IEI Centenary Publication

Rear Admiral T B Bose Memorial Lecture

A Compilation of Memorial Lectures
presented in

National Conventions of Marine Engineers

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The Institution of Engineers (India)

8 Gokhale Road Kolkata 700020

Background of
Rear Admiral T B Bose Memorial Lecture

Rear Admiral T B Bose in 1938 started his career as Lieutenant in the Royal Indian Navy and was appointed an Officer on the dockyard staff. He took special interest in the apprentices assigned to the Dockyard of Engineer Cadets to pass out the IMMTS 'Dufferin'.

Admiral Bose was Principal Officer, Mercantile Marine Department at Calcutta in 1952. Right from the time the new DMET Course was inaugurated in 1949, he identified himself with the new system of training, gave it his full support and, until his retirement from service and even afterwards, became a guiding spirit.

In 1957, when he was Chief Surveyor to Government of India, he was appointed Chairman of a Committee to advise Government on the indigenization of ship-ancillaries. The assignment involved considerable touring, data collection and discussions with shipyards and industrial enterprises. The Report of the Committee led to the formation of a Marine Engineering Division of the then ISI (now BIS) and to the setting up of an indigenous development cell at the Hindustan Shipyard, Vishakapatnam.

Admiral Bose was largely responsible for the development of Naval College of Engineering at Lonavala. Even though he had retired from the Navy, Naval Headquarters had a very high regard for his sagacity and expertise and valued his advice greatly. Even after his retirement from service, he took keen interest in the development of marine engineering and was a constant source of inspiration to all at the Ministry in New Delhi and at the new shipyard at Cochin.

As Vice-President of the Institute of Marine Engineers, London, he was a beacon light to the marine engineers of India. In spite of the high offices he held, he was easily accessible to young marine engineers who found his guidance invaluable. Admiral Bose, during his professional career, was closely involved in shipping, ports, shipbuilding, and ship repair and state policy pertaining to these sectors.

In memory of his dedicated service, The Institution of Engineers (India) instituted an Annual Memorial Lecture in his name during the National Convention of Marine Engineers.

Rear Admiral T B Bose Memorial Lecture

presented during **National Conventions** of **Marine Engineers**

Rear Admira T B Bose Memorial Lecture

Shri S Kasthuri, *Fellow*

Rear Admiral Bose as I knew him

A Tribute

It is indeed a unique privilege to have been asked to deliver this lecture in memory of an outstanding marine engineer and a distinguished son of India. I am deeply grateful to the Institution and to the organisers of the Convention for according me this privilege.

The audience has already listened to the biographic outline of the Admiral; hence it is not necessary for me to repeat the same. I shall, therefore, restrict myself to describe Admiral Bose as I knew him over a period spanning four decades.

I first met Admiral Bose in 1938 when I was an Engineer-Apprentice at the Royal Indian Naval Dockyard, Bombay and he, Lieutenant in the R.LN. at that time, was appointed an officer on the dockyard staff. He took special interest in me since I was the first engineer apprentice to be assigned to the Dockyard from the first batch of Engineer Cadets to pass out of I.M.M.T.S. = "Dufferin".

Bose was Principal Officer, Mercantile Marine Department at Calcutta in 1952 when I was transferred to that city as Deputy Director of Marine Engineering Training. Right from the time the new DMET Course was inaugurated in 1949, he identified himself with the new system of training, gave it his full support and, until his retirement from service and even afterwards, became a guiding spirit.

In 1957, when he was Chief Surveyor to GOI, he was appointed Chairman of a Committee --to advise Government on the indigenisation of Ship-ancillaries. I was then Vice-principal of the Nautical & Engineering College, Bombay. Admiral Bose desired that I should join the committee as Member-Secretary which I accepted. The 'assignment involved considerable touring, data collection and discussions with shipyards and industrial enterprises. The Report of the Committee led to the formation of a Marine Engineering Division of the then I.S.I., (now the Bureau of Indian Standards) and to the setting up of an indigenous development cell at the Hindustan Shipyard, Vishakapatnam. To this day, I cherish my association with the Admiral during that assignment.

Admiral Bose was largely responsible for my appointment as the First Principal of the Naval College of Engineering at Lonavla. Even though he had retired from the Navy and had opted for service in a civil department, Naval Headquarters had a very high regard for his sagacity and expertise and valued his advice greatly.

Even after his retirement from service, he took keen interest in my career and was a source of inspiration during my tenure at the Ministry in New Delhi and at the new shipyard at Cochin. After my return from Ghana where I had gone on a Commonwealth Secretariat assignment, I visited Calcutta when I met him and obtained his blessings for the consultancy venture I had embarked upon.

As India Vice-president of the Institute of Marine Engineers. London he was a beacon light to the marine engineers of India.

In spite of the high offices he held, he was easily accessible to young marine engineers who found his guidance invaluable. On this auspicious occasion, I salute the memory of this doyen of the marine engineering fraternity of the country.

I have chosen for this inaugural lecture a topic which is in the nature of an over-view of the national maritime transport-sector as it has grown during the four decades since independence. I consider this appropriate since Admiral Bose, during his professional career, was closely involved in shipping, ports, shipbuilding, ship-repair and state policy pertaining to this sector.

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National Maritime Transport Sector-Progress, Problems, Prospects

INTRODUCTION

India has had a glorious maritime tradition from time immemorial. Evidence from Moheajadaro and Lothal reveal that shipping was known to India 5,000 years'before Christ. Historians have recorded the indisputable fact that India was a leading maritime nation with many busy ports all along its coast and thousands of sea-worthy ships built in India and operated by Indian sea-men. However, it is sad to reflect that the sway of British imperialism over India and the technological transformation of shipping frorn sails to powered propulsion resulted in the total decline of our supremacy over the high seas.

The national maritime transport sector may be likened to a platform supported by four pillars. While shipping, ports, ship-building and ship-repair constitute the four pillars, sea-borne trade constitutes the platform which is firmly secured to the pillars by State Policy. It will, therefore, be pertinent to examine each of these elements first in terms of progress achieved since independence, then in terms of the problems being faced currently and finally in terms of the future prospects and potential.

PROGRESS TO-DATE

a) Sea-borne trade:

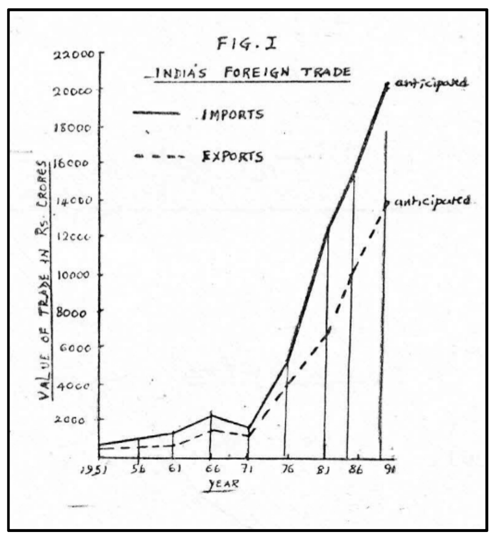
The growth of India's foreign trade, most of it sea-borne, is reflected in Table I and Fig. I. It will be noted that, value-wise, the trade has increased twenty-fold between 1950 and 1985. The pattern of trade too has undergone significant transformation. In the field of exports, it is interesting to note that, during the ten-year period 1970-71 to 1980-81, the share of traditional exports like jute, tea and iron-ore fell from 12.4, 9.6 and 7.6 per cent respectively to 3.6, 5.7 and 4.3 per cent and that the share of engineering goods and handi-crafts increased from 8.5 and 4.6 per cent to 13.4 and 13.5 per cent respectively. This trend has continued till the present. The steep increase in imports is primarily accounted for by petroleum crude (Rs, 103 crores in 1970-71 to Rs. 3437 crores in 1980-81) and to a lesser extent by fertilizers and fertiliser inputs like rock-phosphate, sulphur, phosphoric acid, liquid ammonia etc.

TABLE—I

GROWTH OF INDIA'S FOREIGN TRADE

(in Rupees-Crores)

Year	Imports	Exports	Total
1950—51	650	601	1251
1955—56	Data not available		
1960—61	1140	660	1800
1965—66	2210	1300	3640
1970--71	1634	1535	3169
1975—76	5265	4036	9301
1980—81	12549	6711	19260
1984—85	15600	9962	25262
1989—90 (Projected)	20694	13831	34525



b) Ports:

Ports constitute the vital infrastructure required to facilitate free flow of seaborne trade to and from the country. On the dawn of independence, partitioned India had 5 major, all weather ports and over 200 minor/lnterrnediate ports. The traffic handled at the major ports was of the order of 17 million tonnes, and at the minor ports around 4 million tonnes.

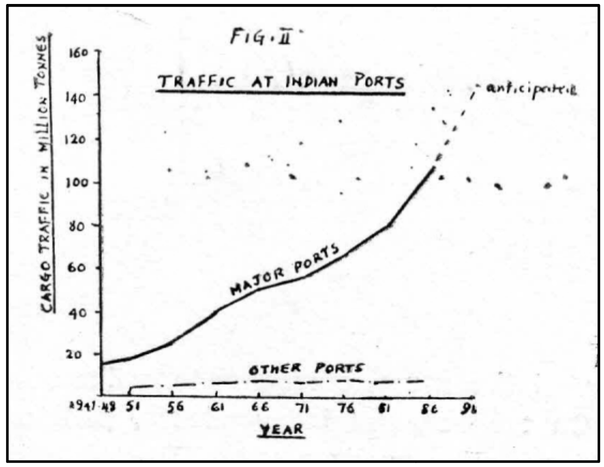
The four decades since independence have witnessed a doubling of the number-of major ports concurrent with the massive expansion of the older ports whereby the overall port capacity increased nearly 7 times. The investment on major port development upto the end of 1985 has been of the order of Rs. 16 Billion. Unfortunately, the growth of minor/intermediate ports has been abysmally poor since the State Governments (under whose jurisdiction these ports lie) have not been able to raise the necessary resources.

Considered in terms of the volume of traffic handled at ports, Table II and Figure ll set out the information covering the period from 1947 till date. Currently over 95% of the traffic is accounted for at the major ports. An analysis of the traffic handled at major ports in 1984-85 reveals that P.D.L. accounted for 50% and iron ore for 25%. General Cargo and container traffic represented about 19%.

TABLE II

GROWTH OF TRAFFIC IN PORTS
(in million tonnes)

Year	Major ports	Other Ports
1947—48	16.9	4.0
1950—51	19.2	3.7
1955—56	23.0	N.A
1960—61	39.9	N.A
1965—66	50.0	7.7
1970—71	55.7	6.8
1975—76	64.9	7.6
1980—81	81.0	N.A
1984—85	106.7	6.8
1989—90 (Projected)	147.00	——



Apart from the numerical or quantitave growth witnessed during the four decades, the qualitative and technological transformation of the major ports has been phenomenal. Exclusive high speed bulk cargo, (iron ore, coal, fertiliser etc) handling facilities, computerised container terminals, special oil berths, etc., have enabled our ports to meet the challenge of fast turn round of ships. The author recalls how. in 1964-66. the import of over 10 million tonnes of food grains per annum by GOI posed exceptional problems of handling at ports. Today, the major ports claim a high capacity-utilisation ratio of over 80%.

c) Shipping:

Largely through the vrsion and courage displayed by Seth Narottam Morarjiee and Seth Walchand Hirachand, the foundation for national shipping (in the modern sense) had been laid in the twenties. At the time of independence, the national fleet comprised 59 vessels totalling 192000 GRT. Table III and Figure III record the progress achieved till date. The position as on 1.7.1987 is reflected in Table IV. The average size of the ships in the fleet has increased five-fold from 3200.

TABLE III

GROWTH OF INDIAN SHIPPING

Year	No. of vessels	GRT
1947	59	192000
1951	94	372378
1956	126	479880
1961	172	857833
1966	221	1540476
1971	255	2616859
1976	359	5114752
1980	377	5544000
1985	N.A.	6320000
1990 (Projected)	N.A.	7500000

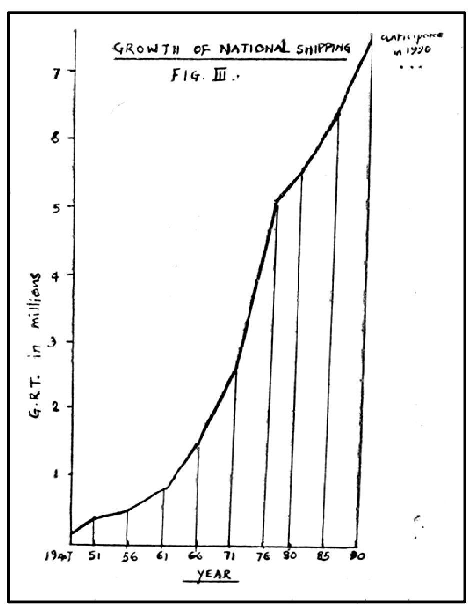


TABLE IV

COMPOSITION OF INDIAN MERCHANT FLEET as on 1.7.1987

Type	Number	GRT (million tonnes)
Dry Cargo Liners	124	1.072
Tramps (below 15000 grt)	38	0.425
Dry Bulk Carriers	74	1.903
O.B.Os	9	0.543
Oil Tankers	57	0.711
Passenger Cargo Vessels	13	0.052
Acid Carriers	2	0.0[illegible]5
Container ship	1	negligible
Off-shore supply vessels	67	0.082
Total	385	5.825

g.r.t. to 17000 g.r.t. The composition of the Indian fleet indicates a degree of versatility. It is, however, sad to reflect that, while the progress story relates almost entirely to the fleet engaged in overseas trade, Coastal shipping has registered negligible growth. From a fleet of 79 vessels (212700 g.r.t.) in 1951, it stood at 60 vessels (340000 g.r,t) in 1987. In the course of the last decade, the off-shore oil sector has led to the development of a fleet of supply and support vessels. On 1.7.1987, this fleet comprised 67 vessels. An important factor in the growth of Indian shipping has been State participation. Public sector ownership accounts for 53.8% of the total tonnage.

d) Ship-building:

An humble beginning had been made in 1944 by Seth Walchand Hirachand who set about establishing a shipyard at Vishakapatnarn for building sea-qoinq ships. The first ship "Jala Usha" (8179 d.w.t) was launched and later delivered to the owners in 1948. In 1956, the Hindustan Shipyard was taken over by Gal. Most recently, a modernisation-cum-expansion pioject at a cost of Rs. 100 crores has been completed. Six years later, Gal took over from the British owners the Mazagon Dock at Bombay and the Gardenreach workshops at Calcutta. Both of these were ship-repairing facilities. Following the take-over, they ventured into defence and service vessel building. The post-independence era witnessed the commissioning of a "green field" shidyard at Cochin 1976, equipped with modern facilities and using up-to-date technology. Four other small yards in the public sector are currently engaged in construction of various categories of service craft and fishing vessels. Table V indicates the installed capacities of the eight shipyards. Hindustan shipyard has to-date built 90 vessels aggregating nearly 1 million tons deadweight. The Cochin Shipyard has delivered five Panamax bulk carriers to-date. The Mazagon Dock has built a number of sophisticated frigates for the Indian Navy. CRSE have built dredgers, bulk carries etc.

e) Ship-Repair:

Prior to independece, British shipowners running regular cargo/passenger services to India had found it cheaper to get these ships repaired in this country. For this purpose, the P&O, B.I. groups developed Mazagon Dock & Gardenreach Workshops while the Turner Morrison group had developed Alcock Ashdown and Shalimar Works. Bombay and Calcutta Ports also had built drydocks to facilitate commercial ship-repair on lease-basis.

In the post-independence period, HSL and CSL commissioned large ship-repair drydocks. Table VI records data on repair earnings in India and foreign exchange outgo on repair overseas, during the 10 year period 1976-86.

f) State Policy & Action:

Almost immediately following the declaration of independence, the new National Government made known their total commitment to the development of national shipping and indigenous ship-building. GOI has played a crucial catalytic role in this regard. The various measures initiated by it include, inter-alia.

i) Creation of a nodal agency for shipping administration in the form of the Directorate General of Shipping;

ii) Reservation of coastal trade to Indian bottoms;

iii) Legislation leading to the Indian Merchant Shipping Act. 1.958;

iv) The constitution of National Harbour Board, National Shipping Board and the Development Council for ship-building & ship-repair;

v) Direct participation in shipping;

vi) Reservation of large ship-building to Public Sector;

vii) The setting up of a Shipping Development Fund Committee and making large funds available on concessional terms for assisting in the expansion of shipping; .

viii) Expansion of existing training facilities as well as establishment of new facilities for sea-going personnel;

ix) The creation of a Marine Engineering Division in the Indian Standards Institution;

x) Evolution of a National Register of Shipping;

xi) Active participation in the activities of the International Maritime Organisation;

xii) Setting up a Dredging Corporation of India;

There can be no doubt that, but for such active role by GOI, the progress narrated in the r recedinq sections relating to ports, shipping, ship-building and ship-repair would not have been possible.

TABLE—V

INSTALLED CAPACITIES OF 8 PUBLIC SECTOR SHIPYARDS

Yard capacity	HSL	CSL	MDL	GRSE	GSL	HDPE	RD	AA
Type of vessels	B.Cs Liners service	B. Cs Tankers	Defence & service	Defence B. Cs service	Defence Service	Service trawlers	Service trawlers	Service trawlers
Berth facilities	1 × B.D 3 × B.B 1 × G.D 3 × Wet betths	1 × B.D 1 × G.D 3 × west berths	2 × B.B 1 × G.D 3 × Wet berth	1 × B.D 2 × B.B 2 × Wet berths	2 × B.B 2 × Wet berths	1 × B.D 1 × B.B 1 × Wet	2 × B.B 2 × Wet berths	1 × B.B 1 × Wet berths
Maxm. vessel size GRT/DWT	30000 / 47500	41500 / 75000	18000 / 27000	19000 / 28000	3200	N.A.	3000	N.A.
Annual output : GRT/DWT	100,000 / 140,000	85000 / 150000	N.A.,	N.A.	N.A.	2000	1100	N.A.
Steel Throughput per annum Tonnes	33350	25000	8000	5400	2500	750	1200	N.A.

Abbreviations :

B.C. — Bulk Carrier.
B.D. — Building Dock.
B.B. — Building Berths.

HSL — Hindustan Shipyard
CSL — Cochin Shipyard
MDL — Mazagon Dock
GRSE — Garden Reach Shipbuilders.

GSL — Goa Shipyard
HDPE — Hooghly Docking
RD —— Rajabagan Dockyard
AA —— Alcock Ashdown.

TABLE VI
DATA ON REPAIR EARNINGS IN INDIA
AND
FOREIGN EXCHANGE OUTGO ON REPAIR OVERSEAS

A. Repair earnings in India :

Year	No. of ships	Earning (in Rs. Cross)	F.E. earnings (in Rs. Crores)
1976–77	1421	18.51	4.62
1977—78	N o t	a v a i l a b l e	
1978—79	980	18.08	3.48
1979—80	612	15.25	2.88
1980–81	565	20.11	2.15
1981—82	611	26.86	3.21
1982—83	528	26.49	2.19
1983—84	416	24.58	1.29
1984–85	286	24.39	1.04

B. REPAIR BILL OVERSEAS FOR INDIAN SHIPS :

Year	No. of Ships	Expenditure (in Rs. Crores)
1976—77	69	25.76
1977—78	66	28.27
1978—79	73	37.93
1979—80	108	40.32
1980—81	75	62.68
1981—82	151	75.54
1982—83	120	75.77
1983–84	110	45.86
1984—85	135	41.70
1985—86	171	49.47

PROBLEMS

While there is justification for a sense of satisfaction over the progress achieved so far in the maritime transport sector, there is no call for becoming "euphoric" on such achievement, esdecially in the background of the phenomenal progress registered in a number of other maritime nations of the world. A single port like Rotterdam hadles 273 million tonnes of cargo annuall'\t whereas less than half that quantity is being handled by all the ten major ports in India, taken together. It will, therefore, be. far more purposeful to examine the short-comings and problems in regard to this sector so that corrective measures can be initiated and future progress accelerated.

a) Foreign Trade:

It is a matter for concern that, while imports have tended to exceed, exports have been falling short of the targets set for them, thereby increasing the balance of payments. Conscious efforts have to be made made to step up exports of iron ore, textiles and g'arments, engineering goods and chemicals and to reduce dependence on imported crude and finished fertilisers.

b) Ports:

The least problem-ridden area of our maritime transport sector can be said to be the major ports. Although the labour productivity at our ports is, by world standards, rather low, the overall management of the major ports in terms of performance, technical expertise, capacity utilisation etc., has been goed It is in the area of minor ports' development that the nation can be said to have floundered. For a maritime nation with 6000 km long sea coast, there should have been atleast fifty to sixty viable ports capable of utilising the sea-transport mode for coastal trade and of serving as feeder-ports for the major ports. The reason for failure is not far to seek. The State Governments are in no position to invest in port development especially when such development promises no assured returns for themselves even though trade may benefit. The peninsular configration of our east and west coasts inhibit growth of coastal sea-borne transportation of goods since distances between ports on opposite coasts are longer by sea than by land. Only in Gujarat where the Gulf configration obtains in Carnbay and Kutch, there is scope for viable coastal movement but the hinter land potential for such trade is limited.

Apart from their importance for trade, ports are also vital from the defence anqle. It is, therefore, high time that the' development of port facilities over the entire length of Indian coast-line be treated as a 'national' responsibity and taken on by the Government of India, if necessary through appropriate legislation. A planned programme of development of one port (other than major ports) along the coast of each maritime state during each five-year plan will ensure that, during the next twenty years, 25 new feeder ports will be available to ease congestion in Railwavs Roads and in the adjoining major ports, to serve as focal points for industrialisation, to assist large-scale marine products utilisation and to support the national defence system. The experience of Tuticorin, Mangalore and Paradip Ports clearly demonstrate the fact that, in a developing economy, 'a prior' viability is not necessary to take up a port project since the creation of the port undoubtedly tiggers off industrial and economic development of the hinterland which more than justifies the investment on the port.

c) Shipping:

The prolonged world-wide recession in sea-borne trade and in shipping has created problems for Indian Shipping too, though it may be pointed out that the impact has bsen less harsh for us owing to the extent of protection available as a result of government support in the form of Transchart fixtures and use of national tonnage for carriage of imported crudel Shrinkage in world sea-borne trade, surplus shipping tonnage, cut-throat competition in freight rates and proliferating flags of convenience have been the major causes of world recession. Excessive manning, lack of aggressive marketing and over-depence on loan capital have contributed to the woes of Indian shipping. Mushroom growth of shipping companies with uneconomic fleet sizes, mainly for the purpose of tax-manipulation, has been a most unfortunate development on the Indian scene. We see, before our eyes, a battle for survival and it is clear that only the fittest will survive. As an old employee, it breaks my heart to be witness to the collapse" of the Scindias, the pioneer Indian shipping company.

The way out is not easy. It is most esssential that Government should reappraise the entire gamut of policies and practices governing Indian shipping development and initiate measures to ensure a fair share of traffic to Indian bottoms, economic transportation and competitiveness. It is time that State assistance to shipping must be linked to competent management and credit-worthiness. It is also necessary that manning scales be revised to keep in tune with technological innovations. The development of coastal shipping which, hitherto, has received little attention, needs to be taken up in earnest. Stuides have established that Ro-Ro services between Mangalore or Ccchin and Bombay Gujarat and between Madras and Calcutta are feasible and viable. Moreover, there is scope for container-feeder services between Madras and Viazaq and between Cochin and Tuticorin. Such services will significantly ease congestion on Railways. It is vital that shipping development should be viewed as an economic priority unpolluted by political interference.

d) Ship-building:

Although, in terms of rhe 1986 industrial policy resolution, ship-building (other than small craft construction) was reserved for the public sector, it is a painful fact that shipbuilding has been treated as a step-child to be tolerated but not developed. The reason is not far to seek. At the modal ministry, viz the Ministry of Surface Transport, the shipping lobby has been exceptionally powerful and has succeeded in promotion of orders on overseas ship-building yards to the detriment of the Indian yards. All the successful ship-building nations have recognised the simple fact that building solely for internal needs will not be viable and that building for export is a vital necessity. Ship-building even in countries like Japan & South Korea is subsidised by the state covertly if not overtly. Ship-building, on the basis of miniscule capacities, makes no sense since costs are inflated by high overheads and non-availability of indigenous industrial support.

To make things worse, the two major yards engaged in the building of commercial ships have unfortunately turned sick units. The work-culture at the shipyards is so lacking in content that productivity at all levels is abysmally low. If one considers ship-building as a fusion of three major activities, viz: design & documentation, steel hull construction and ship outfitting engineering the first activity is minimal and the productivity in the other two is about 30% of that obtaining even in the less competitive countries of Europe, not to speak of Japan and Korea.

Furthermore, yard-outputs have been so low that, even the installed capacity, low as it is by world standards, remains unutilised to the extent of 50 to 60%. Since the shipyards are in the public sector, much of the responsibility for this sad state of affairs must be borne by the Government since they hav consistently failed to monitor performance and discipline managements.

What then is the solution? Firstly, it is absolutely essential that ship imports are severely curtailed and shipowners and other parties like ports, fisheries fleet owners etc., directed to place orders on indigenous yards. Secondly, there has to be a conscious drive to discipline the yards, to ensure productivity levels comparable to overseas yards and to maximize capacity utilisation. Thirdly, the pricing policy governing Indian-built ships must be revised so as to compensate fullY the disparity between costs of indigenous material and equipment and prices of identical imported items. Fourthly, a conscious development programme for indigenous materials and ancillaries must be launched. Fifthly, it is high time that self-reliance is not sacrificed by G. O. I. at the altar of overseas financial packages which result in import of even categories of craft like fishing trawlers, supply vessels, harbour tugs and dredgers. Sixth, it is imperative that a National Ship Design & Research Organisation be set up without delay to serve the shipyards and to be the repository of all accumulated experties in the field of ship design and ship-building.

e) Ship repair:

In 1980-81, almost 9000 ships called at the ten major ports. Most of our major ports are terminal ports for one or other of various categories of cargoes, viz: crude oil, iron are, manganese are, coal, fertiliser inputs etc. It is, therefore, surprising as well as saddening to find that ship-repair activity in India is woefully low. Only Bombay, Calcutta, Vishakapatnam & Cochin have repair dry docks. The repair performance at these places is very poor. Here again. as in the case of ship-building, it is a distressinq fact that Indian owners prefer to get their ships repaired overseas and that Indian ship-repairers help the flight of custom by their inefficiency and time delays (See Table VI). Even repair yards in countries like Malaysia record significantly better performance than our yards. Unlike ship-building which, even in countries like Japan & Koera is a no profit industry, ship-repair is basically a profit oriented activity provided the repairer is time and quality conscious. It is, therefore, most essential that Ship-repair facilities are expanded and efficient performance ensured.

f) State Policy & Action:

In the background of the dominant role played by Government directly or through public sector in the development and functioning of ports, shipping ship-building and ship-repair, the problem areas in regard to government policy and action deserve consideration. In terms of organisation, administration and co-ordination, GOI have set up the necessary tools in the forms of various agencies listed earlier. It is, however. necessary to continually re-assess their performance in the light of changing technology and world trends. To give but two examples, the sea-farer training infra-structure has been well-laid. But the curricular content has to be modified to suit latest ship-technology. To be able to perform this task on a continual basis, it is necessary that all training facilities are brought under the umbrella of a national maritime university. Subsidisation of ship-building can be reduced only by conscious expansion of capacity so as to facilitate ship-exports and by effective indigenisation of ship-board ancillaries. B.H~E.L. and H.M.T. are classic examples of purposeful development of power sector and machine tool industry to cater to indigenous needs and to foster exports.

PROSPECTS

What does the future hold for the national maritime transport sector? It is difficult to answer this question, Much will depend on the world economic scenario on the one hand and the success attendant on the five year plans in India. Unless the foreign trade of India picks up significantly especially in the field of exports, growth of national shipping and development of ports will be inhibited.

a) Foreign Trade:

A perusal of the VII Plan document reveals that exports are likely to increase from Rs. 99.62 Billion per annum in 1984-85 to Rs. 138.31 Billion per annum in 1989-90 and imports will rise from Rs. 156 Billion per annum to Rs. 206.94 Billion per annum in the same period. Provided these projections materia lise, the potential for increase in port capacities and shipping tonnage will be good.

b) Ports:

When the Navasheva Port Project is completed, capacity on the West Coast will be significantly augmented. There are also proposals for expansion of Madras Port with Asian Development Bank assistance. Tha need to establish thermal power-plants along the coast is increasingly felt and may well lead to development of new ports. The increasing use of containerisation for movement of general cargo will necessitate creation of new container terminals, in addition to the one at Madras. The plans to augment the dredqinq capacity of the D.C.I. should result in improving port depths. By 1989-90, the major ports' capacity is expected to be around 160 million tonnes per annum.

It is widely recognised that the Railway System along the East and West Coasts as well as the coastal Highways are fast reacting saturation levels. It is, therefore, vital to develop selected intermediate ports on both coastas to serve as feeder-ports for containers for transportation to the major ports by the sea-route and also as delivery points for fertiliser inputs and other industrial raw-materials.

c) Shipping:

The Seventh Plan target for national shipping is 7.5 million g.r.t. in operation and 750.000 g.r.t. on order by March 1990. As on 1.7.1987, the operative tonnage (excluding OSVs) is only 5.825 million g.r.t while the tonnage on order amounted to 512000 g.r.t. This means that in the remaining 30 months of the plan period, additional orders to the extent of 1.913 million g.r.t will need to be placed and two-thirds of such tonnage must be operative before the plan period ends.

Even more important than the quantitative augmentation of national tonnage, it is vital that the tonnage to be acquired is suited to the needs of modern sea-transportation. Hence emphasis has to be laid on acquisition of fast container ships chemical carriers, product tankers, Ro-Ro vessels etc.

In the off-shore sector, it is learnt that ONGC have now taken a policy decision not to directly acquire, under their own aegis, additional supply ships. Simultaneously, the S. C. I. are reported to be creating an off-shore fleet division. In the context of the strenuous efforts being made by ONGC to exploit off-shore oil wealth in the Palk-straits, and off-Godavari and Mahanadi estuaries, the prospects for the expansion of off-shore fleet are quite bright.

d) Ship-building:

Most recently, there are clear indications that Government of India are concerned over the poor productivity and low capacity utilisation at the two large shipyards building commercial ships, viz.: HSL & CSL and that various measures are afoot to stem the rot and improve performance. If these two yeards perform satisfactorily, the annual output of commercial vessels can be of the order of 200.000 g.r.t. which would mean an addition of 1 million g.r.t per plan period. The defence oriented yards at Mazagon, Garden Reach and Goa will have their hands full with defence orders. The smaller yards at Calcutta and Bhavnaqarshould be able to cater to the needs of Port Trust. ONGC etc.

GOI has under consideration, for over 10 years, detailed proposals for the construction of two more shipyards, one at Hazira on the West Coast and the other at Paradip on East Coast. Both on grounds of ensuring self-sufficiency in the expansion of the national fleet and on grounds of improving viability of Ship-building, it is to be hoped that positive decisions towards the setting up of the two new yards will be taken soon. In this connection, it is interesting to note that the People's Republic of China which, until a decade ago, did not figure at all as a major ship-builder in the world has now attained the fifth rank in world ship-building and is expected to attain third position before long. A significant feature of their growth lies in the export orders they are executing.

e) Ship-repair:

Properly managed, this a profit oriented activity and it is to be hoped that conscious efforts will be made to maximise Ship-repair in the country and conserve/earn foreign exchange. There are reports that a private industrialist will be shortly acquiring two floating dry docks to be berthed at Madras Port. This is a welcome development.

The long term objective ought to be to encourage ship-repair business at every port city which, for certain commodities, is a terminal port. If a small island nation like Singapore can cater to ship-repair needs of world merchant shipping in a big way, there is little reason why India cannot become totally self-sufficient and also service overseas tonnage in a lucrative manner.

CONCLUSION

Reference was made, at the commencement of this lecture, to the glorious maritime traditions of India in the by-gone centuries. As we enter the last decade of the twentieth century, let us resolve that the nation will recapture the past glory and will rank among the top maritime nations of the world at the turn of the century.

Rear Admiral T B Bose Memorial Lecture

Shri V R Rajagopalan

It is indeed a great privilage to have been asked to deliver the Third Admiral Bose Memorial Lecture.

I first came in contact with Admiral Bose in 1946 when I appeard for my Second Class Certificate of competency at Calcutta and Lieutenant. Commader Bose as he then was examined me. Subsequently when I joined the Mercantile Marine Department as a Junior Surveyor, he had become the Principal Engineer and Ship Surveyar, Calcutta. Not only was he the first Indian officer in the service, he became the first Indian Chief Surveyor with the Govt. of India and Chief Examiner of Engineers.

Admiral Bose had the ability to get along with everyone. He was always courteous and when he wanted he could be very convincing. I remember one incident particularly well. I was in Cochin when he as the Chief Surveyor had come on tour. He had wanted me to go on transfer to Calcutta and I was most reluctant to go at that time. In the evening after dinner he got talking to my wife and convinced her row it would be in her interest to go to Calcutta. Before she could change her mind he telephoned from my house to the Director General of Shipping in Bombay and had the transfer orders issued.

He represented India at the International conference on Safety of Life at Sea in 1948 and 1960. Apart from his other distinctions he had devoted the major part of his working life to administering and implementing the, laws relating to Marine Safety and I have chosen for my lecture the subject of Marine Safety, the evolution of international conventions. The subject is rather vast and the lecture which I am delivering today cannot but touch only the major areas of evolution of international standards.

MARINE SAFETY

Marine Safety as we know it today has a number of components. The primary componant is the ship itself i.e. the strength and construction of the hull and its watertight integri ty.

The construction and efficiency of the machinery; The equipment provided on board to secure safety; such as fire appliances, life Saving appliances, light and sould signals.

The means of communication; Training and examination of personnel; Search and rescue operations.

The various requirements relating to these are contained in The Merchant Shipping Act and the rules made there under. The primary responsibility for implementing these in India rest with the Director General of Shipping and the Hercantile Marine Departments.

In the early part of this century before any international requirements came into being the world of Shipping was divided along primarily colonial lines the trading being essentially between the so called mother country and the colonies. There was little or no cross-trading as we know today and the laws of the mother country were made applicable to the colonies. In India we generally followed British Laws with minor modifications.

Most-of you from the marine fraternity will no doubt be aware of the pioneering work done by Samuel Plimsol is having permanently marked load lines to ships. These load lines were evolved in a rather simplistic way. The early requirements for "free loard" was a flat 25% of the moulded depth of the vesse1. Statutory inspections and surveys became mandatory only at the turn of the 19^{th} century.

The first international convention relating to Marine safety was in respect of radio telegraphy. Prior to this we had serious and some times comical situations. An Americans Ship looking for another American Ship in distress came across a German Ship and enquired on the Radio Telegraph the position of the distressed Ship. The German Ship refused to answer on the plea that he could communicate only with ships fitted with the same made of wireless equipment. It is now mandatory for every ship receiving a distress message to proceed with all possible speed to the aid of the distressed vessel.

The tragic loss of the "Titanic" with over 1000 passengers led to the convening of the first international conference on safety of Life at Sea in 1914. However due to the outbreak of the First World War the recommendations of the conference were not adopted internationally. The first effective international conference (SOLAS) was held in ondon in 1929. The requirements of the conference related mainly to passenger ships engaged on international voyages. The conference laid down standards of sub-division to be adopted for ensuring safety under damage conditions the length and extent of Double bottom tanks, construction and testing of water-tight bulkheads, side scuttles and openings below the balkhead deck etc. With regard to machinery the stipulations laid down were in respect of Bilge mps and pumping arrangement, power for going astern and auxiliary steering gear. Although not spacifying any standards regarding machinery the conference by Regulation XXII laid down that the material and scantlings of the Hull, Boilers and their appurtenances, main and auxiliary machinery fully comply with the requirements of the convention and of the detailed regulations promulgated by the Governments concerned. The above regulation also laid down that passenger ships were to the surveyed before being put, into service and thereafter periodically every twelve months. This clearly placed the onus on the contracting governments for making detailed rules.

One of the noteworthy features of the '29 convention was that when sub-division load lines were assigned it recognized the existence of National Laws on Load Lines but did not recommend bringing these within the ambit of SOLAS Regime. To most of us it will come as something of shock that the '29 convention while prescribing the requirements for life saving and fire appliances for passenger ships did not lay down any such requirement for Cargo Ships. The only requirements prescribed for Cargo Ships were in respect of Lights and Sound Signals in pursuance of the international collision Regulations and provision of Radio Telegraphy for Cargo Ship of over,1600 tons gross. The Convention for the first time recommended the stting up of ice Patrol for the North Atlantic Routes and for exchange of information on weather.

The 1929 conference recommended that Special rules be framed in respect of unberthed passenger ships on pilgrim and other special trades by administrations which were directly interested in such trades. As a result of this a conference was convened at Simla and adopted standards of sub-division slightly lower than those of passenger ships carrying Berthed passengers. The modified rules were called the Simla Rules 1931. The sub-division load lines under the Simla Rules were designated D1, D2, D3 as against the Convention load lines C1, C2, C3, etc.

In view of the large number of unberthed passengers carried in these vessels the requirements relating to carrying of life boats was also modified. Where the number of life boats provided were not sufficient to accommodate all persons on board the deficiency was permitted to be made up by life rafts and buoayant appalatus.

The International Load Line Convention –1939

Although the load line conventions are also intended to secure safety of life and property at Sea the Load Line and SOLAS conventions have developed along parallel lines.

I had indicated earlier the pionering work of Plimsol to have compulsory load lines marked on the side of the Ship. The 1930 Load line convention largely reflected the standards in vogue in respect of British Ships. This wap to be expected as Britain had not only the largest merchant fleet in the world at that time, but also had a long history of marine safety.

The 1930 L.L. convention for toe first time laid down the requirements for strength standarqs to be adopted for mid ship sections modulus, frame spacing and frame modulus and thickness of shell plating. The free board calcuiations were based on the length of the ship, Block coefficient and the amount of effective super structure. Credit was given where the sheer was more than standard. Penalties for increased freeboard was stipulated where these was no fore-castle. The entire philosophy was based 0I! securing adequate reserve BuoYm,acy and comparing any given ship to a st.andacd ship having a moulded depth of L/15, Block co-efficient of 0.68 a standard sheer profile which was twice forward as it was aft and a standard height of superstnucture.

As was to be expected with ships of that time the closing of Hatch ways was by means of hatch boards laid on hatch beams and canvas covers secured by battening bars and wedges. The convention laid down the heights of Hatch comings and ventilators for various positions on the ship. Cargo and coaling ports, seppers, inlets and discharges and air pipes and their closures were also dealt with.

It may appear a little strange today that openings in bulk heads were permitted at the aft end of fore castle and mid-ship superstructures –to be closed by wooden boards fitted into channels.

For the first time, the entire sea area of the world was demarcated into Summer, Trophical, Winter and other seasonal Zones on the basis of force and frequency of storms and other meteorological factors.

Special freboards were assigned to ships carrying timber deck cargoes and sailing ships.

SOLAS CONVENTION 1948

Compared to the requirements of the 1929 convention the 1948 convention had imposed stricter requirements for sub-division of passenger ships which were permitted to carry passengers in excess of the life;boat capacity and engag-ed on short international voyages. Consequent upon experience gaine;d between the two world wards the standards of damago stability for passenger ships were laid down. This included the extent of damage to be assumed longitudinally, transversely and vertically. Arrangement for reducing unsymmetrical flooding and cross-flooding arrangements were called for. In the case on unsymmetrical floading the angle of heel was not to exceed 7° and in no case was it to exceed 15°. In the final stages of flooding the metacentric height had to be positive. Since the transverse extent of damage was to be 1/5 of the moulded breadth all bilge pumps and pipe lines were to be necessarily inboard of this to enable them to operate under damuge conditions.

The '48 convention prescribed requirements for Electrical installations for passenger ships for the first time. The requirements included having at least two main generating sets each of which could maintain all essential electrical systems necessary for the propulsion and safety of the ship. An emergency source of power located above the bulkhead deck was also stipulated. The capacity of the Emergency Source of Power and the various emergency services to be catered for was also stipulated. Special requirements for feeder cables to electrically operated steering gear was prescribed as were general electrical precations against electrical hazards and fires.

