rescue operation. In comparison with salvage operations required urgent attendance quite a many cases are required fundamental operations. In addition, few cases can be risky to a salvage company. At present, it is atendency to decide the cost based on the actual expenses in case of removal operation instead of "No Cure, No Pay" open form basis.

(2) Settlement on the expenses regarding the removal operation for sunken vessels

1) Cutting method

The removal operations for sunken vessels consist mainly of mud removal, underwater cutting, lifting operation, which don't require much applied technical skills and less risk to a salvage company, so that the expenses are fundamentally calculated on the numbers of working days multiplied by the daily cost regarding mobilized personnel, machines, and equipments. As for a floating crane which isn't mobilized for an entire period of the removal operation, but for part of the entire operation period, it is a common sense for a salvage company to minimize the expenses in view of reasonable method of mobilization as much as possible.

2) Refloating method

Unlike the cutting method, many operational cases were practised on an applied high competence with a long period of actual experiences and practical operations, which can be reflected by technical elements. However, the expenses for the above are calculated just like those of the cutting method as a principle.

(3) On the other hand, regarding the hull value after removing a sunken vessel, the piece mealing cutting method can only expect scraps as raw iron materials, while the refloating method can restore the hull to a vessel or to remodel part of the hull into a flat barge or something. In case of the reutilization or treatment of the hull, it can be hull, it can be towed by a tug boat, namely, it can be easily added the value.

(4) Therefore, a salvage company examines the feasibility to refloat a sunken vessel, first of all, and then to cut it into blocks if the first method should be impossible.

(5) In case that a floating crane can lift a whole of sunken vessel out of the seabed for the removal operation unlike the refloating method, it could be mentioned that to lift and remove a sunken vessel cost cheap as for the direct expenses, because the method doesn't require to make water tight and remove mud. However, it can't be defined which one of them could be advantageous to implement when a salvage company examines the transportation expenses for the sunken vessel. (For example, in case a sunken vessel is removed at Tarakan and transported to Surabaya, and processed there. In case a sunken vessel is restored as much as possible, it is towed to. Or in case a sunken vessel is desposed to that extent that it can be loaded onto a cargo ship or a flat barge, it is transported to.)

(6) In case that a 500 ton floating crane removes a sunken vessel of 3,000 gross tonnage, let us examine as follows;

1) Refloating method

Although there are some differences in weight depending on the location, the depth, the damaged, the degree of listing, and the other states of a sunken vessel, the underwater hull weight is estimated approximately 2,000 tons, so additional 1,600 ton buoyancy are required to refloat the hull. In general practice, even if air is blown inboard or water is drained, the total buoyancy won't be sufficient enough to refloat the hull. In this case, unless holds and other sections should be air- and/or water-tightened, and/or reinforced inboard, the hull won't be able to be refloated. As mentioned in the general operation method, the tightening operation is easy on land, while the inboard operation in the underwater large tanks and hulls requires a high level of technical competence and many days to complete it. If the underwater operation should take long, the already water-tightened sections may be damaged under the stormy weather, and may be impossible to repair again. As for a salvage company, there will be no other ways than saying that it should be case by case to decide how much he can stand for.

2) Cutting method

This method is less risky to a salvage company. They cut the hull into a block which can be lifted by the floating crane with 500 tons, and remove it one by one out of the site. Even if the hull should break due to the stormy weather, it won't hurt much. Besides, if the contract should be based on the piece work, the payment for one lifting after another will be made to a salvage compnay.

3) Likewise, in an event that an orderer should decide a removal operation method for a sunken vessel in advance, a salvage company may refuse the offer since it could imply the peculiarity to be conducted in the ocean. Furthermore, the salvage expenses will be more expensive because the contents of the contract implies highly risky on the top of additional conditions involving the matters concerned. As this theory is taken into, it'll be expected to return to the basic principle of salvage like "No Cure, No Pay."

As mentioned above, it could be the characteristics for the salvage operation expenses as they are not simply liquidated, for there are some cases that the salvage risks will be added by a selection out of the removal operation methods.

(7) The cost cauculation regarding the removal operation is based on a cost on machines and equipments per day. That is to say, the expected days of operation multiplied the daily cost on machines and equipment should be deducted the necessary expenses to make the base on calculation for the removal operation in case that the necessary expenses are available to consider, i.e. annual depreciation expenses, maintenance

expenses, premiums, repair expenses, personnel expenses, and others.

(8) The costs (tariffs) of personnel in removal operation are decided as follows.

1) Evaluation on specialized knowledge and technique

2) The contents of operation implies the high degree of risk.

3) The annual days of operation are not constant and holidays are not given as specified.

4) The detained working hours are longer in the ocean.

5) To work apart from their families.

Similar work is performed by sea-men and harbour workers. This can be taken into one of the good examples, but it leaves a problem on the rate of operation. It hasn't been vailed out to the public as one of the industrial secrets, but it could be about 40–70%.

(9) The consumable expenses regarding the removal operation are consisted of two types of goods, the ones that are actually consumed in operation, are propane, oxygen, fuel oil, cutting bars, etc., and the others that can be left the original shapes, but that can be reutilized depending on the damaged degree, are small wire ropes, diving suits, etc. These expenses are regarded as cash bases. Besides, there are cases to calculate the goods which are partly interpreted as consumable goods and which are partly treated as machines and equipment. It is common that they are inclined to be damaged by being touched the shell plating and damaged openings due to the turbid visivility much more than they are on land. And the costing will be carried out including the above factors.

(10) The removal operation expenses are consisted of a removal operation expense (shifting/relocation expense), an administration expense, taxes and charges, premiums, a food expense, a travel allowance including a hotel charge, a communication expense, compensation expenses, etc. However, the rate of an administration expense is, in general, in the rage 10–15% of the total, which tends to fluctuate according to the degree of risk and job site.

(11) On the condition that the basic items for calculating a removal operation expense as mentioned in Item (10) & (11), are based on the operation in the calm sea like inside the harbour, it is natural that the removal operation expense in the ocean should be expected higher than that inside the harbour.

(12) That was all for the items to be calculated as the removal operation expenses and to be examined the difference in cost fixing. In order to minimize the whole expenses rationally, it would be a major target both to level up the efficiency in each removal operation and to curtail the working days.

(13) The Government of Indonesia provides an annual budget regarding the removal operation expenses and private salvage companies are selected on the basis of bidding to undertake the operations. The D.M.S. keeps a table of tariffs for calculating the removal operation, such as, the daily tariff on machines and equipment, the mud removal operation cost, and the basic cost regarding the underwater cutting operation. (Note: It was made on the bases of the tariffs used by salvage companies in Singapore, Manila in the Philippines, and other countries.)

(14) In the past the removal operation method for sunken vessels employed by the Government of Indonesia, was the cutting method, details of which are explained in the following;

1) Mud removal operation .... Dig out the buried sections of the hull.

2) Cutting operation ..... Cut the hull into a suitable block which can be adequate for lifting.

3) Lifting operation ..... The charge of F.C. mobilization

The above operations have shared the most part of the operations. Therefore, it will be incumbent upon any salvage companies to increase the efficiency in operations.

(15) The D.M.S.'s table of tariffs calculats the daily expense on each type of removal operation as mentioned above. In another aspect that can be considered in actual operations, there are some types of operation possible to implement in pararell to the other types of operation, such as, removal operation of sandy mud, shells, other living creatures at the sections of underwater cutting if divers in charge could well prepare for them in advance. Even in the case of lifting any size of small block, there will be surely many cases to fix sling wire ropes prior to the arrival of the heavy floating crane at the operation site if five ton capacity is available. It will be more appropriate to introduce the calculation methods as mentioned in Chapter 4 than to calculate the costs in a fixed form of D.M.S.'s tariffs. There exist various kinds of operational preparation and paralleled operations although they are perhaps only for a short period of time comparing with the total period of operation, so that it'll have to exert the strenious efforts to meet the operation expenses by grasping actual operations as accurate as possible to the existing factors.

(16) Although the expenses for unit-by-unit operation were mentioned above, the most expensive expense would be the ship expense particularily for a chartered floating crane, and followed by the general expense on machines and equipment, and the personnel expense. (In Japan, it's common that the personnel expense is more expensive than the general one on machines and equipments in view of the total expense rate.) In Indonesia, it's the fact that no floating crane with the lifting capacity of no more than 300 tons is available. It is a fact that the floating cranes are chartered from other countries in the vicinity and the chartered expenses for a floating crane will be higher than that in Japan. Therefore, it is quite considerable that an operation order should cover a group of sunken vessels in the harbour so as to utilize the floating crane efficiently, which will contribute to curtailing the expenses for the mobilization.

(17) There is no other method which can implement a very simple removal operation and which can drastically minimize the operation expenses. However, there is an exception in the removal operation for a sunken vessel in the Strait of Malacca, where they have curtailed the removal operation expense by cutting the hull over the sea bed just to remove it off from the view of securing the navigational depth in the Strait. This will be a good example to rationalize the expenses for the Government of Indonesia, for the mud removal operation for sunken vessels will share more than the half days of the total operation period and be examined to introduce this method as long as the depth of water can be secured for navigational traffics.

5-1-5 Final Inspection

This is a sea-bed inspection at the time of completion of the removal operation. Usually, it is implemented by orderer for the purpose of checking whether or not the sunken vessel has been completely removed. There are such methods as mentioned below.

1) Inspection by diver.
2) Dragging with wire rope, etc.
3) Inspection with echo sounder or side scanner.
4) Magnetic investigation.
5) Combined method of the above.

In the case of removal operation by refloating method, most of these inspections are not required, but in the case of cutting method, some sort of inspection should be applied, otherwise, confirmation will be difficult.

In the case of a removal operation by a reliable enterpriser, there are many cases in which completion of the operation is approved without applying these inspections but by the report of the enterpriser on his own voluntary inspection. Also, parties attending at

the time of final inspection are not fixed. Members may include the administrator of the water and those who actually carried out the operation, in addition to the orderer. However, in such cases as port area, upon completion of the removal operation, there is the need for notice of navigation routes. Considering this, the enterpriser is bound to inform not only the orderer but also other parties concerned of the completion of the operation.

5-1-6 Preparation of Report

Form of a report on removal operation is not fixed. It may be only a periodical mail with a description of necessary matters (generally, contents are decided by orderer), or sometimes a report is sent everyday on oderer's request. Usually, reports for submission are those mentioned below.

(1) Bidding

At the time of bidding, documents with a description of an outline of operation process for the removal operation, including bidding price and period of operation are submitted. Even for a contract not by bidding, it is a matter of common sense to obtain understanding of the orderer by reporting him the progress of the operation or the operation process.

(2) Contract

The contract may be prepared on the part of the orderer, or possibly the contractor makes a draft by which to draw up the contract through talks with the orderer. In order to save trouble, in the case of salvage operation, there are internationally recognized forms, for instance, such as the "Lloyd Form." In the case of removal of sunken vessels in Indonesia where the DMS is the orderer, specific forms of their own are used for contracts.

(3) Specification

Specifications, mostly together with total amount, its details and the table of operation progress, etc. are concerned with the following items.

1) Expenses

a) Mobilization cost
Cost of transportation of machines and equipment, and mobilization of vessels.

b) Operation cost
Cost of actual operation

c) Demobilization cost
Cost of demobilization of machines, equipments and vessels.

d) Business management expenses and insurance due.

2) Machines, equipments and personnel

a) Details of machines and equipment required for removal operation.

b) Name list of personnel.

c) Estimated quantity of supplies, and prices.

3) Planned details of operation process (In the case of cutting method)

a) Sandy mud removal method and required machines and equipments.

b) Underwater cutting method and required machines and equipments.

Cutting section.
Number of blocks.
Shapes of blocks.
Weight of blocks.
Length of cutting, etc.

c) Lifting method and required vessels and equipments.

4) Disposition of removed hull

a) Estimated scrap volume.
b) Place for the hull.
c) Method of final inspection.

5) Others

a) Plan for safety of operation (prevention of accident).
b) Method of emergency contact.
c) Method of contact with parties concerned.

(4) Reports During Removal Operation

1) Operation diary

This is an everyday diary or a summery of details of one week operation can be a substitute.

2) Report of collected scrap weight.

3) Revised table of operation progress.

In case of a change in the operation progress.

4) Report of accident.

Diving accident, accident while engaged in the operation, causes and actions, measures for improvement, etc.

5) Report on personnel, machines and equipment.

Report on a change in personnel, machines and equipment, and movements of crane ship, etc.

(5) Report after Removal Operation

1) Report after completion of demobilization.
2) Report after completion of final inspection.

(5) The above are general principles in report preparation. However, according to the results of surveys in Indonesia by the survey teams, they could find no data in government offices regarding sandy mud removal operation or gas cutting, which should have been kept as reference materials. In addition, they were also unable to obtain these materials from private enterprisers. In light of this situation, it is keenly felt that a greater effort should be exerted in order to obtain actual data from the viewpoint of reflection on the future operation.

In view of the very fact that, despite of nearly twenty years of her experience in the conduct of removal operations of sunken vessels, such fundamental data as how much volume is removable per hour in sandy mud operation or what is the possible length per hour in underwater gas cutting were not obtainable as mentioned, it is considered useful for future plans of removal operations to have private enterprises submit the following reports, although part of enterprises might have certain know-how.

1) Place and time.
2) Conditions and quality of sea-bed.
3) Tide, current, weather.
4) Diver's rank.
5) Materials and equipment in use and methods.
6) Hourly volume of removed sandy mud.
7) Hourly length of underwater cutting.
8) Gas pressure and amount used.
9) Details of materials and equipment in use.
10) Hourly volume of consumption goods such as fuel, etc.
11) Lifting time of crane vessel.
12) Time required for mobilization, horse power of tug.
13) Degree of wear and tear of machines and equipments.
14) Other matters worthy of reference.

5-2 Present Situation of Salvage

5-2-1 Equipments

The equipments for the operation of removal of sunken vessels in the Indonesian waters are to be studied from the point of view of the status quo as well as provision and supplies. They are, for the purpose of the study, classified into three categories as follows:

(1) General equipments
(2) Floating crane
(3) Equipments for the preliminary diving survey belonging to DMS.

(1) General equipments

1) The outline of the general equipments preserved by the private salvage companies in Indonesia is as per following list.

List 5-2-1 Resistered Salvage Equipment List

Company Name	Barge	Tug	Floating Crane	Diving Apparatus Kind	Diving Apparatus Number	Cutting Apparatus Kind	Cutting Apparatus Number	High Compressor	Compressor	Pump	Generator	Data of Equipment
1. PT. Yalagada	4	0	1	Mask Type Scuba	20 6	Gas OXY-ARC	12 4	1	10	14	2	1978
2. PT. Insal	2	0	0	Mask Type Scuba	16 8	Gas OXY-ARC	9 3	1	5	5	2	1978
3. PT. Bayu Samodra Sakti	1	0	0	Scuba	12		0	2	6	4	1	1978
4. PT. Salvage Antasena	2	0	0	Mask Type Scuba	6 5	Gas	6	0	4	4	0	1978
5. PT. Komaritim	5	4	4	*Helmet *Mask Type	1 1	OXY-ARC	1	1	2	0	3	1977
6. PT. Karya Asih Agung	1	1	1	Scuba Mask, Scuba	3 18	Gas	2	1	4	10	2	1977
7. PT. Calmarine	4	0	0	*Mask Type Scuba	4 9	OXY-ARC	2	3	8	0	0	1977
8. PT. Kaliraya Sari	3	1	0	Mask Type	3	Gas	1	0	4	6	6	1979
9. PT. Anugrah Tirta	2	1	0	Mask Type Scuba	6 2		0	0	2	2	2	1978
10. PT. Indosal Inti	2	0	0	Mask Type Scuba	3 8	Gas OXY-ARC	5 1	1	2	6	2	1978
11. PT. Tosan Galin	0	0	0	Scuba	3		0	0	1	1	1	1979
12. PT. Bahari Cakrawala	Data not available											
13. PT. Allient	1977 Bankrupt											
14. PT. Yala Prangkasa Raya	1974 Bankrupt											
15. PT. Emdece	1977 Bankrupt											

* Diving apparatus with communication

2) Comparison of the equipments of Indonesia with those of Japan

The comparison is to be made between two countries with regard to the general equipments available for the removal of sunken vessels.

Conditioned that:

a) The vessel to be removed is of the gross tonnage 1,000 - 3,000.
b) The operation is to be conducted in port or bay at the depth of water less than 20m.
c) The number of divers in the operation are 8 - 10, including tenders for divers.
d) Floating crane is to be employed for the operation.
e) Only main equipments are described herein.
f) The description is concerned not with any particular case which may occur in the actual operation but with only the general case.

