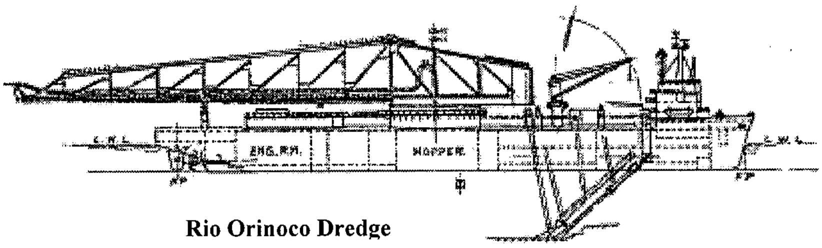
6.4.4 Evaluation of Current Dredging Activities

(1) Disposal of Dredged Materials from the Outer Channel

Materials dredged from the Outer Channel are disposed by the side casting method except in the case of the Guayana dredge. The discharge arm of the dredge is constructed to rotate at an angle of 90 degrees from the longitudinal axis of the vessel to ensure that dredged spoils are discharged outside of the Outer Channel. However, the arm is actually rotated at about 15 degrees only, as can be seen in Fig. 6-4-19 below, due to stability reasons which according to INC is caused by strong wind and wave actions. Apparently, the dredged materials are being disposed inside the Channel, thus, the accumulation of deposits is just being transferred from one place to another within the Channel. It could be effective to some extent as vessels can still navigate through the fluff as long as the fluff remains loose. However, as the fluff consolidates it becomes difficult for vessels to navigate safely.



Rio Orinoco Dredge

Outer Channel

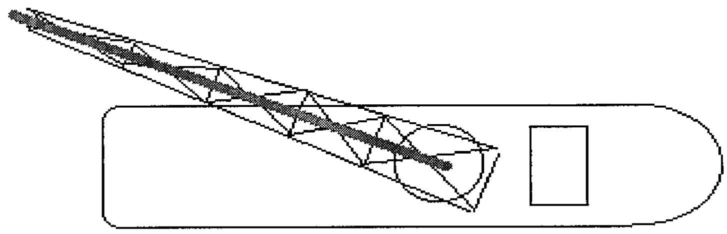
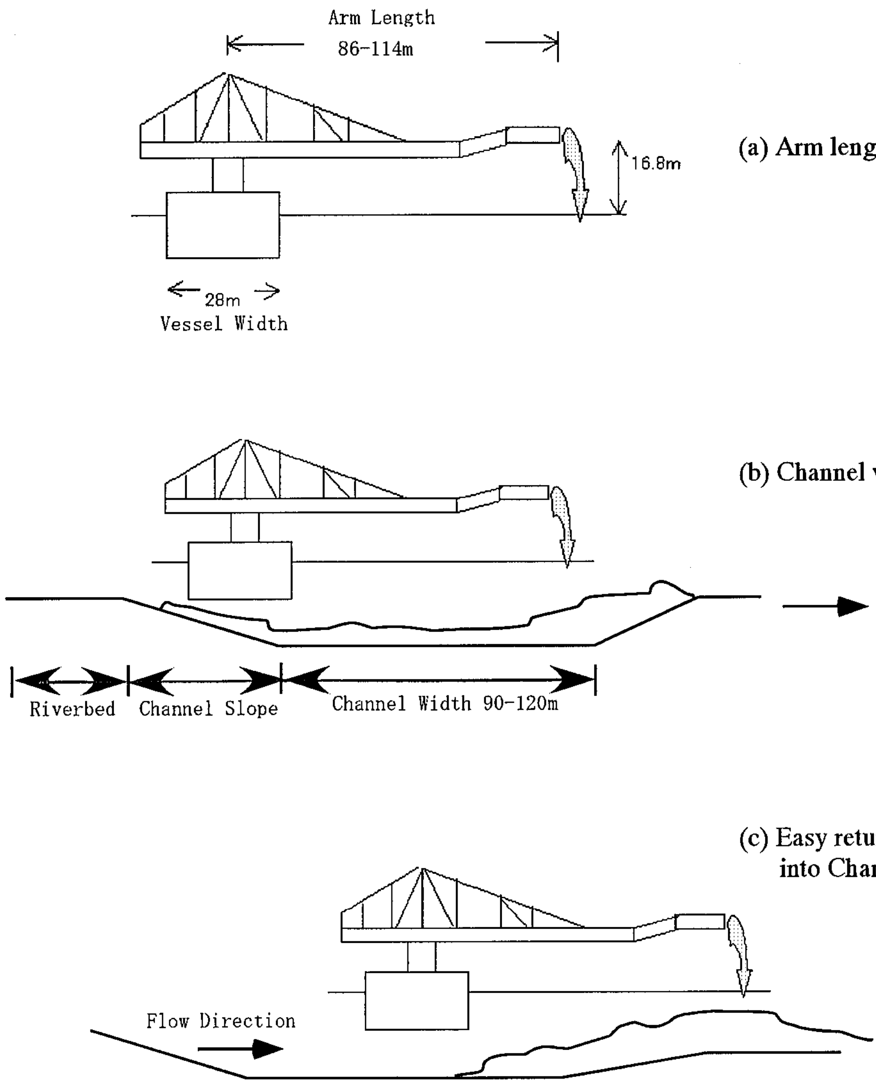