A system of fire protection was stipulated for accommodationed and service spaces. This could be by means of one of the following:

a. Construction of internal divisions without a fire detection or sprinkler system;

b. Installation of an automatic sprinkler and fire alarm system without any restriction on internal bulkheading and;

c. A system of fire resisting bulkheads within each main vertical zone and automatic fire detection system.

The convention laid down for the first time the tests for various classes of fire resisting bulk heads, the treatment of openings in these bulkheads and ventilating trunks passing through them, protection of vertical stairways, lift trunks, machinery spaces and control stations. The requirements of fire rumps, water service pipes, hydrants and hoses, fire smothering system for Cargo and machinery spaces, sprinkler system, fire extenguishers, bceathing apparatus etc. were spelt out.

For the first time cargo ships of over 2000 tons gross were required to be fitted with fire smothering system in the cargo spaces and smotheing gas or froth discharging arrangments in machinery spaces containing oil fired boilers or oil fuel units 2nd settling tanks. In addition the requirements for fire pumps, fire hoses, hydrants, fire extinguishing and breathing apparatus were specified.

Life Saving Appliances:

The '48 convention had stipulated stricter requirements in respect of lifeboats and their construction. The provision of additional motor bouts in passenger ships, the requirements for motor boat engines, their speed and fuel capacity, Dynamo for recharging battery for search lights and fitting of lifeboat radio apparatus for transmitting and receiving messages in respect of ships carrying more than 20 lifeboats.

For the first time cargo ships were required to be fitted with lifeboats having sufficient capacity on each side to uccommodate all persons on board. On ships of 1600 tons gross and over a motor boat or a mechanically propelled life boat was to be provided. Special requirements in respect of oil tankecs were laid down.

Radio Telegraphy:

Whereas the '29 convention required Radio Telegraph for all passenger ships and cargo ships of 1600 tons gross only, the 48 conventions required fitting of at least Radio-Telephone equipment on Cargo ships of 500 tons gross and above hut below 1600 tons.

All ships of over 150 tons gross were to have efficient clayligh,tsignalling apparatus and ships of 1600 tons grass and above were to be fitted with direction finding apparatus. The convention laid down for the first time some elementary requirements for carriage of grain and dangerous goods.

The '48 convention set out for the first time the control that could be excerciscd over ships of convention countries when in the ports of other countries. Although the Municipal laws of each country would naturally prevail the convention stipulated the extent to which such laws would be enforced on ships holding convention certificates.

For the first times cargo ships on international voyages were required to have valid safety equipment certificates the survey for which included life saving appliances, fire extinguishing appliances and lights, shapes and means for making sound signals.

With regard to passenger ships as in the '29 conventions specific standards were not prescribed in respect of machinery but by Regulation 7 of Chapter I left it to individual administrations to promulgate such standards in respect of Bailer, Machinery Electrical Installations and other equipments.

SOLAS CONFERENCE 1960

The Solas Convention 1960 retained the requirements of sub-division of passenger ships of SOLAS 48 with only minor refinements in materials used affecting the subdivisions. The conference for the first time required cargo ships to be inclined on completion and stability data supplied for various conditions of plying. This information was to be kept upto date following any material alteration to the ship. Damage control plans giving details of W.T. Bulkheads the openings therein with the means of closure, positions of controls and arrangements for correcting any list cue to flooding were to be permanently exhibited and booklets containing the above informations was to be available foe all officers.

The conference stipulated for cargo ships for thc first time provision of an emergency source of Electrical power sufficient for at least 6 hours of continuous oparation and capable of oparating under a heel of $22^{1}/_{2}°$ and a trim of 10º. Ships of less them 5000 tons gross were required to have a self-contained source of electrical power for emergency capable of operating for a period of at least three hours.

General precautions against shock, fire and other electrical hazards were prescribed for cargo ships for the first time. Similarly sufficiant power for going astern were also prescribed. Cargo ships were also required to be provided with anxiliary steering gear sufficient to steer the ship at navigable speed. Cargo ships of over 5000 tons grass when fitted with electric and electro-hydraulic steering gear were to be supplied with two sets of circuits which were separated as widely as possible both vertically as well as horizontally. Only short circuit protection was to be ~rovided to these circuits. (Preferential Tripping)

Fire Protection

The fire protection arrangements for passenger ships generally followed the requirements of the '48 convention with some minor refillements.

For Cargo ships of over 4000 tons fire protection arrangements were prescribed for the first time. The hull superstructues, structural bulkheads, dacks and deck houses were to be constructed of steel. All corridor bulkheads were to be of steel or "B" class bulkheads Deck coverings were to be of material that will not readily ignite. Crew lift trunks and interior stairways were to be of steel. Materials rendered ineffective by heat were not to be used for overboard, sanitary and other outlets where the failure of this metal would lead to flooding. Power ventilation of machinery were to be capable of being stopped from an easily accessible position from outside the machinery spaces. The number and capacity of fire pumps, the pressure in the fire mains, fire hoses and nozzles and the requirement for an international shore connection were laid down.

In addition to the froth fire extinguishing systems stipulated in the '48 convention all ships with internal combustion machinery of over 1000 BHP were to be fitted with a fixed fire extinguishing system.

Means of Escape:

At least two means of oscape were to be provided from below as well as, above the bulkhead deck in all passenger ships. At least one of these is to provide continuous fire shelter upto the life-boat stations. Two means of escape were required from machinery spaces in both passengcr as well as cargo ships.

Means were to be provided for stopping all ventilating fans serving cargo and machinery spaces, closing of all door-ways and ventilators from outside these spaces, Machinery driving fuel oil transfer pumps, unit pumps as well as forced and induced draft fans were to be stopped from positions outside their location. Similarly oil fuel suction pipes from storage, settling or daily service tanks were to be fitted with arrangements for closing them from outside the space concernod.

All passenger and Cargo ships were required to be provided with permanently exhibited plans showing clearly the control stations, the various fire resisting and fire retarding bulkheads, the fire alarms and fire detecting systems, the fire extinguishing appliances, the remote controls etc.

Life saving Appliances: On every Passenger ship a motor 1ifeboat was to be provided on each side. Cargo ships 1600 tons and above were required be carry atleast one motor lifeboat and tankers were required to have a motor life boat one each side.

For the first time inflatable life rafts were required to be provided. In passenger ships the life raft capacity was to be not less than 25% of the total number of persons carried. In Cargo ships lifcrafts with a capacity of 50% of the peeple on board were required to be provided.

The general requirements relating to construction and equipment of life boats remained the same as compared to the 40 conventions except for the provision of lifeboat cover and fishing tackle.

Safety of Navigation:

The requirements of Ice Patrol and Metrological Information were continued. A new Obligation on ships receiving distress messages to proceed with all speed to the assistance of ships in distress was imposed.

For the first time, the requirement relating to sufficient and efficient manning was referred to but it was left to individual Administrations to adopt suitable measures. Similarly it was left to individual Administations to provide along their coastline Radio becons and other aids to Navigation and search and Rescue arrangements along their coastline.

Carriage of Grain:

The requirements relating to carriage of grain in bulk head been expanded considerably. Requirements of stability is the various conditions of grain carriage were also stipulated. All ships carrying grain in bulk were to be provided with grain loading plans indicating stability under various loading conditions and the fittings provided for preventing grain from Shifting.

Dangerous Goods:

All dangerous goods were divided into 9 classes and general requirements relating to packing, marking, labeling and storing were laid down. These have been supplemented by the IMCO Dangerous Goods Code which gives detailed requirements regarding the above.

Nuclear Ships:

A new chapter was introduced dealing with nuclear ships and laid down in general terms the requirements relating to approval of reactor installations, stability of the installations, rediation safety, safety assessment, operating manual, survey etc. These were supplemented by recommendations giving detailed requirements relating to nuclear ships.

Certificates:

In addition to cargo ship safety equipment certificate prescribed under the '48 convention, the '60 convention had prescribed issue of cargo ship safety construction certrificate. The survey for issue of cargo ship safety constructions certificate were to be such as to "ensure that the arrargements, materials and scantlings of the structure, boilers and other pressure vessels and their appurtenances, main and auxiliary machinery, electrical installations and otherequipments were in all respects satisfactory for the service for which the ship is intended".

<u>International Conference on Load Lines 1966</u>

The 1966 load line convention divided ships into two classes, Type "A" ships were those designed to carry liquids in which cargo tanks have very small access openings and are closed water tight by gasketted covers of steel. Such ships because of the high integrity of the exposed deck and high degree of safty against flooding due to the low permeability of the loaded cargo spaces and the degree of sub-division provided were assigned reduced freeboard compared to all other ships classed as Type "B".

All type A ships of over 150 metres in length and designed to have empty compartments when loaded to the summer load water line were to be capable of with standing flooding of anyone of those empty compartments. In ships of over 225 metres in length the machinery space was to be treated as a flood able compartment. In the final stages of flooding the water line was to be below any openings through which progressive flooding could take place, the maximum angle of heel due to unsymentrical flooding was not to exceed 15° and the metacentric height was to be positive. Credit was given to type "B" ships fitted with metal hatch covers. Ships fitted wi th wood hatch covers in the weather deck were penalised by assignment of a bigger freeboard. The various correction for depth, sheer, superstructure block coefficient etc. followed the same practice as in the '30 Load Line Convention. However instead of a forecatle a concept of minimum bow height was introduced. In otherwords additional buayancy forward to give the necessary lifting effect is a seaway could be obtained by having sufficient excess sheer.

International Conference on Special Trade Passenger Ships 1971

As a result of this conference the sub-division enquirements relating to criterion of services numeral was modified slightly to give a higher standard than under the Simla Rules. The requirements relating to carriage of life boats was also modified. Lifeboats on each side had to have a capacity for carrying atleast 35% of all persons on board.

SOLAS 1974

The sub-division of passenger ships, the bilge pumping arrangements and stability requirements were the same as laid down in the '60 convention.

The requirements relating to electrical installations, main and emergency genarators and general electrical precautions were the same as in the '60 convention for both passenger as well as cargo ships. The requirement relating to steering gear and electrohydraulic sterring gear were also similar to the '60 convention.

The major change made in the '74 convention was in respect of construction, fire protection, fire detection and fire extinguisting arrangements for both passenger as well as cargo Ships. A part from the categorization of Bulkheads and divisions into "A" & "B" class divisions depending on fire integrity as in the 60 Convention all spaces on board were categorized into 14 groups on the basis of fire risk and the kind of bounding divisions that were to be provided. These were spelt out in 4 tables. The requirements for minimising spread of fire through ventilating systems including galley uptakes were made more stringent.

A new part was introduced laying down fire safety measures for Tanker and combination carriers including inert gas systems for cargo tanks.

Life Saving Appliances:

Excepting for minor details there were no changes compared to the 60 convention

Safety of Navigation:

For the first time carrying of Radar and fitting of gyro compasses was made obligatory for all ships of over 1600 tons gross and echo sounding machines for all ships of over 500 tons grass.

Carriage of Grain:

The requirements had been greatly amplified with regard to loading and strength of' grains fittings. The requirements relating to stability were also clearly spelt out. The angle of heel due to shifting of grains was not to exceed 12°. The residual area between the heeling arm curve and the righting arm curve was not to be less than 0.075 meter-redians and the initial metcentic height was not to be 1ess than 0.30 meters.

STCW CONVENTION 1978

I had mentioned earlier that one of the important areas contributing to safety was manning. Although the subject of manning had been rectified to in the earlier conventions no acceptable standards could be evolved till 1978 when the conference relating to standards of watch keeping, certification and training was convened. Prior to the coming into force of this convention all ships followed their national laws and when in foreign ports were not proceeded against for under manning.

The STCW convention prescribes the minimum manning requirements of certificated personnel for Deck Engine and Radio Departments. The convention also lays down the additional training and qualifications of masters, officers and ratings of oil tankers, chemical tankers and liqluified gas carriers.

For the purpose of manning in the Deck Department ships have been divided into two classes, those above 200 tons gross and those below 200 tons gross. Three classes of certificate have been prescribed Master, Chiefmate and Officer-in-Charge of a navigational watch. The Officer-in-charge of a navigational watch can also be a master of ships of less than 200 tons.

In the case of Engine Department Ships have been divided into two classes. Those with machinery above 300 KW and those between 750 and 3000 KW. Each of these classes of ships requires a Chief Engineer Officer, a second Engineer Officer and for everyone in charge of watch can person holding a watch-keeping certificate.

The detailed requirements relating to standards of training for various categories of officers have beon spelt out. Although our own standards regarding training and certification are not less than those of the convention we have to welcome these requirement.s on an international scale as ever 80% of maritime accidents are the result of human error.

Provision has also been made in the convention for reexamination every 5 years of those already in possession of certificates to ensure that their knowledge is updated. This is also necessary in the case of those who have been ashore for a long time and wish to go back to sea.

It will be seen from the brief high lights from the various SOLAS Conventions held so far that there has been hardly any major changes in the sub-division of passenger ships since the 29 convention. Electrical equipment, generators and firs and other risks of an electrical nature have become increasingly important particularly since the 1960 convention. Similarly structural fire protection, fire detection and extinction have become progressively more stringent.

As regards cargo ships the changes have been more striking. The 29 convention did not specify even Life Saving Appliances for Cargo Ships. The 48 convention, stipulated safety equipment certificates the 60 convention laid down cargo ships safety construction certificates. The 74 convention had laid down improved fire protection arrangements for cargo ships and tankers. All these also indicate the pattern of evolving ship types and the increasing fire risk not only due to the operation of the ship itself but also due to the cargo being carried. Between the world wars the majority were passenger ships which also used to carry a good quantity of cargo. From the late 50's there was a marked reduction of passenger ships. With the competition from the Airlines the big passenger ships have all best disappeared. However with the progressive increase in world trade the big cargo ship and bulk carriers and container ships and other special purpose ships, oil and chemical tankers, vehicle carriers, stern loaders etc have made their appearance. Each of the specilized type of ships have different features requiring special attention in respect of safety. Added to these are the problems posed by ships intended to ply with unattended machinery both with regard to operation as well as the requirements of minimum manning for maintenance and emergency situations.

One of the more striking developments has been in the field. of communications Technology as a result or which satellite navigation, homing signals from radio beacons etc. have contributed to increased safety of navigation, Telex and direct telephone conversation between ship and office becoming more and more common has greatly facilitated operetional and planned maintenance programmes.

We have seen from the earlier part of this lecture how international standards have evolved over the years. By this it is not to be construed that there were no worth while standards followed by most countries. Most maritime nations had national standards not inferior to the required international standards. I have myself served on passenger ships built in the early 1920's which more than met the 1929 convention requirements. What the conventions lay down are minimum acceptable standards to be followed by all countries.

In the case of a majority of countries these have bocome the maximum of their standards. One may ask what would happen if any country did not accept the convention requirements or whose ships were found to be difficient. Both the control procedured laid down in the conventions and our own laws lay down the procedures for detaining such ships and ensuring compliance with the convention requirements.

I had mentionad earlier that as far as India is concerned the laws relating to maritime safety are contained in the Merchant Shipping Act as amended from time to time. The conventions had also imposed responsibilities on the contracting Governments for making detailed technical rules to incorporate the requirements of the various conventions. It is in this area that there have always been delays which has caused a great deal of inconvenience to Indian Ships and ship owners. This is because of the normal buraccurate delays end Hindi translations having to be made for all rules which are to be tabled in Parliament and also due to absence of a mechanisam for continuous review of all technical rules. Since technical developments are rapid perhaps having a "Code of Practice" for various requirements would best serve the purpose is the legal requirements can then be kept seperate from technical requirements. Having said this let us see how the various convention requirement are implemented. The conventions clearly spell out that all inspections and surveys are to be carried out by officers of the country in which the ships are registered provided the Government may entrust such surveys and inspections to organizations recognized by it. In every case the Government concerned fully guarantees the completeness and efficiency of the inspection and survey. The conferences recognized the fact that there may be countries which may not have the organization or expertise required to carry out these inspections consequently the requirement relating to delegations of functions was adopted. It is however to be noted that the ultimate responsibility rests with the Government concerned. As with most countries with India also a number of classification societies are authorized to carry out some of the surveys and inspections on behalf of the Government of India. The report on these surveys are sent to nominated officers of the Government of India who issue the appropriate Convention Certificates to the ships. Only in the case of Load Line Surveys are the classification societies authorised to issue the certificates directly on behalf of the Government of India. In all cases of such authorization the classification societies are required to furnish the Director General of Shiplcing copies of approved plans, details of arrangements, detailed report on inspections, materials etc for scrutiny and record.

The first two SOLAS Conferences and the 1930 Load Line Conference were all convened by the Government of United Kingdom as the leading maritime country in the world. With the setting up of the IMCO (Inter Govecnmental Maritime Consullative Organization) under the U.N. all the work relating to international Maritime Safety have passed on to the organization. The 1960 and 74 SOLAS Conferences as well as the 66 L. L. Conferences were convened by the IMCO which has since been redesignated the international maritime organization. Convening of international conferences are time consuming and expensive. Consequently a procedure for rapid ammendment of technical requirements was adopted at the 1974 SOLAS conference. By this method if two thirds of the merrbers present and voting in the Maritime Safety Committees of IMO approve of any measure these are recommended to all countries for adoption. A number of subcommittees function under the Maritime safety committee. It is at these sub-committees that atl technical proposals and amendments are discussed and examined in detail. It has been the anxiety of many developing countries including India that this procedure could be used to impose on developing countries safety standards which they may find economically difficult to comply with. It is through these sub-committees and the Maritime Safety Committee that new requirements relating to developments in intact stability of cargo ships, sub-division of cargo ships, detailed requicements relating to construction and materials of Machinery, Boilers, pressure vessels, Electrical Equipment, structural fire protection and fire safety of all specialised vessels, Life Saving Appliances and Safety of Navigation etc are being brought out.

The IMCO/IMO have brought out a number of codes for adoption by number countries. These include:

1. Code for the construction and equipment of ships carrying dangerous chemicals in Bulk (1977).

2. Code for the construction and equipment for ships carrying liquified gases in bulk (1975).

3. Code for the construction and equipment for mobils off shore Drilling Units (1980).

There is one class of ships where international standards of safety had not reen prescribed by the above four Solas and two Load Line Conventions. This is in respect of fishing vessels. Because their operational requirement were very different these vessels were totally exempted from the various international conventions. However due to mounting pressure from international organizations such as ILO and F.A.O. an international conference on fishing vessels was held in Spain in 1978 which adopted safety standards relating to construction, stability, Hachinery and Electrical requirements, Fire Protection, Life Saving Appliances, Communications and Safety of Navigation of Fishing vessels. However a large number of countries have indicated their reservations regarding these and have not ratified the conventions.

Although not directly related to safety and intended primarily to protect the Marine Environment a convention on Marine pollution was adopted in 1973 dealing with oil pollution from tankers, cargo and passenger ships as well as pollution from Chemical Tankers. Since the requirements relating to chemical tankers were not acceptable to a large number of countries, the oil Pollution control requirements in a modified form was adopted for implementation by the international community through a protocol signed ir 1978. This has now been ratified by the minimum humber of countries and has become law.

FUTURE TRENDS

I had indicated earlier that the maritime safety committee through the various sub-committees was entrusted with the task of examining proposals for improving safety standards. Some of the subjects which the Maritime safety committee has under examination are:

1. Intact stability of ships of over 100 metres in length.

2. Sub-division of ships other than passenger ships.

3. Fire safty requirement for cargo ships, novel crafts and special purpose ships.

4. Construction, control and maintenance of main propulsion Machinery.

5. Safety requirements of un attended machinery spaces and remotely controlled installations.

6. Specific safety requirements for novel craft, special purpose ships and those carrying dangerous chemicals and liquified gases in bulk.

7. Amendment and bringing upto date the Dengerous Goods Code in such a manner as to facilitate through transport.

One way wonder why it takes so long to adopt technical standereds on safety internationally. To answer this shall I cite the instance of how purely technical institutions do not come to an understanding on basic matters due to their own compulsions. When the Association of classification societies was first formed one of their early attemps was to retionalize on the number of qualities of structural steel as each society had six or seven qualities for structural steel. After agreeing to three common qualities of steel each society insisted on expressing its reservation on the other steel qualities prescribed in their respective rules with the result that amongst them they had nearly 25 different steel qualities. If this is the situation amongst only half a dozen societies one can imagine the problem of getting acceptance of over 100 countries subjected to various kinds of political, economic and technological compulsions.

Admiral T B Bose Memorial Lecture

Shri A B Thakur

Development Adviser, Shipbuilding & Shiprepair, Government of India, Ministry of Surface Transport

The Theme of the Seminar-"Integrated Approach towards Shipping, Shipbuilding & Shiprepair" is a subject which is of vital importance for the development of the country's trade and economy.

Shipping is a servicing industry, a necessary adjunct of international trade. Shipbuilding and Shiprepair similarly is an essential servicing industry to the shipping which has tremendous impact on our national economy, particularly in the present context of the difficult balance of payment situation.

With the advancement of transport technology and means of communication, the world has come closer and the inter-dependence of nations has become more pronounced. International trade is a pre-requisite today for economic growth and welfare and is one of the decisive factors for stimulating industrialisation and growth of local markets for goods and services. As you are aware, the overwhelming majority by volume of the imports and exports of India are carried by sea, both on account of India's geographical location and the economics of transportation. In order to successfully encourage the international trade, India, therefore, needs access to means of transportation, specially shipping. Frcm Independence till about 1985, the Indian fleet expanded rapidly 28 times in a span of 38 years. At the end of the Sixth Five-Year Plan (31-3-1985), the Indian merchant fleet stood at 6.32 million GRT (10.42 million DWT). The growth of Indian tonnage during the Seventh Five-Year Plan was negative to the extent to around 6 million GRT (9.80 million DWT) at the end of March, 1990.

THE WORLD SEABORNE TRADE — A CHANGING SCENARIO:

During the last two decades, world's seaborne trade has undergone a sea-change. Developments during this period can be divided into two distinct phases which are separated by the energy crisis of 1973. In the first phase from 1965 to 1973, world seaborne trade in terms of tonne miles, grew rapidly at a compound growth rate of 12.98% per annum. World shipping tonnage also expanded to meet the growth in trade but growth in tonnage at a compound rate of 10.1% per annum lagged behind growth in seaborne cargo. The first phase was therefore characterised by few ships chasing too much cargo.

In the second phase from 1974 to 1986, world seaborne trade in tonne-miles, stagnated (world seaborne trade in 1986 was 16% less than the trade in 1974). Yet, despite the stagnation in trade, shipping tonnage (which was ordered in the early seventies prior to the oil crisis of 1973 in anticipation of a rapid growth in trade) continued to expand till about 1978 so that the world fleet in 1978, in te-rns of tonnage, was about 59% more than that in 1973. Hence in the second phase, world fleet expanded rapidly while seaborne trade stagnated resulting thereby in a huge gap between supply of and demand for tonnage. This in turn led to a substantial decline in ocean freight rates. The percentage growth in world seaborne trade during the period 1965-1986 are indicated in Annexure-I. The growth of world seaborne trade and the relative share of various countries including India are indicated in Annexures II & III respectively. India's seaborne trade (excluding Coastal Trade) between 1976 to 1986 are indicated in Annexure-IV.

FREIGHT RATES

An analysis of trends in freight market would indicate that the Shipping Industry is highly cyclical in nature. Graphical representation of the dry cargo time charter rates would reveal that from 1972 to 1974, the freight rates mounted steadily, and thereafter declined continuously for a period of 3 years, i.e. upto the end of 1977. From 1978 onwards, the freight rates again climbed steadily, reaching a peak by end 1980. However, from 1981 onwards, these rates declined sharply till end 1982, and the freight market has continued to be depressed till the end of 1987 (Annexure-V). However, recently the freight rates have shown some increase.

PROJECTION FOR THE FUTURE

The world shipping scenario has changed considerably during the last couple of years. The total gross registered tonnage of shipping which had peaked in 1982 to 42.47 million tonnes has declined thereafter and is presently around 403.4 million tonnes. The world seaborne cargo which had shown a steady decline since 1979 has gradually started picking up and the prospects of increased world trade are good. This would, therefore, result in increased demand for new tonnage in the coming years, as also increased freight rates. Both these factors confirm continued buoyancy for the world shipping scenario and for the Indian shipping industry.

Preliminary projections of overseas sea-borne cargo at the end of the 8th Plan seem to indicate an annual compound growth rate of 9% per annum over the 1986-87 figures. It is estimated that the total overseas sea-borne cargo would rise to 147.6 million tonnes as compared to 88.07 million tonnes in 1987-88.

The target for the next five years 1990-95 envisages gross addition of some 7 million DWT including replacement of 2 million DWT of old and obsolete vessels from the existing fleet so as to increase Indian tonnage to 14 million DWT by end March, 1995. The basic aim, therefore, is to consolidate the existing position of Indian shipping in the movement of our overseas cargo and move it up from the overall 40% so that the national shipping would emerge stronger by the end of the 1990s. Presently, Indian bottoms carry about 90 to 95 percent of India's overseas oil trade but in the carriage of dry bulk cargo, the share of Indian ships is about 45 percent in imports and 20 percent in exports. In the liner trade, it is extremely poor at barely 15 percent only. While it is envisaged that India's overseas trade will increase by 6% per year during the next five years, the objective for the 8th Plan is to develop Indian fleet adequately to maintain the share of Indian ships in the carriage of oil trade at the existing level, improve the dry bulk carriage to 50% and the liner carriage to 40%.

The estimated investment in terms of foreign exchange to acquire the necessary tonnage, as mentioned earlier, is likely to be Rs. 14000 crores. It is obvious that one of the most crucial problems that the shipping companies would have to face in their developmental endeavour during the next five to ten years is likely to be of financial nature. From the hard realities of the experience of the long period of recession, from which the industry has emerged, there appears to be no other alternative but to build up the strength of the financial base of the shipping companies to ensure their survival during adverse operating period of recessions, particularly in view of the capital intensive and cyclical nature of the industry.

As mentioned earlier, since October 1987, there has been a revival in the world shipping scenario. The second hand prices have nearly doubled or trebled during this period and the prices of new buildings has also increased considerably in recent years.

As a result of the price increase, many shipping companies have been reviewing their acquisition plans and have also temporarily deferred the acquisition of second hand vessels. This has been due to the fact that at the present high prices, the viability of the acquisition has been undergoing significant change. This may be seen from the fact that although the Ship Acquisition Licensing Committee had since May 1987 approved the acquisition of large number of vessels, Shipping Companies have acquired only 33 second hand vessels comprising 5,92,023 DWT.

The main causes for the rise in ship building prices are :-

i) The world ship building capacity has substantially decreased due to extensive rationalisation mainly in Japan and South Korea.

ii) It is to be noted that 66% of the world's ship building capacity is concentrated in Japan and South Korea. The appreciation of the Japanese Yen and the South Korean Won against the Dollar has also contributed to an increase in the New Ship Building prices.

iii) During the last 5 years, there has been a decline in the world tonnage due to extensive scrapping of vessels. It is estimated that 58 million DWT has been scrapped during this period, while the net addition has only been 54 million DWT.

While the sea-borne traffic and the present status with future projected requirement of Indian tonnage has been dwelt on so far, it is time that we turn around towards our two main servicing industries, namely, the shipbuilding and the shiprepair industry as to how far they could effectively meet the formidable challenge and its inherent opportunities.

Ship Building & Ship Repair Industry — Present status:

The Ship Building Industry could be broadly divided into three distinct sectors pertaining to our national demand:

i) Large ocean-going sector catering to overseas as well as coastal trade;

ii) Defence and Navy crafts; and

iii) Specialised vessels like port crafts, fishing trawlers, off-shore sector and other smaller crafts.

As of now, there are only two large Shipyards, namely, Hindustan Shipyard Limited. Visakhapatnam (HSL) and Cochin Shipyard Limited, Cochin (CSL), who are catering to the large ocean-going sector. In addition, there are two smaller yards in the Private Sector who are also constructing smaller coastal vessels for the coastal trade of the shipping companies. The installed capacity of HSL and CSL together at the end of 7th Five Year Plan (March 1990) is 2.8 lakh DWT per annum (HSL 1.39 lakh DWT and CSL 1.5 lakh DWT). However, the capacity utilisation vis-a-vis the installed capacity for the entire 7th Five Year Plan has remained at 49.18% only.

Some of the important constraints which' have substantially contributed in the shortfall vis-a-vis the envisaged target in the 7th Five Year Plan, are as follows:-

a) Lack of regular flow of adequate number of orders in time, resulting in intermittent idling of capacity at various shop floor levels and particularly in the steel processing/fabrication complex.

b) Reluctance on the part of Indian shipowners to place order during the period due to higher price of indigenous ships vis-a-vis the lowest international price and long construction period required by the Indian shipyards.

c) Lead time required for indigenous procurement of steel has been found to be between 10 to 14 months and that also not in matching sequence of production schedule.

d) Due to substantial gap in the cost of production of the Indian ships and realizable price (including Government subsidy) both the shipyards have been facing acute cash flow problem which in turn delayed timely acquisition and positioning of material and equipments.

e) The shipyards experienced enforced power cut during the period almost on regular basis.

The cumulative result of the above mentioned factors along with low out-put of the employees have resulted in the overall low productivity of the shipyards.

Pricing of ships built at Indian yards :

The pricing formula for ships built by Indian shipyards for overseas trading is laid down by the Government of India under the Pricing Formula presently in vogue:

i) The shipowners are required to pay to the shipyard a price which is 10% over and above the International Parity Price (IPP).

ii) The price is also subject to escalation to a maximum of 7% of the International Parity Price on account of statutory rises in prices of items such as steel and increasing wages due to wage revision, etc.

It may be mentioned at this stage that the Ship Building is by and large subsidized by the various national governments, overtly as well as covertly, as the price of ships continuously fluctuates between region to region and the international freight rates. During the unprecedented recession of the last one decade, the price of ships in the international market came to its all-time low and number of shipyards all over the world, particularly Far Eastern ones, resorted to dumping prices, whereby the total price of the ship was sometime found lesser than the material and equipment cost of such a ship.

The current pricing policy of large ocean-going ships built in Indian yards along with the associated sutsidy (30% of IPP) are linked with the IPP which in itself was the result of extensive subsidy by the individual national government. The indigenous shipyards during the period were confronted with a situation that their realisable price was far below the actual cost of ccnstruction in India. As a result the two Indian shipyards have incurred substantial loss, cumulatively which has run into few hundred crores. Most of the current orders which are under construction in the Indian yards were placed at a time when the International price was at its lowest. Though the ship's price has considerably appreciated during the past 3 years, benefit of the same cannot be occured by the Indian shipyards till such old orders are completed and delivered.

Shiprepair :

The existing shiprepair facilities in the country are inadequate to meet our total national demand. As of now. there are 3200 dry dock days available for commercial shiprepairs at 70% occupancy. As against the above requirement, the dry dock days required for the entire Indian fleet (including large ocean-going vessels) is about 4,500 dry dock days.

As can be seen from the informations furmished above that at its best, the indigenous shipbuilding capacitv for the large ocean-going sector can supply only about 15 to 20% of our national demand for the next five years (1990-1995). Even, such limited capacities are not being fully utilised due to the constraints mentioned earlier in this Paper.

Similarly, a huge amount of foreign exchange expenditure (about Rs. 100 crores) are being incurred every year towards repair of Indian ships engaged in the foreign trade. With our precarious balance of payment position, it is about time that serious integrated approach towards the basic requirement of optimum utilisation of the installed shipbuilding capacity and further augmentation of shipbuilding and shiprepair facilities be considered on priority basis.

Anomalies and conflicting nature of the situation :

After going through the present status of all the three sectors viz. shipping, shipbuilding and shiprepair, their future prospect and the constraints for meaningful and positive contribution to the national economy, we are confronted with an apparently anomalous and conflicting situation as follows :-

i) The country needs a sizeable shipping fleet to promote the country's interest in international trade and earning/saving of foreign exchange of a very high magnitude.

ii) To acquire such a sizeable fleet, investment in foreign exchange is of a very high order and a'most impossible considering the criticality of the balance of payment position of the country.

iii) While there exist a substantial market, the available indigenous capacity can cater to about 15 to 20% of our total requirement. With the industrial infrastructure already developed and the technical know-how and skill acquired, it should be possible to build a sizeable number of ships required by the Indian shipping industry within the country.

However, the past experience and the financial loss incurred by the existing shipyards in India raises certain basic issues linked with the future of shipbuilding industry in Inda.

Some of these issues are as follows:-

a) Whether it is really wise to expand the indigenous shipbuilding industry on a subsidised basis when our requirements can be met from foreign shipyards.

b) Even if the answer to the above question is in the affirm ative, whether the matter is sufficiently important for the country to mobilise initial capital investment considering the overall national priority.

c) Whether the economy will be able to generate funds to the extent of subsidization that may be required per annum to absorb the output of these shipyards.

Practically all maritime nations build ships atleast of a sizeable portion of their own national requirement. Though, the prolonged recession has taken its toll on the shipbuilding industry resulting in a substantial cut-back in the shipbuilding capacity of the world recent EEC Maritime Industries Policy Study completed in 1988 stress the need for encouraging the shipbuilding industry of the EECcountries with number of protective measures.

The real answer to the universal subsidisation or this industry perhaps lies in the very high multiplier factor of the shipbuilding industry. It is a wholly assembly industry, and it operates at three to four removes from the primary producer. Therefore, when a shipyard produces a vessel worth Rs. 30 crores. it generates economic activity to the extent of 90 to 120 crores of rupees.

Secondly, it is one of the most labour intensive industry till date. For every worker employed by a shipyard, at least two more workers are employed in the manufacture of boughtitems and ancillaries required by the shipyard. Till today, one of the most pertinent criticism of our approach to industrialisation has been that whereas India needs labour intensive technology, it is all the time importing capital intensive technology from the West.

The payment of subsidy to shipyards may dampen one's enthusiasm and raise many a eye-brows for ship-building to a large extent. But is it really a very rare phenomenon? Leaving apart the extent of subsidy given to this industry internationally, a large range of industrial products manufactured in this country have higher production costs than their imported counter-parts. Judged on the basis of the cost of production alone, there is hardly any case for the manufacture on non-ferrous metals, diesel engines, automobiles, air-craft, cargo handling equipments, conveyor, belting, heavy engineeri ng and heavy electrical plants and consumables.

Perhaps, the main reason as to why subsidy to shipyards sticks out so prominently is that whereas other subsidies are most hidden, this one stands out wholly above the surface. For instance, the cost of indigenously producted flame retardant electrical cable is nearly 400% more than that of imported cable. There are numerous examples where the indigenous cost will vary between 100 to 200% or more of the imported cost of the similar industrial products of imported origin. In other words, the extra cost is met from public funds. Call it what one way, it is a form of hidden subsidy for import substitution. But it does not hit the public eye. On the other hand, if only 30% of the cost of a ship (not the international price) is subsidised by the Government this gives rise to immediate resentment.

Before proceeding further on this theme, I would like to stress that the Author under no circumstances is inclined to suggest that the Indian shipping companies should purchase an indigenously built ship on cost of production basis. It must be appreciated that the Indian shipping companies have to operate on a highly competitive international freight market. If we saddle our shipping companies to purchase ships at a premium vis-a-vis the eventual outgo in terms of purchase of ships in the international market, we will only be killing the hen which lays the golden egg. After all if the viability of the shipping companies become doubtful, the shipbuilding or shiprepair industry which is directly linked with the fortune of the shipping companies will be totally doomed. Hence the necessity of an integrated approach to ensure that all the three sectors survive at an optimum level.

The subject and its spectrum is vastly complex. Issues like mode of financing, cargo support, tax relief, technology upgradation for improvement of productivity, ready access to inputs at the international price, planning, scheduling and quality assurance of production are subjects each of which could be subject for an exhaustive paper in itself. In any way, it is an impossible job to give a blue-print of an integrated approach on such complex matters in course of a Memorial Lecture in a National Convention.

Keeping the above in view, the broad areas/issues which calls for in-depth examination and evaluation at the national level are enumerated below :-

1. Financing of Ship Acquisition:

As mentioned in the Paper, if the Indian tonnage as envisaged to be acquired during the next five years are to be adhered to, the fund requirement in terms of foreign exchange will be to the tune of Rs. 14,000 crores. Even if the total amount need not be disbursed during the next five years, the minimum fund requirement considering suppliers credit etc. and including the previous liabilities and Seventh Plan spill-overs may come to the tune of about Rs. 8,500 crores. Takng into account the improved freight market, it may be possible for the Indian shipping industry to mobilize more than Rs. 2,500 crores from their own internal resources. The balance requirement of about Rs. 6,000 crores, therefore, has to be met from external sources like equity capital, shipyards credit, commercial loans and commercial borrowings. Considering our balance of payment position, it may be difficult to place order for acquisition of new ships from abroad. In view of the above, it is suggested that the acquisition process may be divided into following categories:-

a) Ships that may be built and delivered within the next seven years by the two Indian Shipyards should be ordered on the Indian Shipyards only.

b) Acquisition/leasing of second hand ships should be given the next top priority. Since for availing the tax benefits, it may be necessary to register such ships in the country of the lessor. This may require certain structural change in the Indian Merchant Shipping Act for considering such ships as a part of the national fleet.

c) Ships which are of high technology and beyond the capacity of the Indian Shipyards to build, should be acquired new from the roreign shipyards.

As the shipping industry normally acquire such ships under yard credit or foreign exchanqe borrowings, the shipping companies carry large foreign exchange loans on their book and is exposed to the risk of foreign exchange fluctuation to a much greater extent that non-shipping companies. It is, therefore, necessary to examine ways and means of minimising such exposer.

d) While necessary steps for strengthening the capital base of the shipping companies (both public as well as private shipping companies) are to be initiated on urgent basis, pending completion of such exercise which generally is likely to take a longer time-frame, the policy of providing back up loans requires to be continued.

2. Cargo Support:

As a first step towards cargo support, the Government owned agencies require to adopt a general policy to buy on FOB basis and sell on CIF basis. This requires a coordinated approach between the various agencies of the Government and Ministry of Commerce appears to be instrumental in formulation of such a policy.

As regards import of Government controlled dry bulk cargo, the present policy of giving preference to Indian ships should be further expanded and more and more import cargo should be brought within the ambit of transchart.

3. Share of Private Shipping Companies in Indian Tonnage:

With the prevailing resource constraint, share of the Indian tonnage for the private shipping companies requires further expansion. However, the efforts should be made to grant such further expansion to the financially sound and proven professionally managed companies instead of prolifirating acquisition of such tonnage through one or two ships-shipping companies.

4. Fiscal Incentives for the Indian Shipping Industry:

Provision of fiscal and other incentives to the national shipping companies is not a phenomenon only related to the developing countries. Several developed countries including United States of America subsidised its shipping and shipbuilding industry. Such fiscal incentives/support provided inter-alia includesi)

i) Ship operating and construction subsides.

ii) Tax holidays/tax in: entives and tax reliefs.

iii) Accelerated depreciation and free depreciation.

Since it will be imperative for the shipping companies to have stronger capital base (equity plus reserves), it is necessary to consider some of the following measures which will go a long way to strengthen the capital base of the shipping companies :-

a) Exclusion of shipping companies from the ambit of Section 115J of Indian Income Tax Act.

One of the peculiar provisions of Section 115 J is that for computing income for tax purposes, previous year's losses, investment allowance and unabsorbed depreciation determined as per income tax assessment cannot be set off. Considering the cyclical nature of the shipping industry and its inherently low profitability, the provision of Section 115J would erode the ability of even the few profit making companies to generate funds for expansion and modernisation. To that extent, it is essential that the scope of Section 115J be modified to exclude shipping companies from its ambit.

b) Modifications to Section 80 CC and Section 80 RRA of the Indian Income Tax Act.

Section 80 CC of the Indian Income Tax provides incentives to investors, in shares of initial issues in those companies involved in construction, mmufacturinq and production of certain items. Shipping being a service industry is excluded from the benefit under this Section. As there is a need towards developing a stronger capital base for shipping companies for which they would be required to raise equity capital from the market, shipping industry should be made eligible for this benefit and the scope of this Section should be widen to include existing companies also.

So far, the Author has primarily dealt with additional benefits and incentives etc. that should be given to a shipping company which will go a long way to improve its capital base which is the prime objective at the moment.