List 5-2-2 Available Equipment List

	Equipments	INDONESIA		JAPAN	
		Item	Quantity	Item	Quantity
1.	Diving pontoon	L X B X D = 10 X 5 X 1.5m Trans portation boat	2	L X B X D = 40 X 20 X 2m Having accomodation or Hotel boat	1
2.	Diving Equipments	Full face Mask without communication system	6	Full face Mask with communication system	3
				Hard hat type with communication system	3
	SCUBA		3		3
	Low pressure compressor	for divers	2	for divers	2
	High pressure compcompressor	for air charge	1	for air charge	1
3.	Underwater Cutting apparatus	Gas cutting torch	4	Electric cutting touch	4
	Compressor		1		0
	Generator		0	150KVA	1
	Rectifier		0		1
4.	Equipments for removal of mud/ sand				
	Air lift set		2		1
	Compressor	Including jet pump	1	Including jet pump	1
	Sand pump		0		2
5.	Recompressor Chamber		0	Remark: Should be used in case depth of water exceeds 10 meters.	

The difference between the equipments of Indonesia and Japan as shown in the above list is considered originating from the difference on the commercial basis as follows:

List 5-2-3 Difference on the commercial basis

Items	Indonesia	Japan
Personnel charge	cheap (1/5 of Japan)	expensive
Equipments charge	expensive	cheap
Fuel oil charge	cheap	expensive
Procurement of equipments	a bit difficult	easy

In view of the above situation, the Japanese companies tend to attach importance to the efficiency of the operation introducing cheap equipments for the purpose of realizing the high productivity, while the Indonesian companies tend to carry out their operation using their own equipments on the basis of the work schedule which is not considered hard.

3) Provision and Supplies

The sunken vessels have been removed in the past ten years from 1969 to 1979 in an amount as much as average about 2,500 metric tons annually in Indonesia. However, it is, for the purpose of implement the removal operation within a limited fund, necessary to the existing equipments in an effort to increase the efficiency of the operation. The following are the descriptions as per each equipments.

a) Diving equipment

The diving apparatus for the removal of sunken vessels mainly used in Indonesia at present is that of the surface-supply light weight gear which is called the full-face mask type. This apparatus is not provided with communication system mostly made in England by SIEVE CORMAN Co. The use of the diving apparatus without communication system is not appropriate in the region of SURABAYA where the visibility in water is poor and the current is forceful preventing the normal diving work. Moreover, the close communication between the staff on the surface and the diver in the water is indispensable for the purpose of safety in the operation of the heavy lifting as in the case of the removal of sunken vessels.

The reason why the diving appratus provided with the communication

installations is not used in Indonesia is assumed that the cost of the apparatus is 6 - 8 times as much as that without communication system. The daily average water temperature in Indonesian waters never descends under 25°C and, under the circumstances, it is not necessary to use the apparatus of the helmet-dry suit type as used in Japan, but the use of the apparatus of the full-face mask wet type provided with communication system like KMB MARK-10 manufactured by U.S. Divers Co. is recommended.

b) Recompression equipments

The decompression sickness is rearely seen in the case of the diving work in the water of the depth less than 10 m, but when the depth becomes deeper than 10m the sickness occurs rather frequently. Therefore, in case the depths of water more than 10 meters, the recompression chamber is usually carried with. The recompression chambers in Indonesia are now maintained in the following institutions;

i) Division Center of the Indonesian Navy in Surabaya base.
ii) Jakarta Navy Hospital of the Indonesian Navy.
iii) PT. COMARITIM
iv) PT. CALMARINE

As far as the private companies operating diving business are concerned, the above two companies iii) and iv) onw the recompression chamber. However, the two companies mainly concern the oil producing industry and do not carry out the removal of sunken vessels. No private companies handling the removal of sunken vessels own the recompression chamber. Therefore, when the private companies carry out the removal of sunken vessels in Surabaya or Jakarta or in its vicinity, the precautious means must be taken beforehand so that any patient of the decompression sickness can be carried into the Navy Hopsital for the ready treatment by the recompression chamber. The Navy Hospital is alwyas prepared to accept the patients.

When the operation is performed in the region other than Surabaya and Jakarta and in the water deeper than 10m, the facilities of the Navy Hospital are not available and, therefore, portable recompression chamber must be carried with.

c) Under-water cutting equipment

In Japan, under-water gas cutting by the use of the hydrogen gas was adopted to some extent, but it is no more employed nowadays inasmuch as the under-water oxy-arc cutting method which has been introduced since the end of the world war II and is more efficient than the gas cutting.

In Indonesia, however, the under-water cutting by the propane gas is most familiar in connection with the removal of sunken vessels.

List 5-2-4 Comparison of under-water oxy-arc cutting with gas cutting.

Methods / Items	Oxy-arc cutting	Gas cutting
Efficiency	Excellent	Inferior
Technic	No specific technic is requested.	Pre-heating must be continuosly kept. Skill and special technic is requested.
Ignition	Arc is easily produced	Once failed in water, another ignition cannot be made therein. It must be made on the surface.
Equipments	Generator Rectifier, Cutting apparatus	Compressor, Cutting torch
Depth of water	Efficiency does not decrease though depth increases.	Efficiency decreases as depth increases.
Cutting torch	Light, easily handled	Heavy, 3 hoses attached (one for propane, one for oxygen and another for air). Adjustment of flame requested.
Safety	The impulse may travel to divers, but safe if rightly operated.	If gas gathers in some places of sunken vessels, explosion may occur. Not free from gas danger.

In Indonesia as well, the oxy-arc cutting method is employed among the companies concerning the oil productive industries. Some of those who operate the removal of sunken vessels own 1 - 4 sets of under-water oxy-arc cutting apparatus.

The diving center in the Surabaya Navy base extends training of under-water oxy-arc cutting even to divers of the private companies. However, the above method is hardly adopted in the operation of the removal of sunken vessels in Indonesian waters. The chief reason is, it is considered, attributable to the following factors.

i) The cutting rods are the imports from the foreign countries and the procurement is not easy because of time and money.

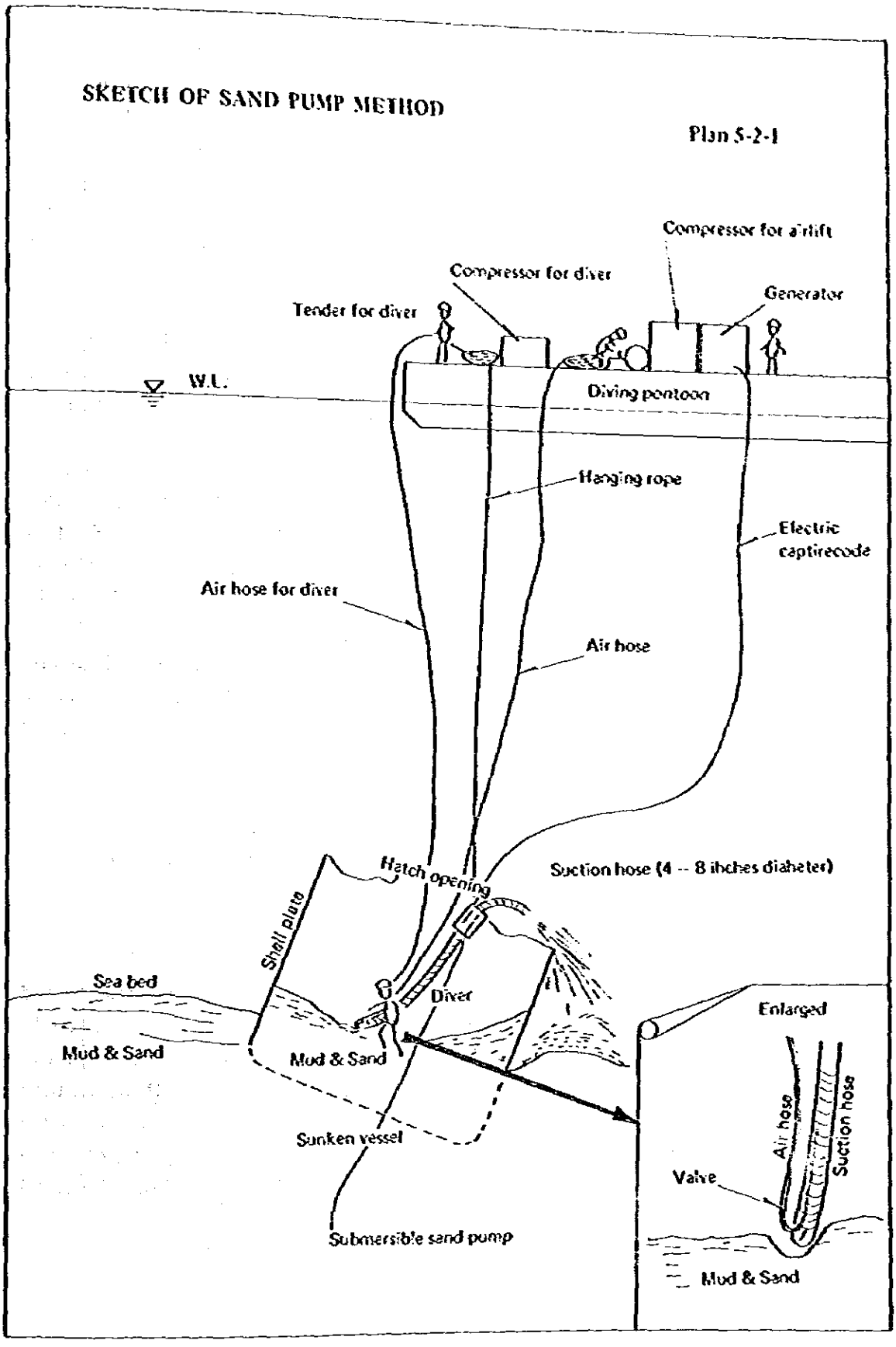
ii) The generator, rectifier and others for the use of cutting are expensive. They are elaborate as compared with gas cutting.

iii) The divers are afraid of the electric impulse and do not like to use the oxy-arc cutting apparatus.

The divers trained in the Navy are familiar with the electric impulse. If rightly handled, the oxy-arc cutting apparatus is quite safe for human bodies. In order to increase the efficiency of the under-water cutting operation, it is considered necessary to have the gas cutting method converted to the electric cutting method.

d) Equipments for the removal of mud and sand

The removal of the mud and sand is very much important in the operation of the removal of sunken vessels in the Indonesian waters because of the fact that the vessels have been sunken in the water for quite a long period. So much so that more than half the diving work is the work of removal of mud and sand. In this connection, the Indonesian salvage companies do not own the pump for the removal of mud and sand and they work by way of the air-lift method. According to an Indonesian salvage company, a small quantity of dynamite is introduced in the water for the purpose of softening the mud and sand in case where those in the hold have turned hard. The Japanese salvage companies usually employ, for the purpose of increasing the efficiency, the submersible electric sand pump as per the attached illustration in connection with the air-lift method. The submersible electric sand pump is more efficient than the diesel or gasoline driven pump generally used by the Indoesian salvage companies in that the main motor and driving section are submerged and the suction head is as high as 15 - 20m. The observation of the above is good not only in the removal of sunken vessels but also in the general work of draining. The sand pump is very useful in the general salvage operation and, therefore, it is desired to have it popularized in Indonesia.


SKETCH OF SAND PUMP METHOD
Plan 5-2-1
Compressor for airlift
Compressor for diver
Generator
Tender for diver
W.L.
Diving pontoon
Hanging rope
Electric captirecode
Air hose for diver
Air hose
Suction hose (4 -- 8 inches diameter)
Hatch opening
Shell plate
Sea bed
Diver
Enlarged
Mud & Sand
Mud & Sand
Air hose
Suction hose
Sunken vessel
Valve
Submersible sand pump
Mud & Sand

e) Diving pontoon

The diving pontoon is employed in the operation of the diving as in the case of the removal of sunken vessels, and is loaded with the diving compressor etc. The divers work using the pontoon as their diving boat. In Indonesia, the companies of the removal of sunken vessels generally use the pontoon of the size L x B x D = 10 x 5 x 1.5m as the diving pontoon.

If the volume of the work increases, another pontoon will be put into the work. In Japan, a variety of form and size of the pontoon is available. Therefore, any pontoon which is suitable to the size of the operation or to the equipments to be loaded thereon is ready for use. And, for the purpose of eliminating the loss of time, the accommodation for the divers is in most cases provided. In Indonesia, on the other hand, the size of the pontoon is tiny as is seen above. Therefore, the deck of the pontoon leaves little room for the accommodation if it is loaded with a bulky compressor and some other equipments. Under the circumstances, the workers for the removal operation in Indonesia have to lodge on the land and have to travel a long way to the job site by car and small boat spending a lot of time. So, they sometime have to get up before dawn to have adequate tidal time. The loss of the time can be dispensed with if the accommodation is provided on the pontoon. The loss of the physical strength of the workers can also be dispensed with, with a result that the efficiency of the operation will greatly be enhanced. Such being the case, the pontoon and the operation method shall better be examined in the direction of the accommodation being provided with at the operation site.

(2) Floating Crane

1) Present status of the floating crane in Indonesia

a) The floating crane owned by the government quarters

Those of 75 tons and 50 tons are only for the use of cargo loading and unloading, and useless for the operation of the removal of sunken vessels. Those of 200 tons, as indicated above, are available only in the respective ports. They are available for the removal of sunken vessels. However, their main winch is driven by steam and their age exceeds 20 years, so the seaworthiness of the vessels has been degraded. The capacity of lift has also been reduced through the agedness of the vessel. It is declared that the actual ability is 70% of the indicated figure.

List 5-2-5

Owners	Nominal capacity of lift	Number of vessels
Indonesian Navy	240 tons	1
	200 tons *	1
	75 tons	2
	50 tons	4
Port Administration	200 tons **	1
	75 tons	2
Total		11

* available only in port Surabaya

** available only in port Jakarta

b) The floating crane owned or operated by private companies

The private company in Indonesia which actually performed the removal of sunken vessels and which operate the floating crane is only PT. Yalagada. No other companies own nor operate the floating crane. The owner of the floating crane operated by PT. Yalagada is the Indonesian Navy. This is the one indicated at the top of the above list. The particulars are as follows:

List 5-2-6

Type and name of vessel	Floating crane "RAKIT BELALAI"
Owner/Operator	Indonesian Navy/PT. Yalagada
Built	1965 in YUGOSLAVIA, engine in WEST GERMANY
Lifting capacity	Normally 240 tons, actually 170 tons
Dimension	L X B X D 38.0 X 16.5 X 2.7m
Motor	Diesel engine
Crew	18 persons

On top of the above, the following private companies obtained permission from DMS and own the floating crane.

List 5-2-7

Name of company	Lifting capacity	Floating crane
PT. Comaritim	15 – 50 tons	4
PT. Karasin Agung	15 tons	1

PT. Comaritim is a company concerning the oil industry and does not carry out the removal operation. The floating crane of PT. Karashi Agung is of the limited capacity 15 tons and is available only for the removal of small wooden vessels. Therefore, when the domestic vessels are to be employed in the removal operation in Indonesia, there are no alternative but either to use the aged floating crane of 200 tons or to use the floating crane operated by PT. Yalagada.

Actually, the two Indonesian companies have entered the business contract with companies in Singapore as shown below for the purpose of chartering the Singapore flating crane in case the Indonesian floating crane fails to accommodate the removal operation.

List 5-2-8

Company	Singapore company	Floating crance recently employed in Indonesia
1. PT. Yalagada	SMIT INTERNATIONAL 2014, International Plaza, Anson Road Singapore	Smit Cyclone lifting capacity 500 tons
2. PT. Insal	SELCO/Singapore No. 1 J1. Samolun Jurong, Singapore	Selco L8 lifting capacity 300 tons

2) Provision and Supplies

In case Salvage Companies tender the removal operation of the sunken vessels in Japan, a lot of floating crane are available. They select the most appropriate type of the floating crane after having examined the size, type, condition etc. of the sunken vessels concerned. In Indonesia, however, the floating crane are few as mentioned above, and the actual capacity is lessened from the nominal figure. As

regards the ship's age, even the latest built floating crane's age is as old as 15. In other words, all the Indonesian floating cranes are old-aged even though it is claimed that they are still workable. They are too old to be redressed or restored to the higher grade. Therefore, the alternative of the improvement shall be either that the floating crane of the foreign flag shall efficiently be employed or that the new floating crane shall be procured in Indonesia.

The selection from the two shall finally be made after closely examining the following items:

a) Charterage
b) Season and duration
c) Capacity of the floating crane
d) Condition of the contract
e) Maintenance
f) Frequency of operation
g) Depreciaiton
h) Others

Generally speaking, the capacity of the floating crane employed in the operation of the sunken vessels is ordinarily around 500 tons. The floating crane of this capacity gains an advantage over that of 200 tons as used in Indonesia in respect that:

i) Lifting capacity is superior as indicated in Chapter 4 so that a block which is lifted at one time shall be quite large. Therefore, the length of the under water cutting becomes curtailed and the number of the block to be lifted decreases.

ii) From the same reason as above, the operation of eliminating mud and sand gets curtailed.

iii) The reserved lifting capacity is so big that there remains a room for the winch to be over-worked.

As seen above, it is recommended that the floating crane be improved by employing a floating crane of the capacity as large as 500 tons.