Fig. 6-4-19 Method of Disposal of Dredged Materials (Outer Channel)

(2) Disposal of Dredged Materials from the Inland Channel

In the case of the Inland Channel, the discharge arm of dredge is generally rotated perpendicularly to the axis of vessel to discharge dredge materials far away from the Channel. However, shorter length of discharge arm compared to the Channel width would only permit the disposal of dredged materials either into the Channel or immediately adjacent to the Channel. Hence, return of dredged materials partially into the Channel is unavoidable. Especially, at the meandering reaches of river where Channel alignment is not parallel to river flow such as Macareo bifurcation reach as shown in the Fig. 6-4-20, return of dredged material would be quite high since it is obliged to dispose in to only one side of navigation channel (downstream side of river flow) to minimize easy return of dredged material from the opposite side by river flow.



(a) Arm length of dredge: 86-114m

(b) Channel width: 90-120m

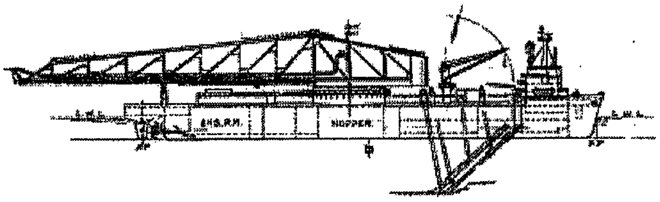
(c) Easy return of dredged material into Channel

Fig.6-4-20 Method of Disposal of Dredged Materials (Inland Channel)

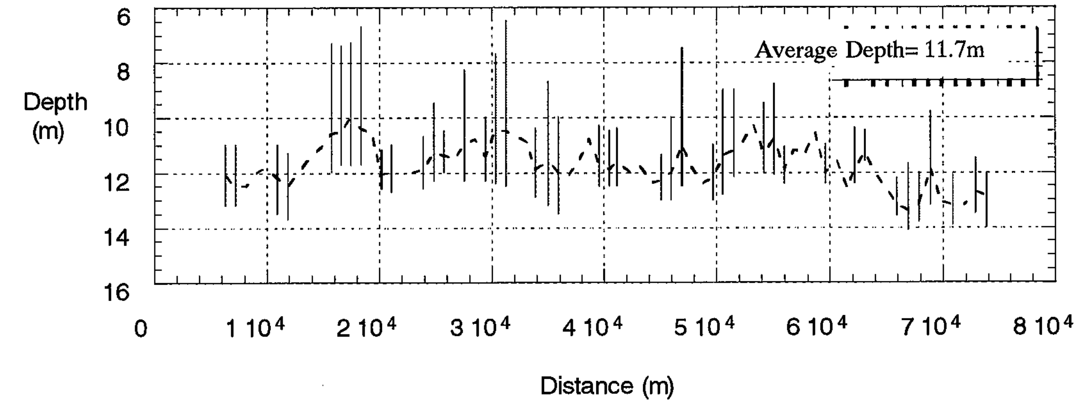
(3) Extremely Uneven Dredged Channel Bottom