However, without denying the fact that the shipping industry is a net earner of foreign exchange, it is necessary that some part of such additional incentives and measures should also percolate down to the Shipbuilding and Shiprepair Industry for the overall benefit of the national economy. The net foreign exchange earner nomenclature to a great extent is also applicable for the Shipbuilding and the Shiprepair lndustrv in general. In the strict sense instead of calling it 'earner', it helps to save foreign exchange by necessary imports substitutions. Keeping the above in view, it is necessary to further examine and evaluate the following measures vis-a-vis the Shipbuilding and Shiprepair Industry to make it viable and attractive for the Indian Shipowners :-

i) Development of design an associated research & development sbould be funded by the Govt. for all the Shipyards in the country:

One of the main constraints leading to inadequately long lead time required by the Indian Shipyards for construction of ships is absence of proven and well developed design and drawings. The Government has recently taken a very right step in this direction by establishing National Ship Design & Research Centre (NSDRC) in Visakhapatnam which is expected to be fully operational by early 1993.

ii) Inputs for shipbuilding (Material & Equipments) should ba available to the Industry at international price since the end price of the product is linked to international price.

Since Shipbuilding is basically an assembly industry where 50 to 55 percent of the costs are bought out items, it is necessary that the shipbuilding industry is allowed to import 50% of the value of the ship at International price by allowinq duty free import under OGL.

iii) Subsidy should be linked to cost of production instead of IPP.

Currently, the subsidy given by the Government is linked with International Parity Price (IPP). The evaluation of IPP is not based on a scientific base and these are primarily based on certain unsound assumptions by the international ship valuers. These are primarily subjective valuation which under certain circumstances could be influenced by extenuous factors. In view of the above, the Government and shipping companies' subsidy should be based on the actual cost of construction of the Indian Shipyards.

Further Incentives

The Government recently has allowed the shipping companies to place order on Indian Shipyards without any requirement of licensing and such tonnages could be on and above the prescribed tonnage requirement approved by the Government. While this has been a right step in the right direction, it is necessary to consider further incentives to encourage the shipowners to place more and more orders on indigenous shipyards.

i) Ships built in the Indian Yards should not attract any customs duty while consigned to ship-breaking yards:

At present, such dues are levied proportionately on the basis of imported equipments etc. which have been installed in the indigenously built ships initially at the time of construction.

ii) Section 80 HHC should be suitably amended:

Section 80 HHC provided certain tax relief to Indian exporters based on the FOB value of exports. This deduction may be permitted on CIF base on the condition that the exporter uses Indian flag ships built in the Indian yard. This in one hand would help the Indian shipping companies in increasing their share in the movement of export cargo and place order on the Indian Shipyards, if, in addition, the shipping companies are granted the same benefits which me available to the manufacturing companies under 80 HHC.

iii) 100% EOU status for Shipbuilding Industry:

Government has recently recognised the ship-repair industry at par with 100% Export Oriented Units (EOUs). Since the Shipyards catering to the large ocean-going sector are basically saving the foreign exchange outgo, the shipbuilding industry may be given the same status and benefits as have been already bestowed to the shiprepair industry by the Government.

iv) Extent of subsidy:

After strengthening the capital base of the existing two Shipyard with the upward trend in the international price of ships and some of the measures suggested above, it should be possible for the indian Shipyards to work viably. As regards current pricing policy, under the present circumstances this has to be continued at least the existing level, till the capital base of the existing shipyards are strengthened. However, a mechanism required to be developed, where quick decision could be taken on case to case basis so that the required adjustment in the level of subsidy could be done by having the overall objective of eventual viability of the industry.

v) Shipbuilding to be taken out of Schedule A of the Industrial Policy for all sizes of ships and the entire industry should be delicensed :

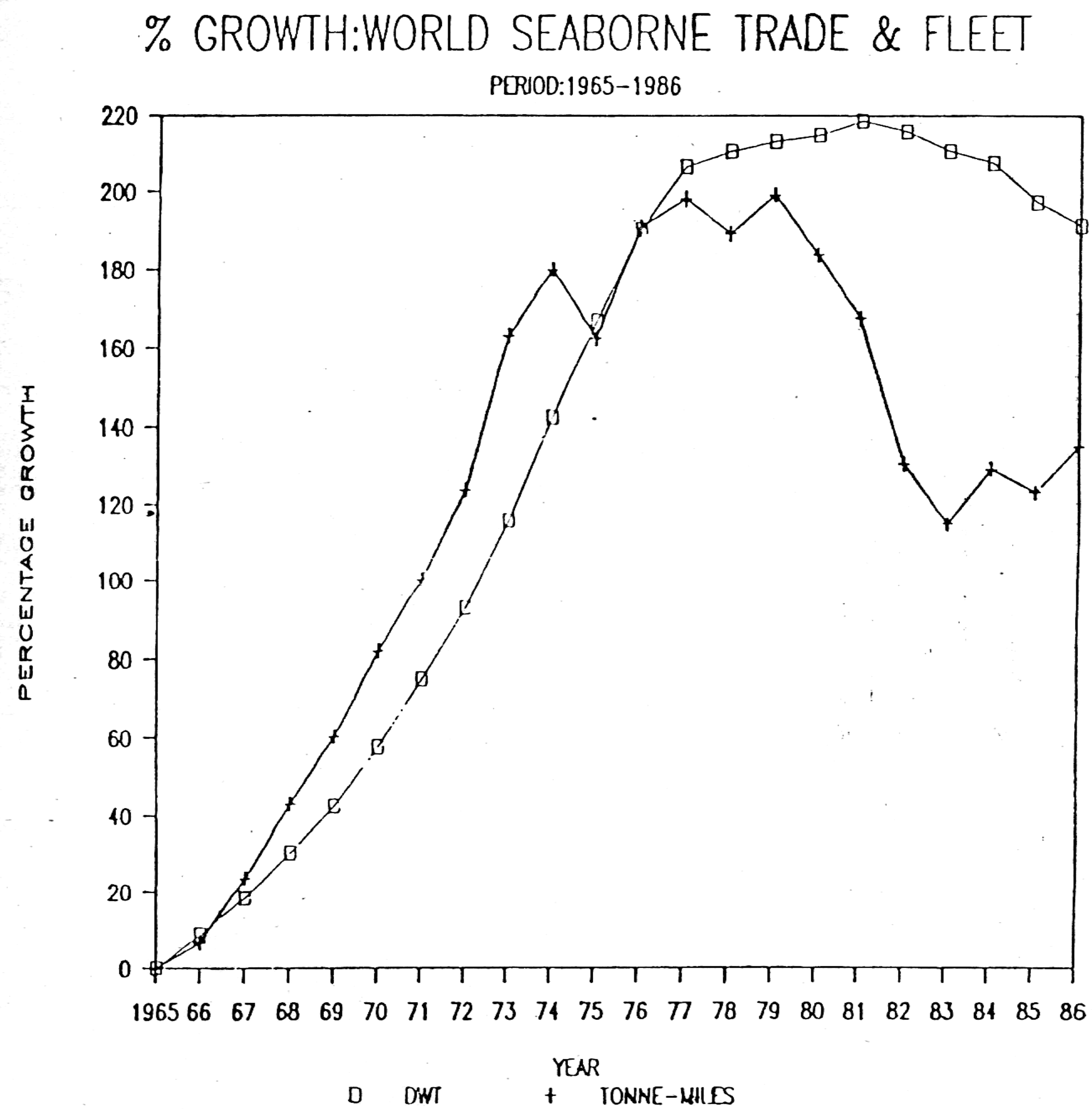
In the context of the large demand, it is also desirable that further augmentation of the ship-building capacity is initiated in the country. While doing so as a first step towards liberalisation. the entire shipbuilding industry should be de-licensed and the private sector should be allowed to create such facilities without any limitation of size.

vi) Shiprepair Industry should be allotted land and water space for creation of new shiprepair facilities at the important Major Ports at concessional rates.

vii) Shiprepair Industry may be given tax benefit by suitably modifying Section 115J, 80CC & 80HHC of Income Tax Act, in same line as suggested for shipping coso

viii) The present system of Quarterly scheduling of ships for repair in the Indian Dry Docks should be further strengthened to ensure that ships once slotted for such repair do not avoid repairing the same under pretext or other.

ANNEXURE—I


% GROWTH:WORLD SEABORNE TRADE & FLEET
PERIOD:1965-1986
PERCENTAGE GROWTH
220
200
180
160
140
120
100
80
60
40
20
0
1965 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86
YEAR
D DWT
+ TONNE-MILES

ANNEXURE—II

GROWTH OF WORLD SEABORNE TRADE 1974-86 *

(Figures in million tonnes)

YEAR	CRUDE OIL	OIL PRODUCTS	IRON ORE	COAL	GRAIN	OTHER CARGO ESTIMATE	TOTAL TRADE ESTIMATE	** INDIAN TRADE ESTIMATE
1974	1361	264	329	119	130	1045	3248	63
1975	1263	233	292	127	137	995	3047	63
1976	1410	260	294	127	146	1075	3312	66
1977	1451	273	276	132	147	1120	3399	59
1978	1432	270	278	127	169	1190	3466	64
1979	1497	279	327	159	182	1270	3714	71
1980	1320	,27	314	188	198	1310	3606	95
1981	1170	267	303	210	206	1305	3461	78
1982	993	285	273	208	200	1240	3199	78
1983	930	282	257	197	199	1225	3090	76
1984	930	297	306	232	207	1320	3292	82
1985	871	288	321	272	181	1360	3293	86
1986 Est	940	310	304	268	160	1380	3362	87

* Source: Fearnley's Review 1985 & 1986

** Source - D.G. Shipping.

ANNEXURE—III

GROWTH OF WORLD TRADE BY
COUNTRY GROUPINGS *

(in billion US dollars)

	1950		1960		1970		1975		1980		1983	
	Trade	% of world	Trade	% of world	Trade	% of world	Trade	% of world	Trade	% of world	Trade	% of world
Developed market economies	37.1	61.1	85.7	66.3	225.1	71.4	578.3	65.9	1262.4	62.8	1157.8	64.0
Developing countries & territories	18.7	30.8	27.8	21.5	56.5	17.9	212.7	24.2	570.2	28.4	451.1	24.9
Socialist countries East Europe	4.1	6.8	13.0	10.1	31.0	9.8	78.3	8.9	156.5	7.8	177.0	9.8
Socialist countries Asia	0.8	1.3	2.7	2.1	2.7	0.9	8.2	0.9	20.4	1.0	24.0	1.3
World	60.7	100	129.2	100	315.3	100	877.5	100	2009.5	100	1809.9	100

* Source "Handbook of International Trade and Development Statistics - 1985 Supplement" published by United Nations Conference on Trade and Development.

ANNEXURE—IV

INDIA'S SEABORNE TRADE (EXCLUDING COASTAL TRADE)

BETWEEN 1976-77 & 1984-85 *

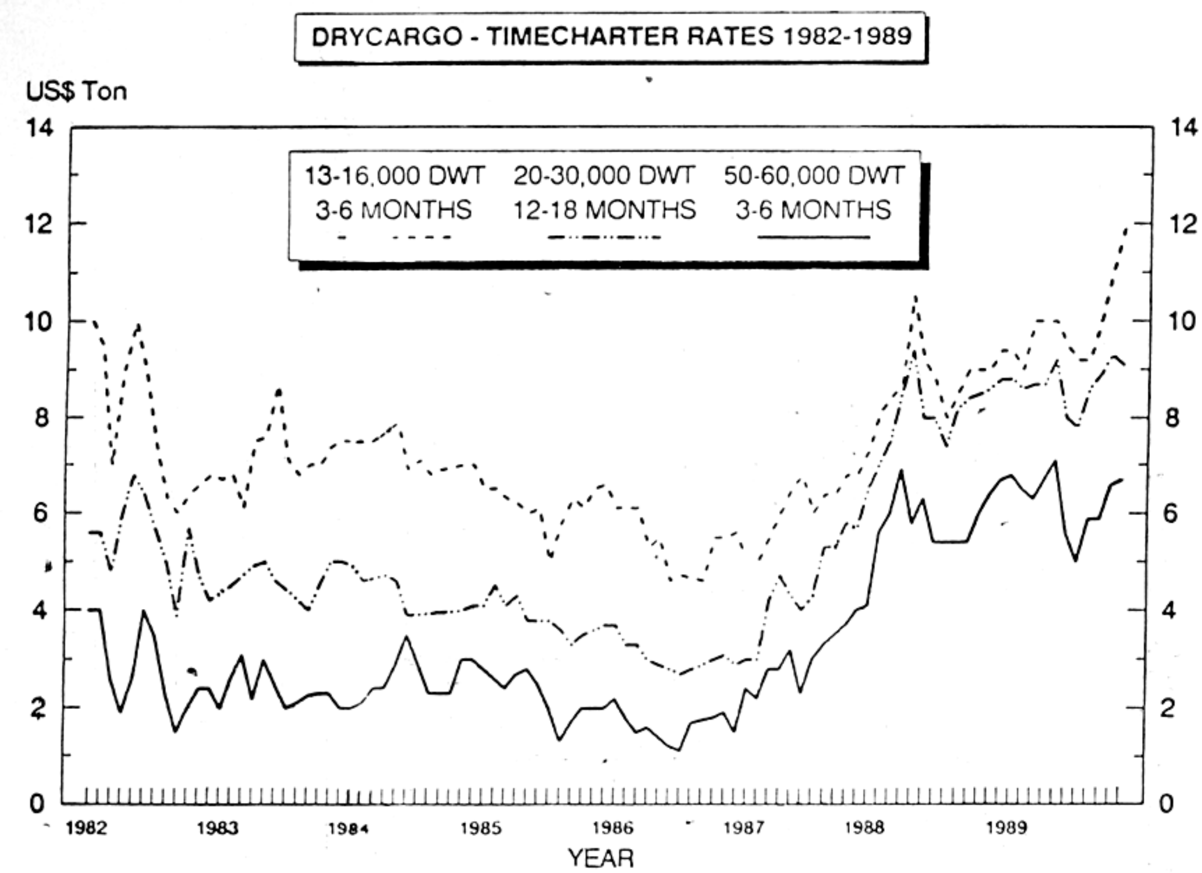
(Figures in million tonnes)

YEAR	GENERAL CARGO			BULK CARGO @			CRUDE OIL & PETROLEUM PRODUCT			TOTAL CARGO MOVED		
	EXPORT	IMPORT	TOTAL	EXPORT	IMPORT	TOTAL	EXPORT	IMPORT	TOTAL	EXPORT	IMPORT	TOTAL
1976-77	6.71	2.92	9.63	25.70	9.90	35.60	0.10	16.60	16.70	32.51	29.42	61.93
1977-78	6.59	2.45	9.04	24.10	6.08	30.18	0.10	17.40	17.50	30.79	25.93	56.72
1978-79	5.57	4.43	10.00	22.59	6.52	29.11	0.10	18.60	18.70	28.26	29.55	57.81
1979-80	5.98	5.60	11.58	26.51	6.71	33.22	0.10	20.80	20.90	32.59	33.11	65.70
1980-81	5.01	5.91	10.92	23.76	8.26	32.02	neg	23.50	23.50	28.77	37.67	66.44
1981-82	4.85	7.19	12.04	25.10	5.91	31.01	0.90	20.20	21.10	30.85	33.30	64.15
1982-83	4.28	6.15	10.43	24.03	5.35	29.38	5.30	21.90	27.20	33.61	33.40	67.01
1983-84	5.80	5.71	11.51	23.52	8.14	31.66	7.00	20.30	27.30	35.32	34.15	70.47
1984-85	4.96	7.00	11.96	27.20	7.90	35.10	7.40	19.80	27.20	39.56	34.70	74.26
1985-86 (provisional)	4.39	9.34	13.73	28.81	9.67	38.48	2.50	19.00	21.50	35.70	38.01	73.71

* Source: (1) Directorate General of Commercial Intelligence & Statistics (DGCI&S)
(2) Indian National Shipowners Association (INSA)

@ Including edible oil but excluding crude oil and petroleum products.

ANNEXURE—V



DRYCARGO - TIMECHARTER RATES 1982-1989
US$ Ton
13-16,000 DWT
3-6 MONTHS
20-30,000 DWT
12-18 MONTHS
50-60,000 DWT
3-6 MONTHS
0
2
4
6
8
10
12
14
1982
1983
1984
1985
1986
1987
1988
1989
YEAR

Delivered during the Seventh National Conventions of Marine Engineers on 'Energy Conservation in Marine and Allied Industry' organized by Visakhapatnam Local Centre, February 26-27, 1993

Conserve the Non-Renewables and Convert the Renewables

Dr L R Chary

The Shipping Corporation of India Ltd., Madras.

ABSTRACT

Our country imports oil to cater to the ever increasing needs of all our industries including the marine industry. Conserving energy, in.this case, oil, would mean conservation of not only the limited natural resources but also ccnseruation of precious foreign uchange. While this is a must under the present circumstances, as a complementary measure, large scale conversion of renewable energy resources is necessary. Such an effort wquld not only enabLeus to meet the growing demand for power but also reduce pollution olthe environment. This paper suggests a feasible idea for harnessing energy (rom wind, wave and ocean currents for generating electricity out at sea. It also discussf!8 certain design features and criteria for setting up offshore power stations. The paper winds up with a proposal for a 3MW offshore power station.

1.0 Introduction:

The present power generation capacity of our country is about 69,000 MW. Our annual per capita consumption of power is 250 KWH (this figure dips down to a mere 30 KWH in the rural areas) as against 10,000 KWH which is the per capita power consumption in advanced countries. To attain this figure in our country wouldmean a forty fold increase in our present generating capacity which is well high impossible not only because of the huge investment involved but also because of our meagre natural resources which are dwindling rapidly. For example, the per capita availability of coal in the erstwhile USSR, USA, China and India is 20,060, 13,488, 1,668 and 176 tonnes respectively.

Similar figures in tonnes for oil are 30.3, 16.0, 2.3 and 0.78 respectively. Therefore to reach the per capita consumption figure of 10,000 KWH appears to be beyond the-realm of reality. To compound matters, any further increase in the use of nonrenewable sources of energy like coal and oil will only give rise to more environmental pollution and the establishment of huge hydel projects will result in ecologicalimbalance and environmental degradation; both of which are considered taboo particularly after the recently concluded Earth Summit in Rio. This, however, does not mean that all energy dependent development should come to a grinding halt. On the contrary this means that besides adopting strategies to conserve energy, and to increase the efficiency in both generation and utilization of same, vigorous efforts must be made to design and develop systems to harness non-conventional energy resources which are inexhaustible in nature. This, besides being an environmentally friendly way of generating electricity, also holds tremendous potential. As per current estimates about 40,000 MW of power can be generated from wind, about 50,000 MW from wave, currents and tides and about 50,000 MW from ocean thermal energy conversion (OTEC) all of which indicate a very favourable environment. While efforts to this end are on in our country, all such efforts are concentrated on designing systems which are land based. This paper suggests a feasible idea for harnessing energy from wind, wave and surface currents for generating electricity out at sea and keeping in view the peculiar marine environment, discusses certain design features and criteria for setting up an offshore power house. The paper also puts forward a proposal for a three megawatt integrated offshore power station for harnessing wind, wave, current and solar energies at sea.

2.0 Justification for harnessing non-conventional energy resources:

It is a fact that India's coal and oil resources are minuscule when compared with those of U.S.A, erstwhile USSR or China. One may consider this as a blessing in disguise considering the damage the burningof fossil fuels can cause to the environment. On the other hand India is fortunate to have a large coastline of about 6,000 Km. making available plently of wave and, surface current energies and is also happily placed as far as solar energy is concerned, with almost 300 days of bright sunshine available in a year. It is therefore imperative that these inexhaustible non-polluting sources of energy be fully exploited for generating electricity. As of date, about 40 MW of solar energy and 38 MWof wind energy have been usetuny converted into electricity. There is a vast potential of the order of 80,000 MWor more ofwind, wave and surface current energies that remain to be tapped. In the following paragraphs methods to exploit these resources have been discussed.

3.0 Wind energy:

In our country, considerable amount of progress has been made in the installation of wind power generators and setting up of wind energy farms. Installations totalling up to a capacity of 38.31 MW have already been completed and 24.47 MWcapacity is under installation. All these installations, however, have beencarried out on land. As the method of generating electrical power from wind energy using windmills is a very well proven and popularly used. technique and has also been widely reported and well documented further elaboration on this subject is not necessary here.

4.0 Wave energy:

For generating electrical power from wave energy three basic methods have been reported. One of these is the method employed in the Vizhinjam project which uses a Well's air turblno-generator combination mounted ontop of a concrete caisson which acts, as the breakwater. Fig 1 shows a schematic arrangement of this system. In this scheme the energy present in the waves gets imparted to a column of air inside the caisson. This air drives the Well's turbine which in turn drives an induction generator to generate power. Based on this principle an experimental wave energy plant generating about 150 KW has been installed in Vizhinjam near Thiruvananthapuram.

The second system proposed for generating clean electrical power is a wave energy system which is based on air turbines actuated by air movement continuously generated by the oscillating movement of flexible membrane. This membrane, oscillating under wave action, produces in the space between the flexible membrane and solid hull a constant air movement which drives the Well's turbine. The turbine is used to drive the generator for generation of power.

The third method is the one in which a plunger type reciprocating mechanism moves inside a moon pool when activated by the waves. The reciprocating motion is converted into a rotary motion and through a system of gears drives the generator for generating power. Fig.2 shows an arrangement of the plunger type wave-energy generator.

Excepting for the flexible membrane used in the second method, the first and the second methods of generating electricity from wave energy are similar. The second method could become the choice where a total isolation of water from the column of air that drives the turbine is desirable. Both these methods have been used to successfully demonstrate the possibility ofgenerating power from wave energy.

The third method, though equally simple as to the first two, is yet to be tried out in practice, The final choice of a, method will, however, depend upon the simplicity, cost and ease of'maintenance of the system at an offshore location as also the significant wave height at the site.

5.0 Energy from ocean currents:

Ocean thermal energy conversion (OTEC) plants have been experimented with successfully and power generating stations using this principle of energy conversion have been installed in some places in the world. In India there is a proposal to set up a 100 MW (OTEC) plant in the sea 40 kilometres off Kulasekharapattinam near Tiruchendur in Tamil Nadu. However, tapping the kinetic energy present in the ocean caused by the ocean currents, has not been attempted so far. Abrief description of this idea of converting the kinetic energy present in ocean currents into electrical energy is explained below:

It is an established fact that ocean currents exist and that they tend to be stronger near the coastline, at times, attaining speeds ofthe order of6 to 7 knots and extending up to a depth of about 30 metres beyond which the water largely tends to appear as static mass. As per the experience of ships' masters, the effect of surface currents tends to taper off to almost negligible value as one moves away from the shoreline.

While mariners have been putting to practical use their knowledge of ocean currents for the safety and economic operations of their ships, there has apparently been no effort so far to tap the tremendous amount of kinetic energy manifest in the ocean currents and to use it, for the purpose of power generation. It can be easily seen, that, due to the density of water which is higher than air, it is possible to generate the same quantity of power from 3 knots current as from 20 knots wind.

6.0 Methods for tapping energy from currents :

Energy for power generation can be tapped from the currents either by using a device which works on the principle of a horizontal axis current meter or by using a suitable slow speed turbine.

The system using the current meter principle consists ofa propeller mounted at the end of a horizontal shaft. The other end oftne shaft is coupled, through a system of gears, to a submersible generator with a fly wheel arrangement.

The enclosure protection with regard to intrusion of particles and water for the entire assembly should be such that the generator and other components will be dust tight and will be protected against submersion up to depths ranging from 10 m to 20 m. According to an estimate a propeller with a diameter of 5 metres can help generate about 150 KW of power. As an alternative, a slow speed turbine coupled with a generator, can be used to generate power from ocean currents.

Fig. 3 shows a system deployed for the conversion of surface current energy into electricity. The arrangement mainly consists of a submersible generator driven by a propeller through a suitable shafting and gearing arrangement. This assembly can either be a stand alone unit as depicted in Fig.3 or can be mounted on a bracket which is fixed under water to one of the legs of the platform at depths ranging from 10 to 20 metres. Adequate care should be taken to locate the braket and deploy the propeller-generator assembly in such a a way that uniform laminar flow of water past the blades of the propeller is always ensured.

As the mass ofwater flows past the propeller, the blades ofthe propeller rotate the shafting; The gear box steps up the rpm to a suitable speed to match the speed of rotation of the generator.

This method of generating power from current can also be very effectively carried out on rivers and at·estuaries where the speeds of currents are appreciably higher than the speed of sea currents. An integrated offshore power plant which combines the design and installation of wind energy, wave energy and surface current energy generators on a single platform is shown in Fig. 4.

7.0 Design. considerations:

It is a fact that the design and working principles of all machinery or systems, be it for onshore or offshore installation, are the same. However, certain design considerations, par ticularly those that are peculiar to the offshore environment, must be kept in view while designing an offshore power station. Some of these considerations are enumerated in the, following paragraphs:

7.1 Environmental Factors:

It is desirable to install equipment and systems that are designed to operate satisfactorily under the following environmental conditions:

1. Ambient Temperature	:	45°C
2. Relative Humidity	:	85% (Min)
3. Wind Speed	:	100 knots
4. Precipitation	:	2.5cm/hour
5. Current	:	8 knots

6. Vibration velocity amplitude of 20 mm/sec. in the vibration frequency range of 5-50 Hz.

7. Peak acceleration 0.6 g to l g with duration 5-10 sec.

8. Enclosure: The type of enclosure provided for the protection of equipment should be irrrelation to the location ofthe equipment. For, example, equipment intended to be located on open platform should atleast have an enclosure type IP 56. and equipment required to be installed under water should have an enclosure type IP 68. Shipboard practice could be used as guide-lines for choosing the type of enclosure for equipment to.be installed at other locations.

7.2. Structural Design Factors :

The structural design considerations for the offshore power stations should, largely be in line with those for normal oil production jacket platforms. The regulations, design codes, and construction materials, and design loads are now well documented and available. They can be as per API, who are the pioneers in the field or, as per DNV, ABS, and Lloyds. In India, over 200 such platforms have been constructed and the design, construction and installation techniques are well known. The design considerations normally include:

1. Self weight and working loads of the equipment on the deck.

2. Environmental loads, like wind under steady and gust conditions, waves and precipitation.

3. Accidental loads; like the seismic load.

4. Transportation and Installation loads.

5. Dynamic and fatigue loads.

For the offshore power station under consideration, the loads and moments due to the wind mill structure on top, and the underwater current turbine structure, and the uplift forces due to the wave energy convertor, along with the equipment and housings on top of the deck, should be carefully considered to arrive at the total load.

Since the structure is intended to be within 30m depth of water steel appears to be the likely choice of material. However, with the wave energy module, bottom side concrete structure may be considered. Keeping in view the flow of currents and the likely interferences, special care needs to be taken in the design of under water structures.

7.3 Electrical Design Factors:

As regards the electrical design, the main factors to be considered, are the choice of the type of generators and the connectivity of the generators to the State/National power grids.

Keeping in view the fact that the offshore power station is eventually required to be conneeted to the state power grid, the electrical parameters specified by the electricity Boards are required to be met by these installations.

A typical set of electrical parameters is given below :

1. Voltage variation	:	400± 13%
2. Frequency variation	:	- 50 Hz ± 2 Hz
3. Voltage and current asymmetry	:	12.5%
4. Power Factor	:	Above 0.8 lag
5. Starting current	:	$\ngtr$Full load current

Giventhe above specification and the fact that in the he case of power generation from wind,wave and currents, the speed of the generator is subject to wide variations, the 'automatic choice between the synchroncue generator and the induction generator would be the latter because of its superior characteristics which are elaborated in the following paragraphs.

7.4 Characteristic of induction generators :

An induction generator which is also referredto as asynchronous generator is nothing but an induction motor functioning as a generator. It differs from the ordinary synchronous generator in the following respects

1. It has no direct current excitation.

2. It will only, generate when its stator is connected to a grid of fixed frequency, its exciting current being the wattles magnetizing current drawn from the gird. This current produces a rotating magnetic field, and there is no difference between the conventional rotating magnetic field produced by a polyphase alternating current (AC) and the one produced by a direct current (DC) excited system which is itself driven at synchronous speed.

3. The frequency of the magnetising current fixesthe frequency of the A.C. supplied by the induction generator. Thus the frequency is not affected by the speed at which the induction generator is driven. However, there must be at least one synchronous generator connected to the system in order to fiX the frequency.

4. No synchronising is required since the machine cannot generate any e.m.f until it is connected to the grid.

5. The induction generator always delivers leading current only (the power factor is loading) whereas most commercial loads require lagging current (lagging power factor).

6. The distinct advantage of the induction generator lies in the fact that it does not hunt or drop out of synchronism; it is simple and rugged, and when short circuited it delivers little or no' sustained power, because its excitation quickly' becomes zero.

From the above it can be noticed that an induction generator appears to be the ideal choice for power generation with wind or wave or current energy as the prime mover, particularly because the prime mover need not be governed. However, it must be appreciated that because of its ability to supply power with a leading power factor only, it is absolutely necessary to connect the induction generator to a grid so that the grid supplies the entire lawng quadrature current which is equal to the numerical sum of the magnetizing current , of the induction generator and the lagging quadrature current of the load connected to the induction generator. It may be noted that the grid in this case supplies no power. Fig.5 shows a typical grid connection of an integrated offshore power station which generates power from wind, wave and current energies.

7.5 Induction Generator for stand alone Power Station:

In case there is a need for a stand alone offshore power station due to non-availability of power grid in the vicinity for connection, then the magnetization of the induction generator can be provided by a capacitor bank. However, the frequency and generated voltage in this case are affected by the speed of the prime mover, load and the capacitor rating. Further, if the load connected to the power station is inductive, its magnetic energy circulation is taken care of by the capacitor, as the induction generator per se, is incapable of doing so.

As an alternative to the above, the following scheme could be adopted in the design of a stand alone offshore power station: One of the generators used, preferably the one driven by the energy drawn from surface currentsi could be a DC generator. The DC power delivered by this generator can then be converted into AC power using a static inverter. This AC power can be used to supply the magnetizing current of other induction generators installed on the platform and the lagging quadrature current of the load at the desired frequency and voltage.

8.0 General arrangement of an offshore Power Station:

The general arrangement plan of the proposed 3 MW offshore power station is shown in Fig.6. The layout, showing both the elevation and plan of the station, is a star like structure consisting of five platforms with interconnections made up of structural members. Each of the ocatagon shaped platforms is supported by a column which has its foundation on the seabed. This column extends above the platform and serves as the pedestal for the windmill generator. Each platform also supports a wave energy converter which is comprised of a Well's turbine coupled to an induction generator. The bridge like structure interconnecting two such platforms serves as the support for two current energy converters which are under slung from the bridge. These bridges in .turn have supports which have foundations on the seabed.

There are in all five wave energy generators each of 200 KWcapacity, five wind energy generators each of 350 KW capacity, and eight current energy converters each of 60 KW capacity totalling upto a capacity of 3.2 MW. On the deck are installed two enclosed deck houses to serve as switch gear and control gear room, battery room and accommodation space. The roots of these deck houses are covered with solar panels. These solar panels can generate about 10 KWof power which is used for charging the station batteries. The station batteries supply power for control interlock and safety functions.

9.0 Conclusions & Suggestions:

1. Conservation of non-renewable energy resources is the prime need of the hour as this not only saves foreign exchange but also helps. in containing pollution.

2. Conversion ofrenewable energy resources into power must be speeded up.

3. The sea holds tremendous potential for harnesaing non-conventional energy sources like wind, wave and surface currents. These renewable sources of energy must be exploited to the fulles by setting up integrated offshore power stations at suitable locations all along our coastline.

4. Offshore power stations should be installed around the Andaman Nicobar islands as well as the Lakshadweep.

5. Feasibility ofsetting up platforms on large perennial rivers for capturing wind and current energies should be explored.

6. The most appropriate techpology and right talents exist in our country to tap these inexhaustible non-conventional energy resources for meeting our power requirements. All out effort must be made to exploit these resources for generating pollution free power.

Acknowledgments :

The author is grateful to Prof. P. Sambandan ofthe Ocean Engineering Centre, IIT Madras for his valuable comments and useful suggestions.

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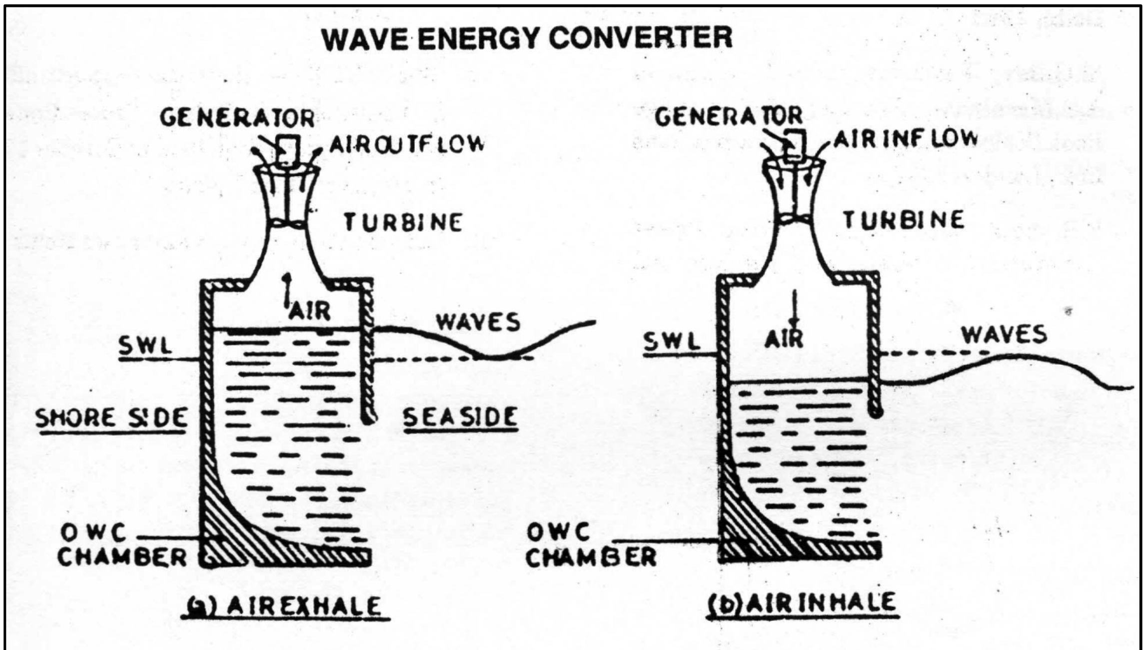


Figure 1.

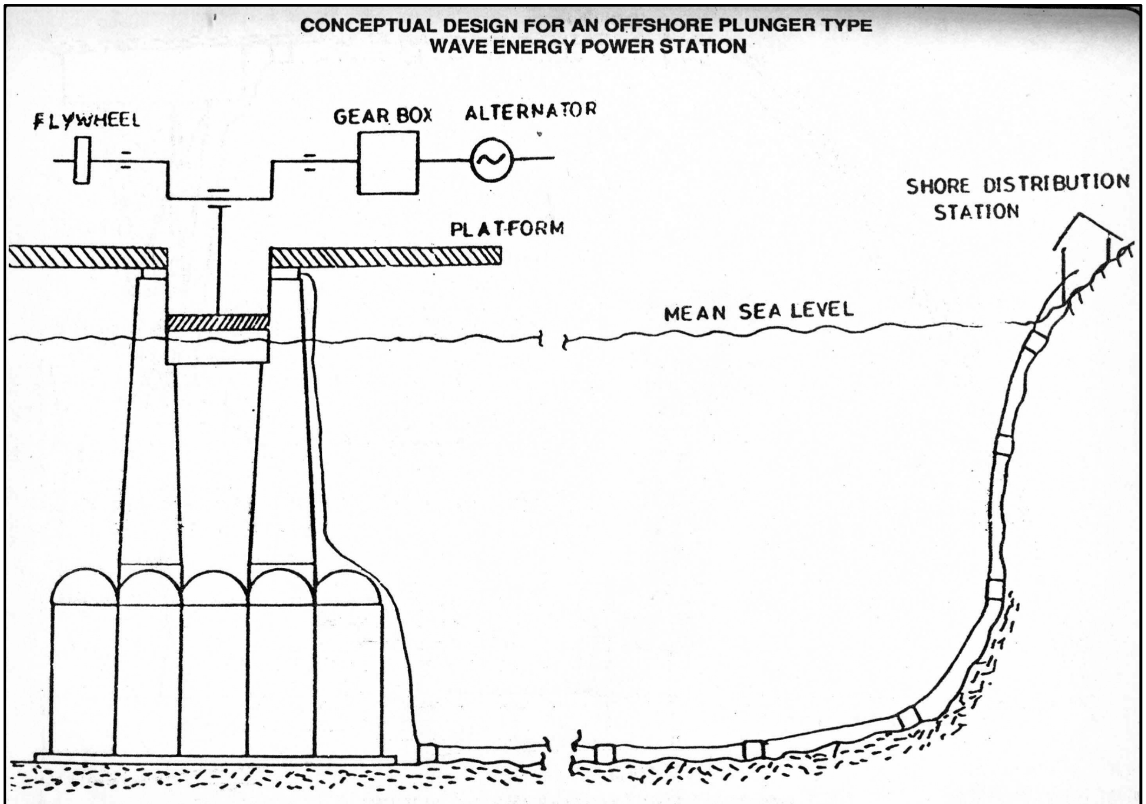


Figure 2.

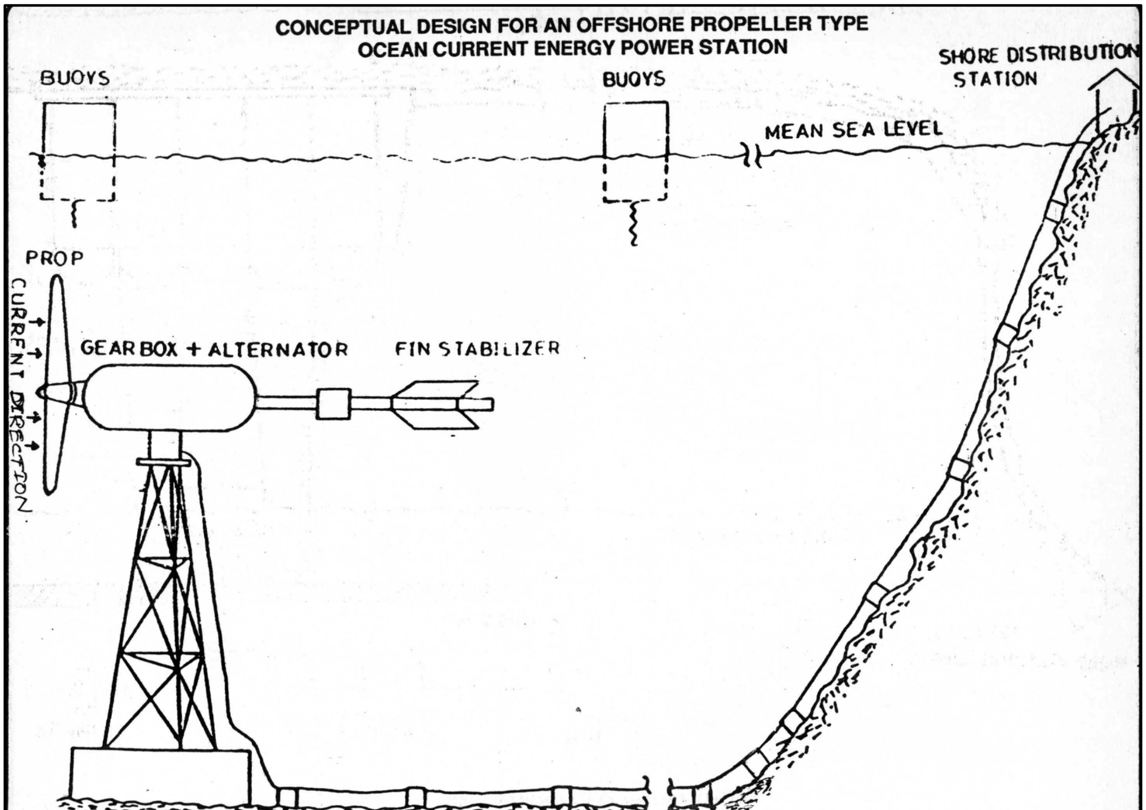


Figure 3.