(3) Equipments of DMS for the purpose of survey

1) DMS staffs 8 divers and owns the following equipments necessary for the preliminary survey of the sunken vessels.

List 5-2-9

	Equipments	Quantity
1.	SCUBA apparatus by DRAGER Co.	12 sets
2.	High compressor	4 units
3.	SCUBA full set made by U.S. Divers	3 sets
4.	Under-water camera (niconos)	3 sets
5.	Side Scan Sonar	1 set
6.	Magnetometer	1 set
7.	Distance meter	2 sets
8.	Echo sounder made by FURUNO Co.	2 units
9.	Under-water thickness gauge	1 unit

(The equipments used by the Japanese study team of this time are not included therein.)

DMS is surveying the sunken vessels using the above equipments and will again survey the definite vessels to be removed according to the Matsukura Report for the purpose of compiling the cost estimate. The equipments of DMS for the purpose of survey are considered quite sufficient if it is taken into account that the equipments used by the Japanese team this time are scheduled to be donated to DMS.

2) Survey boat

There are no boats in Indonesia which is used exclusively for the purpose of the survey.

When DMS renders the survey of the sunken vessels, it charters the small-sized vessel near the job site. If DMS itself owns the survey boat, advantage will eventually follow. For instance, the situation of the vessels sunk in the several Indonesian waters, where no preliminary diving survey has yet been rendered, will be made clear one after another. Further, the order of priority for the removal will be fixed and the estimate of cost of the removal will be figured out. As regards the newly happening sunken vessels, the early-staged activities are made possible, preventing the oil pollution, obtaining the vessel's situation and rendering the salvage work though not on a large scale.

5-2-2 Personnel for the removal of sunken vessels in Indonesia

The personnel for the removal of sunken vessels in Indonesia under the salvage companies approved by DMS is as per following list.

List 5-2-10 Salvage Personnel List of Resistered Salvage/Underwater Work Company

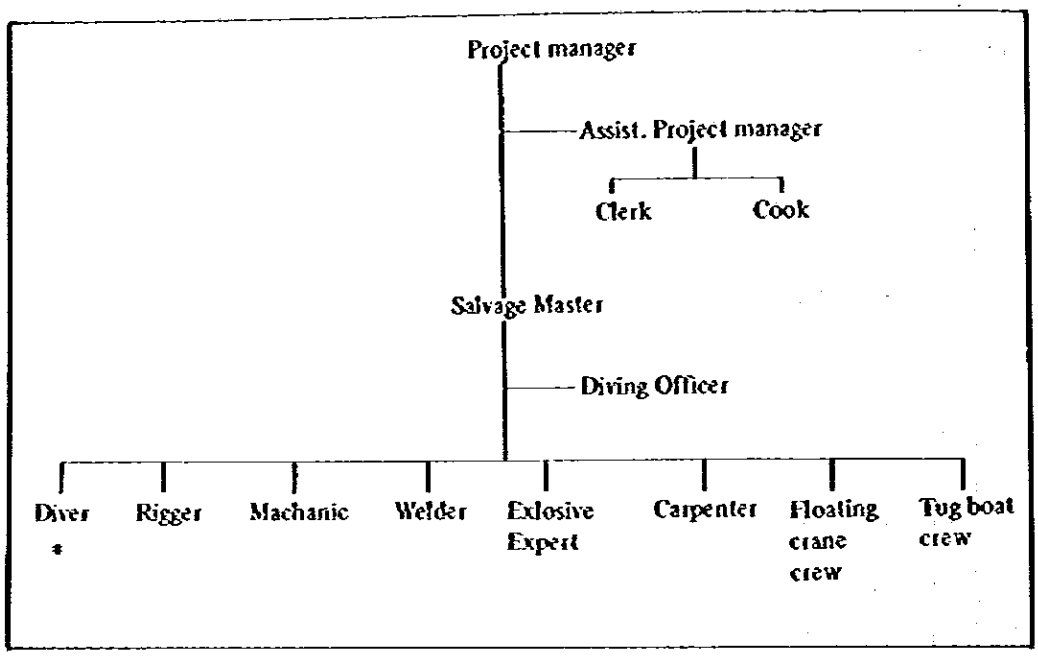
Company Name	Staff		Main Work
	Employer	Diver	
PT. Yalagada	58	12	removal
PT. Insal	23	6	removal
PT. Bayu Samodra Sakti	38	3	removal
PT. Salvage Antasena	69	8	removal
PT. Komaritim	254	11	oil work
PT. Karya Asih Agung	32	12	small ship removal
PT. Calmarine	38	15	oil work
PT. Kaliraya Sari	42	4	oil work
PT. Anugrah Tirta	22	8	harbor work
PT. Indosal Inti	23	15	harbor work
PT. Tosan Galin	16	3	oil work
PT. Bahari Cakrawala	51	11	harbor construction

The study of the formation, assignment analysis, and education of the personnel will follow.

(1) Formation of the personnel for removal operation

The formation varies according to the method, size etc. of the concerned removal operation, but the formation in the case of the removal of a sunken vessel 1,000 - 3,000 gross tons is ordinaly as follows:

Plan 5-2-2 , Formation Plan



* Including Tender for Diver

The removal operation by the refloating method includes the work like air tightening and water tightening necessitating the introduction of the carpenters. However, in case of the cut method, the carpenters seldom work. the arrangement of the personnel varies like this, but above plan shows the ordinary formation in case of the cut method.

The number of the personnel varies according to the dimensions of the operation, varying from something like 10 to 100 as the case may be. In the case of a small operation, the salvage master may hold the post of project manager additionally or the clerk may hold the post of assistant project manager additionally. Sometimes crew of the floating crane work also as riggers. The above plan does not embrace the dismantle gang which dismantle the removed vessel on land. When the operation includes the above work, the dismantle gang is, needless to say, called for. The formation and the number of personnel needful for the operation of removal varies according to the method or the dimensions of the operation, but the fundamental organization is as exhibited in the above plan.

(2) Assignment etc.

The formation plan is as per above. The situation in Japan as regards the assignment of each personnel working for the removal, the relevant formation and the license are as follows:

Conditioned that;

a) The sunken vessel is of 1,000 - 3,000 gross tons.

b) Water depth is within 20m in a port where floating crane of the lifting capacity 200 tons is employed.

List 5-2-11 Personnel and Assignment list on Salvage Operation

	Salvage personnel	A Assignment	men	Preferable licence in Japan	Concurrent or Convertible personnel
1.	Project Manager	Business Negotiation Personnel Management Accounting On-the-spot Management	1	Master of Oceangoing vessel	Salvage Master
2.	Assistant Project	General matters Procurement of material Accounting	1		
3.	Cook	Cooking	2	• Cooking licence	
4.	Salvage Master	Planning/Implemention of Salvage Operation Management of Operation	1	Master of Oceangoing vessel Diver's licence	Diving officer
5.	Diving Officer	Planning/implemention of divers work Supervisor of diving operation	1	Officer of oceangoing vessel • Diver's licence • Medical officer for diver	Chief diver
6.	Diver (Including diver's attendant)	Diving works: Cutting, Rigging, Blasting and Removal of mud/sand	8-10	• Diver's licence • Blasting licence • Rigger's licence	Explosive expert Welder Carpenter Mechanic
7.	Rigger	Rigging Maneuvouring work boat Assistant for diver's work	4-6	• Crane operates • Rigger's licence Officer of 2nd class vessel	Crew of Crane/Tug Sailor Stevedoring Diver's licence
8.	Mechanic	Maneuvouring/ Maintenance of machines	3-5	Vehicles maintenance licence Engineer of 2nd class vessel	Engineer or oiler Vehicles maintenance
9.	Welder	Arc/gas, welding/cutting	1	• Gas welder licence • Electric welder licence	Welder on shore Diver
10.	Explosive expert	Blasting operation: Planning/implementation Supervision	1	• Explosive handling licence • Blasting licence	Carpenter Diver Blasting on shore
11.	Carpenter	Carpentry	1		Explosive expert Diver Carpentry on shore
	Total		24-30		

• denotes necessary and required licence by law.

(3) The assignment and education of the principal removal personnel

As shown above, some removal personnels can be converted from the workers for the shipbuilding on the land or from the ship's crew. However, there are removal personnels who are requested to acquire specific skill, ability and experience like project manager, salvage master, diving officer and divers. The job of these personnels are the subject of the following study.

1) Project manager

The important thing for the project manager is to aquire a lot of experience as a salvage master (his assignment is to be explained later) in the intricate emergency salvage and in the removal spot of sunken vessels. The project manager not only supervises the personnels under the salvage master's control like removal workers, crew of floating crane and tug boat but also plans and transacts whole operation, contract negotiations, financial and personnel management. He is expected to have an ability in these lines and have a lot of experience.

2) Salvage master

He is practically responsible for everything in the removal spot. He is supposed to be well versed and experienced in heavy lifting including diving work, ocean towing, salvage engineering and etc. Therefore, he must have been educated and versed in ship's structure, navivation and salvage. His ability must extend to the planning of operation and the supervision of the removal workers including diving officer, crew of floating crane and tug boat, thus aiming at the harmonious operation at the site of the removal.

3) Diving officer

As shown in the formation plan, he assists salvage master at the spot supervising the removal work. He must be well versed in whole picture of the operation. His work is mainly relevant to diving and so he must fulfil the duty of the safety officer. Hence, the divers in the operation of the removal of sunken vessels are supposed to be educated systematically and by experience about diving technique and relevant works. They must be ready to cope with every emergency happening through the diving operation.

Remarks: Concerning the education in Japan of the main personnel of the removal.

(A) Project manager and salvage master

The education is undertaken by each individual salvage company to those who graduated from mercantile marine college or from shipbuilding course of college of technology and who have finished the elementary educationfor the business he is entering.

(B) Diving officer and diver

The following two are the public educational institutes for divers in Japan.

a) Japan Marine Science & Technology Center
located at 2-15, Natsushimacho, Yokosuka City

b) The Taneichi High School in Iwate Prefecture,
the Aquatic Technology Course.
Located at 38-94-110, Taneichimachi, Kunohegun, Iwate Prefecture.

Besides, Navy of the Self Defence Force of Japan provides education for the divers using the textbook (diving manual) of U.S. Navy. However, those who finished this course seldom join the private salvage company. The private salvage company trains in its own organization thos who finished the institute as a) and b) above.

(4) 1) Education and training of principal removal personnel of the private salvage company in Indonesia.

As may be gathered from the above personnel plan of the removal operation of sunken vessels, the rigger, the mechanic, the carpenter, the welder etc. can be converted from the industries on the land or from the shipbuilding department with a result that no specific education or training as a removal personnel is necessitated. Therefore, the study will be made herein only in repsect of project manager, salvage master, diving officer and divers.

2) Education and training institute

Some of the principal removal personnels of the private salvage companies in Indonesia are, generally speaking, those who used to work for or were trained in the Indonesian Navy.

a) Indonesian NAVAL ACADEMY, (AKADEMI ANGKATAN BERSENJATA REPUBLIK INDONESIA BEGIAN LAUT).

Some of the salvage officers are graduated from Indonesian naval academy. After having finished the course, they undergo the training of salvage and diving.

b) INDONESIAN NAVAL DIVING CENTER, (DISLAMATARMA)

This is only one diving education institute in Indonesia, and is located in the Navy base in Surabaya.
It was established in the year 1962 and provides the three diving training towers in the compound. It also provides, as equipments for training of divers, open circuit SCUBA and light weight diving gear, both of which are often used in the removal operation in Indonesia.

3) Education and training

Generally speaking, the personnels are mostly the graduates from the Naval Diving Center. Some of them go abroad after the graduation for the training made in, for instance, USSR, Poland, Italy, U.S.A., Japan etc. The basic training is, therefore, considered competent and has reached the international standard. Dificiency, if any, may lie in the operation experience on the spot. However, the deficiency is hardly admitted inasmuch as the Indonesian salvage companies performed by themselves the removal of about 80 vessels, large or small, amounting to around 24,500 tons during past ten years from 1969 to 1979. (Pelita I and Pelita II)

For reference, the abbreviated personal histories of three salvage officers of the typica removal operators in Indonesia are as follows:

A.	The year	1962	Graduated from the Indonesian Naval Academy
		1962	Navy salvage officer
		1965	Joined the private salvage company
B.		1960	Finished the course of Indonesian Navy officer
		1967	Joined the private salvage company in the capacity of salvage diving officer
C.		1960	Finished the course of Indonesian Navy officer.

1965 Joined the private salvage company in the capacity of salvage officer.

4) Education and training of divers

Indonesian Navy undertakes, at the diving center in the Surabaya Navy base, the education and training of about 20 divers by trust from private salvage company or from the company related to the operation of diving. The outline is as follows:

a) Level of education
The level of the education in Indonesia at present is at the stage of the second-class divers as referred to in U.S. Navy's textbook. Indonesian Navy issues the certificate at the time the training finishes.

b) Manner of training
To follow up the manner referred to in U.S. Navy Diving manual.

c) Training analysis

i) Underwater gas and electric cutting
ii) Underwater welding
iii) Under-water blasting
iv) Clearance of mud and sand
v) Other miscellaneous under-water work
vi) Recommpression etc.

d) Diving apparatus for training

i) Open-surcuit
ii) Surface-supplied light weight gear
iii) Surface-supplied deep-sea gear as is termed in U.S. Navy

e) Term of training
About 6 months. However, daily training hour in Indonesia is short as from 0700 to 1300. Therefore, the 6 months in Indonesia corresponds to about 3 months in U.S.A. or European countries.

Those who underwent the above training compose the leading divers in Indonesia. For one thing, 12 divers work for PT. Yalagada, the most enthusiastic removal operator accumulating a lot of experience, 2 out of the 12 used to be divers in Indonesian Navy and remaining 10 were trained at the above center. However, there is an exception and the divers exclusively trained in PT. Bayu Samadra Sakti by itself compose the principal divers in the organization. Generally speak-

ing, most of the divers in Indonesia are those who were trained in Indonesian Navy and afterwards jointed the private companies for experience.

f) Manual of diving

The one used in Indonesia for training and operation is in most cases the U.S. Navy Diving Manual. This is of course compiled by U.S. Navy. The Japanese Navy of Self Defence Force as well as removal operators in many countries employ it. However, the recompression table adopted in the manual has been made out for the military purpose with a result taht, although it is good for short-time diving, it is not necessarily welcomed for lengthy operation on the commercial basis. Some private companies in U.S.A. relevant to the diving operation recently quit using the manual on an account that the submarine sickness increases by way of the behavior according to the manual. In Japan as well, a company quit using the manual and replaced it by the improved table suitable for the commercial diving. The results are excellent. The improved table is as attached herewith.

Remarks: Diving Manual in Japan

(A) Textbook for divers
Compiled by Labour Ministry (Labour Health Section, Safety Sanitation Dept.)

(B) Manual for Safe Operation of Diving
Compiled by Ministry of Transportation (Harbour Bureau)

(5) Study of principal removal personnel in Indonesia

1) Education and training of today

Description has already been made in respect of the principal removal personnel. And, as has been seen, divers were trained basically in the Indonesian Navy, and afterwards were trained, educated and acquired experience in the respective salvage companies. Therefore, as far as the education or training is concerned, no shortcoming is observed. However, as has been pointed out in 5-2-1 above, divers trained in the private companies are inclined to be afraid of the impulse at the time of the electric cutting. The appropriate guidance for the divers is indispensable.

2) Education and training in the future

There remains a problem for salvage master and others. Only the divers are the

subject of the following study. The aggregate number of divers employed by the main 4 companies carrying out the removal of the sunken vessels in Indonesia is, for the past 5 years, 29 - 36 as seen below. There is no indication of major change to occur each year.

List 5-2-12

year / company	1975	1976	1977	1978	1979
PT. Yalagada	12	12	12	12	12
PT. Insal	7	7	7	6	6
PT. Antasena	9	9	9	8	8
PT. Bayu Samodra Sakti	8	8	8	3	3
Total	36	36	36	29	29

The above divers are sufficient in number to accommodate the operation of four spots simultaneously, each calling for about eight divers. At present, the demand for the removal operation comes out once or twice a year. Should the demand for the operation increase, there would be no embarassment to cope with the situation.

The reasons are firstly that the Indonesian Navy undertakes the education and training of about 20 divers annually. Secondly, new commercial diving training center is scheduled to be constructed at Jakarta or Surabaya in the year 1981. The feasibility study has been carried out by ISOT in Norway (see remark 1 below). This center aims at the training of mixed gas diving finally, and the level of the training institute in Indonesia will reach, at the time of the opening of the center, the international standard. Therefore, the training organization in Indonesia for the removal of the sunken vessels is well prepared to cope with the increased volume of operation.

Remark 1: ISOT

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5-2-3 Consideration

The arrangement of the equipments for the removal operation of the sunken vessels in Indonesia has partly been described. Now, we are going to summarize the description and state in the order of priority.