Fig. 6-4-21 shown below derived from INC sounding chart data illustrates a sample of a section of the Channel dredged by a trailer suction dredge. As shown, the dredged channel bottom is extremely irregular and contains many peaks and valleys. Considering safe passage of the vessels, the navigable depth of the Channel should be measured from the highest peak of the dredged bottom to the water level. In such case, as can be seen from the figure, the over dredging sections of the channel bed become useless or worthless.

The differences between the average depths and the highest peak of the dredged bottoms in April and September in 1997 are 4.0 m and 3.2 m, respectively. It is very important to minimize the differences between the average depths and the highest peak of the dredged bottoms in order to obtain the maximum depth while minimizing the volume to be dredged.



Longitudinal maximum, minimum and average depth along the channel, Apr. 1997



Longitudinal maximum, minimum and average depth along the channel, Sep. 1997

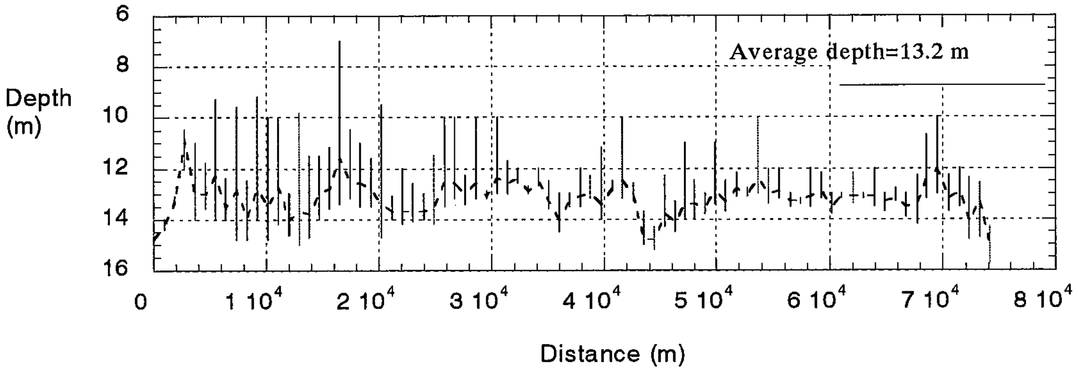


Fig.6-4-21 Method of Disposal of Dredged Materials

(4) Operating Hours

Fig. 6-4-22 hereunder shows the annual operation dredging record of the three (3) dredges equipment in recent years. Based on the record, Rio Orinoco and Hang Jun 6001 have been operating on an average of six (6) hours and ten (10) hours per day only, respectively. Among others, Guyana yields minimal output of dredging and Icoa is no longer operational.

Fig. 6-4-23 shows the planned volume of materials to be dredged against the actual accomplishment covering the period 1992 to 1995. The primary contributory factor to the low performance ranging from about 30% to 50% of the planned accomplishment is considered to be due to the low operating time of the dredge which resulted to a backlog of under dredging of about 15 million cubic meters.