CONCEPTUAL DESIGN FOR AN INTEGRATED OFFSHORE POWER STATION

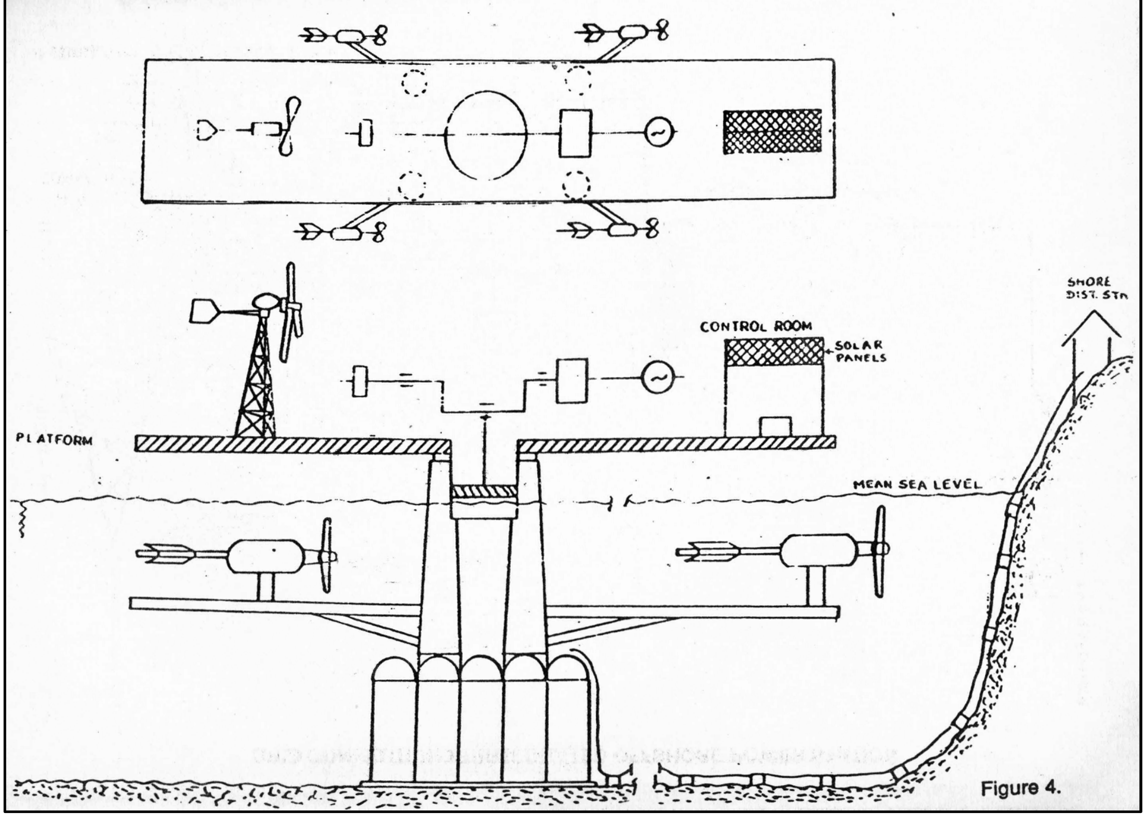


Figure 4.

GRID CONNECTION OF INTEGRATED OFFSHORE POWER STATION

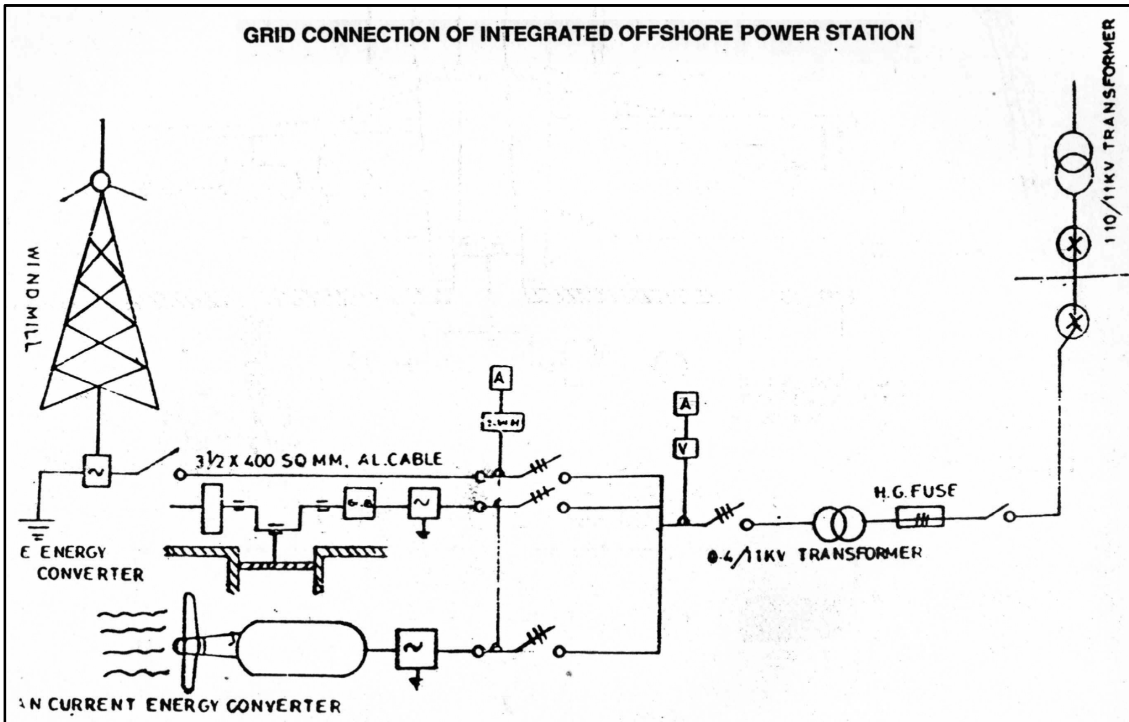


Figure 5.

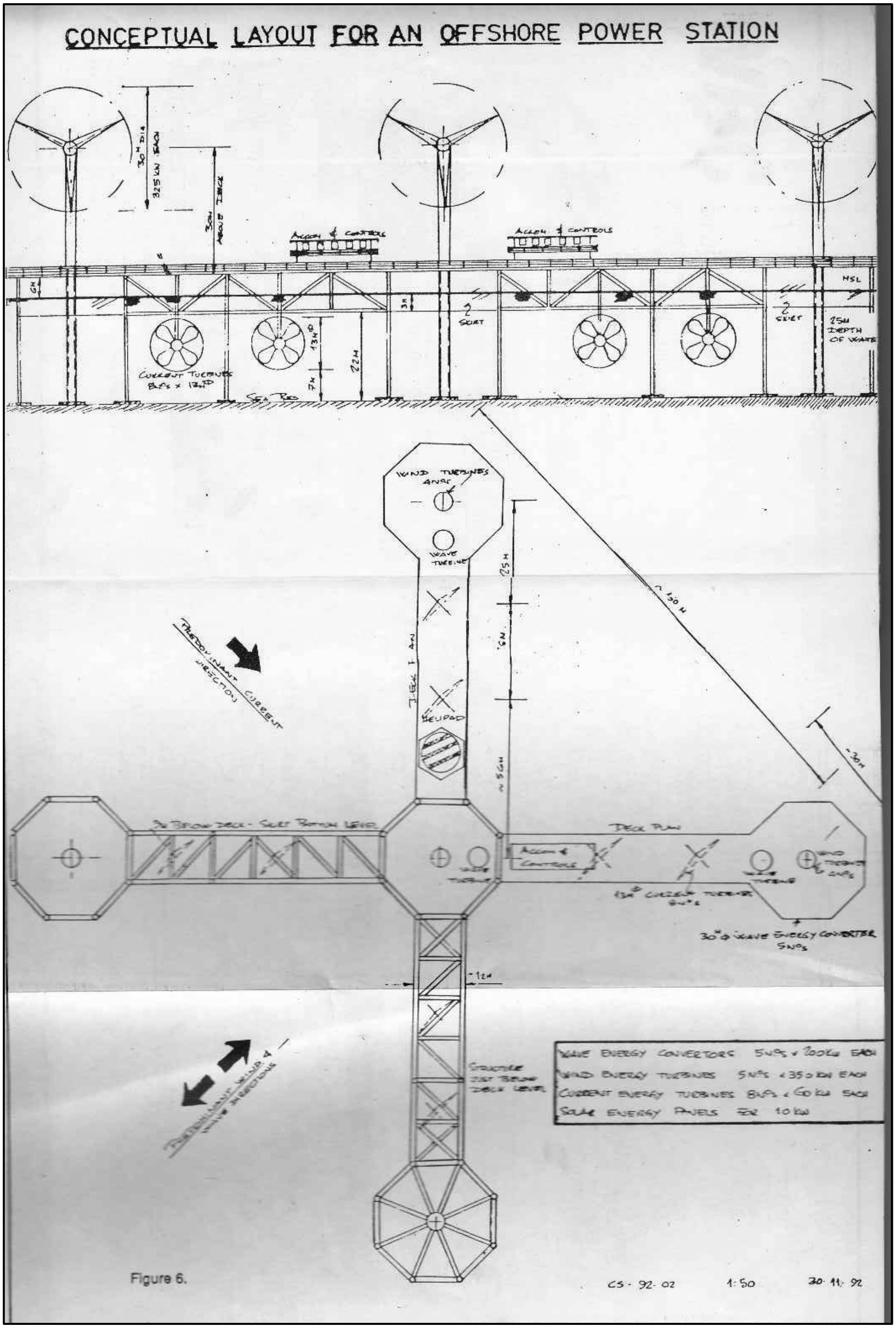

CONCEPTUAL LAYOUT FOR AN OFFSHORE POWER STATION
HELIPAD
DECK PLAN
WAVE ENERGY CONVERTORS 5 NOS x 200 KW EACH
WIND ENERGY TURBINES 5 NOS x 350 KW EACH
CURRENT ENERGY TURBINES 8 NOS x 60 KW EACH
SOLAR ENERGY PANELS FOR 10 KW
CS - 92 - 02
1:50
30 - 11 - 92

Figure 6.

Relevance of Wind Assisted Motor Ship in the Context of Trends in Technological Developement of Future Ship

Shri A B Thakur, *C. Eng, FIE*

INTRODUCTION:

For at least 6000 years the wind systems of the Oceans and of the sea shores were continually utili sed as the principal source of energy for ship propulsion. But at least for the last 60 years or so, commercial shipping has relied completely on fossil - fueled engine propulsion. The large wind - driven ships disappeared from the oceans in the 1920's which were the end product of a long steady evolution. During this period mariners have become used to considering the wind as a more or less serious troublemaker to ship operation since it acted directly to increase the aerodynamic resistance and indirectly by the additional resistance due to the wind induced waves.

The sail propulsion however did not die out completely and in some regions of the world commercial sailing ship fleets still exist. However, after the oil crisis in the 1970's, wind proplusion again raised among alternatives for powering ships. The idea of wind propulsion, not only for pleasure, but also for commercial shipping, has become again an object of discussion and some research activities, during the last 16 years or so. The awarness of ecological problems have also stimulated the idea of wind propulsion. The question now arises whether the technical progress of the last 60 years in aerodynamics and structural, mechanical and control engineering lead to an ecologically and economically useful contribution by wind energy to commercial ship propulsion? And which out of the variety of proposed technical concepts is the best solution for a given type of ship route and trade?

Since for safety reasons, commercial ships are unthinkable today without any engine propulsion, the ratio of installation and application of motor and wind propulsion is therefore the next moot question. Given the present cost structure in the industrialised economics, expressed, for example, as the ratio of annual fixed vessel costs for propulsion, the presure of fuel prices in the shipowners bill is not yet high enough that he would deliberately give up part of his control of the ship's schedule and accept a certain stochastic influence of the weather on the voyage times. Hardly any shipowner today would seriously consider unsteady wind energy for main propulsion. Yet some of them are considering or even testing wind-assistance as, on the Shin Aitoku Maru in Japan, the Mine Lace in the Carribean and soon the Oilman in the United Kingdom. Therefore, a closer look is warranted at the principal physical possibilities and constraints of wind assistance for motorships operated at constant service speed in the natural environment of wind conditions varying statistically both in strength and in direction.

A number of coyntries such as Japan, U.K., USA, France, West Germany, Finland, Norway have been actively involved in the recent past in extensive research and development of wind-assisted motorships of various sizes and categories. Their achievements were first discussed in an international Meeting of Experts on the application of Wind Power in Shipping, held in the ESCAP region, which was organised by the United Nations Economic and Social Commission for Asia and thr Pacific at Tokyo, Japan from 14-16 April 1984. It was further supplemented by a Regional Conference on Sail-Motor Propulsion held in Manila under the aegis of the Asian Development Bank from 18-21 November 1985. Many of the conditions that made the masts and sailing-rigs to be looked at as obstructions to cargo handling are no longer relevant. During the past 15 to 20 years, there have been rapid changes in cargo handling techniques from the basic conventional handling method towards more mechanized handling methods. Within the general cargo sector the Ro/ Rosystem and the side loader system have been introduced, two efficient cargo handling systems for which masts and sail rigs would cause no operational problem. In the bulk sector self unloaders of the gravity discharge type have peen introduced. This system needs only smaller hatches for loading, and consequently there is no conflict with the sail rig. The same is the case for all liquid transport in tankers. Wind power would hardly be feasible on a pure container ship or a 'lash ship'. First, because both systems require totally clear deck space for fast crane operation, and secondly because these type of transport systems are so capital intensive that a fairly high minimum speed is necessary to make them economically viable.

Considerable research and developmental work was carried out in recent years pertaining to aerodynamic shaping of soft sails and their leading edges; mechanised reefing and sail trimming (roller); self supporting rotating masts and adoption of rigid airfoil wings with flaps. However, the Japanese carried out the most spectacular pioneering work vis-a-vis developing the technically sophisticated sail assisted vessels for commercial deployment during the past several years.

Gentleman, when we think about ships of tomorrow, such vital factors as system engineering on main and auxiliary engines and equipment, together with adaptation of main and auxiliary machinery to the use of heavy fuel alone, efforts to work out new systems for waste heat recovery and a technological breakthrough to make possible extensive use of minicomputers for the control of all these machinery and equipment are the basic technological aspects at the one end of the spectrum. On the other end remain the vital commercial considerations such as the building cost, personnel cost, fuel cost and maintenance cost. Keeping the above in view, it is extremely important and relevant to review the performance data available to us pertaining to intermediate (performance) inspection record of the Japanese sail rigged motor tanker "Shin Aitoku Maru" after completing two years of commercial service.

World's first commercial sailing and energy saving ship "Shin Aitoku Maru" was delivered early in September 1980.Some of the important features and principal particulars are as follows:

Principal Particulars

Length (bp)	66.0 mtrs.	Cargo oil tank	about 1300 cubic mtrs
Breadth (molded)	10.6 m.	Major cargo	oil products
Depth (molded)	5.2 m.	Service speed	12 knots (in case of using main engine)
Draft (molded)	4.4 m.	Complement	10 persons
Gross tonnage	about 699 tons	Main diesel engin	1600 hp at 250 rpm
Dead weight	1600 tons (coastal service) 1400 tons (offshore service)	Propeller	Controllable pitch propeller (CPP)

Sailing equipment:

two sets of rectangular, laminar flow type hard sails with a total area of 194.4 square meters, and I?aximum effective wind velocity of 20 meters per second.

Control System:

- Sails to be automatically controlled by a micro-computer (they also can be controlled manually).
- Ship's speed to be controlled by an automated control of main engine and CPP.
- Ship's operation control to be made by a micro-computer.

Features:

Sailing equipment:

Fuel saving will be achieved by engine main with sail auxiliary. The wind direction and velocity are automatically determined, and on that basis a microcomputer controls the expansion or contraction of the sails and their turning in the most suitable direction to achieve the maximum power gain. No additional crew member is required for manipulating the sails.

Ship design:

In order to reduce hull resistance, she has a fine hull form with long length, narrow breadth and suitable stern.

Large-diameter controllable pitch propeller:

Improvement in propulsive efficiency by the use of a large-diameter controllable pitch propeller.

Main engine:

She is powered by a less fuel-consuming engine burning highly viscous fuel oil, and in this connection embodies various adaptive measures to high-viscosity oil.

Exhaust gas economizer:

The use of oil heat carrier results in more efficient recovery of energy than a conventional exhaust gas economizer and adopt oil heat carrier type boiler.

Driving the generator with the main engine:

By driving the generator with the main engine through a hydraulic system, electric power can be generated by low-grade fuel oil.

Homogenizer and fine filter:

Ahomogenizer and fine filter are used to emulsify fuel oil mixed with water. This features contributes to improving the combustion efficiency of the main engine, making its exhaust gas non-polluting and saving energy consumption.

The using of long term antifouling paint with self-polishing type to the ship bottom:

This paint saves fuel oil by reducing the friction of hull due to the increasing smoothness of bottom surface.

Anti-marine pollution:

The hull is double bottom and partially double side plating and equipped marine incinerating type filth treating equipment to prevent marine pollution.

Findings after 2 years of service:

Proves Highly Stable (with 100% Operating Rate) :

i) The tanker sailed the winter-time Japan Sea, previously considered innavigable by a vessel of this small size, and arrived at the Port of Niigata safe and sound through a snow storm of 30 m/s on Jan 6,1982. Later on, the she safely crossed the Tsugaru Strait against strong winds on Jan21. The vessel thereby demonstrated herself to be highly stable, though the reason for this stability has not yet elucidated.

ii) Though the Shin Aitoku Maru is primarily motor-powered and her sails provide only supplementary propulsive energy, when she literally sailed before the wind with her main engine at rest, the vessel achieved a speed of 3.75 knots at a wind velocity of six m/s and, at a wind velocity of 25 m/ s and a wave height of 5 to 6 meters, maintained a speed of as high as eight knots for two hours. She was then confirmed to be more stable and more comfortable then when motor-driven.

iii) During a sea trial at a wave height of three meters, a wind direction of 45 degrees right and a wind velocity of 15 meters, the hull rolled 10 degrees to the left and 17 degrees to the right in 7.9 second cycles, but when the sails were furled, the rolling increased to 15 degrees to the left and 22 degrees to the right in 7.3 second cycles. Thus her rolling angles were reported to be over 30% less, with the rolling period nearing 8 seconds, when the sails were unrolled. Similar results were reported of the sister vessel Aitoku Maru.

Excellent Course Keeping, Rudder Meeting of No More Than 5 Degrees Even in Storm :

The Shin Aitoku Maru also proved excellent in course keeping performance and, unlike conventional ships, permitted rudder meeting within only five degrees even in a rough weather.

Resistance attributable to the rudder is reduced, resulting in energy conservation by an estimated two or three percent.

Over 50% Energy Saving:

Speaking about the energy conservation effect of sails, it has to be kept in mind that the fuel consumption of this kind of ship during a voyage is calculated from the estimated horsepower read on the gauge.When calculations were made with a computer to analyze the Shin Aitoku Maru's low specific fuel consumption of far less than 140 g/PS-h, her estimated horsepower turned out to be about 900, the real power being 40 or 50 PS less than that supposed.

After her sister ship was completed, the two ships' performance in winter were compared (with no furled,except on April 20, 1982 when only the fore sail gear was unrolled), resulting in the confirmation of the 30 percent energy conservation effect of their sails.

Judging from the full-year performance records of the Shin Aitoku Maru,her average propulsive power is 860 PS at an average speed of 20 knots, and even when she hurried back from Taiwan at 14 knots, the power was l,OOOPSon an average or l,050 PS at the maximum.

Coarse Propeller Surface Prevents Energy Conservation:

When the tanker was docked a year ago, her propeller blades were found polished by water, presumably owing to their idle revolution at a speed of 12 knots or above because of the effect of her sails, and their surface was no more coarse than at the time of her completion. In view of this finding and the performance record referred to in the foregoing paragraph, the blade area was reduced to make the propeller 20% lighter (from 265 to 217kilograms); propeller intended for use at 1,600 PS was replaced with one for 1,200 PS, the limit of normal use for a sail-rigged ship, and the surface coarseness of its blades was reduced to 6 (incontrast to the normal coarseness of 12 to 15 for a brand new propeller). After the installation of the new propeller in January 1982, the vessel's fuel consumption was found about5 to 7 percent less than when she had sailed the same route before.

Sludge Also Used as Fuel:

Ships are usually equipped with oil purifiers to prevent sludge from getting into their main engines. The Shin Aitoku Maru is provided with a homogenizer, which integrates sludge and water contents into the fuel and thereby dispenses with the cost and labour of the disposal of sludge, which would amount to some 700 liters a year in a vessel of this class. In addition, sludge containing fuel was found without having any adverse effect on the piston,cylinder etc. when opened up for inspection.

May Contribute to Diaster Prevention (Can Enter Port by Sail Alone) :

When the tanker was to be docked at Imamura Shipbuilding Co.'s yard, her captain attempted, at his own discretion, to get her in to the port by sail alone, something which had been prevented by the

limitation of time on every previous occasion. It was demonstrated that, should her main engine fail to work, she could still be steered - driven by her sails-into the port if the wind direction was 60 degrees off her course to the right or the left, and sail at a speed of about four knots against a wind of eight m/s or before a wind of five to six m/s.

When at anchor with her sail furled, the vessel drifts in the current and can not be turned in any desired direction, but once her sails are spread, she can run in the designated direction, as if driven by an emergency main engine of 230 PS or so.

This is something epochal, unthinkable in the past.

Implications to Future Engine Room Designs:

As her sailing gear limits the pitching and rolling of the Shin Aitoku Maru and thereby enables her to run stably without interruption even in a rough weather, not only her crew but also her machinery and equipment are relieved of undue loads. Her engine department is operating in a state somewhat like that of an automobile running with her accelerator being used, with the unexpected result that the power output of the engine is stable even in a storm and so are the performance of all other items of engine room machinery:

a) The discharge of the fuel pump is kept constant.

b)The exhaust temperature is constant.

c)The temperature of the Thermo Echo is constant, and

d) The quantity of oil consuption is constant, too.

This means that, when the vessel is at sea with her sails unfurled, her machinery and equipment can perform much better than during their shop trials.

In addition to energy conservation, the tanker demonstrated these remarkable benefits, which suggest that instrumentation for the control of temperature and flow rates may perhaps be dispensed with.

Extensively Computerized:

The computer, installed for automatic control of the sailing gear, performed highly effectively without trouble during the first two-year period of the vessel's operation.

Additional computer systems have been successively introduced since her entrance into service to constitute the following list by now:

a) A sail controlling computer

b) An automatic load control (ALC) computer for the main engine and the controllable-pitch propeller (interlocked with the sail controlling computer)

c)A ground speed Loran system for scheduled operation;

d)An operation manual computer for setting the running speed and forecasting the fuel comsurnption and the time of arrival;

e)A stability confirming computer to calculate the C coefficient according to the load condition;

f) A computer system for the inventory control of spare parts and expendables, and

g) A computer for preparing operational reports.

The introduction of these computor systems,which have enabled the operation manual to be established, has resulted in the remarkable benefit of achieving greater harmony between the captain, chief engineer and the rest of the crew.

Lighter Propeller with Smoother Blades Greatly Contributes to Energy Conservation:

Taking note of the finding that the propellor, when the ship was running at over 12 knots, was revolving idly under the effect of her sailing gear and its blade surface was polished by water, immediately the blade surface was made smoother and replaced the initially fitted propeller for use at l,600 PS with a new propeller designed for use at 1,200 PS, having a new fixed pitch blade form smaller in overall area and a diameter of 2,700 mm,instead of the previous 2,650 mm. Comparison of the operational records revealed a 5 to 7 percent saving in fuel consumption brought about by the new propeller.

It was feared that this drastic change in design might subject the propeller to cavitation, but a look at the new type of propeller when the tanker was docked relieved us of the fear. The propeller was like brand new, free from cavitation, not to speak of its blade smoothness.

Costs No More to Maintain Than Conventional Ships

Maintenance Cost about the Same as Conventional Ships:

The engine department of the Shin Aitoku Maru, even though burning sludge-containing fuel oil, has been demonstrated to cost no more, if not less, to maintain than conventional ships.

Gentlemen, in my humble opinion, the confirmed superior performance data clearly indicates that the wind assisted motor ship, if not all, substantially fulfill the concept of a ship of future. If any thing, future refinement of related technology will only contribute to its further improvement.

Keeping the above in view, it is felt that certain initiative in this aspect is more than overdue vis-à-vis the Indian Marine Transport sector. Considering the prevailing international price of Crude oil, it may not be a compelling factor alone, for ship owner to contemplate for a change of such innovative nature but the fact remains, that with our limited fossil based oil resources and the huge amount of foreign exchange involvement on import bill of oil, any meaningful application of alternative energy should be most welcome. Wind power, which is readily available almost everywhere and free of charge would be one of the few remaining sources of energy to fall back on. And wind patterns in the tropics are generally stable and predictable with large areas benefitting from regular trade winds.

While admittedly shipbuilding industry in India is not technologically as developed as Japan or South Korea, still a firm base with requisite infrastructure to undertake construction of all class and size say up to 30,000 DWT does exist. Despite the present recessionery condition, it will be imperative to develop our coastal fleet which could be very effectively be indigenously developed. In view of the above, it would be desirable to initiate some research and development activities in design and production of wind assisted motor ships of appropriate size for coastal deployment.

Though, Department of Science and Technology did identify the development of computerised sailmotor technology as one of their project during the Seventh Plan period, this could not make any meaningful progress primarily due to absence of any appropriate agencies in the country. In this context the newly created National Ship Design and Research Centre at Visakhapatnam under the Administrative Control of the Ministry of Surface Transport, of which the present author was the Founder Director, could be the most appropriate forum.

Acknowledgement:

1) Proceedings of the Regional Conference on sail-motor propulsion - ADB,Manila.

2) Second-Year Intermediate (Performance) Inspection of Sail-Rigged Motor Tanker Shin Aitoku Maru - Noboru Hamada

Rear Admiral T B Bose Memorial Lecture

Vice Admiral A Britto, *AVSM, VSM*

Introduction :

I am extremely honoured to have been given the privilege of delivering this address in honour of Rear Admiral T. B. Bose.

2. Regrettably, I must confess that I did not have the privilege of knowing Admiral Bose who was an eminent marine engineer. For those like me who did not have this privilege, it is for information that Admiral Bose had an illustrious career spanning 20 years (1933-52) in the Royal Indian Navy. In 1952, his services were lent to the Ministry of Transport where he held such senior appointments as Principal Officer, Mercantile Marine Department and Chief Surveyor to the Govt. of India. He was also closely associated in the training systems of marine engineers at the DMET. After his retirement from Government Service in 1963,he continued to involve himself wholeheartedly in marine engineering activities. His career was one of rare achievements and encompassed numerous facets of maritime activity.

3. The theme of this tenth national convention is 'Engineering Trends and Technologies in the Maritime Industry' and am happy to see this fine assembly from across the profession. It would indeed be a fitting tribute to Admiral Bose if we shared his vision and advanced the causes of maritime activity that we represent; this convention would no doubt serve as a catalyst to shape the future in the many areas of interest that have been programmed for deliberation.

The Maritime scene:

4. Before I focus on the subject of emerging trends, let us take an overview of world maritime scene. Most navies have progressively down-sized heir fleets due to the post-cold war effect and fiscal constraints. As against force of numbers, accent is now on quality of ships revolutionised by precision guidance weapons, high grade communications and information systems and quieter ships through 'stealth' technology. The Indian Navy which saw rapid expansion from the late Sixties as a "Builder's Navy" has experienced a drought in recent times with no major combatant vessel having been ordered for the last seven years. As of 1994, the world mercantile fleet grew to 80,776 ships with a record 476 million gross tonnage, the average age of ships rising to 18.2 years. Regrettably, however, the Indian mercantile fleet has hovered around a gross registered tonnage of 5 to 6 million for almost two decades.

5. With a resurgence of the Indian economy, the eighth plan target (1992-97) of 7 million GRT is now being realised and is estimated to reach 10 million GRT by the year 2000. A brighter defence scenario for ship acquisition and building, is also in the offing. With shipbuilding having taken a back seat in recent times, Indian yards capitalised on ship repairs and yet lost out to Singapore with 17% of its repair tonnage coming from India. We have, no doubt, excelled in Shipbreaking, with Indian yards accounting for 10% of the world's shipbreaking tonnage last year, but would do well to recapture our reputation of yore as 'Shipmakers' to the world.

6. I now move on to the theme of this Seminar by first looking at some new trends in shipbuilding.

New trends In shipbuilding:

7. Today's ships are characterised by well advanced equipment and systems with an unprecedented range of automation and controls to reduce operational and manpower costs. These developments have brought out the need for total systems integration to be undertaken, by well qualified and established contractors as a pre-requisite for reliable operation. There is also growing recognition of the 'whole ship' approach to procurement as distinct from procuring many sub-systems collated in ships. The role of systems engineers in both ship design and production can thus be expected to grow considerably.

8. With recent trends in globalisation, a consortium approach is also becoming increasingly evident in ship-building. The "Tri-lateral' frigate in a consortium of Germany-Netherlands-Spain is a typical example where ships would be built independently by each country but where cooperation in design, use of common equipment/systems and joint purchases would lead to economy in design and pricing. An International Joint Venture Company of France-UK-Italy also took shape in London last year for design of a 'Horizon' frigate.

9. Yet another aspect of affordability has resulted in growing use of commercial standards in naval applications. Reductions in factor of safety in warships are being judiciously viewed not so much to compromise military specifications as to recognize appreciable improvements in commercial standards. A case in point is the new 11,400 ton displacement aircraft carrier 'Chakri Naruebet' of Thailand being built by BAZAN, the Spanish Shipyard — a mix of military-commercial standards make it a low cost ship with savings to the tune of around 50 per cent.

10. In the mercantile marine, designs continue to be appreciably affected by considerations of first cost, automation and the impact of legislations. In growing concerns on safety, it has been realised that machinery related problems have contributed to 30 per cent of tanker losses during the period 1976-94. A recent study carried out by a multi-disciplinary team of experts in Finland has concluded that the most economical ship was not necessarily the cheapest one or one with lower operating costs. The most successful design was one with twin engine, twin screw and twin rudder combination. There is a strong likelihood that redundancy criteria, especially in respect of tankers could well be added to regulation requirements in future.

11. To enhance redundancy, class notations are planned to be applied to merchant ships by classification societies. This would be known as the 'PR' (Propulsion Redundant), with a requirement that at least 50% of propulsion power is maintained after any single failure in any system that contributes to propulsion. Plans are underway to widen the 'PR' requirements to encompass failures caused by fire and flooding — thereby implying that redundant components are to be provided with physical separation systems. A new notation 'PRS' (Propulsion Redundant and Separate) is expected to apply.

12. Rules have been promulgated for the phasing out of single hull tankers and construction of double hull oil tankers in the interest of safety and environmental protection. Cochin Shipyard's tanker '009' for the Shipping Corporation of India is the first such example of build in India. It is essential that owners, shipbuilders and classification societies cooperate closely to ensure that the new generation of double hull tankers are designed from inception for the intended operating life of the ship. This necessitates special attention to through-life loadings and fatigue assessment. To further contain environmental damage resulting from tanker collisions, the answer may well be found in solutions such as the high energy absorption capacity polythene fibre called 'Dyneema'. It is reported that during crash trials conducted by Japanese and Dutch researchers in the Netherlands, the hull of a tanker reinforced with 'Dyneema' remained watertight.

Computers in shipbuilding/operations:

13. The advent of digital computers has revolutionized concepts and procedures for design, building and operations in recent years.

14. Modern computers with an array of software tools and immense processing capability have, to a large extent, removed the need for expensive and time consuming model tests during the ship design process. It has now not only been possible to refine new designs on computer to the extent where only the final model test is required for validation, it is also possible to carry out evaluation of collision strengths and the likely damage due to groundings. Propulsion design software permits prediction of performance, speed and power estimates and selection of propulsion systems with greater confidence.

15. Developments in the field of Virtual Reality (VR) now permit optimisation of structural and systems design as well as rationalisation of production, planning and control during construction. By providing the facility of 'hands-on' manipulation, it is possible to optimise designs rapidly, especially from ergonomic considerations without the need of expensive mock-ups. Use of VR for the design of new shipyards or for yard modernisation projects is also known to have yielded cost effective results.

16. Shifting the focus from ship design to the shipbuilding process, increasingly sophisticated structural details in ships have necessitated optimal and precision plate cutting. Consequently, CAD systems have become essential and are networked with CAM operations. Japanese shipbuilders have developed computer integrated manufacturing systems, thereby enabling the yard to electronically coordinate the ordering of equipment, design and operation of robots. A considerable proportion of savings is in the engineering hours, besides enabling the company to further automate a significant quantity of blue collar work and following an efficient 'semitandem' system for building ships.

17. From the era when engineers walked the plates making their log book entries, marine controls and instrumentation have come a long way where engineers can absorb all information from a single location. The strongest winds of change have been brought about by the induction of Integrated Platform Management Systems (IPMS) on board naval ships for propulsion control, power management and survivability. On account of the

significant benefits offered by this system and in keeping with technological trends, IPMS is being inducted in the major future surface combatants of the Indian Navy. When implemented, it will signify a departure from the stand alone control systems of earlier ships and result in appreciable reduction in crew.

18. Ship and fleet operations are also today becoming more computer dependent. Computerisation of on-board loading operations, damage control and planned maintenance are no longer a novelty. Computerised integration of bridge sensors and displays is gaining ground and it is also now feasible for radar data to be overlayed on electronic charts permitting easier and safer navigation.

19. The rapid proliferation of on-board computerization has given rise to the need for certification of software and it is re-assuring to note that classification societies are taking steps in this direction. However, computerisation has also itself given rise to the need for special crew skills which were hitherto not required, but are likely to be a necessary part of the qualifications for on-board operating staff in the years to come.

New techniques for marine machinery and equipments:

20. It would be difficult to review all the advances in marine machinery and systems; in fact this could well be the subject of a separate Seminar. I will, therefore, restrict myself to mentioning a few noteworthy developments.

21. Considering ship structure first, there is a trend towards installation of real time hull stress, corrosion and crack monitoring systems. Hull stress measurement is achieved by strain gauges located at the most critical areas of the hull and by installing accelerometers in the bow; the former gives advance warning of structural deterioration by monitoring the strains developed on hull structures and the latter monitoring slamming loads and associated stresses. Strain rosettes are installed in critical areas to detect and measure propagation of cracks, and corrosion pieces or 'coupons' indicate wastage in critical areas. Such systems not only give advance warning when local stresses exceed safe limits, but, when interfaced with appropriate software can even indicate the course of action to be taken to minimise damage.

22. Moving on to propulsion machinery, the diesel engine remains a favourite prime mover. This has undergone continual improvements, firstly by the incorporation of electronic governing controls and secondly by developments such as the use of water injection into the combustion chamber which lowers NOx emissions, specific fuel consumption and smoke density. Amongst gas turbines, considerable interest is centered on the Westinghouse-Rolls Royce WR 21 Inter-cooled Recuperative engine which is expected to provide increased power with 30% saving in fuel consumption, reduced life cycle costs, lower noise and vibration signature and meet standards of emission.

23. The use of composite materials to replace metals is growing notably in the case of structures, pipe lines, flexible couplings and even shaft lines, thereby giving savings in weight and reduction in noise.

24. With the coming into force of the Montreal Convention for elimination of CFC's, we are now witnessing development of Halon substitutes which offer similar performance to the conventionally used refrigerant R-22. Discontinuation of Halon 1301 has led' to the growing acceptance of water fog and other extinguishing media, 'Pyrocool' being an example.

25. The advent of membrane technology particularly the now well advanced disc and tube distilling plants of ROCHEMhas appreciably eased the difficulties of providing fresh water on board. Extraction of dissolved O_2 from Sea water would further supplement the use of Air Independent Propulsion (AlP) systems, all of which require O_2 in their effective implementation as propulsion package.

26. Fuel Cells are also likely to become commercially available within the next two decades, these could well be the primary means of generating electrical power on board ships. Their attraction stems from an efficiency possibility of 70%, low noise and polluting features and a potential life of 30,000 hours presently estimated under test runs. Areas to be addressed include reduction in size, improvement in controls and reduction in initial costs.

27. Before closing this subject, it would be appropriate to recognise that future technology will be increasingly driven by environmental considerations. To this end, electric drives are gaining ground in the quest for ultra quiet naval ships as well as passenger ships and ferries. Traditional disadvantages of electric propulsion, viz., the large volumes and weight are being overcome with advances in two specific technologies i.e. new generation power magnets to improve density of motors vis-à-vis synchronous motors and secondly through the power electronics revolution in reducing size of high power equipment and distortions in electric supply.

Training and Manning of Ships' Crew (STCW):

28. Despite the increasing sophistication available in the design, production, operation and maintenance of ships, accidents and losses still occur. Regrettably, the cause for many of these can be traced back to crew errors, revealing incompetence, ignorance and inexperience. The environmental fall out of marine accidents and the tragic loss of life have led to a review of the 1978 provisions of the International Conventions on Standards of Training, Certification and Watch-Keeping (STCW) to remove some of its perceived shortcomings such as imprecise standards of competence and lack of enforceability. The revised STCWwere adopted by the IMO in July 1995 and shall be deemed accepted on 1st August 1996 unless objected to by more than one third of the member states owning more than 50% of the World Merchant Gross Tonnage. The rules will come into force internationally on 1st February 1997.

29. The amendments seek to bring about uniformity in the requirements of certification for officers. This also implies the maintenance of a minimum standard by training institutions in respect of trainees and resources as well as the maintenance of log books and records for on-board training.

30. To cope with the training requirements of modern complex on-board systems, the use of simulators for training is being increasingly recognised. Recently, Mumbai's Lal Bahadur Shastri Nautical & Engineering College has installed a new Liquid Cargo Handling Simulator and Engine Room simulator at its premises. The former simulates a 150,000 DWT double hull tanker incorporating all the equipment such tankers carry to load and discharge liquid cargoes and facilitate training of officers in the planning, operations of loading, discharging, ballasting, tank cleaning etc. The Engine Room Simulator simulates the Engine Room of an ultra high speed container vessel having the latest diesel propulsion plants, diesel generators and auxiliary equipments found on board.

31. It would be appropriate for the Indian shipt ping industry to take steps for full compliance with STCW95 in order to maintain the confidence of the international shipping community in our already stringent officer qualification standards.

32. I will now pass on to marine pollution and its effects.

Marine pollution and its effects:

33. IMO's MARPOL 73/78 with its five annexes on waste and hazardous substances is now a well known subject. Minimising the polluting effects of ship operation will henceforth come under greater focus. I will touch upon some measures which can be expected to assume greater importance.

34. The use of tin in Tributyltin (TBT) anti fouling co-polymers is likely to be disallowed in time to come in keeping with the present EU directives. This is likely to once again reduce dry docking intervals, unless effective substitutes are developed.

35. Shuttle tankers, which perform several potentially hazardous loading and unloading cycles per day may well be required to adopt the use of jacketed hoses to contain spillage in the event of hose failure and carry special oil spill recovery equipment for mopping up operations.

36. The threat to the environment from IC engine emissions has resulted in the introduction of Annexe 6 to MARPOL 73/78. Increasing pressure to reduce SOx and NOx emissions has already led to a number of improvements in the combustion process and considerations of reducing sulphur content in bunkers.

37. It is also recognised that bilge discharges are major contributors to oil contamination resulting in effective oily water separation equipment, improved oil content monitors and associated alarms. The effectiveness of currently available IMO approved oily water separation systems is, however, reduced by the presence of detergents used for bilge cleaning; in particular surfactant based cleaning fluids produce chemically stable emulsions which are inseparable by gravity. A need would, therefore, arise to either avoid the use of surfactants or to go in for alternative separation systems of the membrane, froth floatation or biological types, to mention a few.

38. The treatment of shipboard waste will also assume greater significance; ships today are being equipped with on board waste disposal units. They may take the form of holding and processing plants for sewage, incinerators for plastic, oil residues and contaminated waste, with compactors used for metal containers. Port reception facilities, will also need to be appreciably upgraded to meet the growing needs of waste disposal.

IMO regulations and Port State Control:

39. Despite increasingly stringent requirements and constantly improving monitoring techniques, pollution on the high seas, either by accident or by intent, continues to impose pressures on the environment. Masters and owners

obeying and fulfillingthe variety of laws, both international and national, may be frustrated by the port authority whose coastline they are trying to protect.

40. The' Amoco Cadiz' disaster off the Britanny Coast in 1978 prompted the Paris MOU of 1978 which brought into effect Port State Control (PSC), aimed at preventing the operation of substandard ships. The amendments to MARPOL in 1993 extend the powers of Port State Control. It will allow ships to be inspected by participating states to ensure compliance with pollution preventive measures.

41. The ambit of PSC is so wide ranging as to cover shortcomings as per SaLAS 74, MARPOL73/78 and STCW 78. The PSC regime has been criticised by some shipowners for non-uniformity in its application. The IMO is now working towards rationalisation of basic procedures, qualifications and experience of inspectors, and specifying action to be taken for intervention and detention, while at the same time avoiding undue delay.