(1) General equipments

General equipments like diving apparatus, underwater cutting equipment, mud removal apparatus, diving pontoon etc. are the indispensable equipments for the removal of vessels and, different from the big equipment like floating crane, are not so much expensive that the improvement and arrangement thereof at an early stage are recommended. DMS is supposed to utilize the equipments including diving apparatus used this time by the Japanese Team and to have the Indonesian private companies versed with the equipments.

(2) Survey boat

The aim of employing the survey boat is to catch the detailed information about the sunken vessel and to map up the basic plan. In Indonesia, DMS owns the equipments for survey, but does not own survey boat. It is said that several hundreds of vessels are sunk in Indonesian waters. The situation of the vessels is only clarified in the "Matsukura Report" which was drafted 20 years ago. Since then, no up-to-date report has been prepared. The survey boat can be used not only for the purpose of survey but also for tug of, say, floating crane. Its operation extends to the incipient work necessary to the vessel to sink, blocking the oil pollution, having access to the situation of vessel and performing the facile type of salvage.

Therefore, the survey boat is very helpful.

List 5-2-13 For reference: Outline of desirable survey boat

1.	Gross tonnage	200 – 300 tons
2.	Type	Tug type
3.	Navigation area	Indonesian waters
4.	Main engine	Diesel 2,000 HP
5.	Propulsion	Port nozzle twin screw
6.	Accommodation	For 20 persons to dwell
7.	Cargo gear	3 tons derrick
8.	Mooring	Feasible to moor at 4 points
9.	Navigation equipments	Radar etc.
10.	Communication system	VHF etc.
11.	Recompression apparatus	Small recompression tank provided
12.	Towing gear	1 type
13.	Survey equipment	Side scan sonar portable echo sounder portable current meter
14.	Others	Under-water cutting apparatus pumps

(3) Floating crane

The floating cranes in Indonesia are three in number. One is operated by PT. Yalagada, 15 years of age and now actual lifting capacity 170 tons. Another two are of lifting capacity 140 tons each. The three floating cranes are all aged and workable only within the port area of Jakarta and Surabaya. It is unable for them to be towed to other places. There are still many vessels sunk in Indonesian waters. As the existing floating cranes are getting aged year after year, it is considered that new floating cranes are better be procured although the foreign flag floating crane may be employed for the time being. Floating cranes can serve multi-purposely, not only for the removal of the sunken vessels. In the case of the new procurement, thorough study must be made concerning fund, maintenance, capacity etc. As regards the capacity, the most appropriate figure will be 500 tons or the like.

5-3 Most Adequate Method of Removal Operation and Cost Analysis

(1) General aspects of the method of removal of sunken vessels have been explained in 5-1. The method to be adopted shall be determined taking into account the aggregate cost and the value of the vessel removed.

Usually the refloating method, by which a vessel shall be removed as one whole substance, is examined visualizing the vessel's operation once again. Even when it has been made clear that this operation is infeasible and value of the vessel is only that of the scrap, the refloating method still remains to be the subject of examination because of the curtailed period of operation and of the reduced cost. In this occasion, there exists a probelm of risk which can not be ignored from the point of view of the completion of operation. The removal operation is usually conducted based upon the fixed amount of charge.

So, the salvor will not dare to undertake the operation on the fixed amount unless the possibility of removal is made quite definite. Because, if he fails, everything goes on to his shoulders for his responsibility. Any preliminary arrangements for the removal operation, employing a lot of equipments and salvage personnels, arranging for quite a long period, might become nullified once a storm bursts on the sea only for one night. However, the salvor may act positively weighing the risk involved. In that case the term of contract is principally "No Cure, No Pay". If he succeeds, he earns much more than the cost he bears. It has been made clear by the survey performed in Surabaya port that the sunken vessels on the list of the Indonesian Authorities have slept beneath the sea for nearly 40 years.

The vessels are so heavily rotted, rusted and deteriorated that very few vessels will be removed by refloating method. Therefore, only cutting and lifting method will be adopted. The specific features of the cutting and lifting method are:

1) Technically speaking, the weight of the basic operation is great.

2) A lot of equipments are dispensed with.

3) Salvor's risk is minor.

4) By introducing a piece-work payment system, even minor company of little fund can undertake the operation.

The Indonesian salvors performed and experienced the salvage (not the removal) of the sunken vessels, operated by the refloating method or practiced the lift of the vessel employing two salvage boats. They are thus skilfull in adaptation to the requirements

of the case, and, under the circumstances, the cutting and lifting method is, we believe, employed by them without any technical trouble.

Hence, we conclude that the best choice is not other than the cutting and lifting method.

(2) Expense

When the adoption of the operation method is decided, the relevant expense is forcedly figured out. The total sum is, as mentioned in 5-1, the aggregate of expense of equipments, personnels, supplies and of the administration. Another assortment of the expense shall be made according to the operation as follows:

1) preliminary survey
2) prearrangement
3) removal of mud/sand
4) cutting
5) operation of floating crane
6) withdrawal

Above 3), 4) and 5) are the major items of expenditure. As regards the removal of mud/sand and the cutting operation, we described in Chapter 4 (model case) and in 5 to the effect that there exists an improved manner of operation which can be introduced to the manner presently adopted in Indonesia. The manner thus introduced shall be the most efficient manner of the operation. As regards the floating crane, the charter of floating crane of big capacity from Singapore, Japan and other South-East Asian areas is feasible.

However, the charge of bringing the floating crane longway to Indonesia is so expensive that the employment of the Indonesian domestic floating crane is most advisable.

6. EXPECTED EFFECTS

6-1 Improvement of Safety Navigation

Removal of sunken vessels in the waters of Indonesia is necessary for improvement of safety navigation as mentioned already, and so expected effect by removal of sunken vessels is to prevent outbreaks of maritime accidents caused by sunken vessels.

Maritime accidents occurs from various causes as follows; weather and sea condition, state of ship performance and facilities, and their maintenance, breadth and bend of passage, navigation aids, traffic of vessels, knowledge and technique of navigator, and etc. which interact, directly or indirectly. Accordingly in order to prevent maritime accidents from happening, it will be necessary to improve every cause and to work out counter-measures against them from the synthetic viewpoint.

Removal of sunken vessel is one of such countermeasures as that in which only economic evaluation in qualitative can be made and no economic evaluation in quantative is to be made because of lack of data and time limitation. Improvement of navigational circumstances have great weight with general policy for prevention of maritime accidents and there is no need to dwell upon that removal of sunken vessels will contribute extensively to prevention of maritime accidents. Namely, the removal of sunken vessels in passages and anchorages leads to increase in breadth of passage and width of anchorage, and to improvement of bend of passage, and furthermore results in dissolution of passing and meeting with each other, or of psychological apprehension of navigator. It can be said that removal of sunken vessels has significant meaning for safety navigation in Indonesian waters.

6-2 Advantages of Wrecks Removal

Removal of sunken vessels will be expected to have following immediate effects in navigation of vessel.

(1) There would be no waiting time to enter into or leave the port because of large capacity of traffic by gaining in width of passage.

(2) It will become possible to reduce the range of the guidance by sea pilot.

(3) It can be possible for vessels to enter into or leave the port easily, additionally at night.

Besides, completion of removal of sunken vessels could make dredging easy, of which smooth operation would lead to increase in depth and breadth of passage.

For instance, in Western Channel of Surabaya port the navigational depth and width of passage have been maintained by dredging more than 2 million m^3 mud and sand annualy, which has been impeded by sunken vessels distributed in those area. Therefore, dredging operation would be promoted smoothly after completion of removal of sunken vessels. Consequently, large sized vessels half loaded or waiting for high tide so as to enter into or leave the port could have their shipping movement at any time.

That is to say, as mentioned above, it is expected to reduce transportation cost by dissolution of the bottlenecks and by acceleration of port improvement.

6-3 Spreading Effect

Removal of sunken vessels brings not only such direct benefits to navigators as improvement of safety navigation but also some derivative ones.

The first of them is the recovery of steel scrap.

For example, Japan had removed many sunken vessels during 1950S. At the beginning, Japan had planned to solve the problem of shipping shortage with removal by defloating of sunken vessels which had been obstacles to navigation inner and outer harbor. Then, removal operation of sunken vessels in more than 30 m depth has been carried out for the purpose of recovery of steel scrap, even though those vessels were not so direct stumbling blocks to safety navigation. In those days Japan was in postwar rehabilitation period and not well provided with such modern facilities for steal manufacture as large sized blast furnace yet in spite of vigorous demand for steel. The recovered steel scrap from sunken vessels were utilized as rerolling or melting. Accordingly price level of scrap exceeded cost for removal operation of sunken vessels, which has been smoothly carried out on commercial base in many cases.

Following is examined from a viewpoint of such experience as above.

It is the present state that steel can be supplied sufficiently,of which price is relatively low because of world-wide-spread of steel manufacturing method. There are thirty steel manufacturers in Indonesia and they have capacity to supply one million ton of bar and angle per year. On the other hand, sunken vessels are buried in mud, which produces a result of increment in cost for removal operation.

Subsequently, the recovery of steel scrap as resource of iron would be unprofitable in Indonesia. But removal of sunken vessels is expected to have an fair part in recovery of steel scrap, considering that steel scrap has an inclination to be short supplied in Indonesia.

The second is that opportunity of employment would be found.

The removal operation of sunken vessels requires some labor, and still more, in the process of breakdown into small pieces of recovered scrap considerable amount of labor is indispensable. So, it is more effective to get opportunity of employment in the consecutive processes; removal operation of sunken vessels – disposal of scrap – recovery of steel scrap to be manufactured. Accordingly it is necessary to formulate each plan on the premise that removed vessels should be dumped to the point where the price of scrap could be estimated high.

Besides, all staffs including divers who have much experience in actual removal

operation of sunken vessels will be expected to contribute to emergent rescue in maritime accidents or to implementation of ocean development projects.

6-4 Investment of Expediture

To pay the consideration in prevention of outbreaks of maritime accidents by the removal of sunken vessels would bring benefits to navigators and furthermore have excessive public significance as well as other plans to prevent traffic accidents from happening have. So, removal operation requires enormous expenditure, and the leading role for handling of the operation should be naturally taken by the Government so as to maintain public order and welfare. The Government should take initiative in promoting the provision of intra-structure. And there is no doubt that the Government's administration would play major role.

Basically important points of administrative management are as follows.

(1) To give the priority to the investment of expediture for safety countermeasure.

Needless to say, the expenditure is necessary for promotion of any countermeasure. It is one of the most important administrative method for the Government to invest the necessary and enough fund in the measure of prevention against maritime accidents. Accordingly it is considered to be necessary to take financial action with courageous decision to remove the sunken vessels which are obstacles to navigation.

(2) To install the countermeasure in early opportunity

Past countermeasures for safety have begun to be taken in the occurrence of maritime accidents, which have been sustained by the so called "empirical rule". It is quite necessary to take the initiative to promote the countermeasure, always looking for ahead in future.

7 GENERAL RECOMMENDATION

7-1 Summary

Expressing briefly the history of salvage operation in Indonesia, since the year 1960, when the International Salvage Association (ISA) was active, till the year 1965, the removal of sunken vessels has been carried out mainly around wharf and anchorage in such major ports as Jakarta, Surabaya.

Project for removal of sunken vessels is not only unobtrusive but also of little appeal to the public, in spite of importance, in comparison with such projects as construction of roads, airports, ports, etc. In this context, it is the current state that the project is partially left as it is with the policy to control nonessential expenditures for Government which is now seeking for re-establishment of the national budget.

Problem of safety navigation has become highlighted again, as numbers of ships entering and freight remakably increased for four years commencing 1972 to 1975 in Surabaya port, for example, and ships enlarged reflecting expansion of economic development and of foreign trade.

From the viewpoint of safety navigation, navigator could easily identify location of the sunken vessel at the time of sinking because a part of the sunken vessel appeared above the surface of water. But, now, as years rolled by every part of hull sank into water because upperstructure above the surface corroded to breakdown or bottom of vessel was buried in mud of sea-bed.

For navigator, therefore, it is almost impossible to perceive by the eye the location of sunken vessels. As the affect of sunken vessels on the safety navigation has become more vicious than at the beginning, recently considerable numbers of maritime accidents caused by sunken vessels have been reported and psychological apprehension for navigator has been increased.

Touching upon actual state for carrying out salvage operation of the sunken vessels, it is current state that upperstructure of the hull collapsed and scattered into the sea due to corrosion, both inside and outside of the each sunken vessel were piled up with a large quantity of mud, and accordingly most sunken vessels subsided and dipped in the sea-bed. For this reason, in salvage operation it is needed to get rid of mud inside and outside sunken vessels as the first step. Then, the method of salvage could be limited to cutting and lifting because main parts of the hull to which sea creatures such as oyster attached seem to be too decayed and fragile to be refloated as a whole due to corrosion.

In formulating salvage plan and implementing the operation, the largest constraint factor in the natural conditions is extremely low water visibility in Indonesian waters, so diving operation is to nearly grope about in the water. Consequently, it is very hard for supervisor of the operation to accurately grasp real situation of the site in water, to say nothing of difficulty in carrying out diving and psychological apprehension for diver. If the water visibility is sufficiently high, necessary facts and information could be easily transmitted by hydro-photographing, water-TV camera, etc., thereby multiple studies could be made, as the waters are comparatively shallow. On the contrary, as the above method could not be applied to the waters, acceleration of the operation on survey and removal of sunken vessels is impeded even in not so deep water for diving. Challenge to the mud/sand in water induces to a leading factor to increment of difficulty in planning and costs for removal.

Paying consideration to the above problems, the following is a summarized result of the survey we have made this time.

7-2 Intent of Government of the Republic of Indonesia

The government of the Republic of Indonesia, firmly recognizing the importance of project for removal of sunken vessels to secure safety navigation in promotion of economic development, places high priority on it in the 3rd Five-year Economic Development Plan commencing 1979/1980 following 1st and 2nd Five-year Economic Development ones.

For efficient and effective operation of the project, the government has requested the government of Japan to extend technical cooperation on transfer of technology to formulate a basic plan for removal of sunken vessels and to implement its plan.

Historically, the Government of the Republic of Indonesia had initially had a Japanese salvage company make diving survey to identify locations of the sunken vessels in 1959 – 1960, then let joint ventured company remove 53 sunken vessels in 6 major ports. In 1965, the private salvage company was set up to take over operational machines and equipments from the joint ventured company, thereafter the Government has kept the consistent stance to let the national salvage company carry out the operation. The Government is not only expected to hold existing policy hereafter, but also has the intention to tackle this project from the medium and longer term viewpoint, having a plan to procure machines and equipments to be made use of and to educate and train personnel required for efficient operation of the project.

7-3 Management and Operational System

The Government of the Republic of Indonesia, in accelerating to salvage sunken vessels in tremendous numbers being unparalleled in other countries, took the first step to set up the Interdep Committee in 1960 composed of all departments in charge of administration of sunken vessels by issuance of the Presidential Decree No. 333 dated Dec. 20, 1960, then promoted contracting to implement the operation by inviting foreign salvage companies, set up and reinforced the private salvage company in the country and established a new administrative body exclusively in charge of removal of sunken vessels. At present, Directorate General of Sea Communications, having taken over the competency of the above body, is authorized to give permission of establishing company within purview of salvage and under-water-work services, to regulate to offer tender and to place order only to the registered companies authorized.

Directorate General of Sea Communications, introduces, too, permission system for respective salvage operation, so that administrative management system is considered to be more completely provided than any other oceanic countries.

However, there are some problems in respect of its operation. First of all, supervisory authorities concerned does not have detailed record on the salvage operation in the past as well as surveyed data on actual state of the sunken vessels. These record are absolutely necessary in order that data obtained by colossal sum of cost expenditured may be reflected in coming plan of salvage operation or that bottlenecks may be elucidated to operate forthcoming salvage more effectively. In case of deciding the priority given to sunken vessels in the salvage operations, further coordination is needed among the concerned.

In Japan, when the World War II ended, main ports and fairways were almost blocked on account of the sunken vessels including warships in many places around the sea waters of Japan. On top of that, mines and torpedoes were scattered all around the seaways and, therefore, the navigation of the vessels were very dangerous. Under the circumstances, the Government of Japan or the Ministry of Transport stepped into the clearance of the fairways.

(1) Clearance of fairway

The Maritime Safety Agency, the Ministry of Transportation, surveyed the main ports and straits with a result that Osaka port, Kobe port and Shimonoseki strait were designated as to be cleared in the first priority, and contracted with the salvage companies for the removal of the sunken vessels.

For this purpose, insurance companies and shipowners in possession of the sunken vessels were requested to sell the scraps to the scrap dealers.

(2) The clearance of the other ports and straits was carried out on the commercial basis and the sunken vessels were cleared one after another based on the contract between the salvage companies and the insurance companies etc. As regards the warships, the Ministry of Finance appears as an owner and sold by bid the sunken vessels to the salvors who in turn sold the scrap to the iron manufacturers to cover the cost. The obstacles were thus cleared and the safety navigation was brought about. It took several years from the beginning.