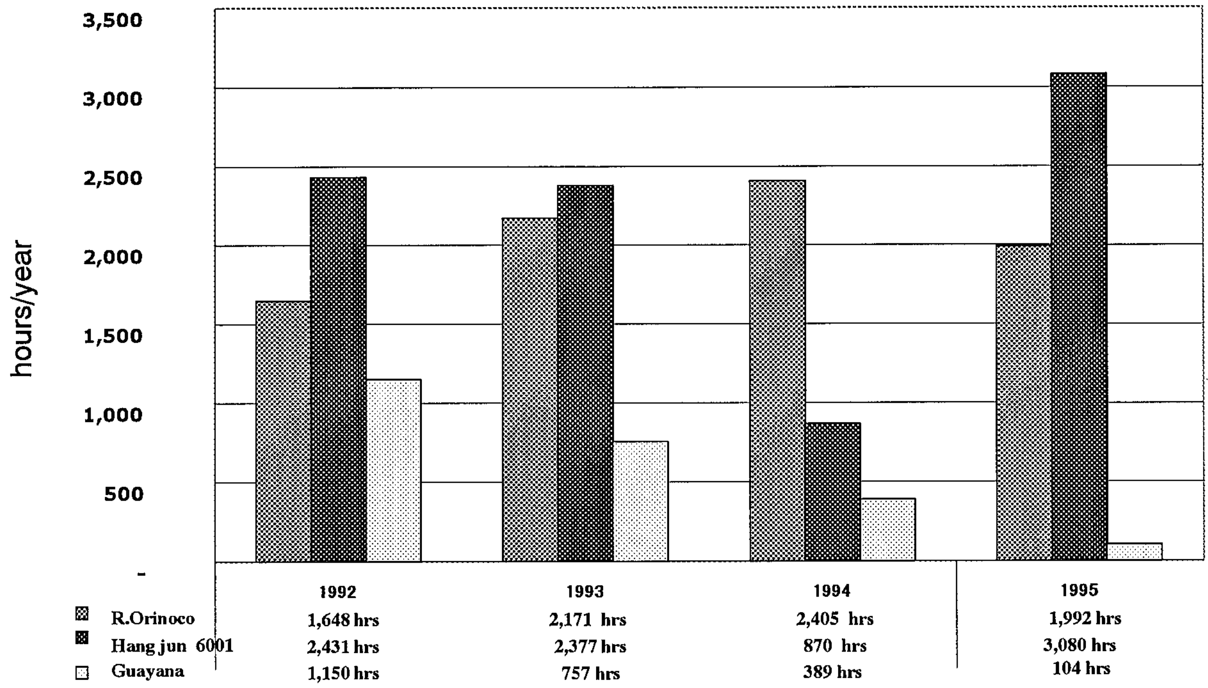


Fig. 6-4-22 Annual Dredging Operation Record

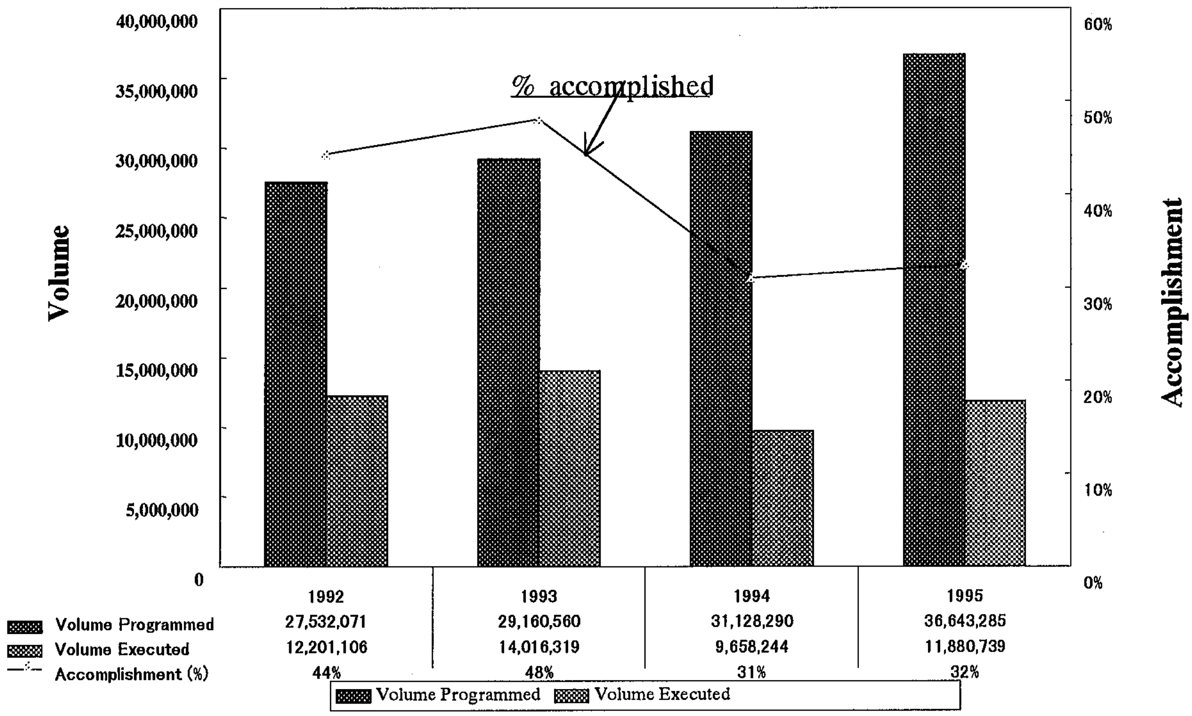


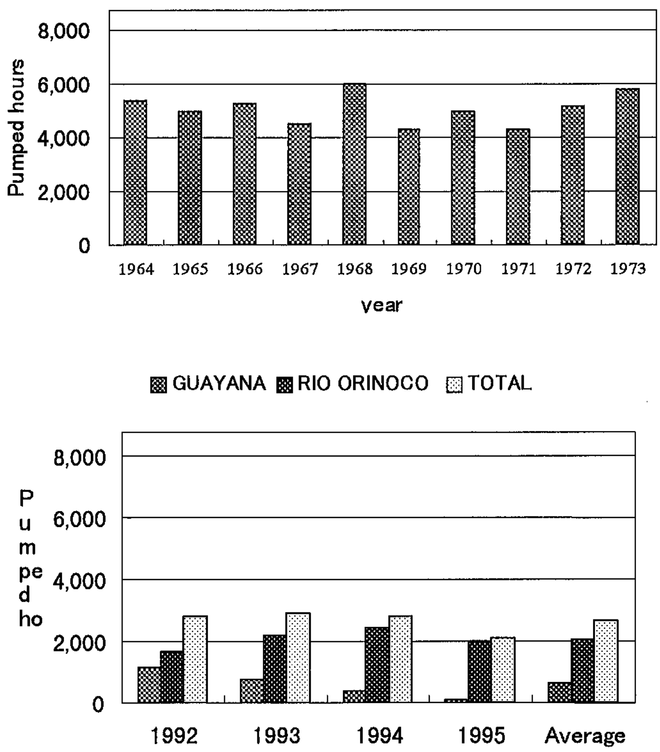
Fig. 6-4-23 Planned Accomplishment versus Actual Accomplishment

Quite Short Operating Period of the Dredges, Particularly GUAYANA Dredge.

Based on information, Icoa is the only dredge maintaining the navigable channel depth. From INC record (Fig. 6-4-24), the average pumped time of Icoa over a 9 year period (1964 to 1973) is 5,065 hours per year. This is only about 66% of total time in a year.

The average pumped time of Orinoco and Guyana from 1992 to 1995 is 2,000-3,000 hours/year only, which is only about half of Icoa. Guayana's operational time from January to September 1999 is only 30% and, the operational time appears to be extremely short.

(ICOA)



Source: INC

Fig. 6-4-24 Yearly Cumulative Pumped Time

Table 6.4.2 hereunder, summarizes the operation time of the dredge fleet covering the period January 1999 to September 1999.

Table 6.4.2 Operation Time of the Dredge Fleet

Unit: days

Dredge	Dredging Days in 1999										No Dredging Days	Operating Ratio (%)
	Jan (31)	Feb (28)	Mar (31)	Apr (30)	May (31)	Jun (30)	Jul (31)	Aug (31)	Sep (30)	Total (273)		
Rio Orinoco	17	27	22	18	15	19	15	0	0	133	140	**49**
Guayana	0	0	8	5	19	17	13	11	8	81	192	**30**

Source: INC

As can be seen, the record shows low operating ratios of 49 % and 30 % for Rio Orinoco and Guayana, respectively. Discussions with INC's representatives, revealed the following reasons:

1) The crew is tasked basically to operate the dredge only. Maintenance and/or repair of the dredge fleet is contracted to other party;

2) For every three (3) weeks of operation, five (5) days are spent on maintenance of the dredge. This is the primary reason why the operating time of the dredge fleet is greatly reduced;