42. A number of countries are progressively introducing stringent PSC inspections and legislations — the US Coast Guard has, for example, now included India in a list of 15 countries whose ships have been targeted for stringent inspection in US waters. Whilst the Govt. of India has started to augment the administrative infrastructure for implementing PSC inspections on vessels calling at Indian ports, much more needs to be done. It would also be advisable for shipowners to view the PSC not as an impediment to Indian shipping but as an opportunity to ensure that Indian ships meet the requirements of international maritime regulations. It would also be in our interest to take the lead in establishing Port State Control Cooperation in our littoral.

43. Measures to prevent the operation of substandard ships have further led to the International Safety Management (ISM) Code and associated certification, which is the last aspect of my talk.

ISM Code and ISO Certification:

44. The requirement of implementation of International Safety Management (ISM)Code by 1st July, 1998 is by now a familiar topic with mariners. The code carries the drive for safe operation of ships and prevention of pollution beyond the confines of the ship and imposes responsibilities on shipping companies and governments as well. The Code has not been drafted with the intention to completely change the way shipping companies operate today, but rather to allow individual companies to develop their own systems with the intention of promoting continual improvement within the Industry over a period of time. It is based upon internationally agreed quality system principles and its main clauses have common areas with the ISO 9002 standard. It differs from ISO 9002 in that the latter does not specifically address safety and environment; therefore standards and procedures in the Code are specifically formulated.

45. The greatest return expected through implementation of the Code and the Safety Management System (SMS)will be by reduction of accidents and an eventual increase in efficiency as participation within the Safety culture would continue.

46. It should be the endeavour of Shipping companies to produce truly active SMSwithin their organisations so that they will not only be prepared to meet the Code requirements, but also achieve positive growth individually and as a collective movement within the marine transportation business.

Conclusion:

47. In conclusion it can be said that the marine industry today is in a state of transition due to global changes all round. To be vibrant and healthy, it will have to be responsive to increasing societal demands particularly related to environment whilst concurrently absorbing and using dominant technologies in a competitive scenario of costs, time and capabilities. Such are the challenges confronting the marine community, as never before, and I am confident that the Indian maritime industry will face up to the future.

48. I appreciate this opportunity to have shared some of my perceptions with you and am sure that the presentations at this Seminar will stimulate considerable interest. I would like to thank the Institution of Engineers for giving me this opportunity to deliver the Admiral Bose Memorial Lecture on vital areas of concern and application in the maritime industry.

Delivered during the Eleventh National Conventions of Marine Engineers on 'Port , Shipping and Multimodel Transportation' organized by West Bengal State Centre, November 28-29, 1997

Rear Admiral T B Bose — A Tribute

Shri B Goswami, *FIE*

It is a privilege to present a paper in memory of our beloved Late Tarun Baran Bose, Rear Admiral (Retd) I.N., an outstanding Marine Engineer and Administrator. I am grateful to the Institution of Engineers (India), to have bestowed me the honour for delivering the Memorial Lecture.

The august gathering will fondly remember the contribution of Admiral Bose to the cause of Marine Engineers of India. He had a vision and today we Marine Engineers have vindicated his dream and have diversified into all spheres of Marine activities besides only running of Engines, the vocation for which we were given the initial training.

In fact, I would not have deviated from University life to Marine education, if not encouraged by Admiral Bose. I recall the help of Admiral Bose, then Lt. Comd. I,N., before my entry to the then Indian Mercentile Marine Training Ship "Duffrin", just before the final interview at Bombay, during the year' 944 and how he coached a student from a vernacular school of Calcutta to face the English Speaking Officers of the Interview Board.

He in turn also remembered the occasion after thirty years, when he was the Chief Guest in the Annu"al Social gathering of Calcutta Port Trust Marine Engineers Association, when as President of the Association, I recalled his contribution to the cause of advancement of Marine Engineers of India.

He remembered me and quipped to the gathering that he know the President of the Association as a young boy of fourteen in half pants.

I always regarded him as my mentor and when during Indira Gandhi's "Emergency", I was hounded by the administration. for being the first President of All India Pbrt Officers Federation, he blessed my decision to resign from the services of Calcutta Port Trust to eventually join the "Dredging Corporation of India" and no other person was more elated than himself when I became General Manager of the Corporation. Before I earmark on my schedule lecture, I pray, as I always have, for his soul to rest in peace.

In this 11th National Convention of Marine Engineering Division of Institution of the Engineers on the subject 'Port, Shipping & Multimodal Transportation', I have chosen to speak on various types of Dredgers briefly outlining the caracteristics and usefulness of deployment of particular type of dredgers at selected places.

1.0. Dredging Activity

1.1. Dredging is a means to mechanically excavate silt, sand and overburden from waterways such as canals, rivers, navigational channels, harbour approaches, docks and from impounded water areas such as lakes, ponds, reservoirs etc.. for creation of design depths and maintenance of same, be it for navigation in port waterways or canals, for erosion/flood control in sea shore or rivers, and for restoration of capacities of the reservoirs/lakes etc.

This is essential for development and maintenance of above areas in the process of sustaining economy of the nation.

1.2. Further the equipment used are required to dispose the excavated slurry from the site to a pre-determined spot by

i) Hydraulic pumping through a system of floating-cum-shore pipe tine,

ii) Pumping of slurry on to a separate floating carrier either for depositing same or for physical removal, for disposal elsewhere.

Iii) By loading the dredger's own hopper and depositing same in, a deeper trough in the waterway nearby the site.

1.3. The activity of dredging can be divided into two major components ;-

1.3.1. One is capital dredging i.e., excavation of virgin soil for creation of new waterways, lagoons, etc. in this type of dredging very often the equipment comes across hard to very hard soil strata. At times rocky bottom have to be blasted out. This rock blasting and eventual removal of the fragments also form part of capital dredging.

1.3. The second activity is maintenance dredging. Existing depths of waterways, lagoons, lakes etc., gets overburdened with sediment deposits. The quantum of deposits varies widely from waterways with silt laden waterflow to deposits in calm/stagnant water emanating from erosion of the banks.

The frequency of dredqinq/desiltation operation-as such varies and is subject to the operational need clubbed with availability of finance. In sea ways the quntum of deposits is mostly due to, littoral drift of sand caused by seasonal shore currents and due to sediments transported by rivers and discharged into the sea which ultimately settles down along the shore.

2.0. Types of Dredgers

2.1. The dredging industry contains a tremendous quantum of experience in earthmoving for the past centuries. It was Leonard-da-Vince, who is stated to have conceived the first dredger to remove underwater soil through mechanical means, Since then the present state of art in terms of capacity, capabilities and technical input, originates from struggle with nature by our ancestors.

With ever increasing impact of environmental control, higher production with reduced cost on the type of equipment, a host of varied kind of dredgers are available today. Each' of these are economically suitable for particular jobs. However the dredger"owners naturally aim to have as much.versatilitv as possible enabling usage of a capital intensive unit for various projects thus fully utilizing the equipment during total effective life span.

2,2. The existing types of dredgers can be divided in different groups. Broadly the two distinctive groups are e.g., stationary dumb dredgers and free sailing operating dredgers. Among the two groups the most important ones are the cutter suction dredger, a stationary one and the trailing suction hopper dredgers as a free sailing unit.

2.3. There are dredgers which remove soil hydraulically using centrifugal pumps and disposes the mixture in way of pumping same to the delivery area or into a hopper or barge and there are dredgers which excavate the soil by mechanical means.

2,4. The most commonly used dredgers are enumerated below :-

i) Plain Suction Dredger.

ii) Trailing Suction Hopper Dredger.

iii) Cutter Suction Dredger. Portable or Non-portable.

iv) Bottom disc Cutter Suction Dredgers.

v) Bucket Dredgers.

vi) Bucket Wheel Suction Dredger.

vii) Grab Hopper or Plain Grab Dredgers.

viii) Back Hoe Dredgers.

ix) Dipper Dredgers.

x) Dust Pan Dredgers.

2.4.1. Plain Suction Dredgers

Figure 1 depicts a plain suction dredger. This type is one of the first ever built as per U K. design. The dredger sucks in free running sand at a reasonable production rate. With the introduction of a suction mouth with jetting arrangement the densily of the mixture is increased for more compacted soil. We cannot incorporate a cutting device at the end of the free hanging suction pipe due to reactive forces. The dredger is by far the most useful for large reclamation works and for an area where free running sand is available. The cost per cubic meter excavated for this equipment is comparatively low.

The main points to be considered for this type of dredgers are as follows ;-

a) In a free running soil such as in rivers etc., a very high production can be achieved. The free running soil may be silt and sand.

b) If the unit is fitted with adequate pumping power in respect to the delivery distance from dredger spot to dumping site, the plain suction dredger needs no additional equipment. If the installed power is not enough in relation to the delivery distance, the unit can be fitted with a barge loading device and the soil can be transported by barges loaded alongside.

c) The maximum dredging depth is about 20 mtrs. However we can increase the dredging depth to about 60 mts. or more if required by inter changing necessary equipment.

d) The dredger has got capability in working in waves and swell upto a limit. This is achieved by fitting of articulated pipes with swell compensators.

e) Pinpoint dredging is difficult as the dredger is basically designed for reclamation works and for silt traps. But with modern equipment with Satellite positioning this also can be achieved.

f) Capital cost of this type dredger is high.

g) The dredger is not portable and has to be moved along waterway only.

2.4.2 Trailing Suction Hopper Dredger

Figure 2 depicts Trailing Hopper Suction Dredger.

This is one of the most widely used dredgers all over the world, specially in India, for capital and maintenance dredging. Maximum amount of research and development activity has gone into improvement of this type of dredgers and presently electronic software has nearly made this dredger an excellent modern tool for dredging with minimum number of personnel with minimum cost per M^3 dredged.

Main features of this type of dredgers are as under ;-

i) Ability to sail under its own power for dumping the spoil loaded inside its own (silt tank) hopper and dump sa-ne at a pre-determined place and sail from one port to the other easily.

ii) It is possible to dredge in free sailing condition without creating hindrance to commercial movement of vessels/crafts along the waterway. The dredger can perform in very heavy seas even when shipping is terminated due to bad weather.

iii) Trailing suction hopper dredgers are suited for both maintenance and capital dredging whereas other types of hydraulic dredgrs etc. are more or less confined to single job. Versatilily is the key word for this type of dredgers.

iv) This type of dredgers loses a lot of time during movement for dumping purpose and depending upon the distance the hours of actual dredging is limited.

v) These dredgers can dredge all kind of soil e.g, silt, clay, sand, some soft rock, loose rocks. Draghead fitted with knives and high pressure jetting system can tackle hard to very hard strata of soil.

vi) Usual dredging depth of these dredgers is 30 mts which can be enhanced to 40 mts by usage of a submersible pump.

vii) Size of the dredgers vary according to the hopper capacity and ranges between 500 to $10000M^3$. Presently larger capacity dredgrs have also been built.

viii) These dredgers are high capital cost oriented equipment.

ix) Maintenance, operating and manning expenditure is comparatively high.

x) Due to the large quantum of excavated material removed and dumped we find that even with high capital and operating cost the return is profitable,

2.4.3 Cutter Suction Dredger

Figure 3 depicts one such dredger which is portable. This is the type that is most widely used for all purpose e.q., harbours, docks, river/waterways, lakes, lagoons, cooling ponds, reservoirs etc.

Some of these cutter suction dredgers mayor may not have their own propulsive capacity. The portable cutter suction dredgers are basically hydraulic dredgers using a dredge pump to suck in the slurry created by a cutter which is positioned ahead of the suction mouth. The size and power of the cutter depends upon the compactness of the soil and required quantum of slurry to be created to match the suction of the dredge pump, The pump size and capacity also varies upon the requirement of dredger's volumetric output per hour and capability of pumping same through a long pipe line.

Presently various types of these cutter suction dredgers are in operation in India.

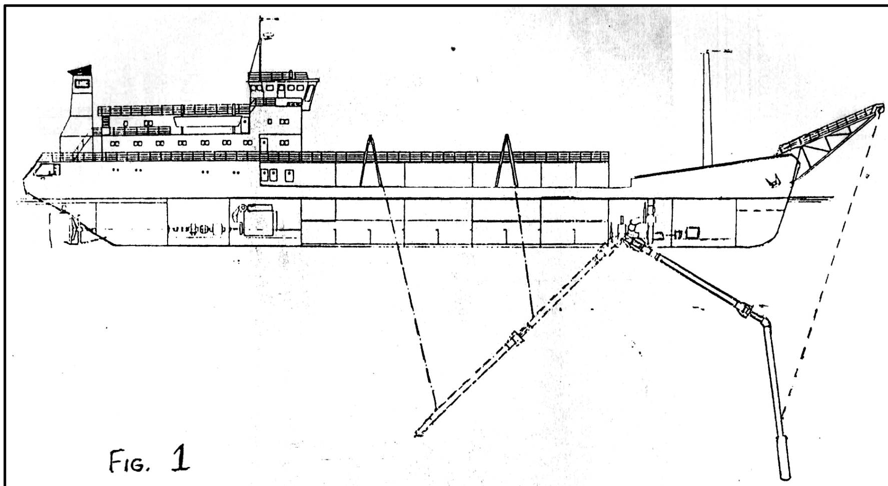
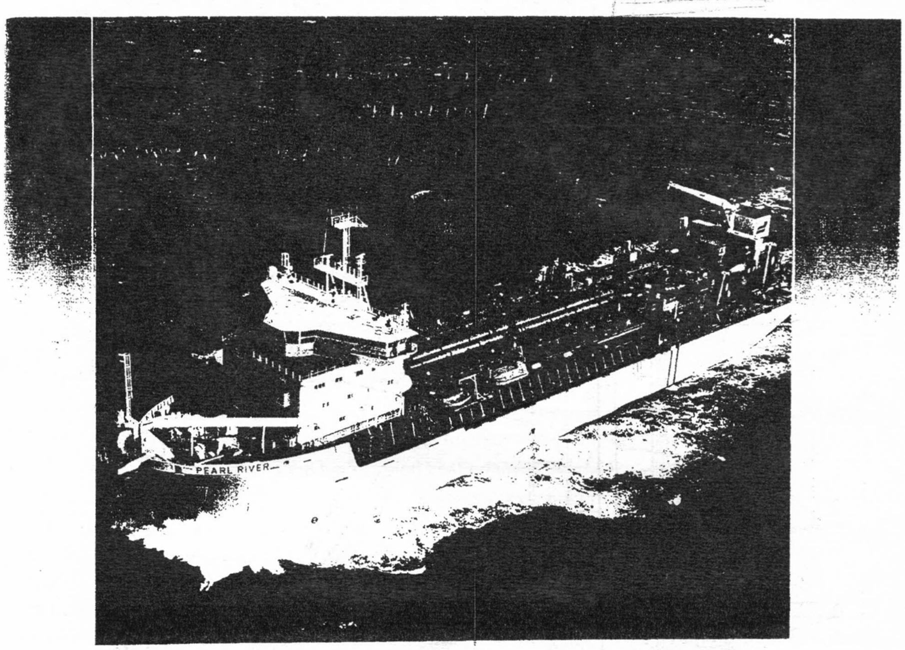


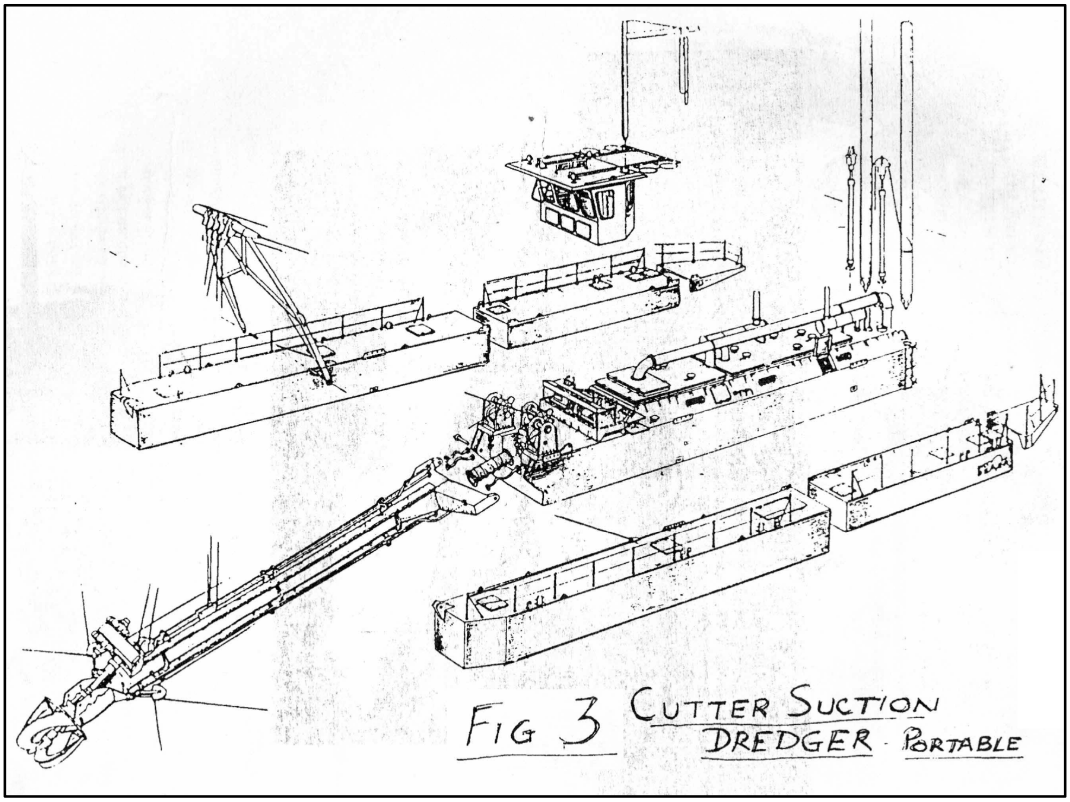
FIG. 1

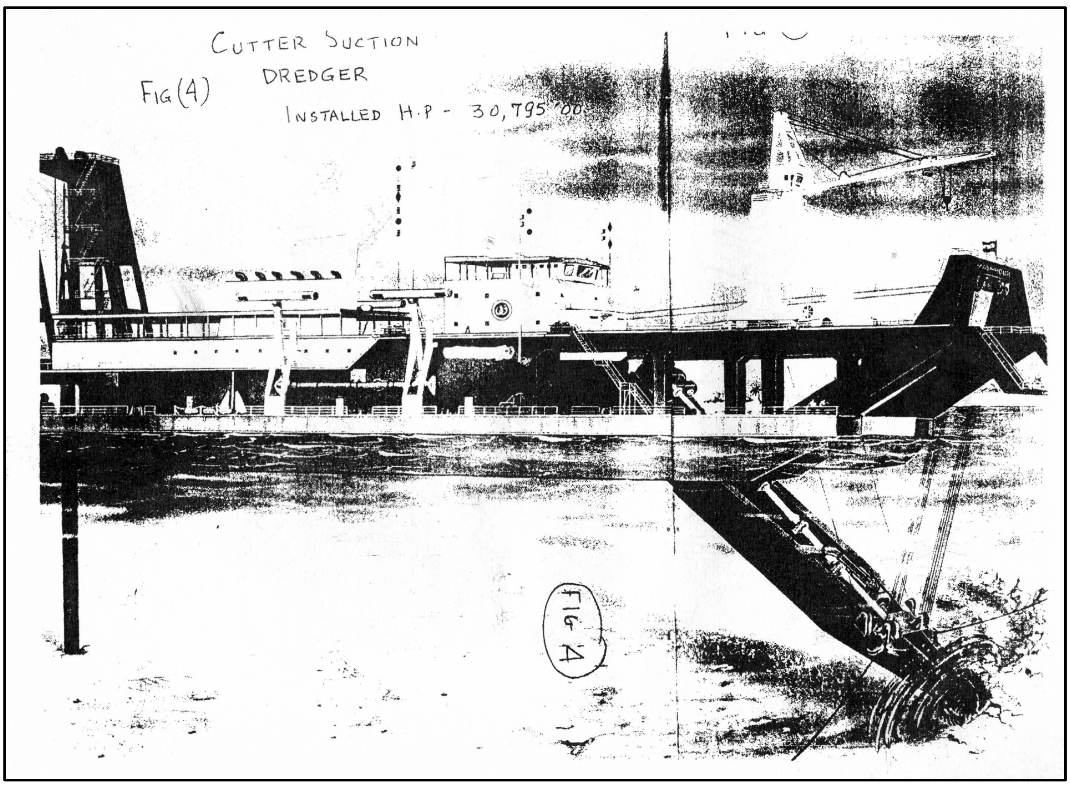
PLAIN SUCTION DREDGER

FIG 2

TRAILING SUCTION HOPPER DREDGER







The main feature of these dredgers are as under :-

i) Accuracy for dredging in vertical plane is good

ii) Horizontal accuracy depending on -the anchoring and· moriitorlnq system is reasonably excellent.

Due to strong positioning system. lnftuencerof. current in rivers and tidal water is negligible.

iii) Production in hard and free run,ning soil is high. For very compact material the installed cutter power has gO,ta direct influence on the production level.

iv) It is difficult for these types of dredgers to work with waves and swell.

v) Maximum dredging depths can vary from 2 mts to 30 mts. However, maximum dredging depth are usually limited to, 10/12 mts. otherwise portability becomes a problem.

vi) Cutter-Suction Dredgers, are most, useful- for Capital dredging, as well as for sites which have been overburdened with silt-vccmpacted for a long period. However even ordinary maintenance dn3dging can also be carried out.

vii) Discharge from these dredgers are done through a long floating-cum-shore pipe line. Movement of other crafts/vessels along the waterways in the above circumstances becomes partially blocked, Whenever situ~tion' warrants for free commercial movement in the waterways with the dredger working, barges are deployed to take in the load for dumping elsewhere. This brings up the cost of dredging under the circumstances.

viii) Large cutter suction dredgers with cutter power of 5000 HP and pumping capacity of 2000 M^3 of solids per hour capable ofdisposinq upto 2 KM has been built and used at places such as Suez Canal, Balari Bar, Abu Dhabi etc. Their numbers are small compared to the number of-portable mini cutter suction dredgers now in use all over the world.

ix) Presently very large cutter suction dredgers have. been built with a pumping capacity 10,000 M^3 of solids perhour,

x) Fig 4 depicts one of the very large cutter suction dredger for Suez Canal. The large dredger are positively not partable and may/may not have propulsive power.

2.4.4 Bucket Dredger

Figure 5 depicts one typical bucket dredger. The bucket dredger is one of the oldest type of equipment used for dredging. . Not very much of technical improvement for these dredgers have taken place except that steam power has been replaced by diesel. The important features of these dredgers can be enumerated as follows :-

i) Bucket dredgers invariably require ancilliary equipment such as hopper barges which is deployed for transportation of slurry to and from the discharge chute of the bucket dredger to the dumping/reclamation site.

ii) It can dredge all kinds of soil varving from silt to clay, sand gravel, medium/hard consolidated rock etc. It can also dredge large stones, boulders, logs etc.

iii) Postioning of the dredger is. carried out through anchors; wires etc, and as such pin point cutting can, be done; and by swinging, through an arc with the help, of winding/unwinding of ropes, can cover a wide area,

iv) Not suitable for dredging in waves and swett.

v) Maximum dredging depth aehieved is about 40 mts.

vi) Production is limited due to slow movement of the buckets.

vii) Causes hindrance to movement of other crafts due positioning wires/anchors.

viii) Bucket dredgers can be dumb or selt propelled.

2.4.5. Grab Dredger

Figure 6 depicts a simple grab dredger. It is a mechanical dredger and is useful in most of the places where other types of dredgers cannot manoeuvre. Grab dredgers can contain in built hopper for dumping the spoil excavated. Usually this hopper grab dredgers are self-propelled and after filling up the hopper move away from the place of dredging to dispose the slurry at a pre-determined spot. Other type i e.; stationary dumb grab dredgers are deployed with ancillary units like hopper barges, self propelled or dumb.

A simple type of grab dredger has a pontoon mounted crane with a single grab, widely used for small Jobs in restricted areas.

The type of grabs that are used for dredging varies in their individual design such as sand grab/rose peal grab/watertight grab etc. for different uses. General points to be noted are enumerated below :-

i) Dredging is more effective in uneven bed and in places where effect of current and tidal movement is less.

ii) Limited workability in waves and swell.

iii) Dredging depth can be very high beyond 30/40 mts, Sometime depth of 100 mts. has been achieved.

iv) Capacity i.e.; output per hour entirely depends on-the dredging depth.

v) Can deal with all kinds of soil, hard/compact, rocky/loose rocks. boulders etc. similar to bucket dredgers.

iv) Production is in the low side as compared to hydraulic dredgers.

2.4.6. Dipper Dredgers

Figure 7 gives us an idea of a dipper dredger. The dredger is very useful for limited areas only. It is specially designed to dredge very hard/broken materials mostly consisting of stones. boulders or blasted rocks. This dredger can be used as a supplementary unit to a cutter suction dredger during capital dredging/rock blasting etc.

2.4.7. Back Hoe Dredger

Figure 8 shows the outline of a modern back hoe dredger. This is a very modern mechanical dredger. Originally the 'back hoe' started with their use in land. mines etc. but recently they were used on pontoons for dredging duties. Due to accuracy of dredging in both planes i.e.; horizontal and vertical planes with a low rate of turbidity and with correct monitoring system, this type of dredgers are ver.y much preferred in closed waters such as docks, lakes, silt traps etc.

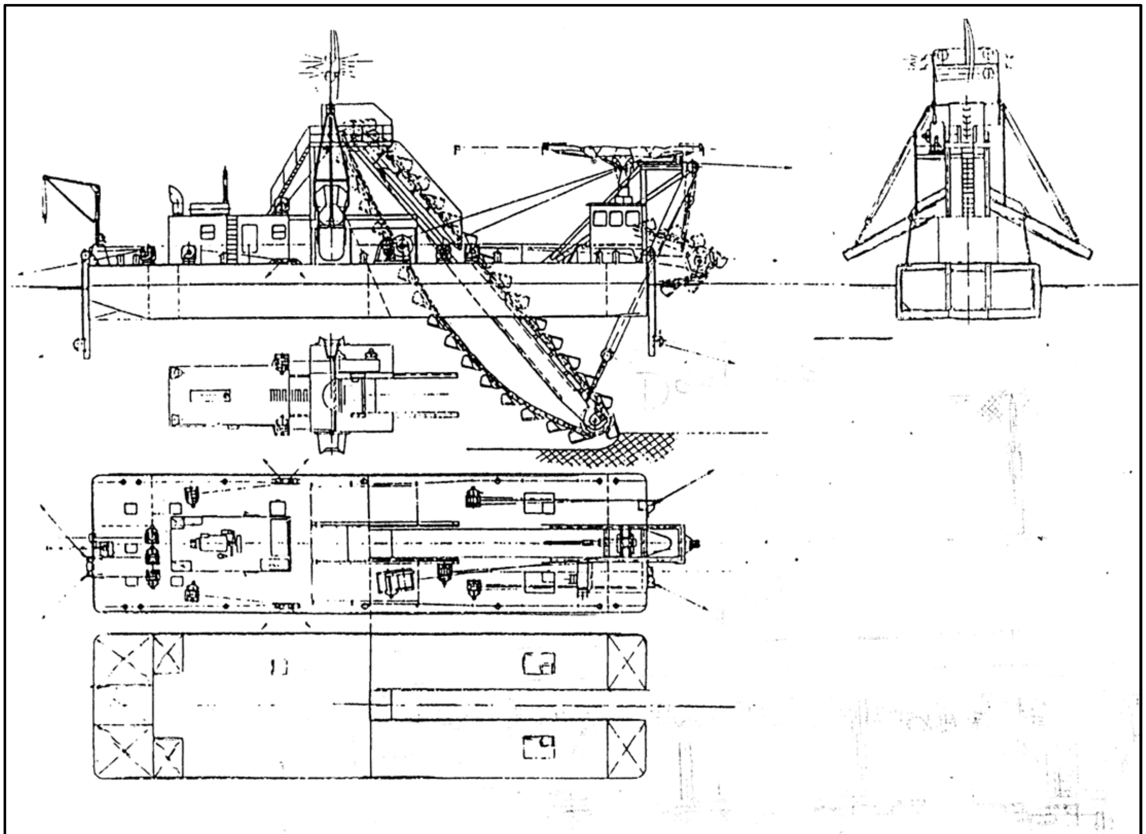


FIG 5 BUCKET DREDGER

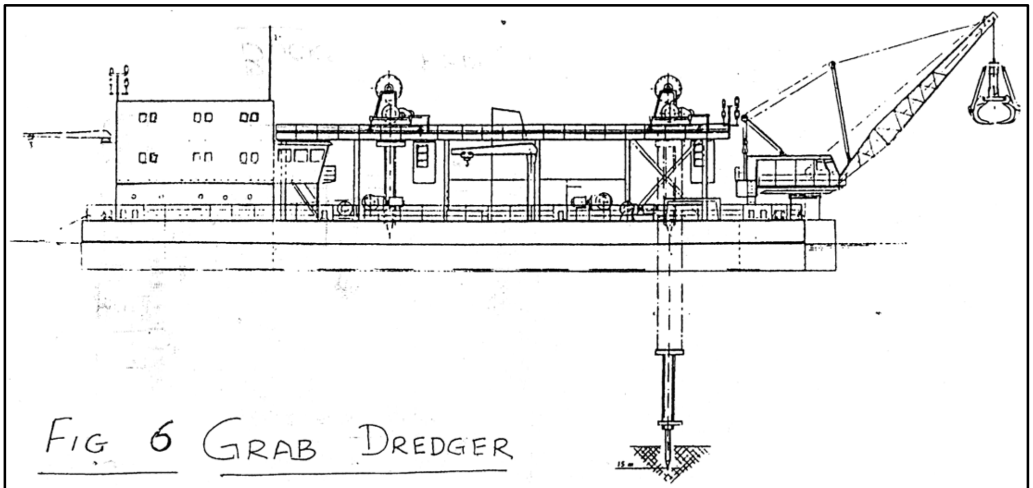
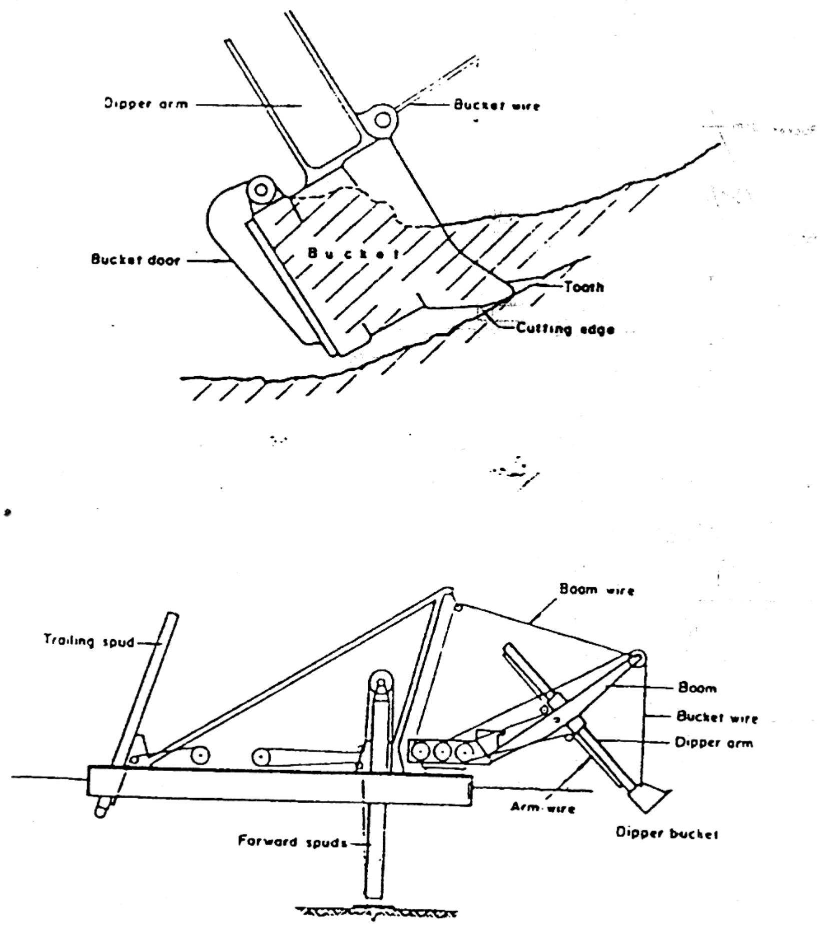


FIG 6 GRAB DREDGER

FIG 7



DIPPER DREDGER

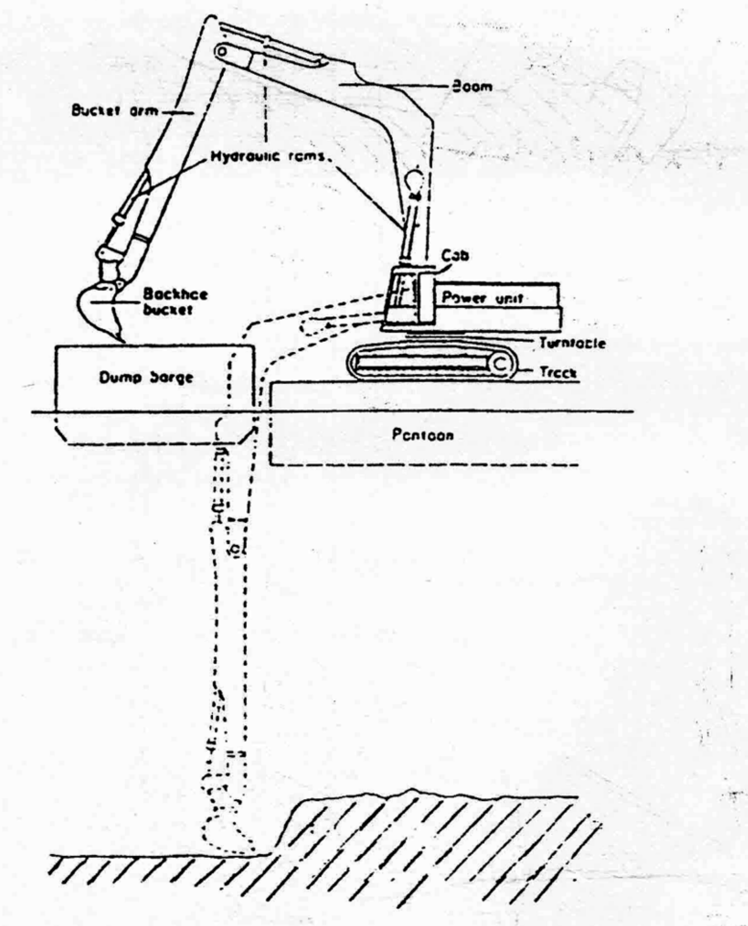


FIG 8 BACK HOE DREDGER

We can summarise the main features as under :-

i) With an unit having a back hoe equipment mounted on a pontoon with spuds, excellent results can be obtained as regards to accuracy and pinpoint dredging. Current in rivers has little effect when they are thus deployed.

ii) Production is limited to the dredging depths required.

iii) Dredging depth of 7 to 8 mts. can be tackled easily. The unit becomes too large if the requirement is of a far deeper dredging depth.

iv) Limited workability in waves and swell.

v) Back Hoe dredgers rarely have a hopper of its own. A dredger of this type with a hopper has to be self propelled for freely moving away from the site and dumping the spoil elsewhere.

The most economical use of the equipment can be achieved by having ancillary barges which takes the load from back hoe and move away leaving the unit free for loading another barge.

2.4.8. Miscellaneous Types of Dredgers

There are many other kind of dredgers which are in existence which have been manufactured and being used for dedicated jobs; but positively not widely used.

i) Dustpan Dredger

Figure 9 shows a dustpan dredger.

It is a modified plain suction dredger with a horizontal dustpan fitted and designed for agitation dredging.

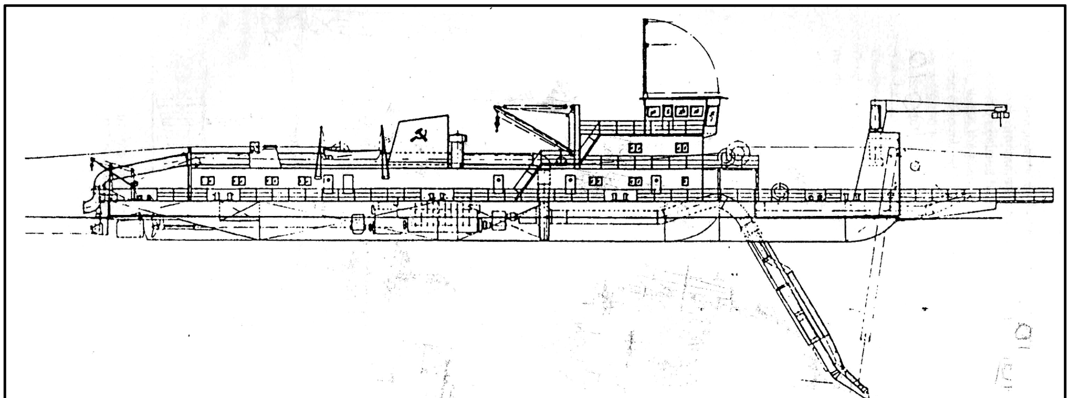


FIG. 9 DUST PAN DREDGER

ii) Boom Dredger

When dredging fast flowing rivers a trailor suction dredger sometimes is fitted with a long revolving boom which allows continuous dredging and pumping/spraying the slurry through the boom in the river. In the USA for dredging the Mississipi/Missourie the boom dredgers have proved very successful.

iii) Bucket Wheel Suction Dredger: Figure 10

The unit is basically the same as cutter suction dredger. However, the cutter is replaced by a bucket wheel rotating in a vertical plane. The bucket wheel system is heavier than the cutter system and rotates also at a lower .speed. It combines a bucket dredger with a cutter suction dredger and has been developed in the last decade and proved successful.

Production of this type of dredger is much higher and production is independent of dredger's swing direction.

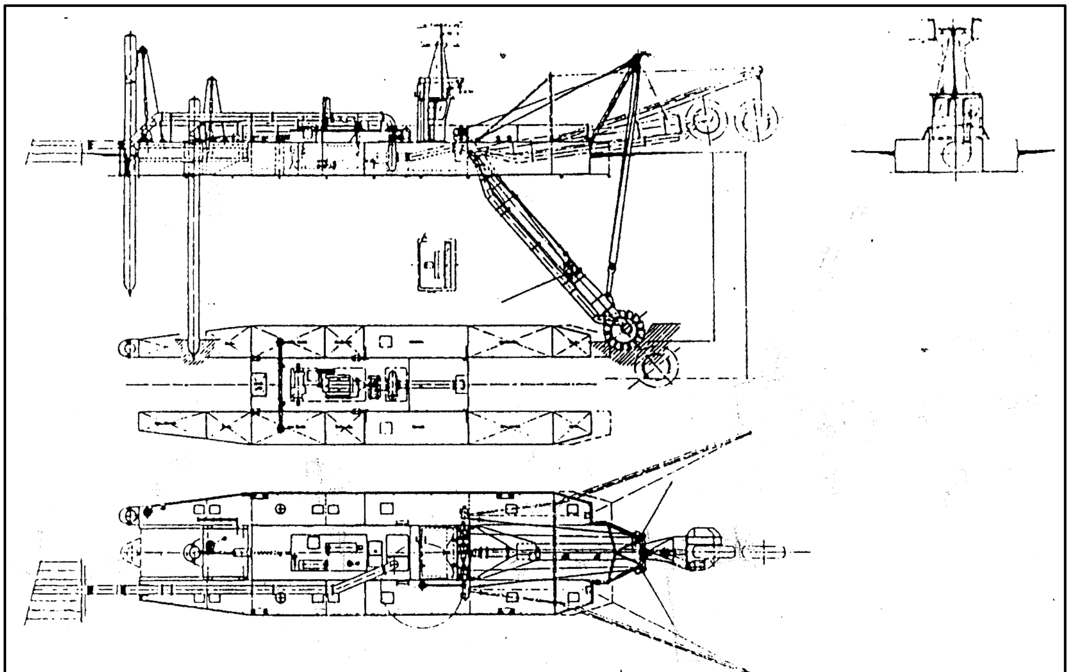


FIG.10 BUCKET WHEEL SUCTION DREDGER

3.0. DREDGING INDUSTRY

3.1. General

The industry has two distinctive features varying widely on approach, capital outlay, type of dredger and mode of dredging. First one relates to all the major ports and harbours inclusive of large minior ports and secondly we have the small fishing harbours. inland weterways. lakes, ponds. reservoirs etc. Although the industry virtually bi-furcated. only one of the leaders in the industry i.e.; Dredging Corporation of India is geared to cater both the areas, the first one being their monopoly and they have also ventured into the second area, with not so much of success.