(3) The Government of Japan sold the scrap to the salvors at the reasonably low price, and no other favorable steps were taken by the Government to the salvors. The salvors were financed by the commercial bank based on the removal contract. They raised money, by selling the scraps, for the vessel and equipments needful for the operation.

7-4 Policy and System

Expenditure for salvage operation is a sort of investment for provision of infrastructure, so that it is needless to say that necessity is to raise efficiency of investment (cost).

Directorate General of Sea Communications not only stands in a position of placing order, but also should pay attention to nurturing sound private salvage companies in order to perform steadily salvage operations.

In this connection, although four leading private companies are dependent upon highly order awarded from the government, it is of necessity for the Directorate General of Sea Communications to place stably orders of salvage operation and to level off the volume of order by which the companies could be able to modernize the machines and equipments, to secure required personnel and to improve the efficiency of operation. To this end, to make efforts to secure sufficient source of revenue for this operation is essential.

As witnessed in the articles of cost analysis, in the Republic of Indonesia modernization in machines and equipments is earnestly desired, in particular what is short of among them is a kind of ship such as floating crane with big capacity, etc.. If each of these machines and equipments is owned or chartered by an individual company alone, rate of operation would be lowered, and reduced efficiency will ensure. Therefore, to avoid overlapping huge investment, it is desirable that these machines and equipments owned by the government should be in common use or those jointly owned by companies concerned should be collectively utilized. And if ship are chartered from foreign countries, which is one of the most effective ways, the Government should study and examine such method of placing orders as the chartered ship in one navigation should be consecutively in use for removal of several sunken vessels.

Furthermore, as to machines and equipments imported efforts should be actively made to exempt them from customs duties in so far as these are not made by domestic producers and as no competitors appears in the country. In addition, it is desirable that supply system of materials should be consolidated so as to realize the on-the-spot supply.

7-5 Provision and Supply Plan for Machines and Equipments

Although views on the plan has been indicated in the preceding Article on the assumption that the above could apply elastically on step-by-step basis in the situation of financial stringency, it is desirable to consider future effective provision and supply plan for machines and equipments if determined to proceed removal operation of a numerous number of sunken vessels as shown in the Article 1-2, with the medium and long term prospect.

As, in Chapter 6, the detailed examination had been made, here is shown the typical machines and equipments as follows:

Vessel	Specification	Price (CIF in Jakarta) US$
1. Floating Crane (self propelled type) 2000 PS	Hoisting capacity 500 ton	approximately 13.5 million
2. Salvage Tug/Survey vessel	Gross Ton approximately 390 T Engine 1000 BHP x 2 sets	Approximately 4.5 million
3. Salvage Support Vessel	Gross Ton approximately 110 T Engine 250 BHP x 1 set	approximately 2.0 million

The required amount for provision of the above is approximately US$20 million, for procurement of which necessary budget should be secured. The comparison between in present state and in future state when new machines and equipments are supplied has been already made in chapter 4.

7-6 Education and Training of Salvage Personnel

In the Directorate General of Sea Communications of the Republic of Indonesia, there are 8 divers in charge of the preliminary survey on sunken vessels who, having diving license at 2nd class of U.S. Navy, are considered to have no difficulty in their diving techniques to dive in 20 meters of water. As most of diving personnel at the master level in the salvage companies once had training in Japan, European countries, etc., they are sufficiently qualified to handle salvage operation by means of training newly employed personnel. In addition, as the plan is being put forward as to further provision of the facilities in training institutes which covers up to advanced diving techniques, it is expected that both quality and quantity of divers can be improved when the above plan is completed and put into operation.

For the divers in the Directorate General of Sea Communications, the following works should be performed for themselves, even if actual operation of salvage will be done by private salvage companies; (i) identification of the location of sunken vessels left alone in major ports, (ii) preliminary survey on their actual states, (iii) technical survey to carry out salvage operations, and (iv) inspection after the salvage. Particularly, the survey mentioned above (iii) is aiming at obtaining fundamental data to examine the method of and to estimate cost for salvage operation, and the result of survey might affect accuracy in calculation of the cost, namely, it makes difference between budget appropriated and actual cost at times according to its result. Therefore, as referred to in Chapter 5, the diving survey should be carried out on the basis of the most adequate method of salvage taken in the past, grasping the detailed points like the cutting part, and then reflecting the result in the coming operation. For this purpose, the divers in the Directorate, in our opinion, should always attend actual operation of salvage for which the government placed order.

8 PROPOSAL

This study on planning the removal of sunken vessels as stated in the preface has been made for the purpose of formulating a basic plan on the removal of sunken vessels in the Republic of Indonesia, and of transferring its technology to the Directorate General of Sea Communications to implement the plan. As to the transference of technology of removing the sunken vessels, the technology varies according to such conditions as of type and scale of the sunken vessel, situation of sinking, etc. and, salvage operation itself should be handled on case by case basis because it is largely affected by natural conditions, etc. of the site. So that, there are so many factors specific to this technology which differ from unified on pertaining to commodities producing industries. This study team, therefore, from Japan, modeled after several sunken vessels located around Buoy No. 4 in west channel of Surabaya Port as the example, has made the diving survey by having brought divers with a plenty of experiences as well as by having transported machines and equipments from Japan. Then the team has researched and examined into the most adequate method and cost, required machines and equipments, etc., taking account of the actual conditions in the area.

There are various views of the sunken vessels, but it had better touch upon its reality here. There prevails a nearly established recognition among owners/operators of ships that a large number of sunken vessels are left as these are in the major ports in the Republic of Indonesia, for the reason of which they are inclined to hesitate introducing newly produced ships with a colossal sum of investment because of the sunken vessels being obstacles to safety navigation. In promoting economic development in the Republic of Indonesia, though further provision and modernization of ports is obviously the basic one among other things in infrastructure, as a precondition of realizing the above, it is necessary to improve safety navigation and restore navigators' confidence. To this end, though there are such alternative plans as provision of navigational aids, dredging new passage, etc., what is more essential is to carry out quick removal of all sunken vessels in the passages and anchorages which is prerequisite for developing the modern ports.

Heretofore, examination on item by item basis has been made. In summing up, we propose that the following points be emphasized.

8-1 Medium and Long Planning

From the viewpoint of securing safety navigation; it is necessary to formulate medium and long term plan on removal of sunken vessels to grasp the whole picture of the sunken vessels, for which at first step, survey of the actual state is needed in the major ports. Sunken vessels between Bouy No. 4 – No. 5 and No. 9, West Channel, port of Surabaya on which preliminary survey has been made as the model case, should be promptly removed,

collectively judged from all factors such as status of maritime accidents, etc.. The same could be pointed out in the inner harbour and anchorage.

From the viewpoint of removal operation; main structure as deck of every vessels sunken on which diving survey has already been made in this study corroded because of the lapse of more than 30 years after sunken, and both inside and outside of sunken vessel are being piled up with a great quantity of mud/sand owing to strong current forward North and South in a cycle of alternately half day at the site. In addition, fine red clay floating up in the water from the bottom makes visibility extremly poor, whereby making salvage operation more difficult. It is presumed that the same situation is found in sunken vessels in other ports. In order to safely and smoothly perform the salvage operation in such unfavorable conditions, the following should be fully considered in formulating the operation plan; (i) to select favorable time, last operation should be done in rainy season, (ii) to examine working hours & day upon completion of tidal chart, (iii) to study operation method suitable for the site and (iv) to adopt the mother ship with dwelling facilities for working personnel to step up the rationalization of mobility to the site, by which safety in operation and improvement of efficiency could be secured. And in performing the operation it is essential to promote the adoption of (1) discharger of mud/sand, (ii) under-water oxy-arc cutter and (iii) diving apparatus with telephone, as well as to secure safety in the operation by (i) improving mooring method, (ii) use of guide rope, (iii) managing diving, etc..

8-2 Personnel and Machines and Equipments in Salvage Operation

As to personnel for diving operation, present educational training centered on diving and existing divers are considered to be sufficient. In the long run for salvage and underwater engineering, a commercial diving center is urgently needed.

As current machines and equipments are poor and mean, it is essential to further provide such ships in kind as survey boat movable and manageable within the water basin, floating crane, tag boat, etc. for the realization of which necessary budget resources should be secured. Additionally, it is desirable to promote the spread of discharger of mud/sand, underwater oxy-arc cutting apparatus and diving apparatus with telephone.

Furthermore, in introduction of a sort of large sized ship(s), appropriate consideration should be paid to invitation of supervisors during the period required for mastering its operation and maneuvering technics.

8-3 Regulation and Rule

At present, in order to remove the vessels which have been already sunken now in Indonesian waters, regulations and rules are mostly completed already. But regarding to new maritime accident, as there are many cases in which the newly sunken vessels can not be removed promptly according to current regulations and rules, it may be necessary to adopt new regulation and rules which depend upon international regulation or covention.

8-4 Salvage Fleet

With regard to the role that the Government should take in order to accelerate the wreck removal operation, it has been already mentioned in chapter 7-4.

And considering the actual situation in Indonesia, one of alternatives to improve removal operation is that the Government should support the salvage fleet as initial investment.

1 MEMBERS OF THE SURVEY TEAM

The Japan International Cooperation Agency (JICA) which is a semi-government body specializing in technical cooperation under the Government of Japan, organized the steering committee and the survey team to draft a basic plan for the removal work of sunken vessels in Indonesia and to implement the transfer of technology, and compiled the report.

Members of the first survey team

Leader	Mr. Hisashi Mishima	Deputy Director, Ship Bureau, Ministry of Transport
Member	Mr. Akinobu Munakata	Officer, Ship Bureau, Ministry of Transport
Member	Mr. Yoshio Saito	Consultant, Overseas Shipbuilding Cooperation Center
Member	Mr. Tatsuro Kato	Consultant, Overseas Shipbuilding Cooperation Center
Member Late	Mr. Yoshio Mukunoki	Social Development Cooperation Dept., Japan International Cooperation Agency

Steering Committee

Chairman	Mr. Yasuhiro Hosokawa	Deputy Director, Ship Bureau, Ministry of Transport
Member	Mr. Hisashi Mishima	Deputy Director, Ship Bureau, Ministry of Transport
Member	Mr. Akinobu Munakata	Officer, Ship Bureau, Ministry of Transport
Member	Mr. Masanori Kohara	Technical Officer, Navigation Safety Planning Div., Guard & Rescue Dept., Maritime Safety Agency
Member	Mr. Morifumi Tanaka	Technical officer, Kanto Maritime Bureau, Ministry of Transport

Members of the second survey team:

Steering committee

Chairman	Mr. Yasuhiro Hosokawa	Deputy Director, Ship Bureau, Ministry of Transport
Member	Mr. Masanori Kohara	Technical Officer, Navigation Safety Planning Div., Guard & Rescue Dept., Maritime Safety Agency

Member	Mr. Morifumi Tanaka	Technical Officer, Kanto Maritime Bureau, Ministry of Transport
Member	Mr. Hiroyuki Nishijima	Japan International Cooperation Agency

Consultant group

Mr. Hiroshi Ishikawa	Manager, Overseas Shipbuilding Cooperation Center (O.S.C.C.)
Mr. Tatsuro Kato	O.S.C.C.
Mr. Hisashi Yano	O.S.C.C.
Mr. Henji Furuta	O.S.C.C.
Mr. Takajiro Shiomi	O.S.C.C.
Mr. Masatsugu Goto	O.S.C.C.
Mr. Sadakatsu Hayashi	O.S.C.C.
Mr. Isomi Oi	O.S.C.C.
Mr. Nobuo Taira	O.S.C.C.
Mr. Yutaka Tsuchida	O.S.C.C.

List of Person Concern in Indonesia

1. Hamid Hadijaya N.A.	Director for Maritime Services.
2. R. Saman Abdullah	Chief, Sub Directorate of Salvage & Under Water work.
3. Ir. Lubrien Silitonga	Chief, Sub Directorate of Investigation of Maritime Technology.
4. Ir. Mashur Effendi	Research & Development Centre Directorate General Seacom.
5. Supardi	Planning Bureau Department of Transportation, Communication & Tourism.
6. Ir. Uung Solibun	Planning Division, Directorate General Seacom.
7. Bambang Wahyudiono	Chief of the Regional Headquarter IV.
8. Ir. Alex Kesaulia	Sub Directorate of Investigation of Maritime Technology.
9. Drs. Eman Soepono	Sub Directorate of Investigation of Maritime Technology.
10. Ir. Setyono	Sub Directorate of Salvage & Under Water Work.
11. Rasulina	Sub Directorate of Salvage & Under Water Work.

2 AN OUTLINE OF THE STUDY

2-1 Purpose and History

The government of Indonesia aims at magnifying a maritime trading policy as part of the development of the economic growth. She has much concerned of the improvement of the maritime transport and its safety measures. However, it is reported that there still exist many sunken vessels lying on sea bed in the leading ports of the Republic of Indonesia as the debris of the World War II and others. Due to the above fact, it goes without saying that they'll pull a trigger to cause an additional sea disaster in relations to the navigational obstacles. The government of Indonesia has planned a basic plan to remove the sunken vessels as scheduled. However, I wonder if the team could say that her technical standard to remove sunken vessels could be high and efficient. This is the fact she has requested the technical cooperation regarding the technical guidance for drafting the basic plan and the removal work of sunken vessels in the major ports of Surabaya, Cilacap, Ujung Pandang, Palembang, and Padang. In response to the request of the Government of Indonesia, an annual consultation mission of our technical cooperation is committed to implement the above technical cooperation in 1978, and dispatched the first survey team to Indonesia from February 28 to March 9, 1979 to obtain her intention more in details to the basic plan for the removal work of sunken vessels. As a result, the government of Japan has decided to carry out the survey necessary for the transfer of technology regarding both the planning techniques for the basic plan of Indonesian sunken vessels and the implementation techniques of the said basic plan in 1979. This survey has taken up Surabaya Port as a model case pertaining to the environmental survey in Surabaya Port, drafting the standards to decide the priority order to remove sunken vessels, the survey for the removal work method of sunken vessels, the general implementation standards for the removal work, the manpower training, the procurement of machines and equipment, and the first and second surveys have been decided to conduct, that is, the first survey team was dispatched in August 1979 for the confirmation of "SCOPE OF WORK" (draft), the surveys on the existing state of Surabaya Port, and on the procurement of machines and equipment so as to implement the second survey smoothly, and for the collections of the information and data. On the bases of the scope of work, the second survey team conducted the comprehensive survey by centering sunken vessels near No. 4 buoy in Surabaya Port of Surabaya City and Jakarta City.

2-2 Scope of Work

2-2-1 Scope of work

The survey was conducted to transfer the implementation and drafting techniques of the basic plan regarding sunken vessels in Indonesia to the Directorate General of Sea Communications in Indonesia.

In implementing the survey, the main points of the scope of work have been decided by the first survey team as follows;

(1) Survey for the present state of Surabaya Port

(2) Drafting the standards to decide the priority order for the removal work of sunken vessels

(3) Deciding the priority for the removal work of sunken vessels

(4) Survey on the removal method of sunken vessels

(5) Survey on the general implementation standards for the salvage work

(6) Survey on the manpower training for the salvage work

(7) Survey on the procurement of machines and equipment for the salvage works

2-2-2 Policy on survey

The history of salvage works in Indonesia dates back to 1960s when the Government of Indonesia has initiated as a national enterprise.

However, in order to clear quite a few sunken vessels scattering in the vast territorial waters of Indonesia, the existing state of the progress hasn't caught up with them. In consideration to the backgrounds laid behind the request of the present technical cooperation, the basic policy was implemented in the following.

(1) To make sure of the hindering factors to find out what would be a bottleneck.

(2) Though the transfer of technology should be to the Directorate General of Sea communications, the planning would be consisted of upon the thorough awareness of the actual state and not be too far from the technical level of an actual uner-taken of the planned removal work.

(3) Although the removal work method is steady, it should be appropriate and accurate, so that it wouldn't run to an extreme.

(4) Judging from the focal natural conditions and the state of sunken vessels, the removal work method should be based on the safety on work and efficiency, economical and rational work.

(5) Judging from the administrative situation of the Government of Indonesia, the transfer of technology should be smoothly implemented.

(6) The rashing solution shouldn't be looked for and the removal of a sunken vessel should be performed by the domestic operator according to the priority order.

2-3 Method of Survey

2-3-1 An outline

Upon the actual planned survey for the removal work of sunken vessels in Indonesia, the field survey was conducted as follows corresponding to the survey concept as illustrated in plan "FLOW OF GENERALIDEA"

(1) Collection and analyzation of the information and data regarding the surveys already implemented in the past in Japan, and hearings and analyzation of experts' opinions.

(2) Collection and analyzation of the information and data available for any salvage operations so far conducted in Indonesia, and hearings of experts' opinions.

(3) Survey for the state of sunken vessels in the vicinity of No. 4 mooring buoy, Surabaya Port, Indonesia.