3) The Guayana dredge is continuously in trouble, hence it is almost non operational. The discharge system of the hopper is confronted with many troubles particularly on the closing and opening system of the hopper bottom cover (see Fig. 6-4-25) which discharges the dredged spoils. In addition, Rio Orinoco dredge has stability problem;

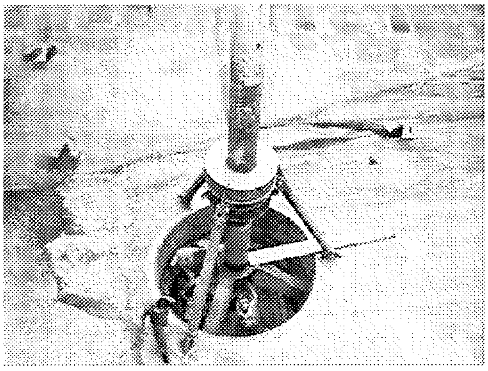


Fig. 6-4-25 Hopper Bottom Cover of Guayana Dredge

4) The requisition for the procurement of the needed spare parts sometimes takes more than six (6) months before the spare parts are made available;

5) Spare parts are being damaged due to the high temperature exhaust of the engine.

6) The impeller as shown in Fig. 6-4-26 is being subjected to rapid severe abrasion particularly at the inner side of the impeller.

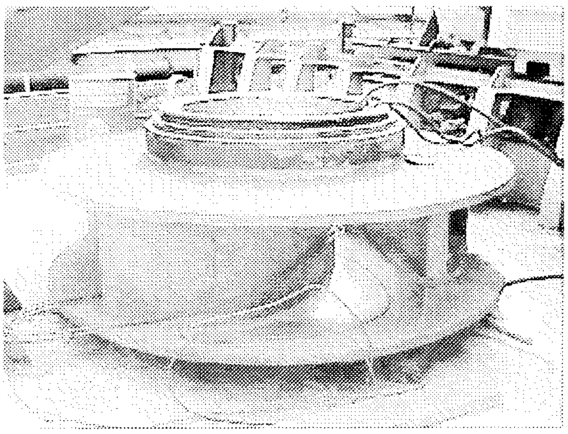


Fig.6-4-26 Shape of Impeller

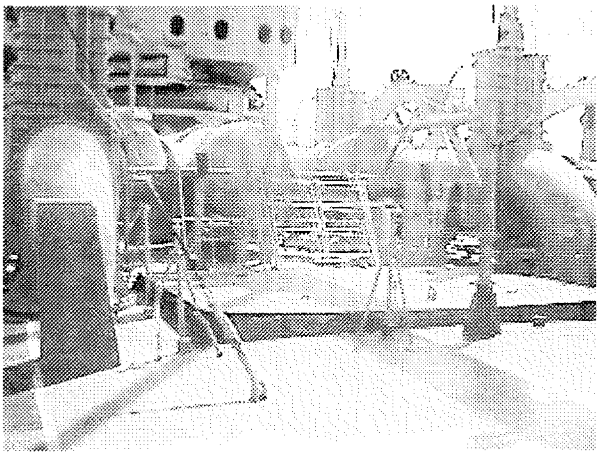


Fig. 6-4-27 Pumps Merged into one Big Pipe of 1600 mm Dia.

Rapid abrasion is due to the following.

The capacity of the four (4) pumps is 48,000 m^3/hr or 12,000 m^3/hr per pump. The flow velocity of the 1,600 mm diameter merged pipe is 6.5 m/s as shown in Fig. 6-4-27. However, all the pumps are not always operational and most of the time, only two are operational. With two pumps in operation, the flow velocity would be 3.0 meters per second only. A part of the delivery pipe is vertical being perpendicular to the deck of ship. As a result of low flow velocity in the vertical pipe, settling of sand inside the pipes occur and it causes pumps to be filled with sand, thereby subjecting the impeller to severe abrasion.

The material of the impeller now in used is quite strong and durable. However, in order not to subject it to severe abrasion, the size of pipe diameter should be reduced to prevent the pumps from being filled with sand.