3.2. Prior to formation of Dredging Corporation of India, major Port Trusts carriedout dredging operations with their own fleet of varied type of dredgers, capital dredging or intensive maintenance dredgers requirements of the ports were met by foreign contractors. Lacunae of this system with one port having more capacity than their requirement was somewhat negated by temporary transfers of crafts between ports. With further modernisation of POtts after 60's and increase in tonnage of world shipping, dredging activity of the country had to be augmented. As a central dredging organisation with dredgers of their own and catering to the needs of the ports, M/s. Dredging Corporation of India was established.

3.3. Other than D.C.I. and Major Ports, there are no other organisation in India which has large Trailor Suction Hopper Dredgers and sophisticated large Cutter Suction Dredgers, to work in Ports/Harbours and their approaches from the sea.

3.4. For the second part of the industry we have a number of public and private organisations which owns mostly smaller cutter suction dredgers. Except one or two of them they are all portable. Dredgers owned by States, statutory authorities, are numerous in number but majority of them are defunct or running at a very low efficiency. Private organisation owning proper 'Dredgers' are few and can be counted on finger tips.

4.0. Selection of dredgers — types & mode of disposal :-

4.1. Dredgers cannot be selected by intuition only. In the past we have come across typical hopper suction dredgers for cleaning the navigable channels and dumping the spoil from the hoppers in a convinient place, either at sea and/or deep areas of rivers. The beneficial aspects of spoil to be utilized for reclamation, sand winning etc. were not in the minds of authorities specifying the dredger construction. Over the years we have now an expanded choice of craft. instruments and appliances which provides us with a systematic step by step procedure to specify the best dredger suitable for particular ports and its environs.

4.2. The selection criteria are determined by the confines of soil, kind of work, logistics, environment and other (e.g. legal) implications. Soil characteristics understandably are of utmost importance, since the need to more soil is the reason for dredging. Thorough soil investigation is therefore essential for any kind of project, to avoid the undesirable situation where the actual conditions require an entirely different kind of dredger than the one reserved for the job. Further more the soil properties, such as grain size distribution. also determines the production of dredger or the wear it has to cope with. In fact the entire dredging process is influenced by the soil characteristics.

4.3. Accessibility and manoevering space within the area dictate size and mobility of the dredger. Weather, seastate, tides, streams and depths can impose design and work procedures specially in untamed tidal esturies and rivers. Beach nourishment, sand by passing system and offshore trenching are kind of projects where the tension between dredq.nq efficiency and seaworthyness dictates the dredger's charecteristics.

4.4. Other requirements may also impose limitations on the dredging operation e.g. legal or environmontal consideration such as the need to severely restrict amount of pollution caused by dredging process. This also calls for a comprehensive study when the same dredger is used for several different projects. The selection is also determined by economic consideration. High investment costs should be weighed against alternatives that are probably less suitable for a particular project, but are also less costly. On the other hand, a more expensive dredger can be selected when its production characteristics reduce the price per M3 dredged in comparison with a cheaper but less efficient dredger. In fact the Dredging Corporation of India, owner of the largest fleet of dredgers in India/ nearby South East Asian countries, have gone in for versatile type of dredgers which are regularly used for dredging very thin silty sand as found in Haldia approach channeljKandla creek and heavy sand of Paradip, There is of course a lot of dredging efforts lost in this concept of versatility. However in India today neither we have a dredge training school or a programme for adaption to various kind soil dredging.

5.0. Dredging Requirement 1991-2000 A.D.

5.1. Major and Large Minor Ports etc.

5.1.1. India's coastline stretches to about 6000 Km, 12 major and 146 minor ports are spread along the coastline inclusive of riverine major ports of Calcutta, Haldia, Kandla etc.

Several Navar establishment and major waterfront Shipyards are situated in the East and West Coast. It is imperative that in or derto maintain the specified draughts for safe navigation of vessels of Merchant Navy and Indian Navy, in these vital areas, dredging is essential.

5.1.2. A summary study of the requirement till the year 2000 A.D. is detailed as per Annexure -1 and 2 indicates a total requirement of -48.74 million cubic mtrs., of maintenance and capital dredging to be carried by dredgers owned by Major Ports and Dredging, Corporation of India etc. Details of requirement is annexed as Annexure - 1 & 2.

ANNEXURE—1

Dredging requirement of major ports during VIII Plan with possible spill over to the IX Plan i.e. ; upto 2000 AD

Sl. No.	Major Ports	Maintenance req. in L.Cu.M by Trailor Suction Dredgers and large cutter suction dredger	Capital Dredger req. in L.Cu.M Trailor Suction Dredger and large Cutter Suction Dredger	Total requirement in L.Cu.M
1.	Cochin	613.00	88.00	701.00
2.	Marmugoa	150.00	203.60	353.60
3.	New Mangalore	370.00	194 24	564.24
4.	Bombay	235.00	—	235.00
5.	Kandla	235.00	32.00	267.00
6.	Nabha Sheva	60.00	194.24	254.24
7.	Calcutta	1000.00	—	1000.00
8.	Paradip	150.00	169.00	319.60
9.	Madras	107.50	130.08	237.58
10.	Vizag	84.05	192.00	276.05
				4208.31

ANNEXURE—2

Total dredging requirement by Navy and Shipyard and minor ports during VIII Plan with possible spill over to IX Plan i.e. ; 2000 AD

Sl. No.	Place	Maintenance dredging by Trailor Suction Dredger and Large Cutter Suction Dredgers in L.Cu.M	Capital dredging rqrd. by Trailor and large cutter suction dredgers	Total requirements in L.Cu.M
1.	Karwar	51.0	35.2	86.20
2.	Kakinada	25.0	45.76	70.76
3.	Goa Shipyard	3.0	—	3.00
4.	Hindusthan Shipyard	60.0	—	60.00
5.	Cochin Shipyard	5.0	—	5.00
6.	Various Fishing Harbours	75.0	—	75.00
7.	Navy	205.8	160.0	365.80
				665.76

5.0. Present status of dredgers in India

5.1. Dredging Corporation of India, a public sector undertaking, under the administrative control of Ministry of Surface Transport was incorporated in the year 1976 to cater to :

i) Enhanced needs for Capital 'and Maintenance dredging of major ports in India.

ii) Land reclamation, shore nourishment, wreck removal, marine salvage and towage.

iii) Desiltation of ponds, reservoirs, lakes, rivers and inland canals.

5.2. Prior to the formation of this public sector organisation, major ports and some minor ports used to attend to their dredging needs with their own fleet or at times with crafts borrowed from any other port with excess capacity.

5.3. For capital dredging and for extensive time bound maintenance dredging, foreign contractors used to be invited to work. This need is now fully met by Dredging Corporation of India.

5.4. A detail list of present pOSItIOn of all types of dredgers owned by Dredging Corporation of India and by Major Port Trusts are appended herewith.

5.5. It is to be noted that average yearly eombined capacity of major ports and Dredging Corporation of India comes to :

D.C.I. capacity	702.50 L.Cu M
Major Ports capacity	12545 L.Cu.M
	827.95 L.Cu.M

against an average annual requirement of only for the VIII Plan is 9.74 L.Cu.M.

5.6. Although the VIII plan did provide additional capacity to be added for the purpose of augmentation the procurement action have positively spilled over to the IX plan.

5.7. Dredging Corporation owns the following dredgers.

Sl. No.	Type of Dredgers	Hopper Capacity	Building year	Name of Vessels
1.	Twin Screw Hopper Suction	3450 M^3	1974	D.C.I. Dredger V
2.	- do -	3770 M^3	1975	D.C.I. Dredger VI
3.	- do -	6500 M^3	1977	D.C.I. Dredger VIII
4.	- do -	4500 M^3	1984	D.C.I. Dredger IX
5.	- do -	4500 M^3	1986	D.C.I. Dredger XI
6.	- do -	4500 M^3	1990	D.C.I. Dredger XII
7.	- do -	4500 M^3	1991	D.C.I. Dredger XIV
8.	Non-propelled Cutter Suction	Solid Pumping Cap. 1000 M^3/hr.	1976	D.C.I. Dredger VII
9.	Self propelled Cutter Suction	3000 M^3/hr.	1977	Aquaris
10.	Dumb Portable Cutter Suction	150 M^3/hr.	1984	D.C.I.,I.D.-I
11.	Crawl Cat	80 M^3/hr.	1989	D.C.I.,I.D.-II
12.	Portable Cutter Suction	350 M^3/hr.	1991	D.C.I.,I.D.-IV

D.C.1.has presently placed order on I.H.C. Holland for procurement of a 7500 M3 capacity Hopper Suction dredger and is proposing to place order for another (2) two numbers 4500 M^3 Hopper Suction Dredger.

9.8. Dredgers owned by various ports

Sl. No.	Type of Dredgers	Hopper Capacity	Year Built	Owner	Name of Craft
1.	Trailing Suction Hopper	4740 M³	1978	Calcutta Port	S. D. Mahagunga
2.	Bow Well Suction Hopper	1700 M³	1961	—do—	S. D. Churni
3.	—do—	1274 M³	1966	—do—	S. D. Subarnarekha
4.	Trailing Suction Hopper	2512 M³	1977	Vizag Port Trust	S. D. Varaha
5.	Trailing Suction	2500 M³	1976	Kandla Port Trust	S. D. Kutcha Vallabh (being replaced)
6.	—do—	990 M³	1970	Bombay Port Trust	Vishal
7.	—do—	1615 M³	1962	—do—	Vikram
8.	Trailing Suction	2500 M³	1975	Cochin Port Trust	Mattanchary
9.	—do—	1111 M³	1973	Madras Port Trust	Coleroon (being replaced)
10.	Grab Hopper Self	500 M³	1973	V. P. T.	Durga
11.	Grab without Hopper	110 M³	1948	V. P. T.	Mudlark
12.	Grab Hopper Self Propelled	611 M³	1977	Cochin	Bolghatti
13.	Cutter Suction Dredger Non-Propelled	—	—	C.P. T.	Netai
14.	Cutter Suction Dredger Portable	—	—	C. P. T.	Madhai
15.	Grab Hopper Self Propelled	850 M³	1959	B. P. T.	Vikas
16.	—do—	890 M³	1978	—do—	Virhat
17.	Grab Dumb	—	1967	—do—	Vindur
18.	—do—	—	1967	—do—	Vasishta
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Onward into the Era of Opportunity

Shri B S Makhija, *MBA, CEng, FIE, FIMech E, FIGas E,*

Marine Consultant
Visiting Lecturer, Engineering Management, University of Hong Kong
Ex-Principal Surveryor of Ships, Hong Kong Government and Engineer and Ship Sureveyor, Government of India

INTRODUCTION

For too long engineers have been expected to confine themselves to defmed and limited roles within organisations. This shackle, for which en.gineers themselves must bear some responsibility, is eventually in the process of being broken. But its pace must be accelerated if our economic progress is not to be inhibited. In an era where technology is the vehicle for promoting excellence in industry and generating new business options, the key to success lies in engineers being well endowed in both technical and management skills.

As one who believes that engineers - the wealth creators of our times-may freely poach territories outside their conventional niches, the author makes no apology for his transgressions. He may, however, be forgiven for being irresistibly drawn to a piece from Blondie cartoons in prefacing this paper.

Bumstead: I've been here a long time without a promotion, Boss.

Mr. Dithers : So you have.

Bumstead: Tell me, how can I move up ?

Mr. Dithers: There's only one way for you to move up. Put lifts in your shoes.

Noengineer who takes his professional development seriously and has the necessary personal attributes need put lifts in his shoes to move up. But those who do not take the trouble may have even a worse fate awaiting them. They may soon be redundant. We live in times where change and innovation have become the way of life. Jobs are being frequently redesigned as organisations increasingly strive to be at the cutting edge to combat competitive pressures. The concepts in today's organisations are efficiency, productivity and quality. Leaner, flatter and flexible structures are necessary to achieve these aims for quick response to global markets.

THE IMPORTANCE OF VERSATILITY

As a consequence of the new developments only organisations that can continually adapt to the ever-changing demands of the market place can succeed in the long term. This accounts for the recent re-engineering ofmany of the world's leaning companies, radically changing jobs and the skills they require. With this trend, the talents in demand today may be outdated tomorrow. Present day engineers thus need to be highly versatile and have the ability to acquire a wide variety of skills, both now and in the future. Not only must they keep up with the accelerating pace of technology but also cope with business pressures.

Another area causing worldwide concern today that engineers must engage in is ecology. Much of the industrial development to this time has been so haphazard that it is fast leading to exhaustion of our irreplaceable resources and deterioration of the environmental ecological balance. We must recognise that the abuse of nature and its resources cannot be allowed any longer.

Not to be seen as some environmental buffs exhortation, a new challenge that engineers ought address is to remedy the ills arising from blatant disregard of the environment. In the face of clamour for greater industrialisation amongst the underdeveloped nations and ever-growing wants of the more privileged, it is a balancing act demanding great ingenuity, In their new role engineers must go beyond today's competitiveness and tomorrow's growth. Social responsibility should be one oftheir major concerns.

As society's demand for a better life-style grows, so does the need for translating scientific innovation and refining existing knowledge into various applications. Accomplishing these tasks presents engineers with exciting challenges as also opportunities like never before.

This in not to say there will be jobs galore for engineers or for that matter any other 4 professionals in the future. There will be a lot more work to be done, resulting in increase in demand for specialised skills but not as many jobs.

The current pressures had resulted in widespread downsizing, aimed at making organisations lean and agile. But organisations must guard against becoming so lean that they cannot handle change. The purpose is to trim fat, not muscle Cost cutting, together with improved productivity, quality and efficiency will, nevertheless, be the order of the day.

RE-ENGINEERING

Re-engineering, the process referred to earlier, is a total review of an organisation's operations, tapping into trends and ideas that sit with its vision. Its purpose is to ensure that the organisation is performing as well as it should and maintaining its competitive edge. It is an in-depth examination of where the organisation is and where it wants to be, unencumbered by any hangover from the past.

Re-engineering involves a complete re-appraisal of the organisation's strengths and its weaknesses, its management and its policies its business objectives and aspirations, its human resources and their deployment, its technology and equipment as also its finances and other assets. It is an exercise demanding meticulous implementation of a well thought out plan of action and is often accompanied by radical changes. There are no sacred cows.

The foundation of re-engineering, in the author's view, was perhaps unwittingly laid with the total devastation of Japan's and Germany's industries after World War II (WWII). While Britain, for example, basking in the glory of victory, went on the reconstruct its partially destroyed shipyards on traditional lines, the Japanese were forced to start from scratch with a clean slate. Adopting the latest technology and supported by an ingenious workforce eager to pick up the pieces, they rebuilt their shipbuilding industry leaving the erstwhile leaders way behind.

One of the worthwhile lessons ofWWIIwas that victory in war did not necessarily lead to a nation's prosperity. It's the economy. And re-engineering was the way to vitalise it. The problem with re-engineering, however, is that it is not a painless process. It, interalia, involves downsizing, de-layering and restructuring, bringing in new people while retrenching some.

Because vested interests may inevitably be hurt, its execution is better left to out side consultants with the necessary expertise. Its success, however, hinges on full commitment and support from top management.

The plan, once finalised, will require being sold to the organisation, identifying both its positive and negative aspects. By and large, the proposals must appear fair, given the organisation's long-term objectives, Otherwise, those entrusted with the task may themselves feel threatened and demotivated. It is essentiaJ that they pursue their responsibilities with energy and enthusiasm. Anyhalf-hearted attempt at implementation of the project may do more harm than good. The whole process of assessment, planning and execution must be conducted with precision.

The top management must be closely involved throughout the exercise so that it is continually monitored and necessary adjustments made as it proceeds. Finally, once the project is completed, it should be carefully reviewed at close intervals to ensure that it is yielding the expected results.

IMPACT OF ECONOMIC PROGRESS

In the rich countries manufacturing provides fewer jobs today than it used to, following increase in manufactured exports by developing countries like China and Brazil. The share of manufacturing in, total employment in rich economies fell from 28 per cent in 1970 to 18 per cent in 1994. In the USAmore that 70 per cent ofworkers are now employed in services and the figure is expected to increase. Its, reason is that productivity is growing much faster in manufacturing than in services in the developed world-the rate being more than. twice as-fast. This has shifted employment from manufacturing, where now fewer workers are needed, to the service industry, where more workers are needed.

The trend, which began in the USAand spread to Europe and Japan, followed by the Far East, especially Hong Kong, is already becoming visible in developing countries like India. Part of the shift may also be explained by manufacturing firms tending to hire outside help for services that-were earlier provided in-house, e.g., accountancy, payrolls, recruitment, office mail, house-keeping, transportation. And growing demand for jobs in teaching and training, financial and technical consultancy, information technology, etc. is expected to further boost the services sector.

Not with standing the current shift, manufacturing is the major occupation of er:gineers in one form or another. And they must be adequately equipped to produce competitive products. The must face competition in a world where market forces have made globalisation inevitable. There is no way any nation can escape the rapid process oi integrating with world economy unless it deliberately chooses to stay poor and backward. We must adopt to live with the new trends that sit with our special circumstances and not fear competition. Competition brings out the best in human talent. And it is engineers who are best placed to meet the challenge of competitiveness. They have the knowledge and skills to put innovation to work.

OUTSOURCING

Another recent trend changing the way many engineering based industries operate is outsourcing. Especially, those engaged in electronic, automotive, aerospace and medical industries, find outsourcing increasingly attractive in today's economic climate.

Computerised machining centres, for example, need enormous investments. Besides the equipment, they need expensive machinists and maintenance. Firms offering the service are usually well provided with both the machinery and manpower to meet a wide range of orders from a few individual components to complete assemblies. They not only have advanced technical capabilities in their specific activity but also have built-in flexibility and engineering know-how that may be difficult to match in-house.

Firms specialising in this form of service must have intimate knowledge of the industry and marketing trends with up-to-date technology to create new products. A manufacturing firm, for example, may wish to outsource its next generation product to stay competitive in a rapidly changing market so that it can concentrate on its core competencies. It may not have the internal resources to carry forward its plans. Yet, it must if it is to maintain its reputation and marketshare. Through outsourcing, the firm is enabled to extend its activities without having to invest in or manage a new facility of 4 its own. And with the partnership, the new product moves rapidly from design to delivery, efficiently and cost-effectively.

As a result of globalisation of the world economy, outsourcing firms site their facilities where the markets are. Locations are carefully selected to permit low cost manufacturing with high volumes.

Outsourcing contractors offer interesting opportunities to high calibre engineers seeking early responsibility with rapid career advancement.

NEED FOR UPDATING

When the author first went out to sea, WWII had just ended and ships powered by steam reciprocating engines crawling at 7 knots were the most common. Steam was supplied by coal-fired Scotch boilers, often on natural draft. Frequently, there was no running water in cabins or crew bathrooms, nor refrigeration to preserve food.

Engine-rooms were unbearably hot in summer, with temperatures in 40s (C) and boiler tops, which needed tending from time to time, at around 50 C. Even engine-room ventilator blower fans were regarded a luxury.

Woe betide the engineers if a boiler tube burst at sea, when one would have to don wet gunny sacks to brave the extremely hot combustion chamber and the too in rough weather.

Then in the late 40s, as shipbuilding started to pick up after the war-scarred years, motorships began to make their appearance, soon to supplant the old steamships.

And today, we have automated ships, with powerful engines often operated from air-conditioned control-rooms with computers on bridge. The importance of continually up-dating one's knowledge and skills thus becomes starkly clear, if one is not to be seen as obsolete and a part of history.

ADVANCES IN SHIP SURVEYING

In the author's own area of ship surveying, too, things are changing rapidly. Over the last ten years the use of fibere optic endoscopes, borescopes and more recently videoscopes are becoming the common tools for visual inspection of diesel engines, gear boxes, boilers pumps, heat exchangers, fuel tanks, water jackets etc.

The need for indiscriminate removal of bolt after bolt and stripping down of machinery before an inspection will soon be a thing of the past. The hammer and torch, which have long since held primacy as the surveyor's ultimate inspection tools, are fast being overtaken by remote inspection devices and inspection scopes that are efficient and costeffective.

Then there are thermal imaging cameras and a variety of other equipment becoming available for condition monitoring. With the information thus gathered, engineers may decide whether or not to open the machinery, saving time and money in the process.

With developments such as these, together with rapid advances in computers, and communication technology, it should even be possible to download the information through compu ters via Satcom, thousands ofmiles away, to surveyors or superintendents on land. Thus the whole manner of ship inspection and surveying is in for some radical changes.

CONTINUING PROFESSIONAL DEVELOPMENT

It would be seen from the foregoing account that had the author's knowledge and skills been limited to those acquired in his early years, he would be a total misfit today. Clearly, the need for Continuing Professional Development (CPD)is not a matter of choice. It is imperative.

CPD is essential for maximising one's potential for lifetime employability and maintaining his professional competence. Aperson's CPDmust encompass the complete range of activities he is engaged in so that he never finds himself inadequately equipped at any stage of his working career.

The objective is to ensure development of both technical and business competence so that the engineer is trained to full effect in his job area as also to meet future technology changes.

Today, engineers are expected to be well-rounded professionals. Organisations need to allocate substantial resources towards CPD of engineers if they are to maintain a competitive edge. For world-class performance there must be coordinated support from academe, government and industry. In the USA similar cooperation in R&D has led to commercial exploitation of research and around 4,000 businesses have sprung from the MIT along.

At the current pace of technological advances, at least three per cent to five per cent of the time at work should be dedicated to professional development. As ones with the know-how for transforming scientific developments into products, engineers are the key to our progress. The rewards are likely to well outweigh the cost.

CPD programmes are of necessity individual, formulated on the basis of one's needs and aspirations and the business needs ofthe employers. In general these should cover:

(a) developing technical knowledge and skills in the individual's own specialism

(b) broadening technical knowledge and skills parallel to one's own, including entrepreneurial skills, enabling him to move laterally, should the need or opportunity arise; and

(c) acquiring non-technical skills, e.g., management techniques, presentation and communication skills finance and relevant law, for assuming wider and greater responsibilities.

On the job activities and everyday situations in the work place also represent a significant proportion of one's learning.

NEW APPROACHES TO LEARNING

The electronic revolution is changing the face of conventional learning. Starting with the Satellite Instructional Television Experiment (SITE). satellite communication was used for the first time in India in the mid-seventies to beam educational programmes into homes. Then followed the more innovative UGC programmes. And now, the advent of world-wide-web is a further advance over the way we may educate ourselves. Leading universities around the globe are offering course materials as alternative to classroom teaching and corporates providing their training programmes, all sitting at home. Already, the multimedia programming system-a mode eminently suited to the engineer at sea - is transforming the way distance learning works. Most programmes need no previous computer knowledge. Short ofone - to - one instruction, it is probably the best form of training one can get.

A gear pump for instance, can be animated to show fluid flow and the pressure gradient around the gears providing clear understanding of the principles involved. This gives the multimedia programming a clear advantage over written or video material and is being rapidly recongised as an efficient and cost - effective method in training. With face to face interaction on the cards and other advances in computer technology, the possibilities in distance learning are vast. And rather than going to a second rate university, it may be the preferred choice for higher learning.

VALUE OF PERSONAL ATTRIBUTES

Early in this paper reference was made to the necessity of personal attributes. A fact of life is that highly qualified people do not always get to the top. According to a Harvard study, too often it is not their brightest who are the most successful.

To get ahead, first, there has to be the basic need for achievement, but more importantly, the right attitude of mind. Attitude is a significant factor in all positions. The problem is, it is not easily changeable, while skills are relatively easy to acquire. Modem organisations do not just look for knowledge and skills. They look at the whole person - his head and heart, and basic personality traits.

According to Peter S. Drucker - the business management guru - the future organisations will largely be composed of specialists who must direct and discipline their own performance through feedback from colleagues, customers and superiors. This calls for interaction and mutualism. The university topper with an "Iam what I am" approach, who is an indifferent team player and lacks commitment to the organisation's business objectives will be a disaster despite his assets.

As in one's personal life, success at work requires positive thinking, a natural interest in people and a sense of personal values. Personal values include integrity, courage of one's convictions, fair-mindeness, and self-discipline, among others. Self-confidence, sense of humour, compassion, humility, openness, adaptability, determination to succed, even temperament and keeping one's head in a crisis, are the other valuable qualities that cannot be readily taught.

Then there are leadership, entrepreneurship, social etiquette, street smartness and conceptional thinking, together with the ability to articulate - both in writing and speech - to put one's ideas across. The list is undending and few have them all. Yet, one should strive to acquire or cultivate as many of the attributes as possible, if he is to get ahead.

CONCLUSION

Besides positive personality traits, what the modern engineer needs is a T-shaped skill profile - a broad horizontal band of general skills with a deep vertical pool of expertise in a specific area. The combination should provide an in-built flexibility and an appreciation of the kind of continuing personal and professional development needed to cope with changing conditions.

The current turmoil in the-industrialised world, triggered by fissures in the Far East economy, has. spared few. With globalisation, on country is insulated. Industries across the board, whether, manufacturing or service, are having to lay-off and unemployment is growing. Organisations need to understand how the industrial landscape is changing and ask themselves whether they are addressing those changes. For therein lie opportunities for the future. The forward looking are responding with new ideas in product innovation, in processes, in customer service and in people motivation.

As in the past, in tomorrow's world too, there shall be demand for engineers with specialised skills. In fact, a lot more. But the real winners shall be the broad-based professionals, with the necessary personal attribu tes and imaginative minds, who can see the big picture.

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The Indian 1 MW Floating OTEC Plant — An Overview

Shri M Ravindran

Director
National Institute of Ocean Technology, IIT Campus, Chennai, India
E-Mail:mravi@niot.ernet.in

INTRODUCTION

India is geographically well placed as far as the OTEC potential is concerned. Around 2000 km of coast length along the south Indian coast, a temperature difference above 20°C through out the year is available. That is about 1.5 x 10^6 square kilometeres of tropical water In the Exclusive Economic Zone around India with a power density of 0.2 MW/km^2. Apart from this, attractive OTEC plant locations are available around Lakshedweep, Andaman & Nicobar Islands. The total OTEC potential around India is estimated as 180,000 MW considering 40% of gross power for parasitic losses. This indicates the promise of OTEC for India and points out the urgent need to develop OTEC technology.

BACKGROUND

The Indian OTEC programme started in 1980 with the proposal of General Electrical Co. of USA to install a 20 MW plant off the Tamil Nadu coast and subsequently in 1982, an OTEC ceU was formed in the Indian Institute of Technology, Madras. A preliminary design was also done in 1984 for a I MW closed Rankine Cycle floating plant with ammonia as working fluid. After a bathymetric survey, a land based, I MW capacity OTEC plant was suggested for one of the islands of Lakshadweep group and a detailed design report was also prepared.

In 1993, National Institute of Ocean Technology (NIOT) was formed by the Department of Ocean Development (000), Government of India to pursue the research activities on ocean energy as part of their various mission-based activities. Under this mission a major thrust was given for, the technology development for OTEC. Early 1997,000, Government of India proposed to establish a 1 MW gross OTEC plant in India. which will be the first ever MW range plant established anywhere in the world. NIOT had been exploring the participation of national and international expertise for a joint research and development. Saga University in Japan, headed by Prof. Uehara, has been doing excellent and practically oriented R&D on OTEC for more than twenty five years and this team also showed keen interest in closely working with NIOT on OTEC technology development. Considering this, an MOU was signed in 1997 between NIOT and Saga University. Japan for a joint development of OTEC in India. NIOT conducted detailed surveys at the proposed OTEC site near Tuticorin, South India. Based on the temperature and bathymetric profiles, the optimization of the closed loop systems was done with the help of Saga University in 1998[1].

The bathymetry of the coast around main land of India where cold water at a depth of 1009 m is available at about 40 km from the shore necessitates the use of a floating platform to house the OTEC plant. There exist some locations where a shell mounted OTEC plant can be constructed at a depth of 200 m. However, considering the future need of large plants, it was decided to design a floating OTEC plant. NIOT aims to build a I MW floating OTEC plant off the coast of Tamil Nadu near Tuticorin port on the south east coast of India which is free of cyclones in the last four decades.

After arriving at the detailed specifications of power module a global tender was floated during October/November '98 for the various sub-systems like heat exchangers, turbine-generator, seawater pumps etc. Tenders have been analysed and orders have been placed. NIOT is currently involved in the detailed design of the power system and components on the floating barge and the assembly is expected to start on March 2000.

POWER MODULE AND SEA WATER SYSTEMS

All commercial OTEC plants are expected to be 10 - 50 MW range or larger. Therefore a I MW gross power output plant is selected for the present design, considering the scaling up for the future. The design of the power module is based on a closed Rankine Cycle with ammonia as the working fluid [2]. Titanium plate heat exchangers are suitable to such an environment. A cold water pipe made of HDPE of Im outer diameter is selected, as it is the largest diameter locally available. Axial flow turbine having a higher adiabatic efficiency is chosen for power conversion and also for easy scaling. up for future. The following are the baseline design conditions and the schematic diagram is given in Figure 1.

Gross power output	1 MW
Warm water temperature	29°C
Cold water temperature	7°C
Cold water intake	1000 m
Cold water pipe (ID)	0.90 m

The evaporator and condenser consist of four modules of plate heat exchangers, which will be largest of its kind used for such an application. The ammonia side of the evaporator is coated with stainless steel powder to enhance the overall heat transfer co-efficient. The coating is expected to improve the power output by 20 - 40%

Radial inflow turbines have been previously used in the US-Mini OTEC experiment. The power system flow rates and net power is very much dependent on the turbine efficiency. Parametric studies showed that a 4- stage axial turbine could improve the efficiency up to 89%. The basic aerodynamic design of the turbine is done by NREC, Massachusetts, USA. While the original intent was to operate the turbine as a direct dri ve at the 3000 rpm, the commercial non-availability of the generator necessitated the use of 1: 2 reduction gear box.

The seawater pumps are of vertical, mixed flow type due to the low head and. high discharge combmation. Two identical pumps are to be connected in parallel on both warm water and cold water side and are driven by a variable speed drive to adjust the flow rates. As the system is highly sensitive to the flow variables, a variable speed drive is an essential component in an OTEC system.

There are several configurations for cold water pipe mooring. After studying several options the concept finalized consists of a floating platform connected to a cold water pipe which itself acts as mooring for the platform as shown in the Figure 2. Makai Ocean Engineering, Hawaii, carried out the conceptual design of the seawater systems. The platform assumes a great significance due to the fact that it houses the entire plant, accommodate the seawater pumps and the cold water pipe or mooring system. NIOT has carried out studies with the help of numerical simulation as well as model tests to arrive at the motions and stresses in the vessel and pipe. The simulation for the barge and pipe combination has been carried out using the software called Visual Orcaflex. The motion studies for the barge were carried out using software like TRIBON and WAMIT. In addition to this model studies were carried out in the model sea basin of size 30 m × 30 m × 3 m at the Ocean Engineering Centre in the Indian Institute of Technology, Madras [3].

A brief comparison of the current design with the previous OTEC plants in the world is given in the Table 1. It could be noted that as a whole the current system is large and complicated compared to the previous demonstration plants.

EARLIER INTERNATIONAL OTEC PROJECTS AND LESSONS LEARNED

A complete OTEC system was constructed, deployed and operated successfully at the sea off shore Hawaii in the US Mini-OTEC program during August-November '79. In this first demonstration of OTEC power with an installed capacity of 50 kW gross, the net power was low due to fact that the turbine generator could operate with only at 53% efficiency. Also seawater and ammonia pumps were operated at roughly half the efficiency consuming 35 kW of the gross power produced.

OTEC-l experiment, sponsored by Department of Energy, USA and conducted by Argonne National Laboratory, was to simulate OTEC heat exchanger operation. It used shell and tube titanium heat exchangers. The project gave valuable information about the operation of heat exchanger, the deployment of cold water pipe and also about the bio-fouling control. The turbo generator was replaced by a throttle value. It was operational only for four months in the year 1981 and hence seasonal variations on OTEC system could not be studied.

The Nauru plant in the Pacific region was a shore based plant with Freon-22 as the working fluid for a Rankine Closed cycle and it had optimal environment for an OTEC Plant. It was operational for nearly ten months from October 1981. The heat exchangers were of shell and tube type with titanium as material. The evaporator tubes were coated with sprayed copper particles to improve the heat transfer co-efficient. Nauru test provided accurate experimental data on the performance of the power cycle and the construction and operation of a pilot plant. It provided record for gross and net power production and the power was supplied to the grid [4].

In 1992 a land based open-cycle experimental plant, with funding from PICHTR, was designed, built and operated by Dr. Luis A. Vega and his team for a 210 kW gross output. This was the first open cycle plant after Claude's pioneering work. It could produce a record of 255 kW gross and 103 kW net. This plant provided much valuable information such as the corrosive nature of seawater, violent outgassing of cold seawater, unstable synchronous generator output due to the large inertia of the turbine etc. The equipment, which caused frequent trouble to the system, was the vacuum pump [5].

OTEC ECONOMICS

The OTEC power can be cost effective only if the unit cost of power produced is comparable with the fossil-fuelled plants. OTEC system can also have other benefits like enhanced mari culture, desalination or even air conditioning, which might reduce the cost of electricity generated. As OTEC is capital intensive, Government agencies may provide substantial initiative in developing the technology. Dr. Luis A. Vega has done extensive work on OTEC economics for open cycle plants and closed cycle plants [6].

For small plants of 1 MW range the unit power generation cost is considerable compared to other conventional energy sources as shown in the Table 2. The co-production of fresh water along with power is to be considered for the estimation of unit cost for OTEC plants in islands [7]. It is apparent from the study of Dr. Vega that OTEC is economical and production cost is comparative for higher range of plants. The unit cost of electricity is estimated for Indian conditions for a range of 1MW to 100 MW as shown in Table 3 adopting Dr. Vega's calculation procedure. It could notice that OTEC plants of 100 MW range are competitive with other conventional energy sources such as coal or hydel power plants. In comparison with other renewable energy sources such as photovoltaics and windmills OTEC stands lower for unit investment cost as shown in Figure 3. There are steep cost improvements for these energy sources. The learning rate (the pattern of diminishing costs with increasing experience) is nearly 20% for photovoltaics and windmills. The same result can be expected for OTEC in future with increase in experience and development of technology.

CURRENT ISSUES AND FUTURE PLANS

It is postulated that most of the future commercial OTEC plants are closed-cycle, floating plants of 25-50 MW range. But plants of 200-400 MW range are also feasible and economically more attractive. The commercial plants should be proceeded by demonstration plants of smaller range for power cycle optimization and also for operational information. The design, development and operation of a power system in a hostile sea environment is a great challenge.

The capital cost of the plant is depending much on the heat exchanger cost and hence any improvement in the performance in this single component is an added advantage. Attempts are to be done to find out a proven technology for heat exchangers in seawater conditions with higher heat transfer co-efficient for considerable period of time. The design, fabrication and deployment of seawater system in the environment of the sea is a matter of considerable attention. New materials for the cold water pipe is to be developed to withstand the marine conditions and also for easy fabrication and deployment. The design of the barge also requires care so as to position the seawater pumps for the required Net Positive Suction Head (NPSH). The equipment and the piping system are to be assembled on the barge such a way that the static head and the minor losses are the least. Bio fouling on the warm water circuit and the release of the dissolved gasses in the cold water circuit is a problem to be attended for a considerably long period. As the floating plants are away from seashore underwater power transmission to the land is an area needed further study.

After the completion of testing of the 1 MW OTEC plant, NIOT plans to shift the same plant to the Andaman & Nicobar Islands for power generation. This will be a stepping stone for the proposed 10-25 MW range shore mounted power plants. The experience from IMW floating OTEC plant could be scaled up for the construction of 100 MW range commercial plants in the nearby future.

CONCLUSIONS

It has been assessed that by the year 2010 about one thousand OTEC plants will be installed of the range 1-100 MW [8]. Now there is a considerable interest in different parts of the world though there was sluggishness in OTEC research during 1985-1995 period due to the fall in oil prices. The key problem is now no longer technological or commercial, but the establishment of reliability and confidence. There is an absolute necessity to build demonstration plants representing the nature of future commercial plants. The demonstration of 1 MW Indian OTEC program is expected to contribute in a large way to provide this confidence to the future.

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Rear Admiral T B Bose Memorial Lecture

Cmde H S Kang, *AVSM, VSM, IN (Retd.)*

It is a great privilege for me to honour the memory of Rear Admiral T.B. Bose by delivering this Memorial Lecture at the 14th National Convention of Marine Engineers. Admiral Bose had an illustrious career both in the Royal Indian Navy as well as in the Ministry of Transport where he held several important assignments. He had twenty years of uniformed service starting from 1933 and was the Principal Officer, Mercantile Marine department & the Chief Surveyor to the Government of India from 1952 onwards, when his services were lent to the Ministry. He was deeply involved in the training systems for Marine Engineers at the DMET and even after his retirement in 1963, he continued to take keen interest in several Marine Engineering activities. His legendary career, encompassing various aspects of the emerging Maritime scenario, during the formative years of our demo\cracy, was full of rare achievements and has since served as a beacon of inspiration for successive generations of Indian Mariners.

The theme of this convention is New Challenges to Shipping in the 21st Century and I am happy to see the determination, optimism & enthusiasm with which this distinguished assembly has resolved to not only identify the challenges but to also take the gauntlet and meet them head on. It is indeed a tribute to Admiral Bose that the Maritime community in India has amply proved their merit and accomplished so much with so little investment. I will place before you my thoughts on what the Maritime sector needs to do for 'Leapfrogging to a Position of Leadership in the Infrastructure Sector'.

At the threshold of this new millennium India is poised to take it's rightful place among the polity of Nations. Recent developments are witness to our country emerging as a responsible and stable democracy with significant potential for growth in areas of complex & emerging technologies. Indian Engineers have made their mark in several Industrial and Information Technology driven sectors such as Rail Transport, Heavy Engineering, Bio-technology, Education, Textiles, Jewellery, Pharmaceuticals, Agriculture, Consultancy, Digital Imaging, Medical Transcription, E-commerce, Software support and several others. Our achievements in peaceful uses of Nuclear Energy and the use of satellites for rural communication has enabled us to chart a cost effective short cut for alleviating poverty for a very large number of people. Indian entrepreneurship & diligence are now well established and duly recognized, which explains both, the demand for Indian Engineers & Managers abroad and the desire amongst an increasing number of developing countries to learn from the Indian experience.

The shipping and marine industry however does not reflect this confidence as is evident from the tonnage of Indian registered vessels built abroad, continuing reliance on repair of ships in foreign yards, the low growth rate of freight carried in Indian flag ships, the dismal inland & coastal shipping & transport network, the shift of distribution Hubs away from Indian ports, entry of Philippines, Chinese, Indonesians, other Asian Nations, Turkish & Peruvians in marine training and international job market for ships' crews and indeed the continued threat to the fragile existence of many Indian Shipbuilders & Shipping companies who continue to lead an uncertain existence, are ample evidence of lack of direction and commitment. The reasons for this paradox have been debated for long and time has now come for precipitate action to be taken to give shape & substance to some of the ideas, which had emerged at forums such as this but could not be implemented for want of requisite wherewithal and both the political administrative will to find the necessary resources.

For a growing economy, low cost transportation is essential and it can be made available by addressing the reasons, which underlie stunted growth of maritime facilities and infrastructure. Being the cheapest mode, over water transport should have been developed earlier than the Rail, Road & Air freight options which for decades have taken precedence over it. The damage caused by years of neglect, now requires urgent remedies to enable this industry to leapfrog to the leadership position in the Indian infrastructure sector, which rightfully belongs to it.