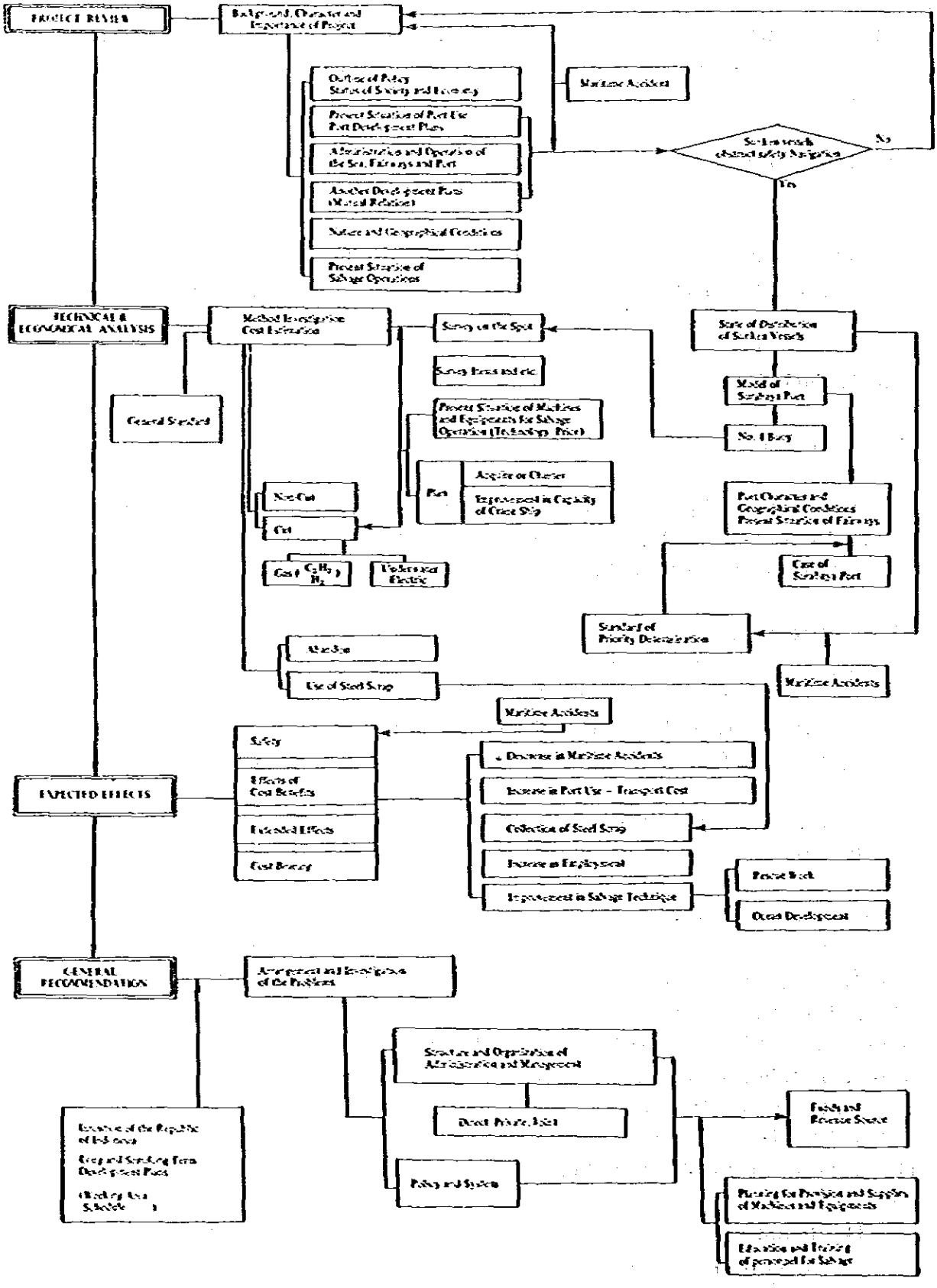
2-3-2 Survey for the data of sunken vessels

The purpose of the survey is to transfer the drafting & implementation of technologies of a basic plan regarding the removal work of sunken vessels to the Directorate General of Sea Communications in order to implement the plan. For the purpose, the research of the sunken vessel in a model port was made are the transfer of the technique was performed to the counterpart in Indonesia.

(1) The contents and the method of the survey

1) In order to survey sunken vessels, the machines and equipment as shown in "List of Survey Equipment"

FLOW OF GENERAL IDEA - STUDY ON PLANNING FOR REMOVAL OF SUNKEN VESSELS IN THE REPUBLIC OF INDONESIA



LIST OF SURVEY EQUIPMENT

Description of goods	Quantity
Kirbby morgan	3 sets
Air hose for Kirbby morgan	3 pcs
Telephone for Kirbby morgan	3 sets
Regulator	3 sets
Air bomb (12 ℓ, single)	3 sets
Air compressor (low pressure)	1 set
Compressor (high pressure)	1 set
Cutting holder	3 sets
Diesel generator (75 KVA) EDG73 Type	1 set
DC Welding machine MR-500	1 set
Distributor	1 set
Submersible pump (with code)	1 set
Submersible camera (with flash)	1 set
Captyer cord	240 m
Hose for Oxygen	1 set
Auxiliary parts for submersible sand pump	3 sets
Tool Box	1 set
Wire rope	200 m
Cremond rope	1 set
Cutting bar	100 kgs
Working glove	20 doz
Rubber glove	3 doz
Leather glove	2 doz
Vynil tape	20 pcs
Black tape	10 pcs
Rubber tape	10 pcs
Poly-buoy 50 cm ϕ	10 pcs
Schackle	1 set
Wire	1 set
Power transmission wire	50 m
Engine parts for diesel generator	1 set
Generator parts for diesel generator	1 set
Diving suit	3 sets
Submersible wire light (100w–500w)	1 set
Submersible hand light	3 sets
Cap for cutting holder	5 pcs
Spare parts for aircompressor (low pressure)	2 sets
Spare parts for aircompressor (high pressure)	1 set

as the results of the first survey, were air-transported to Indonesia and were mounted onto the "BOGA" in cooperation with the Directorate General of Sea Communications and a transport boat was chartered to ply between the site and the shore.

2) The divers who has full experiences and who were dispatched from Japan, implemented the diving survey for the sunken vessels being laid near No. 4 buoy in the western channel of Surabaya where the first survey team had agreed upon with the Directorate of Sea Communications.

This diving survey is the most important for calculating the standards of costing and finding the ideal removal method under the existing survey plan.

3) In pararel with the diving survey, the other survey work was conducted to collect the data on the navigational state of vessels and the ones on the natural conditions near the vicinity of the site.

(2) Technical transfer on the process of the diving survey

The technical transfer was implemented on the process of the diving survey on how the sunken vessels were to be removed to the counterparts of the Government of Indonesia as follows.

1) Diving

a) Operation method of the diving unit with full face mask type tele-communication.
b) Operation of a compressor for a diver
c) Communication between an onboard crew and a diver
d) Reminders between a diver and a tender

2) Underwater oxy-arc cutting

a) Operation method of cutting unit
b) Power current and voltage at the time of cutting
c) Consumable amount of oxygen and cutting rod

3) Mooring the survey boat

a) The most ideal location of the survey boat
b) Mooring method

2-3-3 Environmental survey

In order to draft a basic plan for the removal work of sunken vessels, the following survey was conducted to grasp the actual state and the situation of Indonesia.

(1) Surveyed item

- Distribution state of sunken vessels in Indonesia
- Indonesian removal techniques of sunken vessels
- Actual state of sunken vessels in Indonesia
- Removal plan of sunken vessels in the Third Five-year development plan
- History of salvage operation in Indonesia
- Regulations and administration for salvage works
- Present state of salvage work
- Present state of salvage machines and equipment
- Machines & equipment for underwater works owned by the Directorate General of Sea Communication
- Educational training state on divers
- Actual examples for maritime accidents
- Natural conditions
- Port & harbour administration system
- Ports and harbour development plan
- Utilization state of Surabaya Port
- Present situation on navigational supporting facilities
- Survey on the use of a scrap yard
- Onboard survey
- Interviews for maritime officials
- Others

(2) Quarters was visited for survey

a) Field survey

By centering Jakarta and Surabaya, the survey team collected the data and information and heard their opinions by actually visiting to the central governments concerned, the local governments, its related organizations. The places we visited are as follows;

In JAKARTA

- Directorate General of Sea Communications
- Directorate of Maritime Services
- Tokyo Senpaku Co., Ltd. (TSK)
- Asia Development Bank (ADB)

- Japan International Cooperation Agency (JICA)
- Neptune Services
- P.T. Bayu Samodra Sakti
- Tomo and Son
- P.T. Asuransi Jayasraya
- P.T. Komaritim

IN SURABAYA

- Harbor Master
- Port Administration
- Coast Guard (KPLP)
- P.T. Bayu Samodra Sakti
- P.T. Yalagada
- PT. INSAL
- Navy Hospital
- Sea Pilot
- Harbour Pilot

b) Onboard survey

In order to grasp the state of vessels entering Surabaya Port, the survey team, boarding the cargo ship from Jakarta to Surabaya, conducted the survey for the topography in the north of the Java Island, the navigational traffic state in the Java Sea and the navigational traffic state in the western channel of Surabaya Port.

INCEPTION REPORT

This report states the scope and method of work in respect to the plan for removal of sunken vessels in the Republic of Indonesia.

(1) Outline of survey

1. Objectives
   The objectives of this survey is to transfer to the Directorate for Maritime Services of the Republic of Indonesia the technology to formulate a basic plan for removal of sunken vessels in the Republic of Indonesia and implement the plan.

2. Scope of work
   Investigation on the present situation of Surabaya Port.
   Formulation of standard for determination of priority for removal of sunken vessels.
   Determination of priority for removal of sunken vessels.
   Study on method of removal of sunken vessels.
   Study on general standard for implementation of salvage operation.
   Study on training of personnel for salvage operation.
   Study on necessary machines and equipments for salvage operation.

3. System of survey
   Survey is to be conducted by 10 members as mentioned before.

4. Time schedule
   The period of survey will be from October 1979 to March 1980.

(2) Contents of on-the-spot survey

1. Preparation on the spot.

   1) Customs entry and permission/approval.
      The Directorate for Maritime Serves, Sea Communications of the Republic of Indonesia (hereinafter called DMS) and Japanese Survey team will co-operate in following works in order not to go behind the schedule.

      (1) Customs entry for machines and equipments to be used for survey.
      (2) Negotiation for charter of a survey boat.
      (3) To obtain permission/approval regarding implementation of survey.

(4) Collection of data.
(5) Appointment with

2) Transportation of machines and equipments to Surabaya.
To load machines and equipments onto trucks and to transport to Surabaya upon completion of customs entry and to install them on a survey boat.

3) Charter of a survey boat.
To charter the survey boat "BOGA" after completion of docking duly in time for on-the-spot survey.

4) Procurement of machines and equipments
To procure materials to be consumed in the Republic of Indonesia.

2. On-the-spot survey

1) To survey following items regarding natural condition of the area in vicinity of buoy No. 4.
(a) Location of sunken vessels.
(b) Depth of sea.
(c) Nature and shape of sea-bed.
(d) Tide and tidal current.
(e) Transparency of the sea.
(f) Volume of traffic.

2) To conduct survey including diving inspection of the present condition of more than 4 sunken vessels in vicinity of buoy No. 4 at Surabaya Port as follows.
(Principal particulars of sunken vessels)
(a) Kind of the vessel
(b) Type of the vessel
(c) Material of the vessel
(d) Age of the vessel and date of sinking
(e) Gross tonnage and dead weight tonnage
(f) Major dimensions (length, width and depth)
(g) General arrangement and construction
(h) Kind and horse power of main engine

(Present condition of sunken vessel)
(a) Degree of ship's head and longitudinal and athwart ship list
(b) Kind and quantity of cargo
(c) Kind and quantity of fuel oil

(d) Buried condition
(e) Condition of damage
(f) Condition of corrosion
(g) Quantity of steel scrap
(Volume of traffic of vessels)

3) Schedule is as annex 5.

3. On-the-land survey

1) To survey the present situation of removal of sunken vessels in the Republic of Indonesia as follows.
(a) Present condition of machines and equipment to be used for removal of sunken vessels.
(b) Present situation respecting to method and expenses for removal of sunken vessels.
(c) Present situation of training for personnel for removal of sunken vessels.

2) To survey present condition of Surabaya Port and other principal ports as follows.
(a) Natural condition
(b) Condition of sunken vessels
(c) Status of use of ports
(d) Maritime accidents

3) Schedule is as annex 6.

4. Others

1) Explanation of summary of on-the-spot survey report.
To prepare summary of on-the-spot survey report in English, and to explain to DMS and to exchange opinions.

(3) Work to be done in Japan

To prepare draft report through analysis according to following items based on the data and information obtained by on-the-spot survey, taking into consideration the opinions of DMS against summary of on-the-spot survey.

1) Regarding formulation of basic plan for removal of sunken vessels at Surabaya Port.

(a) Present condition of Surabaya Port. (based on existing data)
(b) Standard for determination of priority for removal of sunken vessels.
(c) Determination of the priority for removal of sunken vessels at Surabaya Port.

2) Regarding method and expenses for removal of sunken vessels in vicinity of buoy No. 4 at Surabaya Port.
(a) Present condition of sunken vessels.
(b) Method of removal of sunken vessels.
(c) Expenses for removal of sunken vessels.

3) To study the general standard for method and expenses for removal of sunken vessels in the Republic of Indonesia referring to model cases at Surabaya Port.

4) Regarding training for personnel for removal operation in the Republic of Indonesia.

5) Regarding necessary machines and equipments in the Republic of Indonesia.

And furthermore, to invite staffs of DMS of the Republic of Indonesia in order to do counterpart study.

(4) On-the-spot explanation of the draft final report

To prepare the draft final report in English and make copies by Zerox printing or offset printing.

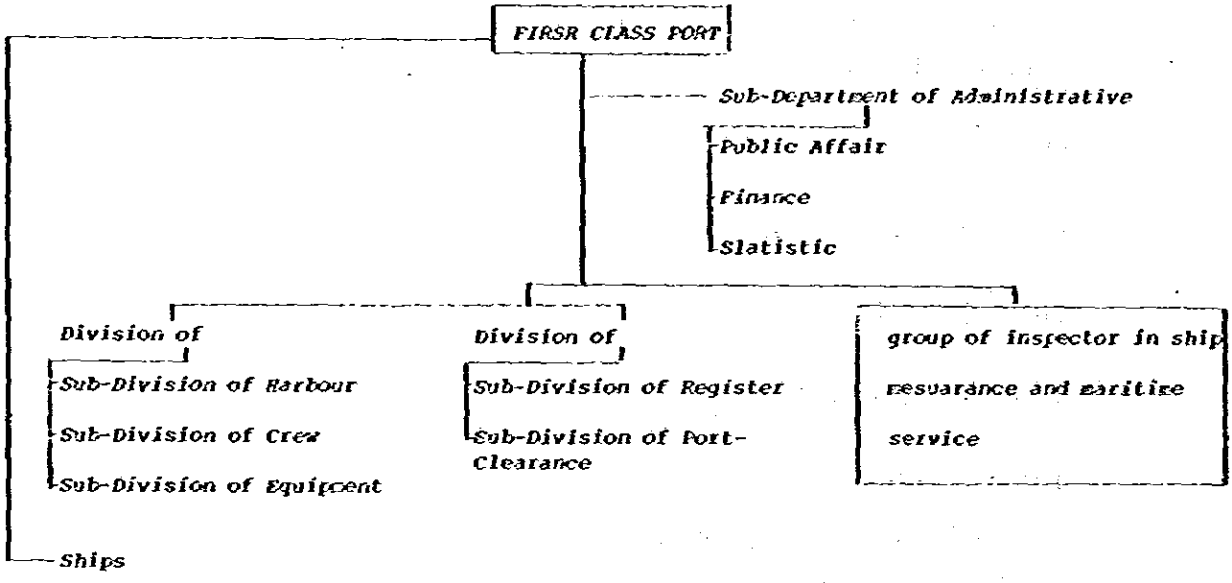
30 copies of the draft final report will be submitted to DMS of the Republic of Indonesia. 15 copies of them will be sent 2 weeks prior to arrival of survey team for explanation.

(5) Preparation of the final report

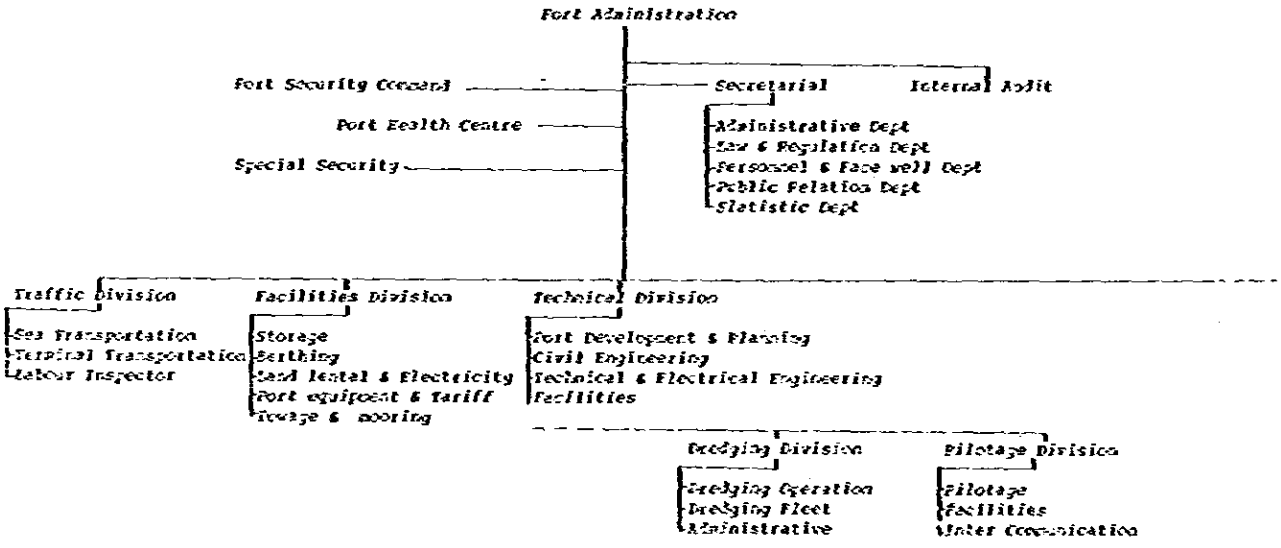
The final report will be prepared in English and 60 copies will be submitted to DMS.

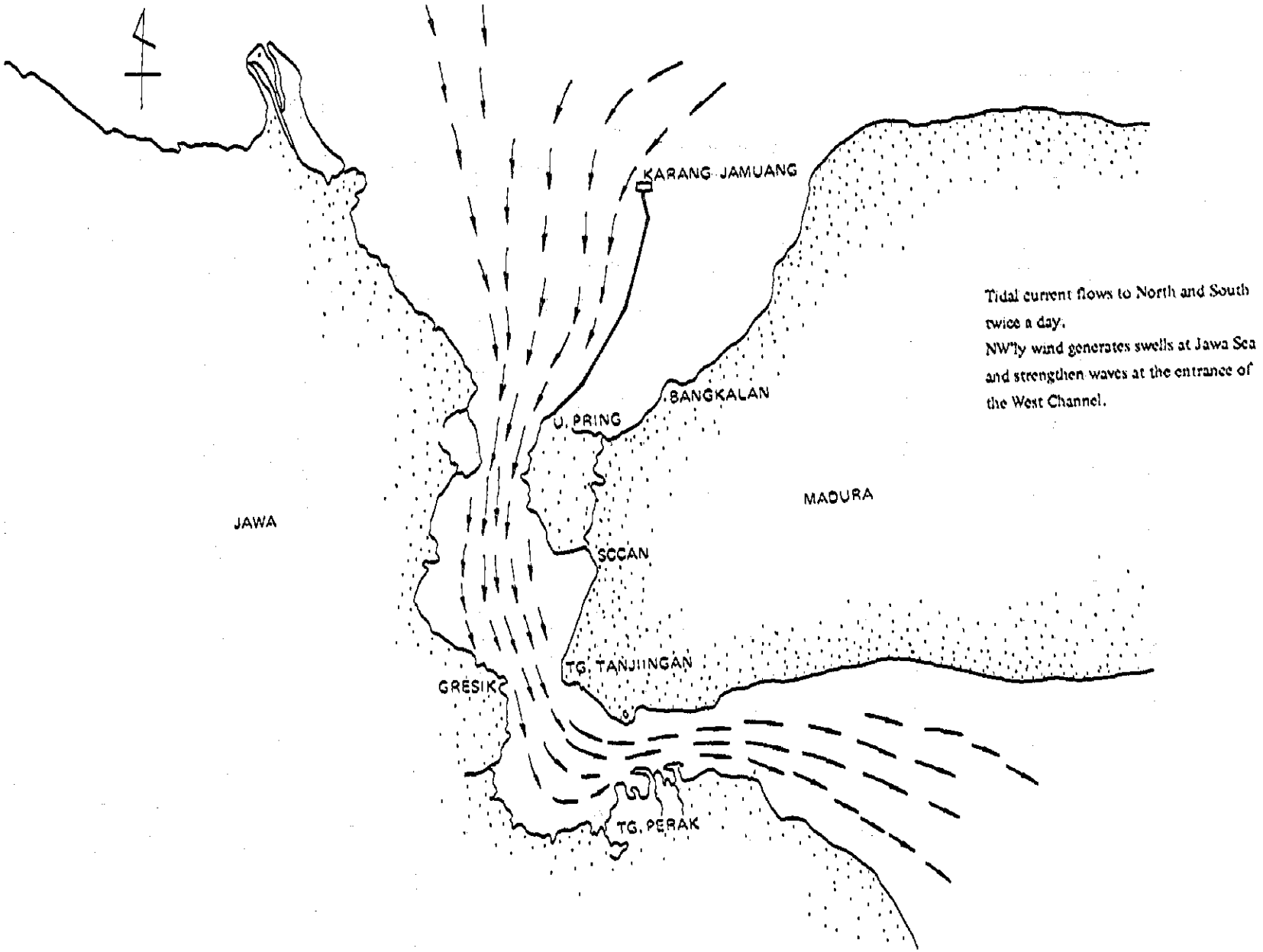
INDEX OF THE DATA

Organization of the First Class Port



Organization of the Port Administration (First Class)





Tidal current flows to North and South twice a day.
NW'ly wind generates swells at Jawa Sea and strengthen waves at the entrance of the West Channel.

The State of Indonesian Iron and Steel Makers

It is estimated that the rate of the demand for iron and steel is largely increasing corresponding to the increasing demand for the construction of steel structures of plants and other industrial facilities in the domestic markets of Indonesia.

In the domestic market of Indonesia there are thirty (30) iron and steel makers, but there is no blast furnace introduced a modern iron manufacturing method. The product was confined to bars which were processed by rerolling scraps and billet with the raw materials of pig iron and/or pig iron in an electric furnace and/or a flat furnace as tabulated in the following.

An Outline of Indonesian Iron & Steel Makers

Facilities	No. of makers	Raw Materials	Productive Capacity (official) ton/year	2 years '75–'76 Output (ton)	'77 (1–7) Output (ton)
Electric furnace	11	Scrap billet ingot	435,000	316,000	72,121
Flat furnace	2	Scrap billet ingot	140,000	70,000	36,320
Press	1	Scrap	40,000	30,000	1,376
	7	Billet ingot			
		Rerolled scrap	308,000	175,000	45,374
Rerolled scrap	9	Rerolled scrap	89,000	65,400	7,303
Total	30		1,012,000	656,400	162,494

Source: Data from Apbesi (Asosiasi Pabrik Besibeton Seluruh-Indonesia)

Area of Location Steel Maker

Judging from the locations of steel makers, they are mostly concentrated in the eastern and western parts of the Java Island classified into 21 private companies of Indonesia and 9 joint venture companies as shown in the following table.

Distribution of Steel Makers Corresponding to the Area

Area		
Java Island	Jakarta	18
	Surabaya	5
	Semarang	1
		1
Sumatra Island	Medan	3
Serebes	Ujung Padan	2
Total		30

In planning the efficient use of scraps from the sunken vessels as part of the removal operation plan for the sunken vessels, to fix a scrap yard which is closer to any one of steel makers, is one of the important conditions to value up scraps.

Output & Productive Record

The total official output out of 30 steel makers marks over 1,000,000 tons per year in 1979, while it was 660,000 tons per two years of 1975 & 1976, and 160,000 tons a half year of 1977, which indicates only 32 -- 33% in productivity.

The reasons can be pointed out in the following;

1. The official output value is the max. expected value at the time of applying to the Ministry of Industry, so that it is likely to overestimate generally. For example, in case of 20,000 tons for melting facilities and 40,000 tons for rolling facilities, the plant capacity is indicated 40,000 tons and the like.

2. The facilities are aged and the rate of operation goes down.

3. It is not yet mature to operate systematically including operation know-how.

4. It is estimated that the actual output was 500 -- 700,000 tons per year since the over-production pulled the sales price down during the period of June 6,1977 to the end of 1978.

In addition, although it is common to the developing countries, it is one of the causes so as not to improve the rate of operation of steel makers due to the shortage of scraps which are one of the raw materials for an electric furnace. In order to countermeasure, the Government of Indonesia has introduced the drain control measures regarding scraps collected locally and a policy for the overseas import quota . On the other hand, the Government has protected domestic steel makers simply because only authorized importers are permitted to import foreign products with duties and other taxes and dues, so that they are about 40% higher than the domestic prices. In another words, commercial minister notified to put into force a measure concerning the prevention to export scraps from the entire territory of Indonesia and also to restrict them to transport without permission to the other areas of a productive area.

As for (2), the Government enforced a measure concerning the rate of the official import duty and the import sales tax to reduce 5% of 730,000 to 0%, and aimed at promoting the import.

Supply & Demand Structure of Iron & Steel Product

The supply and demand structure in the steel markets of Indonesia based on the forementioned steel manufacturing plants, can be explained in the follows.

This is, imported items: structural angles, pipes, automobile thin plate coils, mail wires, etc.

exported items: bars for construction if the surplus can be existed after domestic consumption.

demand

structural angles, pipes, coils and wires, etc. for plants, construction, automobiles, etc. (domestic half products) — Deomestic steel makers — Imported product

bars for construction (domestic products) — Electric furnace maker — Imported pig iron

surplus only — for melting

bars for construction — Rerolling maker — for rerolling — Imported scraps

Domestic scraps

Export control measure scraps removed from sunken vessels

Import State of Scraps to Indonesia

Imported Record of Scraps to Indonesia

Country	1976		1977		1978	
	weight (kg)	amount (US$)	weight (kg)	amount (US$)	weight (kg)	amount (US$)
Japan	2,610,500	328,631	7,283,391	866,985	3,727,706	590,683
Rep. of China	2,000,000	368,902	12,508,080	12,508,080	1,943,561	512,500
Singapore	1,781,025	216,381	4,627,650	545,913	8,212,550	1,019,855
Malaysia	1,062,500	127,701	2,900,000	334,648	2,050,000	253,593
Australia	37,546,120	4,076,017			33,399,720	2,267,311
U.S.A.	20,150	974	300,227	5,434	20,980,000	2,267,311
France	279	1,473				
R.F. Germany	2,025,100	253,619				
Hong Kong			998,762	161,901		
Total	47,083,639	5,382,179	29,461,927	3,912,967	80,690,321	9,074,647

Source: Biro Pusat Statistics

Import State of Product

The Government of Indonesia enforced to set the foreign exchange rate of Rupia versus US$ from R.P. 415.- to R.P. 615.-, about 50% reduction. This has brought to steel makers of Indonesia favourable managerial environments.

Import State:

The imported goods are comparatively higher for domestic bars, angles, flat and straps, so that they are not imported any more.

Prevailing price as of Decmber 1979:

Domestic goods:	R.P. 220,000 – 230,000
Imported goods:	R.P. 310,000 – 320,000

Export State:

Indonesian steel makers, although they have ever exported before, have become competitive for exporting the domestic goods and exported them to Near East and South-East Asian countreis under the export contracts up till April 1979.

Steel Makers in Indonesia (As of January 1, 1978)

Name	Status	Product	Materials	Equipment	Production (Tons)		
					Design	1975/1976	1977
1. PT. Air Baja Indonesia Jl. Bandengan Utara Teratai No. 1 Jakarta Barat Tel: 279319-278604	Domestic	Round-Bar	Melting Scrap Billet	Open Furnaced (15T)	60,000	40,000	5,000 (Jan. – July)
2. PT. Jakarta Iron Product Jl. Bandengan Utara 85/159, Jakarta Tel: 273666	Domestic	Round-Bar	Melting Scrap	E/F 2Td 10Td	15,000	–	–
3. PT. Pabrik Waja Wahan Jl. Ancol I No 6 Jakarta Tel: 270261	Domestic	Round-Bar	Rerolling -Scrap		17,000	7,200	263 (Jan. – July)
4. PT. Ancol Iron Factory Jl. Ancol III/11, Jakarta Tel: 270552	Domestic	Round-Bar	Rerolling -Scrap		5,000	4,200	1,220 (Jan. – July)
5. PT. Iron Steel works Jl. Bekasiraya KM 21, Pulogadung Tel: 883490, 856353	Domestic	Round-Bar	Billet Ingot Melting Scrap	E/F 8Tx2	105,000	96,000	25,100 (Jan. – July)
6. PT. Interworld Steel Mills Jl. Muara Baru, Jakarta(P) Jl. Jayakarta No 16, Jakarta(K) Tel: 276117-276369	Joint-Venture	Round-Bar	Billet/ Ingot		18,000	20,000	900 (Jan. – July)
7. PT. National Union Steel Jl. Babelan 26, Bekasi Tel: 33/34 BKS	Domestic	Round-Bar	Rerolling -Scrap		9,000	6,000	–
8. PT. Tubusco Kawasan Industri, Pulogadung Tel: 885629(P) BDN Building IT.8(363413-364523) Jakarta(K)	Joint-Venture	Round-Bar	Billet/ Ingot		85,000	53,000	13,378 (Jan. – July)
9. PT. Master Steel Jl. Raya Bekasi Km 21, Pulogadung Tel: 886715	Domestic	Round-Bar	Billet/ Ingot Melting Scrap	E/F 10Td	40,000	30,000	1,800 (Jan. – July)
10. PT. Pulogadung Steel Jl. Bekasi Timur Raya Km 17 Pulogadung, Jakarta Tel: 856631 Jl. Kopi 1X(Atas)271833-271834 Jakarta(K)	Domestic	Round-Bar	Billet/ Ingot Melting Scrap Rerolling Scrap	E/F 18Td	50,000	40,000	13,300 (Jan. – July)
11. PT. Sun Iron & Steel Industries Ltd. Jl. R.E. Martadinata, Tanjung Priok Jakarta Tel: 690379	Joint-Venture	Round-Bar	Rerolling		15,000	15,000	996 (Jan. – July)
12. PT. Mulikera Industry Desa Jatake Tangerang(K) Jl. (R.H. Juanda 22, Jakarta Tel: 35621/356621 ext 250-251	Domestic	Round-Bar	Billet/ Ingot		60,000	50,000	–
13. PT. Budi Bhakti Sukapura, Cilincing, Jakarta Utara(P) Tel: 691462, 693689, 691443 Sky Line Bldg. Tingkat 7(K) Tel: 356763	Joint-Venture Marubeni KK Toyoda Seiko Local Partner	Round-Bar	Billet/ Ingot Melting Scrap	Open Furnace 50Td	80,000	30,000	31,320 (Jan. – July)
14. PT. Jakarta Kyoei Steel Kawasan Industri Pulogadung Tel: 886656	Joint-Venture Kyoei Seiko (J) Local Partner	Round-Bar	Billet/ Ingot		30,000	20,000	20,425 (Jan. – July)
15. PT. Pembangunan Indi Steel Jl. Bypass 66, Pegambiran, Cirebon Tel 4765,4766(P) Jl. Mangga Besar Raya 65A Jakarta(K)(P) Tel: 270232-212733	Domestic	Round-Bar	Billet/ Ingot		30,000	20,000	950 (Jan. – July)