The Technology Drive

A lot of exciting technological developments have and are currently taking place, which will continue to impact the marine industry in a profound manner. Firstly the Computer & Information Technologies have already changed the way ships are designed, built, operated and maintained or modernized. Imbedding of increasing quantum of artificial intelligence will in future have ships with minimum human for their operation, which in turn will demand greater versatility & dexterity from the few who remain to manage the future fleets. Design & Training development are therefore likely to become the new-g-rowth areas rather than construction, operation & maintenance of ships. Convergence and fusion of traditionally separate jobs, such as, ship handling, navigation, engineering, communication and husbandry may become necessary or even inevitable. Information technology will also change the way turn around time and traffic in ports are managed. Imagine Electronic Port Clearance (EPC) replacing the current paper heavy run around, which takes several days and is wasteful in terms of time and effort. In EPC the port could receive updated statutory and classification data from the class SOCiety register at the same time as the ship's arrival notification. Notification applying for port clearance will be initiated from the ship whilst enroute and communicated electronically to the port. The EPC also communicates the decision regarding clearance directly to the ship, where the Captain then initiates appropriate actions to determine & intimate his ETA. The IT would progressively impact the entire cluster of related activities that surrounds and supports shipping. Be it the New building & Repair Yards, Equipment manufacturers, Education & Training Institutions, Ports, Consultants, Research institutions, Maritime Authority, Coastal Patrols, Offshore & Petroleum Industry, Seafarers union and others. We need to define a time bound objective for making IT an integral part of Indian Maritime, Establishment and to relentlessly work at it till the best practice benchmark is achieved.

Information Management is heralding another great change, the full impact of which will become evident in the near future. It is the phenomenon of business convergence. The State Bank of India has entered into a joint venture with a French counterpart who pioneered the concept of Bancassurance. There may be several such synergies in the shipping and allied trades. It is necessary to foresee the advantages of specific convergence, initiatives, and to adapt to them for remaining globally competitive and locally cost effective in relation to other modes of transportation.

Secondly the, developments in Coatings & Corrosion Protection Technology continue to stretch the time between dockings, whjch is likely to increase in steps from an average of three to five years to between fifteen and twenty years as the self polishing, highly adherent, impermieable and envirornnentally tolerant and adaptable systems come into the market.

These in their wake, will bring the need for increasing the, time between overhaul & maintenance of under water fittings and appendages or developments in designs, which will permit easy afloat repairs or replacement. Microbiological corrosion has emerged as a major problem experienced specially in the double hulled tankers, both in the double bottom ballast spaces and the flat plate bottom of the cargo tanks. The deep terraced pitting caused by the sulphate reducing bacteria, which employs sulphates as part of their metabolism has been found in double hulled ships where the cargo oil temperature remains higher during the passage than was the case with single hulls. Whilst improved quality control and meticulous attention to detail in terms of surface preparation, are the most logical defenses, it is equally important to specify the coating scheme very carefully for the intended role of the ship. The FPSO's and other craft built to offshore, specifications are, already having a coating life expectancy of twenty years and above. The shipping industry will also realize that in terms of life cycle cost, it makes more sense to, pay a higher capital cost for better paint specifications than to settle for frequent structural repairs spread over the vessel's life.

The third area, is the Development of Structural Composite Materials, which is likely to impact the life span of ships. High costs of new construction coupled with better upkeep and low repair costs, have already pushed the average age of existing vessels from about fifteen to twenty years & this may further increase to twenty five years in the foreseeable future. This trend is likely to continue both due to cost considerations as well as emerging technologies comprising a combination of newly developed materials and real time condition monitoring of structural parts. New technology could enable timely and cost effective replacement or reinforcement of parts in distress, well before a catastrophic failure occurred, making the overall operation safe, dependable and with the lowest overall life cycle cost. This trend will inexorably drive the equipment & systems designs to keep pace with the enhanced life of the hull structure by enabling extensions of TBO 's and TBR's.

Another important technical imperative influencing the future trends in, the maritime industries and enterprises, is the improvement in Understanding of the Hull - Medium Interaction. This could result in emergence of newer and more efficient hull forms for a given payload to meet the markets' demand for faster and cheaper transportation on per ton mile per hour basis. Port infrastructure should therefore be tailored to meet the demands of medium size, high-speed ships. Experiments with various combinations of air & water mediums or a combination of both and with various shapes, could reveal surprises in the as yet unexplored territory both for passenger and the goods transportation segments of this business. Sub surface travel and Ecranoplanes using the wing in ground effect are two extremes between which a large number of possibilities could be systamatically investigated to configure marine hull forms of the future. The advantage in this area would clearly belong to the countries or corporations who can use their Maritime R&D investments most effectively in tune with the state of industrial & technological development available for converting the experimental results into useful products.

As environmental concerns continue to become increasingly important overtime, the future rules governing Pollution Control will also be more stringent, necessiating development of new equipment and processes to ensure compliance.

Port Development & Linkages

Seaports are the gateways to international trade and commerce. It therefore needs no emphasis that for a developing economy, creation and efficient management of port infrastructure are the key elements of growth and employment generation. Maritime trade from Indian ports is expected to grow by at least 30 million tonnes every year. We currently have only eleven major ports owned by the central government and there are 139 minor working ports managed by respective state goverments, along the 5600 kms. Of coastline. Considering the growth of marine traffic up to 2010, estimated at 1070 million tonnes, it would be necessary to make substantial investments not only for the development of existing ports but also for creating new ones. These ports will need to be linked with the hinterland through rail and road networks to realize the promise of multi model transportation. Massive investments required for creation of additional berths, development of ports and linking them through rail & road networks are however justified by the projected growth of trade, which will generate enough revenues to assure a reasonable return on investment. Corporatisation & privatisation of ports has moved ever so slowly & the build, own, operate model has not yet seen the light of day. There is an urgent need to draw up a phased m;ster plan wheriby one port's infrastructure is brought up to the contemporary world standards for multi model transportation and the revenues from enhanced productivity, ploughed back into development of another port. This brick train type of model will limit the amount of investment required upfront, freeing resources for investment in other sectors of maritime activity.

Labour Legislation

Labour legislation reforms are currently the Achilles's heel for Indian industry. The tremendous advantage that we have in terms of lower wages in dollar terms is more than offset by the poor productivity on man hour basis. Excessive protection provided to organized labour is now doing more harm than good asis evident from the number of companies opting for VRS, reducing job opportunitiess in the market and draining financial resources which could have been productively and far more effectively utilized for reinvestment and future growth of the company. In the area of employment, both the legislature and the judiciary will do well to limit the regulation to the barest minimum required for ensuring just and equal treatment to all employees. It certainly is not correct to treat the public sector companies as Government organizations and therefore attribu te to them the welfare schemes for the people in general and employees and contractors in particular. Such interpretations foster discrimination and promote inefficiency. Another course correction necessary in the present context is the freedom for subcontracting parts of work solely at the management's discretion. The interpretation whereby the sub contractors employees are deemed to automatically become the employees of the prime contractor is grossly harmful and in many cases leads to avoidable over employment, repeating the cycle of losses, VRS and reliance on reconstruction or similar funds for the bailout.

Design & Maritime R&D

Indian shipbuilding in general and ship design & R&D in particular, have remained areas of neglect in so far as receiving investments is concerned. Consequently as a Nation we have never been able to realize the full promise of ship building as a strategic industry. Dependence on external design agencies has continued to date for all the Shipyards in one form or another, making the Shipbuilders always look backwards rather than forwards, at the emerging maritime technology. I believe that to a great extent the disenchantment of Indian Ship owners has something to do with this incapacity of the Shipbuilding & repairing community. Lately we have taken several initiatives to come out of this mould and it would pay dividends if more Shipyards, were to also invest their time & effort on becoming independent and proactive ship designers. Possibility of bringing about synergy through collaborative work must be exam ined to optim ize best possible use of limited resources.

World Class Training

There is an urgent need to free multi skilled training for seamen from the bonds of existing regulatory framework and to proactively pursue HRD in the spirit of 1995 Standards for Training, Certification & Watch keeping, being the minimum threshold. The skill levels of our seamen have to measure up to the best available in the world, to ensure that job opportunities for them, open up in the same way as has happened in the case of IT professionals. This benchmark for excellence in training should become a part of India's declared maritime policy on Shipping & Shipbuilding.

The training must be tailored to use of information technology, employing simulators to give the trainees a feel of the actual environment in which they will be working. The training centers could target not only the Indian but international students as well to make the programmes financially viable and of world standard in terms of their quality.

Safety & Manning

Despite improvements in design, materials of construction and new processes for inspecction, accidents and losses do occur. Regrettably in a majority of cases these are attributable to ingorance, incompetence or human error. As the ships become more complex, the challenges for trainers will increase making it a major issue impacting on safety of life at sea. In future, the training standards will require a much higher degree of expertise and versatility wherein each crew member will be expected to have more then one skills. The skill convergence should therefore be analyzed very carefully and new skill sets defined.

Mazagon Dock Ltd. recently built a dredger for an overseas client. The total number of crew who came to Mumbai for taking over and sailing the ship to home port was six. The total complement during operation would have been ten and the accommodation provided on board was for twelve persons including the Captain. Under the Indian rules for manning, a similar ship, it would have required a minimum of twenty eight to thirty six officers & crew. Fortunately there already is a growing realization that the attitude of business as usual cannot be tolerated any longer. Time is ripe to make use of this opportunity and to help bring in reforms for a better tomorrow.

Conclusion

Maritime Organisations, Ship Owners & Operators, Port Authorities, Ministries of Surface Transport & Defence, Ship Builders & Repairers, Maritime Educational, Design & R&D Organizations, Marine Equipment Manufacturers, Shipping Agents, Suppliers and other associated corporations should take on the task & responsibility for mobilising opinion in favour of evolving policy initiatives for the growth of maritime activities in the infrastructure sector, leading to development & acceptance of a National Policy on Shipping, & Ship Building. Having accomplished formation of a sound National Maritime Policy on inland, coastal & international transportation, it will than be necessary to implement it in a cost effective & timely manner. This will ensure that returns on investments made, flow back in to the main stream of National economy to give it the desired boost and thereby helping the GNP to grow faster than the proverbial Hindu rate of growth.

We are fortunate that the country today has all the essential ingredients for making the potion for emergence of a highly successful & vibrant Maritime Industry. Whether it is availability of trained manpower to drive the process of change from redolence to pro-activity, availability of funds for investment in remunerative projects, creation of supporting infrastructure to put the required Information Systems in place, political will to undertake reforms in labour & manning legislations or even the vision to look ten to fifteen years ahead for taking investment decisions which could dramatically alter the shape of things to come. It is however necessary to bring the various elements together in the right proportion and in the right manner to make this endeavour succeed. The effort is by no means small but it certainly is also not daunting and I for one consider it to be within our reach, here & now. We owe it as much to those who laid down their lives during the fight for Independence & in the Nation's defence, as to the future generations of Indians who may not only be born free but also as equal & privileged citizens of the world community, to make the effort & do whatever else it takes to bring about a convergence of minds to put this issue on the top of the National Agenda for Planning. The rest will follow as is evident from the recent developments regarding the Pipavav port in Gujarat & the proposal for Vallarpadom container hub near Kochi.

I hope that the deliberations during this seminar will address some of these concerns and help charting a clear way ahead for the short & long term actions, which have remained over due for a long time.

Rear Admiral T B Bose Memorial Lecture

Rear Admiral S S Godbole, *VSM*

1. It is a privilege and honour for me to be present here today for the Admiral TB Bose Memorial lecture and I would like to thank the organizers of the National Convention of Marine Engineers for giving me this honour. R Adm TB Bose started his career in the Royal Indian Navy in 1938 and held many distinguished positions both in the Indian Navy and Mercantile Marine Department during his long and illustrious career. He took special interest in the training of apprentices in the dockyards and also in the engineering cadets who passed out of the training ship Dufferin. Adm Bose identified himself with the new system of marine engineering training right from the time the new DMET course was started in 1949 and gave the organization his full support until his retirement from service. He was also largely responsible for the development of the Naval College of Engineering at Lonavala. In 1957, when he was the Chief Surveyor of Govemment of India, he was appointed on a Committee to advise the Government on indigenisation of the ship ancillaries. Report of the committee lead to the formation of a Marine Engineering Division in the then Indian Standards Institute and also setting up of an indigenous development section at the Hindustan Shipyard Limited at Visakhapatnam. During his illustrious career Adm Bose was closely involved in shipping, shipbuilding, ship repairs and formulation of state's policy pertaining to these sectors. Even after his retirement from the Navy and the Mercantile Marine Department, they continued to seek his advise on all important policy issues. It is thus only in the fitness of things that the Institution of Engineers has instituted a memorial lecture in his name during the Annual National Convention of Marine Engineers.

2. Over the years R Adm TB Bose memorial lecture has evolved into an effective forum to share ideas and thoughts on shipping in general and marine engineering in particular. Today I take this opportunity to share some of my thoughts on the topics, which we were so near to Adm TB Bose, namely the future of shipbuilding and ship repair industry in the country, training, indigenisation, and avenues open to marine engineers in the foreseeable future.

3. We marine engineers are going to experience some very exciting times in the years ahead. By the very nature of our training and job requirements, the marine engineers are capable of handling all aspects of shipping related activities, right from the design and development stage through to ship construction, operation, certifications and survey and beyond, till the ship is finally paid off. In addition the marine engineers can and are very effectively handling all the maritime technical administration issues which include ports management, shipyards management, creation of marine infrastructures, training and examination, enforcement of various regulations and assisting the Government in laying down policy guidelines, pollution control etc. Recent initiatives by the Government have opened many avenues for the marine engineers to grow and make a kill.

Growth Potential

4. World's sea borne trade has registered a steady growth over the years and is expected to reach 5350 million tonnes by the end of this year. Out of this, the share of trade handled by Indian ports taken together is only about 290 million tonnes. For the first time the Government of India has notified a comprehensive trade policy to take an integrated view of the overall development of Indian foreign trade. The objective of the foreign trade policy is to double the existing 0.8% Indian share of global merchandise trade by the year 2009, and thereafter further increase it to about 4% by the year 2020. Transportation by sea continues to remain the most cost effective means for our exports and imports and therefore nearly 7 times export/import target to be achieved by the year 2020 will proportionately increase all the shipping related activities. Between 2000-2003 India's exports have increased by around 32% as compared to the raise of around 17% in world exports suggesting significant improvement in the overall competitiveness of Indian exports. At present India is 31st leading exporter and 24 th leading importer in the world merchandise trade. The Indian Shipping Industry is ranked 17th among the World Maritime Nations in terms of gross registered tonnage and 15th in terms of dead weight tonnage. The total Indian tonnage under the Indian flag remained stagnated at around 6-7 million GRT since 1996. However, in the last two years the Indian Shipping Industry has added almost 1.5 million GRT to its fleet. The Indian National Ship-owners Association (INSA) has projected that with support from the Government of India we could well cross the 10 million GRT mark and emerge in the list of top 10 maritime nations in the next 3-5 years.

Post Tsunami Scenario

5. It is estimated that more than 50,000 small crafts and boats were destroyed in the recent Tsunami disaster in India alone. The figure for small crafts, fishing boats etc., which were damaged in our neighbouring countries, is

estimated at 2 lakhs. In order to put the fishing business back into action accelerated pace of building smaller crafts will be required. Both the Central and State Governments are poised to pump in huge funds into this rather low-tech activity of small craft building. 1, therefore, see tremendous scope and avenues for the marine engineers to join this national and international effort, which will help both the country and the individuals engaged in these activities.

Costal Shipping

6. Coastal shipping is eco-friendly, cost effective and fuel-efficient mode of transport. It can gainfully provide connectivity as well as transportation along India's vast coastline and also to the Islands of Andaman & Nicobor and Lakshadweep. The share of cargo carried by Indian costal shipping at present is merely 7% in our country as against about 32-40% in advanced countries. There is a tremendous potential of costal shipping as a viable mode. Coastal shipping also has tremendous potential for employment generation.

Inland Water Transport

7. India has approximately 15,000 kms of navigable waterways out of which three stretches covering 2700 kms have been declared as national waterways. The Indian IWT fleet comprises of around 350 vessels aggregated to 3.5 lakhs DWT Trained manpower engaged in this sector is less than 1000. It is proposed to increase the share of inland cargo movement from the present level of 0.15% to 2% by the year 2025. This will be achieved through a strategy evolving addition of around 2500 cargo vessels to the existing fleet along with 25000 additional trained manpower during the same time. For achieving this, the funding pattern has been changed under the centrally sponsored scheme. Assistance under this scheme used to be up to 50% and that too by way of loan on reimbursement basis. The assistance pattern as now been revised and now grant of 100% is provided under the scheme to North Eastern states including Sikkim and that of 90% to the other states for the development of inland water transport. Further an inland vessel-building subsidy was operationalised in 2002. Under this 30% of the cost of vessel can be subsidized by the Inland Water Authority of India. All these measures will certainly attract private industry on a large scale and open avenues for marine engineers.

Policy Thrust

8. The Government of India has conceded some mnior demands of the shipping industry specially the demand for levy on tonnage tax. By taxing the shipping companies on the basis of tonnage of their ships and the number of days for which the ships have been in operation, the total tax liability of Indian Shipping Companies would fall to the international norms of 1-2% against the existing 10-14%. Further, it has also been made mandatory for all shipping companies to plough back a minimum of 20% of their book profits to fund vessel acquisition. The draft policy document for Indian Maritime Sector aims to expand Indian tonnage, maximize flow of investment both domestic and foreign and provide level playing field to shipping sector in terms of taxation and creating conditions for the growth of share of Indian companies in the exim trade and promote coastal shipping to enable its share in the movement of inland cargo to increase from the 7% as of now to 15% by the year 2025. All these initiatives will give an unprecedented boost to the ship building activities in the country.

Ship Repairs

9. It is known that shipyards earn a relatively higher proportion of their profits in undertaking ship repairs as against shipbuilding. In the Indian Navy two major dockyards at Mumbai and Visakhapatnam and two naval ship repair yards at Port Blair and Kochi together employ approximately 20,000 industrial workers to look after Indian Navy's fleet of approx 130 ships and submarines and other auxiliary vessels. In spite of that the Navy has to offload the repairs of their ships and submarines to the outside yards like MOL, GRSE, CSL, GSL etc. As a thumb rule 5% of steel renewal is required to be undertaken on every ship per year to keep her floating for about 20 years. With the proposed 10 million GRT being envisaged for the Indian ships approx 5 lakh tonnes of steel renewal will·be necessary per year on Indian ships alone. Therefore there is a need to enhance the capacity of our shipyards by at least 5 times in the near future for steel fabrication work alone. Add to that the requirement for repair of equipment and systems and need to undertake the survey of foreign ships in Indian waters and you can imagine the tremendous potential for establishing new shipyards both big and small.

10. Policy for shipbuilding and ship repair industry would take due note of its status as valuable foreign exchange earner in addition to the potential employment generation with ancillary industries. The draft policy document therefore envisages establishment of at least 2 international size shipbuilding yards one each on each coast, besides modernization of existing public and private sector shipyards. The average size of the existing dry docks in India would also be increased. The building package proposed by the Ministry of Shipping to support the shipbuilding industry and ship repair industry comprises of policy to encourage foreign direct investment, long term subsidy

support up to 20-30 years for construction of all kinds of vessels subject to reasonability of prices, policy support to ensure availability of indigenous steel for all Indian shipyards, encourage ancillary units to support ship repair and ship construction and giving encouragement to Indian ship owners to place series orders for construction of vessels through fiscal incentives and enhanced subsidy support on same design etc.

Infrastructure

11. Infrastructure plays an important part in fueling economic growth. The importance of maritime infrastructure in facilitating international trade is well recognized. Ports provide an interface between the ocean transport and land-based transport. Indian ports have witnessed 20-fold increase ill the cargo handling since 1950-51. With the Indian economy poised for a sustained growth over the next few decades, the Government has proposed to adopt a holistic approach for the development of port sector covering aspects of integrated development, connectivity, organizational and institutional arrangements etc. India has 12 major and about 100 minor ports handling about 458 million tonnes of cargo annually (both incoming and outgoing). Since the problems faced by individual ports differ, these need to be tackled and further growth plannned depending upon the specific requirement of each port. Development of ports will take into account the need for ensuring equitable geographical development, optimal utilization of existing assets and avoidance of unplanned growth of individual ports. A mechanism to coordinate and regulate the development between major ports and minor ports will be strengthened by the creation of Maritime States Development Council (MSDC) under the Chairmanship of Union Minister for Shipping and comprising of Ministers dealing with ports in the states, as members. This will be converted into a Statutory Advisory Body and membership would be expanded to include the representatives from the trade and commerce. Transshipment of Indian cargo taking place outside the country at present will be encouraged to be handled at Indian ports through consolidated measures like increasing the berths avai/able at Indian ports, rationalisation of port dues, providing differentia/levels for different sizes of vessels and cargos etc. I am sure Cmde Banger will talk further on these issues.

Dredging

12. Dredging as an important, activity for the efficient working of ports. Presently most of the Dredging requirements of major ports, particularly maintenance dredging, are met by dredging Corporation of India. Government of India proposes to take measures to promote Indian Dredging Industry, including private sector, to provide competitive dredging at least cost. Major ports will be required to contract out maintenance dredging on long term basis of say three years, which will encourage private companies to procure dredging equipment besides enabling ports to obtain competitive rates. Right of first refusal will be provided to Indian Dredging companies to match the lowest foreign tender without differentiating between a public company and a private company provided their bids are within the prescribed band. The Indian private dredging companies will also be provided conductive fiscal regime to facilitate their growth. They will be gilJen preferential treatment for five years both in the bids as well as the taxes levied. There is, thus, tremendous scope for private dredging industry to grow exponentially.

Organisational and Institutional Issues

13. With a view to give a philip to the Indian Shipping Industry some major organisational and institutional measures are proposed. Full-fledged shipmasters' offices will be opened at all major ports to enable sea fearers to get CDCs issued quickly. The strength of inspectors will be increased, so that a minimum of 20% of foreign flag ships calling on Indian ports and 15%Indian ships, both foreign going and coastal, are inspected mandatorily. A Maritime Accident Investigation Bureau will be established to lend transparency and urgency to investigate marine accidents. Marine Police Force will be established and positioned at important positions to enhance safety in Indian ports. National Shipping Board will be suitably strengthened and empowered for the development of interface of shipping with exporters, importers and other national level trade associations/bodies.

Training

14. Recent BIMCO suruey has projected a global shortage of about 5000 officers over 10 years despite large numbers that already exist. The emerging global shortage of qualified ship personnel provides immense scope to India since India is a leading supplier of trained sea fearers. There is a proposal to develop the concept of Maritime University and one such university each on the east coast and other on the west coat of India, are proposed to be established. Efforts are also on to acquire 10 vacancies in the internationally reputed World Maritime University (WMU) and International Maritime Law Institute (IMLI) and to establish chairs for specific studies in the Indian Institutes of Technology at Kharagpur, Mumbai and Chennai so that specialized faculties in various subjects are built up. Examination centers will also be opened in important major cities of the country to meet the demands of the students opting for sea fearing as a career.

Other Miscellaneous Issues

15. After having seen the tremendous growth potential for the marine engineers over the next decade in the areas of shipping, shipbuilding, port management, dredging and training, I would like to devote sometime on the issues which have not yet caught the imagination of marine engineers. These include hotel and tourism industry, use of IT indigenisation and energy savings.

Hotel Industry

16. Recently Ashoka Group of Hotels recruited few Marine Engineer Officers of Indian Navy as their Chief Engineers and they have won laurels by their ability to maintain and operate various support services in the 5 Star Hotels like air conditioning and refrigeration plants, diesel generators and emergency power supply, kitchen machinery, laundry, water treatment plants etc. The tourist flow in India is poised for a quantum jump and scramble is already on to build high quality hotels and restaurants to cater [or this tourists traffic. Obviously marine engineers will find large-scale openings as tourism industry grows in the country.

Leisure Shipping

17. Leisure shipping or the cruise shipping is emerging the world over as a mode of increasing tourism. With a long coastline dotted with beautiful tourist spots and beaches, India is ideally suited for development of cruise shipping. Recently Andhra Pradesh tourism Corporation has introduced a one-day cruise on the river Godavari and there is a tremendous response for that. Just last week there was a news item in Deccan Chronicle which stated that by operating just 8 mechanised boats, 7 speed boats, 3 cruisers and few pedaled boats in the Hussain Sagar lake, the AP Tourism. Corporation is earning a profit of 20-23 lakhs per month. The Ministry of Shipping has decided to promote cruise shipping by constructing cruise terminals and providing all facilities at the ports. This would be complemented by activities outside port premises and would include planning and coordination with tourism departments of centre and state to promote "fly and cruise" type of tourism. Migration and custom procedures will also be simplified to promote cruise tourism to cover as many Indian ports as possible. Migration officers in different ports empowered to give the Visa and stay permit on the spot are also being thought of. Needless to state that Leisure Tourism is yet another avenue for marine engineers.

Power Sector

18. Marine engineers are ideally suited for employment in the design, construction, operation and distribution of electric power plants. It is anticipated that the power generation industry in the country will grow at the rate of 15000 MW of installed power per year over the next 10 to 15 years. The existing capacity of the Indian companies is only 5000 MW of installed electric power per year. The gap will have to be bridged by other direct investment both by public and private industry. You can imagine the extent of shortage, which will be experienced by the competing companies involved in construction of power plants to meet their requirements. Another big door is therefore open for the marine engineers.

Research and Development

19. The conventional sources of energy are depleting very rapidly and there is a need to look at nonconventional sources of energy to the fullest possible extent. Sometime back a seminar was organized by National Ship Design and Research Centre (NSDRC) at Visakhapatnam on the topic of use of nonconventional energy on naval vessels. Some innovative ideas like covering the exposed surfaces on the ship with solar cells, installation of windmills on the upper decks of the ships to generate power etc. were proposed. There was a general view that w'ithfurther advancements in the technology it may be possible to meet a substantial proportion of ships power requirement by use of non-conventional energy source, Marine engineers can handsomely contribute in this area.

lndigenisation and Standardisation

20. The marine industry has come a long way since the times the indigenisation cell was set up in the Hindustan Shipyard Limited at Visakhapatnam by R Adm TB Bose. Today the Indian Industry is able to provide us with boilers, turbines, diesel engines, air conditioning & refrigeration plants, capstan and winches, gears and shafting, all types of auxiliary pumps and machinery etc. for ship borne use. Further the NSDRC has also produced some standard designs for smaller merchant 'Vessels like fishing boats' & trawlers,ferry boats and cargo ships in the 20,000 - 30,000 DWT range. Indian Navy is very vigorously and consciously pursuing a policy of indigenisation of Naval ships and we have been quite successful in that. It is my conviction that if we use standard designs and indigenous equipment on our ships, we will become extremely competent in International market and at the same

time give tremendous boost to our own industry. I hope this is given a serious thought. It will also be our tribute to Adm base.

Synergy of Efforts

21. Perusal of draft policy document placed on the website by the Secretary to Ministry of Shipping in August 2004 revealed many initiatives which the MOS is taking that we in the Navy were not aware of. I am sure many of the initiatives, which we marine engineers in the Indian Navy have taken, are also not known to the Merchant Navy. Resources being limited. both Indian Navy and the Merchant Navy have a stake in devising most efficient methods of ship design, shipbuilding, ship operating, repairs and training of our respective personnel. It therefore stands to logic that there should be an institutionalized forum for exchange of ideas, views and sharing of resources between the Indian Navy and Merchant Navy for our own good. There is no need for one set of marine engineers to feel threatened by another set of marine engineers because the cake is too big for all of us to eat. With the proposed commitment of approximately Rs. 30,000 crores for building Indian Naval Ships and submarines and another Rs 30,000 crores for induction of merchant marine in the next decade, the slice of the cake is more than sufficient for not only the existing marine engineers, but also for those marine engineers, which are likely to join us in the next 10 years. I had an occasion to go through approach paper on the Maritime Research Institute at Washi. Some excellent proposals, to have institutionalized interaction between the Indian Navy, and Merchant Navy were recommended in that paper. Unfortunately nothing much has happened in this area. I hope we will look at this issue more closely again and evolve ways and means for enhanced institutional interaction between Indian Navy and MMD so that together we can put India on the world map as a leading maritime power.

Creation of Pressure Group

22. The economic survey published recently talks about changes in labour laws and other issues to unshackle the textile industry post Jan 2005 WATscenario. This thought process should have taken place in the year 2000 itself, allowing for sufficient time for all the rules and regulations and laws to be put in place before the Jan 2005 deadline. The Indian IT industry has shown us a way by forming a very cohesive pressure group to make both the center and state governments agree to their legitimate demands. Time has come for marine engineers to follow the example of our IT brothers. Unless we form a very strong and cohesive pressure group of marine engineers who anticipate the winds to change and make firm recommendations to the government, for change or modifications of the existing laws governing the shipping industry, we will never be able to catch up with the rest of the world. China is aspiring to become the world's leading ship building nation by year 2015 and in preparation for that they have established 58 shipyards and have ordered approx 500 ships to be built on priority. As compared to that India has only 45 ships of various categories under construction in Indian yards and another 10 in foreign shipyards. This is no way towards becoming a maritime power. The field is thus wide open for all of us to make our own contributions. It is a win-win situation for India in general and Marine Engineers in particular.

Conclusion

23. Even though we are late, at least we are on the right path. A comprehensive foreign trade policy is in place and so is a comprehensive policy for maritime sector which proposes to adopt a holistic approach for all round development, which include development of ports, shipbuilding and ship repairs coastal and inland water transport, training, private participation etc. Marine engineers will have their hands full in coping with demands that the country expects from us. There is a need for a synergy of efforts between Indian Navy and the Merchant Navy to meet this challenging task and put India among the first 10 maritime powers in the world. IT industry has shown the way and now it is for us the marine engineers to make India a super power in marine sector. However, we must remember that the most advanced technology in the world, the finest ports and infrastructure, the most up-to-date methods of constructing and operating the ships and ever willing government patronage cannot be a substitute for the technical competence and strong leadership of marine engineers. We have to remember this at all times to achieve our ultimate goal. The Golden Era for Marine Engineers has just begun.

24. I once again thank the Institution of Engineers for giving me this opportunity to be with. you today and share some of my thoughts on the shipping industry, which is poised for a rapid growth.

Thank you.

Dredging and Integrated Development of Inland Waterways

Dr P Misra, *DMET (69-73) Extra Class Engineer (DTI-UK), D.B. Mgmt. (AIMA), B.G. Law, M.A. Economics, Phd (Engineering)-Gold Medalist, MIE (INDIA), FIMarE (INDIA), MSNDE (INDIA), MEMIand (INDIA), MSNAME (U.S.A.), MICS (UK), MINA(INDIA)*

Principal Officer - cum - Joint DG (Tech)
Mercantile Marine Department, Chennai

Abstract

Dredging, while earlier an art, is at present a scientific subject that successfully reflects human skills;This process attempts to generate material for beach nourishment, for making roads and railways or for removing settled sediments to facilitate marine transportation. The process, of course, brings about environmental problems in short and long time scales in marine and estuarine environments. Inland waterways are the greenways of the future. Long neglected and misused, the only strategy that can resurrect it is to dredge and design navigable waterways that can act as catalysts for development in hinterland where nature can only act as thevehicle for revival. The task however goes well beyond just dredging. It requires astute planning, strategy, coordination, management and above all a philosophy of "benefits for all". This paper deals with the vision and some of the finer aspects of dredging in such closed waters and the benefit that accrues out of it.

Introduction

The inland waterways have played an important role in the Indian transport system since ancient times. Though inland water transport is comparatively a cheaper and efficient means of transportation in recent times the importance of this mode of transport has declined considerably with the expansion of road and rail transport. In addition diversion of river water for irrigation has also reduced the importance of inland water ways. The decline is also due to deforestation of hill range leading to erosion, accumulation of silt in rivers and failure to modernize the fleet to suit local conditions. The transportation of goocls in an organized form is confined to west Bengal, Assam, parts of North Eastern Region and Goa.

Inland waterways play an important role in the north east region of the country comprising the States of Assam, West Bengal and Bihar. In the south, inland water transport has a significant part to play in the State of Kerala. The waterways in Kerala connect several minor ports and the major port of Cochin number of industries is situated close to them. In the deltaic region of Orissa, again,. inland waterways provide an important means of communication; the principal navigation canals serving the region are the Kendrapara and TaMani Canals and the Orissa Coast Canal. Inland water transport operates in a limited way in the States of Andhra Pradesh and Madras also.

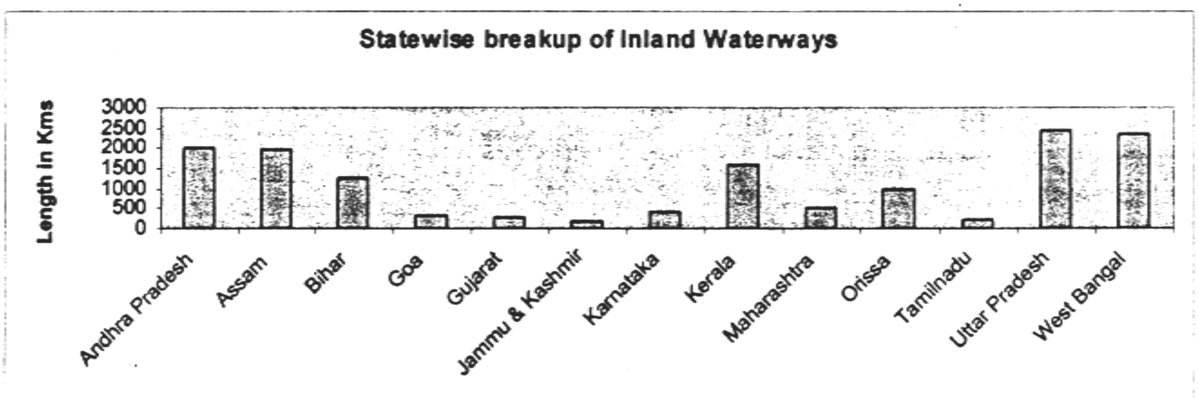
The Central Inland Water Transport Corporation is the operator. This is the predominant operator although there are a few private fums operating as well. The inland water transport strategy aims at generating a more pro-active role by the different government agencies for the development of this sub sector. The Government's revival plan for inland water transport includes increasing the coverage of National Waterways.

Under the current Development Plan, the Government plans to extend the national waterway system by declaring another five waterways as national waterways, i.e. (i) Barak River; (ii) Kakinada-Mercaunam Canal integrated with Godavari and Krishna Rivers; (iii) East Coast Canal integrated with Brahmani river system; (iv) extension of National Waterway 3; and (v) Damodar Valley Canal. The Sundarbans river system may also be considered.The reasons for taking up this developemental programme is

- Development of inland water transport in the regions where it enjoys natural advantage.
- Modernization of vessels and country crafts to suit local conditions.
- Improvement in the productivity of assets.

Even today, waterways are the cheapest mode of transport. According to a recent study conducted by National Council for Applied Economic Research (NCAER) , the per-tone km cost of transportation by inland waterways is Re. 0.55, compared to Re. 1 by road. For the movement of bulk cargo, inland waterways are considered more fuel-efficient than any other mode. Yet today this potential remains highly unexploited. The development of motorable roads, particularly national highways, and the introduction of large trucks, has left the country boats far behind. The motorboats and the passenger vessels that replaced the country boats were hit by infrastructure deficiencies.

According to surveys, India has 15,000 km of navigable inland waterways. By 2007, the IWf traffic is expected to go up to 50 billion tonne kilometers. The Inland Waterways Authority of India, the autonomous body responsible for regulation and development of waterways, had declared three national highways. NW-1 is Ganga-Bhagirathi-Hooghly river system from Allahabad to Haldia, covering a distance of 1,629 km, and passing through three states - Up, Bihar and West Bengal. The NW-2 is on the Brahmaputra river from Dhubri to Sadiya, covering 891 km, passing through Assam and linking the North - East region to the main ports of Calcutta and Haldia. It is also a major link to Bangladesh. The NH-3, the west coast canal from Kottapuram to Kollam, including Chambakara and Udoygamandal in Kerala consists of natural lakes, backwaters, a river section and man-made canals.



Source: IWAI

Benefits of using waterways

As compared to Road and Railways, the Waterways are an important means of transportation, to accelerate the economic growth in the following manner:

- It can be a supporting role for Road and Rail transport.
- It is far more cost effective per kilometer of travel.
- It is highly efficient in energy consumption per ton load carried.
- Load capacity can be doubled by small increase in 1epths by dredging.
- Considerable flexibility in ageing transportation and cost elasticity.
- Inherently low human cost.

Considering the above it becomes quiet apparent that ensuring a Green and consistent Waterways would be at the most meaning for the national level. Toensure that the Waterways get the proper thrust, certain measures need to be taken at the national level which would be in the following lines:

- Raise tax-free point and mobilize fees for infrastructure development.
- Encourage Commercial/Joint Venture and provide for grants and subsidies.
- Encourage private sector participation.
- Introduce phased tax exemption.
- Enhance depreciation rate of vessels.
- Introduce vessel-building subsidy for Waterways.
- Minimize the Custom duty

Developmental phases

In order to ensure that the Waterways get the right projection, the development needs to be done in phases and integrated development of Waterways needs to define the following:

- Determine the human parameters for infrastructure requirement, dredging, navigation equipment, terminal, etc.
- Determine every day requirement and operational matters.

Once the first phase of the proposal is to be in place then the next phase of development would be to define:

• Strategic marketing plan.
• Project master plan.
• Preliminary engineering for infrastructure, channels, navigation, terminals, storage, etc.

Current situation impairing use of Waterways

The reasons for the poor growth of Waterways are basically attributed to the following reasons:

• The share of Cargo currently is very small as compared to Coastal trade.
• There are serious Navigable constraints owing to sedimentation and river courses.
• There are not enough vessels and operators for such routes.
• There is serious lack of storage facility around the Waterways.
• Environmental and social protection are the key factors that need to be addressed in the Waterways.
• There are serious concerns of institutional set up along the Waterways.
• Private sector participation in the developmental plans is still not forthcoming.
• Cargo operator transit arrangement has not yet been standardized.
• Investment loans are not forthcoming.
• Integrated development is not a visionary thrust area.

What role is played by Dredging?

Dredging is an excavation activity or operation usually carried out at least partly underwater, in shallow seas or fresh water areas with the purpose of gathering up bottom sediments and disposing them at a different location.

Main reasons for dredging include:

• Increasing / maintaining the depth of water in a navigation channel
• Spot excavations preparatory to major waterfront construction (bridges, piers, or dock foundations)
• Harvesting sand (for usage in concrete production or for beach restoration)
• Waterways management and maintenance for flood and erosion control
• The process of dredging creates spoils, which are conveyed to a location different from the dredged area; dredging can create disturbance to aquatic ecosystems, often with adverse impacts. On the other hand, dredging can produce materials for land reclamation or other purposes (usually constructionrelated). Dredging has also historically played a significant role in socio-economic development and upliftment,

A dredge is a device for scraping or sucking the riverbed / seabed, used for dredging. A dredger is a ship or boat equipped with a dredge. In technical usage any floating vessel equipped with dredging equipment is called a dredger.

Types of Dredging

There are several types of dredging which is carried out in Waterways to ensure that the Waterways are kept clear and navigable. The common types of dredgers are:

• Clearing and snagging which is used to track log jams, clear debris, sunken vessel, etc.
• The other important types of dredgers are Mechanical and Hydraulic which are principally used to clear riverbeds, ponds, estuaries, interlinks between rivers. Most Waterways have soft soil except for parts where there is a rocky bed. There are other types of dredgers:

• Dust Pan dredger.
• Side cost dredger, which are used to remove loose compacted course grained material at a rapid pace.

Dredgers can also be amphibious and are usually portable.

Relevance of types of dredging to developing waterways

Without the many and almost non-stop dredging operations world wide, much of the world's commerce would be impaired, often within a few months, since much of world's goods travel by ship, and need to access harbours or seas via channels. Recreational boating also would be constrained to the smallest vessels. The majority of marine dredging operations (and the disposal of the dredged material) will require that appropriate .licences are obtained from the relevant regulatorv authorities, and dredging is usually carried out by harbor companies or corresponding government agencies.

The various aspects of dredging are

Capital dredging : carried out to create a new harbour, berth or waterway. or to deepen existing facilities in order to allow larger ships access. This process is usually carried out with a cutter-suction dredge. Maintenance dredging : deepening navigable waterways which have become silted with the passage of time, due to sand and mud deposited by water currents, until they may become too shallow for navigation. This is often carried out with a trailing suction hopper dredge. Most dredging is for this purpose.

Land reclamation : mining sand, clay or rock from the seabed and using it to construct new land elsewhere. This is typically performed by a cutter-suction dredge or trailing suction hopper dredge.

Beach nourishment: mining sand offshore and placing on a beach to replace sand eroded by storms or wave action. This is done to enhance the recreational and protective function of the beaches, which can be eroded by human activity or by storms. This is typically performed by a cutter-suction dredge or trailing suction hopper dredge.