Name	Status	Product	Materials	Equipment	Production (Tons)		
					Design	1975/1976	1977
16. PT. Krakatau Steel Cilegon, Banten(P) Jl. Gatot Subroto KAV. 54, Jakarta Tel: 584385-88(K)	Domestic	Round Bar	Melting Scrap Billet/ Ingot	E/F 65T×4	100,000	58,000	13,600 (Jan. – July)
17. PT. Toyogiri Iron Steel Tambun, Bekasi (P) Jl. Pinta Kecil 10A, Jakarta(K) Tel: 271410, 270452	Domestic	Round Bar	Melting Scrap Billet/ Ingot	E/F 10T×1	40,000	30,000	7,550 (Jan. – July)
18. PT. Inti General Jaya Krapyak, Jl. Raya, Semarang(P) Tel: 25546 Jl. Pasar Pagi 120, Jakarta(KP) Tel: 276092-272737	Domestic	Round Bar	Melting Scrap Billet/ Ingot	E/F 10T×2	40,000	30,000	1,444 (Jan. – July)
19. PT. Wira Jaya Sawotratap, Gedangan, Sidoarjo(P) Tel: 67868 Jl. Belakang Penjara 29, Surabaya(K) Tel: 23849/279550	Domestic	Round Bar	Rerolling Scrap		13,500	12,000	445 (Jan. – July)
20. PT. Jatim Utama Steel MFG. Jl. Taman Sepanjang, Sidoarjo(P) Tel: 139/149 Sepanjang 65674 Surabaya Jl. Kapasan, 69 C, Surabaya(K) Tel: 20287, Surabaya	Domestic	Round Bar	Melting Scrap	E/F 15T×1, 6T×1	17,500	12,000	5,534 (Jan. – July)
21. PT. Artha Logam Jl. Raya Sepanjang 241, Waru Sidoarjo Tel: 66734 L. OF. President Hotel Room 309. JKT.	Domestic	Round Bar	Rerolling Scrap		6,000	4,500	806 (Jan. – July)
22. PT. Hasil Raya Metal Works Desa Jati, Waru, Sidoarjo(P) Tel: 67439, 67613 Jl. Wijaya Kusuma 53-54, Surabaya Surabaya(K)	Joint-Venture	Round Bar	Melting Scrap	Cupola 20T×1	40,000	30,000	1,376 (Jan. – July)
23. PT. Bhirawa Steel Jl. Marga Maya, KEC Tandes Surabaya Tel: 471827	Joint-Venture	Round Bar	Rerolling Scrap		6,000	4,5000	–
24. PT. Grand Pyramid Iron Factory Jl. Binjai Km. 11.5 Medan(P) Jl. Brigjen Katamso 29F, Medan(K) Tel: 20504	Domestic	Round Bar	Rerolling Scrap		12,500	6,000	3,070 (Apr. – July)
25. PT. Industri Baja Growth Sumatera Jl. Yos Sudarso Km. 10, Medan(P) Jl. Pinangsia III No 17, Jakarta(KP) Tel: 272635	Domestic	Round Bar	Melting Scrap	E/F 6T×1	12,500	6,000	1,850 (Apr. – July)
26. PT. Gunung Gahapi PT. Gunung Bahara Jl. Yos Sudarso Km. 9, 5, Medan Tel: 25721, 24138	Domestic	Round Bar	Melting Scrap	E/F 8T×1, 4T×1	15,000	14,000	1,523 (Apr. – July)
27. PT. Sermani Steel Works Jl. Tanjung Tallo Lama Ujung Pandang Tel. Ujung Pandang 22307, 22213 UP(P) Nusantara Bldg. Tingkat 10(KP) Jl. M.H. Thamrin 59, Jakarta Tel 352145, 352413	Joint-Venture NI Godoo Seitetsu Shikifeku Kogyo	Round Bar	Billet/ Ingot Rerolling Scrap		20,000	12,000	9,771 (Jan. – Dec.)
28. PT. East Indonesian Steel PT. Pabrik Besi Baja Baraja Jl. Goa Jaya Km. 4, Ujung Pandang(P) Tel. 5451, 5452 Ujung Pandang Jl. Sulawesi 223-225 Ujung Pandang(K)	Domestic	Round Bar	Rerolling Scrap		10,000	6,000	–
29. PT. Ispatindo (D.N. Andhra Steel Indonesia) Desa Kedung Turi, Taman Sepanjang P.O. Box 83, Surabaya(P) Tel 471424 Surabaya Jl. Jaksa 2, Jakarta(KP) Tel 356222 366190	Joint-Venture	Round Bar			65,000		
30. PT. Baja Indonesia Utama Jakarta	Domestic	Round Bar	Melting Scrap	E/F 34T×1			
Total					1,012,000	656,400	152,123 (Jan. – July)

ESTIMATED PRODUCTION OF CRUDE STEEL

		1975	1976	1977	1978	1979 (estimation up/to Dec. '79)	Remarks
1.	P.T. Air Baja Indonesia (Jakarta)	4.000	20.000	10.000	10.000	Only Processing	30T O/F 1 set middle 1975 operation
2.	P.T. Iro Steel Works (Jakarta)	30.000	30.000	30.000	30.000	Bankrupt	10T E/F 2 sets
9.	P.T. The Master Steel Mfg., (Jakarta)	7.000	15.000	15.000	15.000	15.000	10T E/F 1 set from 1975 April operation
10.	P.T. Pulogadung (Jakarta)	–	20.000	26.000	26.000	26.000	18T E/F 1 set.
13.	P.T. Krakatau Steel (West Java)	–	–	–	30.000	100.000	65T E/F 4 sets 1978 October operation
17.	P.T. Toyogiri (Jakarta)	–	10.000	20.000	20.000	20.000	10T E/F 1 set 1976 June operation
18.	P.T. Inti General Jaya Steel (Central Java)	–	15.000	15.000	15.000	15.000	10T E/F 2 sets.
20.	P.T. Djatim Utama (Surabaya)	6.000	12.000	12.000	12.000	12.000	15T E/F 1 set; 6T 1 set.
22.	P.T. Hanil Jaya Metal Works (Surabaya)	10.000	20.000	20.000	20.000	20.000	2.500T Coupla/month 1975 June 1979.
25	P.T. Industri Baja (Sumatera)	–	6.000	6.000	6.000	6.000	
26	P.T. Gunung Gahari (Sumatera)	8.000	8.000	8.000	8.000	8.000	8T: 4T E/F 1 set each
30	P.T. Baja Indonesia Utama (Jakarta)	–	–	–	50.000	Bankrupt	25T E/F 3 sets.
	Total	65.000	176.000	222.000	302.000	282.000	
	Percentage		26% Up	36% Up	36% Up	7% Down	
				for 1976	for 1977	for 1978	

Realisasi Ekspor Beton

No. Urut	Nama Perusahaan	Pengapalan	Jumlah	Negara Tujuan
1.	P.T Jakarta Kyoei Steel	Okt-Nop.-Desember '78	1.008,937	Saudi Arabia
		Nop.-Desember '78	498,655	Saudi Arabia
		12 Des. '78-Jan. '79	2.000	Hongkong
		13 Pebr-Mart. '79	7.200	Saudi Arabia
		15 Mart.-Apr.-Mei '79	3.000	Malaysia
			3.500	Hongkong
		19 Apr.-Juni '79	1.600	Saudi Arabia
			1.500	Malaysia
2.	P.T Budhidarma	12 Des. '78-Jan. '79	4.000	Saudi Arabia
		6 Pebr-Maret '79)	5.500	Saudi Arabia
		15 Mart.-Mei. '79	1.500	Saudi Arabia
		29 Maret-Mei '79	3.900	Saudi Arabia
3.	P.T Iro Steel	2 Jan.-Pebr. '79	3.000	Saudi Arabia
4.	P.T Krakatau Steel	6 Pebr-Maret '79	8.000	Saudi Arabia
		15 Maret-Mei '79	5.000	Saudi Arabia
5.	P.T Tobusco	28 Pebr-Maret '79	3.300	Kuwait
6.	P.T Master Steel	28 Pebr-Maret '79	3.500	Hongkong
7.	P.T Pulogadung Steel	15 Maret-Mei '79	800	Saudi Arabia
		Jumlah	57.807,592	Ton

Angka-angka tersebut dalam metrik ton.

Jakarta, 21 April 1979. -

WATER FACILITIES

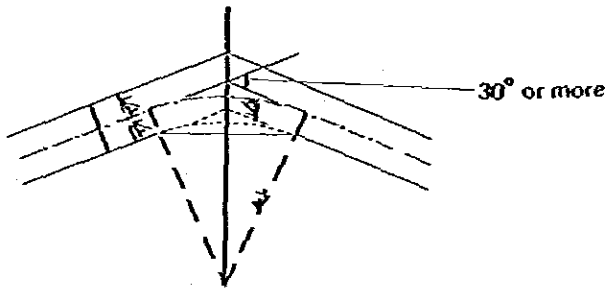
Chapter 1 Channels

1.1 Basic Policy for Channel Planning

For planning a channel, consideration shall be made for safe navigation, easiness of ship operation, topography, weather and marine phenomena, coordination with other facilities, etc.

1.2 Alignment of a Channel

The intersection angle of straight center lines of a channel at a curve is desirable not to exceed 30 degrees. When it exceeds 30 degrees, the center line at a curve of a channel shall be a circular areas with the radius of curvatue of about 4 times or more of the overall length of the ship considered, and the width of the channel shall be more than required.



Overall length of the ship considered
Example of a curve

However, this may not apply when yachts, motor boats and other ships highly capable of turning used for sports or recreation are considered in the use of the channel, or when safe and smooth operation of ships can be made by marks, signals, etc.

1.3 Width of a Channel

The width of a channel shall be a proper value of not less than the length overall of the ship considered, in a channel where ships may pass by each other, or of not less than one half of the overall length of the ship considered, in a channel where ships may not pass by each other, in reference to the overall length and extreme breadth of the ship considered,

navigation volume, and natural conditions such as topography, weather phenomena and marine phenomena. However, when the the width can be reduced to the extent that the safe navigation of ships is not affected. The "when the style of navigation is special" refers to the cases where the use of a tugboat, the provision of a shelter water area, etc., are considered or where the length of a channel is extremely short.

(1) General channel: A double way channel shall be in accordance with Table 1.1, depending on the length of the channel and the navigation situations.

(2) Channel with remarkably large navigation volume, etc: A channel with remarkably large navigation volume, a channel which is forecast to be crossed by sailing ships, or a channel for ULCC, etc. shall have a width with an allowance added to the width in the table of (1) according to actual situations of channel use situations.

(3) Channel for fishing boats or ships of less than 500 tons gross: A proper width shall be decided according to actual situations of use.

Table 1.1. Widths of channels

(L is the overall length of the ship considered)

Channel length	Situation of navigation	Width
Relatively long channels	State where ships considered pass by each other frequently	2 L
	The other state than the above	1.5 L
Channels other than the above	State where ships considered pass by each other frequently	1.5 L
	The other state than the above	L

1.4 Depth of a Channel

The depth of a channel shall be a proper depth beyond the full draft of the ship considered, in reference to the extent of pitching and rolling of the ship considered due to waves, winds, tidal currents, etc., and the trim. However, this may not apply to a channel used for special navigation of ships such as for approaching a dock, etc. In this case, "a proper depth" means a depth which satisfies the depth sepcified in 3.3 Water Depth of a Mooring Basin, Part for the ship considered, with an allowance added for the bottom materials, rolling and pitching of ships, trim, hull sinking, etc. according to the situations.

"A channel used for special navigation of ships" means a channel where the draft of the ships considered during use is always more shallow than the full draft, such as a channel for ships to approach a dock or a channel exclusive for unloading at a second port.

Chapter 2 Mooring Basins

2.1 Basic Policy of Mooring Basin Planning

A mooring basin shall secure a calm and sufficiently wide water surface and a depth, to allow safe anchorage, smooth ship operation and cargo handling. The bottom soil of a mooring basin is desirable to be suitable for anchoring.

2.2 Position and Area of a Mooring Basin

2.2.1 Position

The position of a mooring basin shall be determined in a place capable of securing calmness, by considering the arrangement of breakwater, pier, channel, etc.

2.2.2 Area of Mooring Basin used for Anchorage or Mooring

A mooring basin used for anchorage or mooring but not in front of a pier, mooring post, piled pier or floating pier shall have an area exceeding a circle with the radius obtained by adding a proper value decided in reference to the natural conditions such as topography, weather phenomena, marine phenomena and others to the overall length of the ship considered. However, if the area is not required due to the style of anchorage or mooring, it can be reduced to an area not hindering the safe anchorage or mooring of ships.

(1) "A mooring basin used for anchorage or mooring but not in front of a pier, mooring post, piled pier or floating pier" means mooring basin used for anchorage or buoy mooring. "The radius obtained by adding a proper value decided in reference to the natural conditions such as topography, whether phenomena, marine phenomena and others to the length overall of the ship considered" shall be as specified in Table 2.1 according to the objective, type, etc. of use, as standard.

(2) The style of anchorage or mooring in the second sentence of 2.2.2 is buoy mooring, and "an area not hindering the safe anchorage of mooring of ships" shall be as specified in Table 2.2 according to the type of use, as standard. However, if the horizontal displacement of buoy is expected to be large due to large tidal range, etc., this shall be taken into consideration.

(3) A mooring basin, used for anchorage or mooring in front of a pier, mooring post, piled pier or floating pier shall have a proper area, the length and width of which are respectively not less than the length overall of the ship considered and not less than the

extreme breadth of the ship considered, in reference to natural conditions such as topography, weather phenomena, marine phenomena and others and the style of anchorage or mooring.

Table 2.1. Area of a mooring basin

L is the length overall of the ship considered (m).
D is depth (m).

Objective of use	Type of use	Bottom soil or wind velocity	Radius
Offshore waiting or cargo handling	Swinging mooring	Good Anchoring	L + 6D
		Bad anchoring	L + 6D + 30m
	Mooring with two anchors	Good anchoring	L + 4.5D
		Bad anchoring	L + 4.5D + 25m
Shelter for stormy weather	—	Wind velocity 20m/sec.	L + 3D 90m
		Wind velocity 30m/sec.	L + 4D + 145m

Table 2.2. Area of a mooring basin

L is the overall length of the ship considered (m).

Type of use	Area
Single buoy mooring	Circle with radius (L + 25m)
Double buoy mooring	Rectangle with (L + 50m) and L/2 as sides

A value obtained by adding the extreme breadth of the ship considered shall be standard and the width shall allow the safe and smooth berthing and leaving of ships.

(4) The width of a mooring basin between groins shall be determined carefully, by considering the size of ships, number of berths, existence of tugboats, etc. A mooring basin between groins among many parallel groins shall have a width not less than the width specified below according to the number of berths on one side of a groin.

1) When one groin has 3 or less berths

L

2) When one groin has 4 or more berth

1.5L

L is the overall length of the ship considered (m).

However, the width of a mooring basin used by ships with the ratio of the breadth of the overall length considerably larger than that of general cargo boats, or by oil supply boats, water boats, barges, etc. shall have an allowance compatible with the actual situations of use.

(5) With regard to the area of a mooring basin, consideration shall be made on the berthing and leaving of ships, approach to the basin, anchoring error in case of anchorage, and safety distance in case of a basin used by ships loaded with dangerous cargoes.

2.2.3 Area of a Mooring Basing used for Ship Operation

(1) Turning Basin

The area of "a mooring basin used for turning the bow of ship" shall exceed a circle with 1.5 times the overall length of the ship considered as the radius. For "the turning of the bow of ship (hereinafter to be called "bow turning")" by the self force using an anchor or for the bow turning using a tugboat, the area shall exceed a circle with the length overall of the ship considered as the radius, as standard. However, in a very calm mooring basin used by ships with high bow turning capability or in a mooring basin always allowing bow turning by the use of river flow, etc., the area can be reduced to the extent necessary not to hinder the bow turning.

(2) Mooring and Unmooring Basin

A mooring and unmooring basin shall be determined carefully to allow smooth mooring and unmooring, by considering the existence of tugboats, and the influence of winds and tidal currents.

2.3 Depth of a Mooring Basin

The depth of a mooring basin shall be a proper depth of not less than the full draft of the ship considered, in reference to the extent of pitching and rolling of the ship considered due to waves, winds, tidal currents, etc. However, this may not apply to a mooring basin for outfit or a basin used for special anchorage or mooring of ships.

(1) "A proper depth" shall be a value of the full draft of the ship considered below the construction datum level, plus about 10! of said full draft, as standard. When the draft difference between stern and bow is adjusted during cargo handling in a basin considered for ferry boats, etc., the influence shall be considered. Furthermore, when the seasonal variation of mean sea level is larger than the tidal level variation by astronomical tide, to often cause the sea level to be below the datum level as observed in the coasts of the Sea of Japan, etc., the influence shall be considered.

(2) "A basin used for special anchorage or mooring of ships" in the second sentence of 2.3 is limited to the case where the draft during use by the ship considered is always lower than the full draft, such as a basin for outfit or a basin exclusively for unloading at a second harbor.

(3) The depth of a mooring basin can be determined in reference to the values of Table 2.3, when the full draft of the ship considered is not known.

Table 2.3. Depths of mooring basins

Kind	Depth (m)	Oil tacker	Kind	Depth (m)	Type of ship	Kind	Depth (m)	Type of ship
		Gross tons		4.5	Dead weight			Dead weight
	5.0	1,000		4.5	700		9.0	10,000
	6.0	3,000		5.0	1,000		10.0	15,000
	7.5	5,000		5.5	2,000		11.0	20,000
	9.0	10,000		6.5	3,000		12.0	30,000
	10.0	20,000		7.5	5,000		13.0	50,000
	11.0	30,000		9.0	10,000		15.0	70,000
		Dead weight		10.0	15,000		16.0	90,000
	4.5	700		11.0	20,000		18.0	100,000
	5.0	1,000		12.0	30,000		20.0	150,000
	5.5	2,000		13.0	40,000			Gross tons
	6.5	3,000		14.0	50,000		5.0	1,000
	7.5	5,000		15.0	70,000		5.5	2,000
	9.0	10,000		16.0	100,000		6.0	3,000
	10.0	15,000		20.0	150,000		6.5	4,000
	11.0	20,000		21.0	200,000		7.5	6,000
	12.0	30,000		22.0	250,000		8.0	13,000
	13.0	40,000						
	14.0	50,000