Removing trash and debris: often done in combination with maintenance dredging, this process removes nonnatural matter from the bottoms of rivers and canals and harbors.

Riverbed mining: a possible future use, recovering natural metal ore nodules from the river bottoms. Contaminant remediation: to reclaim areas affected by chemical spills, storm welter surges (with urban runoff), and other soil contaminations. Disposal becomes an proportionally large factor in these operations.

Anti-eutrophication: Dredging is an expensive option for the remediation of eutrophied (or de-oxygenated) water bodies. However, as artificially elevated phosphorus levels in the sediment aggravate the eutrophication process, controlled sediment removal is occasionally the only option for the reclamation of still waters.

Types of dredging suitable for inland waterways

Trailing suction

A trailing suction hopper operates by sucking through a long tube, like some vacuum cleaners. A plain suction dredger has no tool at the end of the suction pipe to disturb the material redger (TSHD) trails its suction pipe when working, and loads the dredge spoil into one or more hoppers in the vessel. When the hoppers are full the TSHD sails to a disposal area and either dumps the material through doors in the hull or pumps the material out of the hoppers.

Cutter suction

A cutter-suction dredger's (CSD) suction tube has a cutter head at the suction inlet, to loosen the earth and transport it to the suction mouth. The cutter can also be used for hard surface materials like gravel or rock. The dredged soil is usually sucked up by a wear resistant centrifugal pump and discharged through a pipe line or to a barge. In recent years dredgers with more powerful cutters have been built in order to excavate harder and harder rock without blasting

Auger suction

This process functions like a cutter suction dredger, but the cutting tool is a rotating Archimedean screw set at right angles to the suction pipe.

Jet-lift

This uses the Venturi·effect of a concentrated high-speed stream of water to pull the nearby water, together I with bed material, into a pipe.

Air-lift

An airlift is a type of small suction dredge. It is sometimes used like other dredges. At other times, often an airlift is used handheld underwater by a diver. It works by blowing air into the pipe, and dragging water with it.

Bucket

A bucket dredger is a dredger equipped with a bucket dredge, which is a device that picks up sediment by mechanical means, often with many circulating buckets attached to a wheel or chain. Some bucket dredgers and grab dredgers are powerful enough to work through coral reefs to make a shipping channel.

Grab

A grab dredger picks up seabed material with a clam shell grab, which hangs from an onboard crane, or is carried by a hydraulic arm, or is mounted like on a dragline. This technique is often used in excavation of bay mud.

Backhoe/dipper

A backhoe/dipper dredge has a backhoe like on some excavators. A crude but usable backhoe dredger can be made by mounting a land-type backhoe excavator on a pontoon.

Water injection

A water injection dredger injects water in a small jet under low pressure (low pressure because the sediment should not explode into the surrounding waters, rather it is carefully moved to another location) into the seabed to bring the sediment in suspension, which then becomes a turbiditv current, which flows away down slope, is moved by a second burst of water from the WID or is carried away in natural currents.

Pneumatic

These dredgers use a chamber with inlets, out of which the water is pumped with the inlets closed. It is usually suspended from a crane on land or from a small pontoon or barge. Its effectiveness depends on depth pressure.

Bed leveler

This is a bar or blade which is pulled over the seabed behind any suitable ship or boat. It has an effect similar to that of a bulldozer on land.

Krabbelaar

This is an early type of dredger which was formerly used in shallow water in the Netherlands. It was a flat bottomed boat with spikes sticking out of its bottom. As tide current pulled the boat, the spikes scraped seabed material loose, and the tide current washed the material away, hopefully to deeper water. Krobbeloar is Dutch for "scratcher".

Amphibious

Some of these are any of the above types of dredger, which can operate normally, or by extending legs so it stands on the seabed with its hull out of the water. Some forms can go on land.Some of these are land-type backhoe excavators whose wheels are on long hinged legs so it can drive into shallow water and keep its cab out of water. Some of these may not have a floatable hull and, if so, cannot work in deep water.

Submersible

These are usually used to recover useful materials from the seabed. Many of them travel on caterpillar tracks.

Fishing

There are types of dredges used for collecting scallops or oysters from the riverbed. They tend to have the form of a scoop made of chain mesh. They are towed by a fishing boat. Scallop dredging is very destructive to the riverbed, and nowadays is often replaced by scuba diving to collect the scallops.

Disposal of materials

In a "hopper dredger", the dredgings end up in a big onboard hold called a "hopper", which has doors in its bottom. The excess water in the dredgings is spilled off by sedimentation: as the mud and sand settle to the bottom of the hopper, the water is siphoned from the top and returned to the sea to reduce weight and increase the amount of dredgings that can be carried in one load. When the hopper is filled with slurry, the dredger stops dredging and goes to a dump site and opens the bottom hopper doors, dumping the slurry out. Or the hopper can be emptied from above. A suction hopper dredger is usually used for maintenance dredging.

Sometimes with a suction dredger the slurry of dredgings and water is pumped straight into pipes which deposit it on nearby land by pipes; or in barges (also called scows), which deposit it in the deep sea or on land. When contaminated (toxic) sediments are removed or large volume inland disposal sites are unavailable, dredge slurries are reduced to dry solids via a process known as dewatering. Current dewatering techniques employ either centrifuges, large textile based filters or polymer flocculantlcongealant based apparatus.

In many projects, slurry dewatering is performed in large inland settling pits, although this is becoming less and less common as mechanical dewatering techniques continue to improve.

Similarly, many groups (most notable in east Asia) are performing research towards utilizing dewatered sediments for the production of concretes and construction block, although the high organic content (in many cases) of this material is a hindrance toward such ends.

Environmental impacts

Dredging can create disturbance to aquatic ecosystems, often with adverse impacts. In addition, dredge spoils may contain toxic chemicals that may have an adverse effect on the disposal area; futhermore, the process of dredging often dislodges chemicals residing in benthic substrates. and injects them into the water column.

The activity of dredging can create the following principal impacts to the environment:

• Release of toxic chemicals (including heaw metals and PCB) from bottom sediments into the water column.

• Short term increases in turbiditv, which can affect aquatic species metabolism and interfere with spawning.

• Secondary effects from water column contamination of uptake of heavy metals, DDT and other persistent organic toxins, via food chain uptake and subsequent concentrations of these toxins in higher organisms including humans.

• Secondary impacts to marsh productivity from sedimentation

• Tertiary impacts to avafauna which may prey upon contaminated aquatic organisms

• Secondary impacts to aquatic and benthic organisms' metabolism and mortality

• Possible contamination of dredge spoils sites

Beneficial Uses of Dredged Material

Dredged material is no longer being regarded as a "spoil" or "waste" but as a resource. Beneficial use of dredged material may be defined as the placement or use of dredged material for some productive purpose. Its mineralogy and geotechnical properties qualify it for use in the manufacture of high value, beneficial use products.

Dredged material may be used in a variety of beneficial use applications. A listing of these include ocean remediation, upland restoration, filling degraded basins and pits, creating and restoring wetlands for water quality treatment and habitat, and creation/restoration of other habitats such as oyster reefs and bird habitat.

Beneficial use end products include topsoil, construction-grade cement, lightweight aggregate, bricks, and architectural tile. Often, these beneficial uses can come at a cost-saving to the public. All dredged material proposed for beneficial use willbe evaluated in a framework which protects human health and the environment.

Schematic Diagram of Traditional Dredged Material Disposal Alternatives

Most dredged material can be a valuable resource and should be considered for beneficial uses.

Agricultural/Product Uses Aquaculture Construction Materials Decorative Landscaping Products Topsoil	Engineered Uses Beach Nourishment Berm Creation Capping Land Creation Land Improvement Replacement Fill Shore Protection	Environmental Enhancement Fish & Wildlife Habitats Fisheries Improvement Wetland Restoration

Principles and premises of integrated Dredging for Waterways

Considering that the Waterways are an important means of movement of cargo and passenger and the essentials of dredging being a tool to enhance the activities on the Waterways, it is essential to now evolve a policy, which goes beyond just moving cargo and passenger over distances. It is essential that we rely on the need for all round development of the socio economic fabric of an entire region near the Waterways so that it can sustain the development and economic growth of the people dependent on these Waterways.

It is also important to understand that in creating a channel or navigable route a number of other issues connected to environmental, eco system, livelihood, flouro also come up. Hence, in a very compreh ensive manner the following principles are proposed for enabling an integrated development of the Waterways.

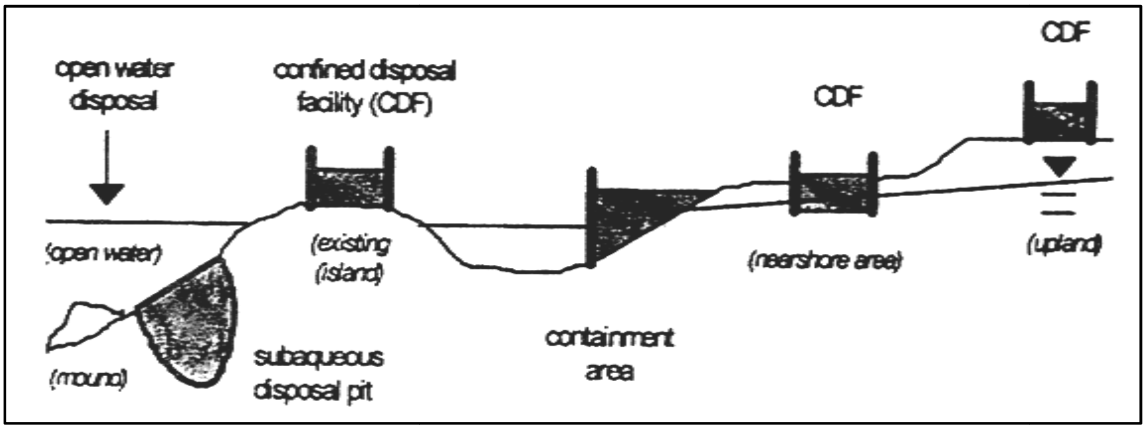
We must first understand that the principles laid down take the following into consideration

• Principle 1: The water ways is a unique resource system which requires special management and planning approaches.

• Principle 2: Water is the major integrating force in resource systems

• Principle 3: It is essential that land and river uses be planned and managed in combination

• Principle 4: The edge of these water ways is the focal point of integrated management programmes



• Principle 5: Water ways management boundaries should be issue-based and adaptive

• Principle 6: A major emphasis of resources management is to conserve common property resources

• Principle 7: Prevention of damage from natural hazards and conservation of natural resources should be combined in water ways management programmes

• Principle 8: All levels of government within a country must be involved in the water ways management and plan

• Principle 9: The nature-synchronous approach to development is especially appropriate for the costing

• Principle 10: Special forms of economic and social benefit evaluation and public participation should be used in the water ways developmental and management programmes

• Principle 11: Conservation for sustainable use is a major goal of resources management

• Principle 12: Multiple-use management is appropriate for most resource systems

• Principle 13. Multiple,-sector involvement is essential to sustainable use of resources

• Principle 14; Traditional resource management should be respected

• Principle 15: The environmental impact assessment approach is essential to effective water ways management

Water-related disasters are virtually inevitable in any coastal nation. They result from cyclonic storm attack, tsunamis (gigantic tidal waves), shore erosion, coastal river flooding, landslides and mud slides, and soil liquefaction. It is usually neither economically feasible to eliminate the hazards through engineering (e.g., by building giant seawalls), nor to exclude all people and structures from the hazards zones. Most societies have developed administrative and social mechanisms to cope with the aftermath of extreme natural events (postdisaster relief). However, prevention of the same type of hazards is often ignored and thus development processes which increase the level of coastal hazards are free of control.

In addition to their ecological values, such coastal resources as reefs, beaches, dunes, and mangroves form important natural defences against wave action. Reefs act to "trip" storm waves, reducing their strength as they pass over the shallow depths. Beaches and their dunes and offshore bars are also efficient dissipators of waves energy. Where beach sand is deposited in bars offshore, water depth is decreased and storm waves break farther from shore; if the sand is deposited landward (in dunes) the effective width and volume of the beach is increased, further reducing the danger of severe loss of Water way Coastal areas are governmentally complex and require a high level of intergovernmental coordination. Some of the reasons are given below:

• the amount and complexity of public interest in these areas are high;

• the effects of conflicts and impacts of one sector on another that require government intervention are exceptionally high;

• there is considerable involvement with public (common property) resources and their conservation;

• water is a fluid resource which is not containable or ownable in the usual sense, and which simultaneously affects all coastal interests;

• a greater variety of coordinated multi-governmental policy decisions is required in coastal areas.

• there tends to be a high level of international interest in water related

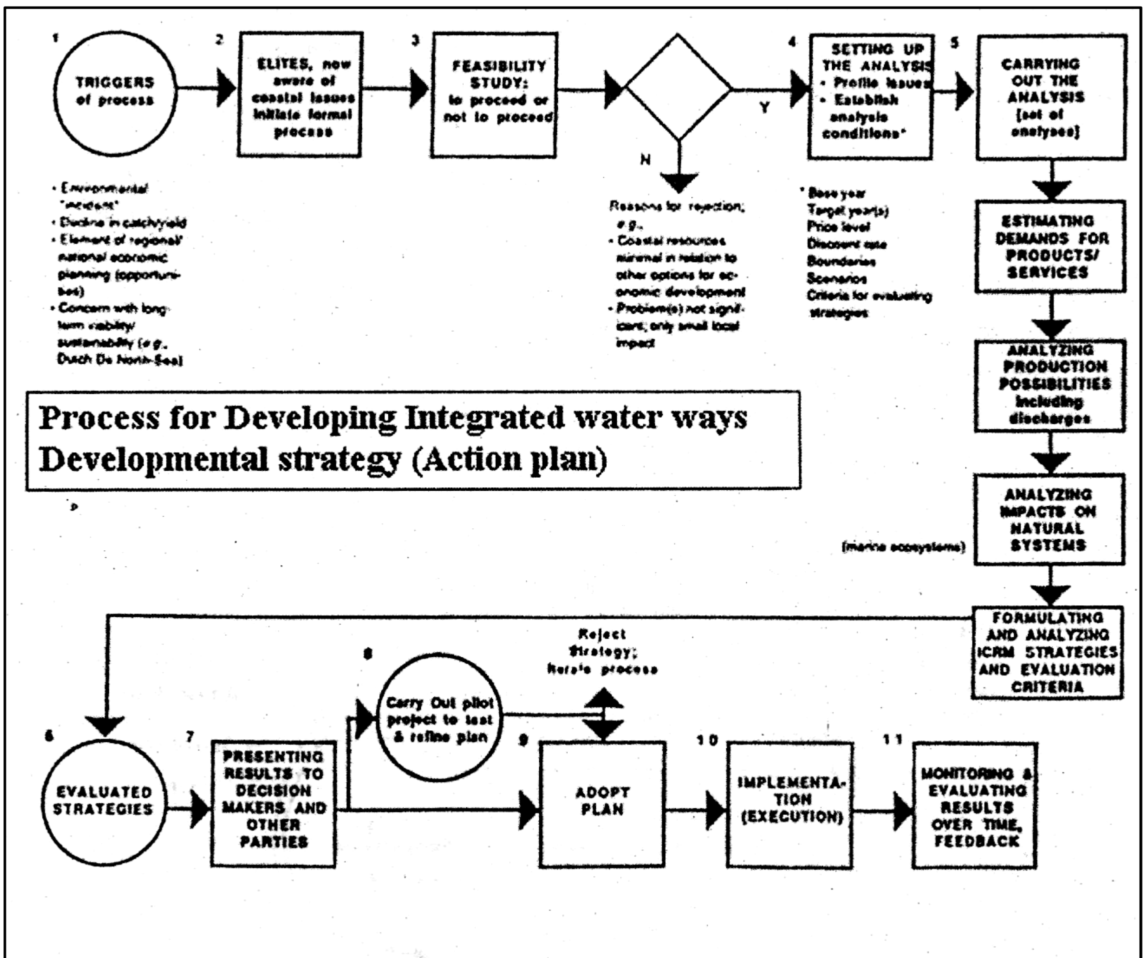


Figure1 — IterativeProcess:

Source: Clark

A national policy is a fundamental requirement for the development and use of maritime resources and for special management of enclosed seas. Such a policy establishes goals, objectives and priorities and lays down basic principles and criteria which provide guidance for the formulation of plans and programmes and a marine development strategy. The policy should outline a framework that identifies the financial, human, technical and institutional resources needed.

Broad participation of the citizenry should be encouraged. Therefore, beginning with policy formulation and continuing through each subsequent stage of development of the programme, intrested citizen groups should be frequently consulted following are the broad themes as examples of those that should be addressed:

- Determination of economic, social, political and cultural situations;
- Respect and support for the culture;
- Dialogue, sharing of agendas and mobilization (not "confidence building"), ability to listen;
- Intervention based on the human system as well as on the natural system-multidisciplinary and multisectoral approaches;
- Participatory research, use of folk knowledge and permanent redistribution;
- Collective problem identification - formal and informal activities;
- Formulation of solutions and promotion of consensus; and
- Utilization of indigenous technology, know-how, and experience.

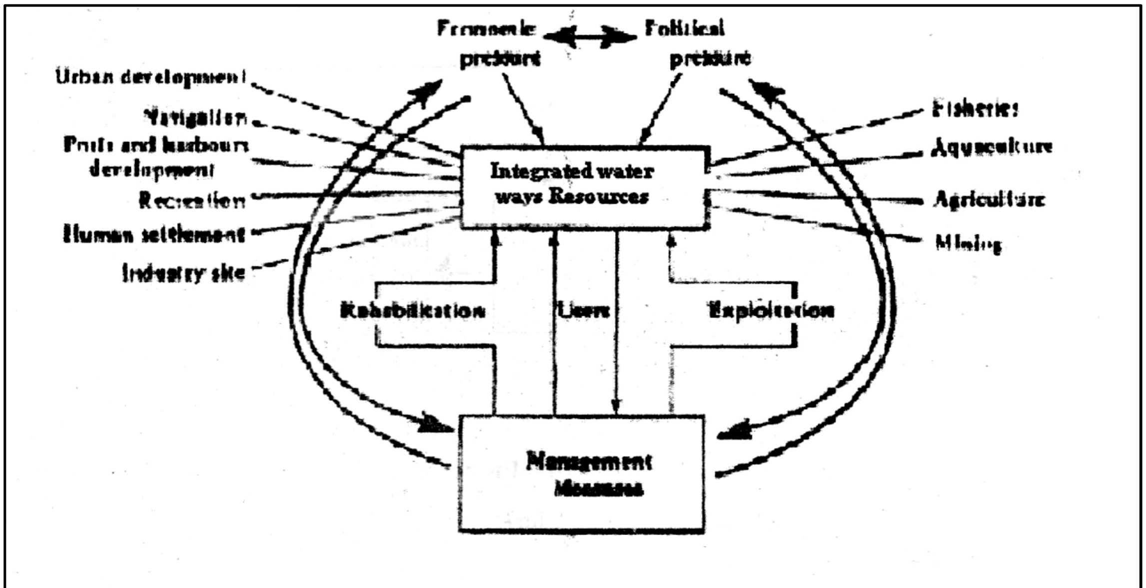


Figure 2 Forces at work on Integrated water ways resources include a variety of economic sectors and political powers, each with a stake in levels of exploitation..

Source: Chua

The sectors, each with its own clientele, compete for funding, resources and political advantage. Therefore, at the planning or budget level, the inputs of different sectors may conflict and pull in different directions. For, this reason, special arrangements are needed to guarantee a multi-sectoral, integrated, approech. For example, the organization of a coastal programme to manage mangrove forests for the sole benefit of the flsheries sector might succeed, but more likely it would fail if it lacks mechanisms to incorporate the interests of local villagers, forest industries, upland agriculture, public health, tourism, port development, and so forth (fig).

It is unlikely that the sectors themselves would cooperate with each other to reduce misuse of coastal resources in the absence of government intervention.

Table 1 Typical Economic Sectors of Countries with large waterways

Sectors that are often waterways specific		Sectors that have direct impacts	
1.	Navy and other national defense operations (e.g., testing, coastguard, customs	1.	Agriculture - Mariculture
		2.	Forestry
2.	Port and harbour development	3.	Fish and wildlife management
	(including shipping channels)	4.	Parks and recreation
3.	Shipping and navigation	5.	Education
4.	Recreational boating and harbours	6.	Public health - mosquito control and food
5.	Commercial and Recreational fishing	7.	Housing
6.	Mariculture	8.	Water pollution control
7.	Tourism	9.	Water supply
8.	Marine research	10.	Transportation
9.	Shoreline erosion control	11.	Flood control
		12.	Oil and gas development
		13.	Mining
		14.	Industrial development
		15.	Energy generation

Source: Sorensen and McCreary

To consider the more specific questions that are involved, it,is useful to review, for example, the major objectives establishment of conservation areas

- management of recreational resources
- management of fisheries resources
- protection of cultural and archaeological resources
- maintenance of coastal aesthetic rsources
- conservation of threatened wildlife resources, such as turtles and seabirds
- management of special environments, such as mangroves, coral reefs, sand dunes, beaches, lagoons, river valleys and flood plains
- proper design and construction of coastal developments such as harbours, marinas, seawalls, groins, piers, breakwaters, coastal roads and dams.

Hazard Prevention

Human activities that remove or degrade protective landforms - for instance, by removing beach sand, weakening coral reefs, bulldozing dunes, or destroying mangrove swamps - may diminish the degree of natural protection that the coast receives. Natural hazards would usually be addressed in sectoral plans for public health and safety. But natural disasters cut across all sectors. Wind damage from a hurricane, inundation by a tsunami, or rapid coastal erosion can affect tourism, the fishing industry, port operations, public works, and transportation. Housing and industry are also vulnerable.

Troublesome erosion of river banks occurs in developed areas where buildings and roadways have been placed too close to the water's edge and are being undermined or threatened by storm induced erosion. In such cases, the beach is often "armoured", that is, seawalls or groins are built to protect the threatened properties or jetties are built to keep inlets open. But these structures are very expensive and may even worsen the situation.

Public Consultation

The general public must be involved in the formation of new waterways policies and rules on resource use if they are to support them. Public participation is a tool available to the entire management community (resource users, public agencies, non govemmental organizations, etc.) to ensure the quality and the effectiveness of the management solutions that willbe implemented. Participation is also a duty because, ... the issue remains, above all, one of human development and because ... people are not the object of that development but the subject of development and the makers of their own history.

Typical information needed in strategic planning

It is seen that during the process of evolution of the policies attention needs to be given to such areas as:

• Impacts on critical habitants, critical species and protected areas.

• Upland damage effective that would result owing to the dredgers and drainages done at the release levels.

• Natural hazard protection areas, which need to be maintained.

• Renewable resources in the Waterways need to be sustained.

• Attention must also be given for protection of Wetlands and flood planes, Plants and Animals, Coastal areas, recreational resources, cultural and historic resources, cynic beauty greenway protection.

Conclusion

The development of a country like India would certainly depend upon making the best use of all resources. In a country where Waterways used to once be an icon of economic sustenance, it is unthinkable that the same source cannot be a harbinger of growth. In the future many of these Waterways are now being revived and the economic growth along these Waterways is fueling enhanced social status. However, intelligent dredging and its management can bring about vast changes in the transportation system as well as the related growth factors. One of the most under utilized and unexplored tools of modern growth needs to be given thai thrust to enable it to turn around the local economy. There are vast opportunitk i in dredging which are appropriate and relevant to the development of Waterways.

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Admiral T B Bose Memorial Lecture — 2007

Shri R C Bhavnani

Country Manager, American Bureau of Shipping, Incharge of India, Sri Lanka, Bangladesh & Maldives

First I wish to thank the organizers for inviting me to this National Convention. I feel particularly honoured and indeed privileged to have been asked to deliver this Admiral T.B. Bose Memorial Lecture. The contribution of Admiral Bose in the field of training of Marine Engineers is invaluable and is well known. I had the good fortune and privilege to meet Admiral Bose when I was a cadet and he was the Chief Surveyor to the Government ofIndia.

Considering the versatility of Admiral Bose, I would not like to speak about any particular topic but rather present a potpourri of various Marine related issues from a historical perspective and the current status.

Since Admiral Bose was a Marine Engineer himself, let me start with the story of Marine Engineering.

Marine Engineering

In the year 1712, Thomas Newcomen, an enterprising blacksmith from Dartmoor, England, developed a steam engine for pumping water out of coal mines. It consisted of a single acting piston working in a vertical open topped cylinder. The piston was connected to an end ofarocker arm by a chain. Steam was injected into the cylinder below the piston and at the end of the working stroke water was sprayed into the cylinder creating vacuum resulting in the piston to come down. The steam and water valves were operated by hand. Some sixty years later, radical improvements were made by James Watt, whose name is more frequently associated with steam engines.

Attempts to use steam engines for main propulsion of ships began in about 1784, but it was only in the year 1807 that Robert Fulton successfully built and installed a steam reciprocating engine in a paddle wheel vessel 'CLERMONT'. Clermont operated on the River Hudson between New York and Albany. Steam pressure was 20 p.s.i. and the engine developed 75 I.H.P. Developments continued at a steady pace and by the end of the Century we had quadruple expansion engines of 10000 I.H.P supplied with steam at 200 p.s.i. by scotch boilers.

By the end of the 19th century, ships propulsion plants had become sufficiently reliable to assure delivery of cargo to any part of the world. Lets hasten to add that this was at a great cost to the Marine Engineer. Mechanical ventilation had not been developed and those working in the Boiler Rooms commonly developed Block Lung. Steam leaks were chronic and in warmer climates the heat exhaustion was very common.

Sir Charles Parson another Marine Engineering Immortal, achieved a successful application of steam turbine to ship propulsion towards the end of 19th Century. Besides his work with Steam Turbines, Sir Parson was the first to recognize the phenomena of cavitation and successfully redesigned the propellers which provided better thrust to move the ships and this brought about the demise of paddle wheels.

In 1892 Dr. Rudolph Diesel, a German Engineer patented a compression ignition internal combustion engine. The progress of this engine was slow and it was not until period of World War II that Diesel engine began to be extensively used. Today of course most ships are propelled by Diesel Engine either as direct drive, through reduction gears or as Diesel Electric propulsion Container vessel 'EMMA MAERSK' which entered service in 1906 has main propulsion power from a single 14 Cylinder Diesel engine delivering in excess of 100000 Brake Horse Power. Together with Auxiliary power the total installed power is in excess of 120 Mega Watts that is more than enough power to light up Goa.

Marine Engineering can not be simply categorized such as Mechanical or Electrical Engineering. It is a combination of many disciplines of Engineering. Marine Engineering is a combination of Mechanical Engineering, Electrical Engineering, Instrumentation and Control Engineering, Municipal Engineering, Airconditioning & Refrigeration Technology etc. etc.

Safety At Sea and Environmental Concerns

Since the earliest times the sea was always associated with danger and Maritime trade was the preserve of adventurers. Accidents were accepted as part of seagoing and associated dangers were probably an attraction to those who sent to sea.

Until the end of Rom an Empire, seafarers were ill equipped to confront bad weather. Ships were loaded well beyond safety limits. Navigators knew little about winds. Wishful efforts were made to combat storms. Ships were bound with ropes fore and aft, to prevent them splitting apart and an anchor was dragged behind to slow down the ships progress.

Realisation ofthe necessity of ship safety came about in middle ages and a start was made by introducing the first preventive rules on loading. Various Maritime authorities of Mediterranean ports began to introduce legislation on freeboard to combat the abuse of greedy owners and Masters who overloaded their ships to earn more freights and laid down regulations placing restrictions on sailings during particular seasons, weather and geographical limitations.

Despite various measures, sea going remained a risky venture. Accidents and losses continued to happen and shipwrecks were a frequent occurrence. Problem was acute. During the winter of 1820 alone, more than 2000 ships were wrecked in the North Sea causing death of twenty thousand seafarers.

With the coming of Industrial Revolution and introduction of Steam powered engines on board ships and construction of Iron and then Steel hulls was a big step forward in the field of Maritime safety. In the 19th Century the Maritime Transport began to be recognized as a real industry. The Maritime authorities of various nations began to exercise their policing powers to monitor safety conditions on board the ship. This was not only in the interest of seamen, but also for the safety of increasing number of people who traveled as passengers on board ships and the increasing volume of cargoes which were carried on board. Various countries issued legislation to control ships and shipping flying their flags.

With increasing contacts and interaction between various states, it began to be realized that accidents and maritime disasters can be minimized through increased cooperation. The move towards internationalization of rules and regulations came about in steps. Some uniformity was achieved through bilateral treaties, agreements, or understanding amongst the leading Maritime nations. Next these nations held international conferences to set up common rules. Finally Intergovernmental organizations took over and proceeded to adopt International instruments to regulate safety at sea and protection of environment.

The first major International maritime Conference was held in Washington DC in 1889, which drew up a code covering rules on steering and sailing, lights and signals and distress signals. The start of 20th century saw conventions on wireless telegraphy, collision regulations, life saving and assistance and more.

On the 14th of April 1912, the liner TITANIC sank off New found and after colliding with an iceberg. This led to a spectacular acceleration of the standard setting process. The most important result of the loss of TITANIC was the first international conference on the Safety of Life at Sea held in London in 1914. The first convention of Safety of Life at Sea (SOLAS) was signed.

A second conference took place in London in 1929 and a new SaLAS convention was adopted containing some sixty articles on ship construction, Life Saving Equipment, Fire Prevention and Fire Fighting, Navigation Aids etc. This was followed by SOLAS 1948, SOLAS 1960 and SOLAS 1974 which together various protocols and amendments is still in force.

Load Line Convention

Another noteworthy convention which must be mentioned is the Load Line Convention which is directed at improving the safety of ships by limiting the Loaded Draught, or in other words providing sufficient reserve buoyancy. In the ancient times many shipwrecks were caused by the greed of ship masters, who overloaded their ships in total disregard of safety.

Modem Load Line Rules are a development of the rules on Minimum Freeboard for Merchant Ship in the later half of 19thCentury which were made more stringent through the efforts of the British Parliamentarian Samuel P1imsoll towards the end of 19th Century and the beginning of 20th Century. Today the freeboard regulations and stability are defined by International Load Line Convention adopted in 1966 which is still in force with certain amendments.

MARPOL Convention

In 1969 Hie IMO assembly motivated partly by the "Tory Conyon" accident decided to organize an International Conference with the aim of adopting a new convention. The conference met in London in OctoberlNovember 1973 and adopted the MARPOL CONVENTION convention for the prevention of pollution from ships. This was modified by the Protocol of 1978. Various annexes to convention deal with various types of pollution caused by the ship e.g. Annex I deals with prevention of pollution by oil while Annex VI deals with oxides of Nitrogen and Sulphur discharged in exhaust gases from the engines of the ships.

MARPOL Annex VI entered into force on 19 May 2005, but is applicable retrospectively to engines/ships built since 01 January 2000.

A recent amendment to Annex VI designates whole of North Sea as a special zone. Effective November 2007, ships operating within North Sea or the Baltic Sea will be required to use Banker Oil with Sulphur content not exceeding 1.5% or use exhaust gas cleaning system which results in an overall emission value of 6.0 g sox/kwh or less. Protective location of fuel oil tanks became applicable to new ships contracted on or after 0 1August 2007.

Ballast Water Management

Alarmed by the damage to sea life in the various parts of the world caused by alien organisms being carried and discharged with Ballast Water carried by the ships, various Governments became concerned and beginning in 1989 some started to institute national and regional regulations intended to minimize introduction of unwanted organisms in their waters. IMO adopted voluntary standards in 1993 and adopted guidelines for management of ship's ballast water in 1997. Various options have been put forward such as retention of ballast on board, exchange of ballast water in open sea, treatment of ballast water ashore or on the ship.

After several discussions and deliberations, a Ballast Water convention was adopted on 13 Feb. 2004 and will enter into force 12 months after ratification by 30 states with 35% world's gross tonnage. As of now six states (0.6% GT) have ratified the convention.

International Maritime Organisation (IMO)

The International Maritime Organisation occupies a special position within the Maritime Community. IMO through the development oftechnical standards aims to achieve safety and prevention of pollution of Marine Environment. These priorities are reflected in its motto "Safer Ships and Cleaner Oceans". It was set up as "Intergovernmental Maritime Consultative Organisation" in 1959. In 1982 the Institution was renamed the "International Maritime Organisation". The setting up of IMO has been a very important step in the evolution oflnternational Maritime Regulations. Since 1959 IMO has facilitated the adoption of more than forty conventions and protocols and many more codes directed towards safety of life and property at sea and protection of Marine Environment.

Classification Societies

Classification societies came into being from around middle of 18th Century. They were initially set up to meet the needs of marine insurers. At that time hull and cargo underwriters were at a great disadvantage, being deprived of any reliable data on which to base their premiums, any periodic dependable statistics on shipwrecks or any accurate information on ships. They regularly met in coffee houses and inns near harbours and exchanged information. Most famous of these was the coffee house opened by Edward Lloyd. These premises provided a club frequented by every one concerned with the sea voyage including shipmasters, owners, cargo shippers, insurance brokers, underwriters etc.

Class society registers provided all the basic information on ships needing Insurance, principal characterization and factors of use in assessing the risk to be insured.

Classification societies have developed over the period and now in addition to publishing records of ships, they set standards called rules stipulating technical requirements for ships. They also perform surveys and inspections to check ships comply with their rules and with statutory regulations.

The classification societies are amongst the key players in the Maritime Safety chain and protection of environment. They are constantly diversifying to provide a better response to the new challenges in the Maritime activity.

Until about 1950 there were fewer than ten societies engaged in ship classification. Now there are nearly seventy, many of whom do not have the capability for performing their role properly. Aware ofthis situation the well established class societies joined forces to form International Association of Classification Societies (lACS) IN 1969. lACS currentlyhas ten members. Indian Register of Shipping, formed in 1975, is an associate member and expected to become full member in due course.

The aim of lACS is safety oflife and property at sea and protection of Marine Environment. lACS actively cooperates with IMO to achieve this objective.

Indian Maritime Status

It is generally believed that India has no Maritime traditions and that we were never a sea faring nation, because "Hindoos" were forbidden by religion to cross the seas. Recent research by Indian Historians proves otherwise.

There is sufficient evidence to show that the era of Mohenjodaro and Harappa witnessed a great deal of Maritime activity and enterprise. Harappan traders had regular business contacts with Sumerian Cities. There was flourishing sea trade with Persian Gulfports as early as 2300 B.C.

The discovery of a big dock at Lothal in Gujarat, measuring 710 feet in length and 120 feet in width indicates that very large vessels were being used during that time.

Yukti Kalpataru a Sanskrit work compiled by Bhoja Narapati and Dhara describes the construction of ships, both river and ocean navigation. According to this treatise, 27 different types of ships were constructed in India. The measurement oflargest ocean going vessel being given as 276 feet × 36 feet × 27 feet, which would translate to approximately 2300 GRT.

The most compelling and exciting reference is to be found in Alharva Veda, Samhita, Kanda 7, Adhyaya 1, Hymn Xiii, 328. I reproduce a translation;

"With thy (Aditis) Blessings, we embark on this ship
That rides well the waves
So broad in beam and spacious; Comfortable, Resplendent;
Blessed are her courses; Her rudders strong,
Fault less in construction, her bilges dry;
So with words of Praise to thee, we embark on this venture
That prosperity may flow;
With thy thrice blessed Protection, O Aditi;
Who are thyselfthe spirit of the Earth;
And the space and the Heavens.

Similar references are also to be found in Sutras, Paranas and in Prakrit, Pali and Tamil literature.

It was through India's Maritime achivism that saw the spread of Hinduism and Buddhism to South East Asia from where Buddhism traveled to China & Japan. Spread of Buddhism did not take the land route to China but the sea route to South East.

However from about 13th Century B.C., India's Maritime prowess went into steep decline mainly due to wave after wave of invaders descended on the plains of North India and moved south of Vindhyachal. Unable to resist them we went into a shell and all progress came to a grinding halt including the Maritime activity.

Since Independence we have made progress but not at a level which we may call satisfactory. This is probably because our policy makers have not paid sufficient attention to development of shipping and shipbuilding. There are strong signals that this is changing and there is realization of the importance of creating a strong Maritime sector to support our growing economy and lead us to be a truly formidable economic power commensurate with our population.

Indian Shipping Requirements

We have 16% of world's population and our share of World Shipping is a little above 1%. Perhaps around 1.2% Indian ships carry approximately 13% of India's Exim trade. India's economy is growing at a rate of 9% per annum. India's manufacturing sector is growing at more than 12% per annum. India's population is transforming from a saving oriented society to consumerising driven society. This will lead to further acceleration of demand and economic activity. Shipping needs will grow at a rate in excess of these numbers. Let us look at growth scenarios of various shipping sectors.

Containers Shipping: The growth in World Economy has been accompanied by unprecedented development of container traffic for transportation of finished goods.

India's container traffic in the year 2007 is estimated to be 5.2 Million TEUs. An analysis of current trend indicates a growth rate of 16% per annum and accelerating. Container traffic is likely to grow to 10 million TEUs by 2010 and

20 million TEUs by 2016. As per the current ship acquisition plans by Indian Shipping companies, share ofIndian ships will remain at not more than 5% for many years to come.

Bulk Shipping

Demand for the Bulk trade has seen the most dramatic rise in the last six to seven years and is likely to see a continued strong growth driven by galloping economics of China and India. Huge expansion of steel making capacity is envisaged in the 11th plan. Nearly 40.0 million tons of steel production is to be added. 75000 Mega Watt of power generation capacity is to be added in the 11th plan, most of it will be thermal and coal based. Considering that nearly 55% will be coal based, the additional coal requirement will be nearly 200 million tons of coal per year by 2012 with further growth potential of 400 MT by 2017, most of which will have to be imported from China, Indonesia, Australia and South Africa. India's iron ore exports have also been rising to countries such as China and Japan.

Crude Oil, Products & LNG/LPG

India's current import crude oil stands at nearly 100 million tons per annum. This is likely to go up to 140 million tons by 2011 and 200 million tons by 2015. Imports are mainly from middle east, west coast of Africa and now also from as far as Russia and Venezuela.

India will have installed oil refining capacity of 230 million tons by 2015 of which the domestic demand will be dedicated to exports. This together with increasing imports of edible oil will create big demand for product tankers.

India currently imports 21 mscmd (million standard cubic meters per day) of gas. This is slated to rise to 190 mscmd by 20 15 and add to this growing imports of LPG.

Offshore Exploration and Production

Thirty five drilling rigs are deployed around the Indian coast engaged in exploration and production of oil & gas. Although production from our offshore oil fields has remained stagnant for many years now, recent discoveries have enhanced hopes for the future. More Blocks are being released by the Government of India for further exploration and many ofthese blocks are in deeper waters on the east coast which will see a flurry of activities in the coming years. This means more drilling rigs and many more offshore support vessels.

At the time of independence in 1947, size of the Indian fleet was 48 vessels of 192000 gross tonnage. Today it stands at approximately 8.5 million gross tons and consisting of more than 800 ships. Of this tonnage less than one million gross tonnage is engaged in coastal trade.

Although the growth seams impressive at first look it is disappointing that it has not kept pace with country's demands. Less than 14% ofIndia's overseas trade is carried in Indian bottoms. Even to maintain this share we have to add to our shipping capacity at much faster pace. Consider that India's exim trade is growing at an annual rate of 12-14%. Task becomes bigger when we consider that nearly 50% Indian tonnage is to be scrapped in next five years because they would have overaged.

Shipbuilding

Considering the above scenario and considering the growing would demand for new tonnage coupled with a shortage of shipyards, there exists an exciting opportunity for shipbuilding in India. India was a great shipbuilding nation once upon a time and then we fell upon bad times and our shipbuilding almost disappeared. It is heartening that the picture is changing once again. Many yards have come up in private sector and are flush with orders. Public sector yards have made great strides in their productivity.

Many new shipyards are planned and hopefully they will come up fast and not get bogged down in Bureaucratic and political tangles. Opportunity is now and speed of implementation is critical.

Maritime Education & Training and Manpower Issues

In spite of our large coastline our involvement in world shipping is not very significant. However, we are and will remain an important manpower-supplying country with about 6% of global seafarers being Indian. Indian nautical and engineer officers have earned a name as being efficient and reliable workforce.

With the entry of private sector in the field of maritime education and training may institutes have opened up across the country. The Administration in taking all necessary steps in ensuring quality in these institutes.

It is ironic that in spite of such large population base and with such lucrative career being offered in shipping, not many candidates are opting for this career. I have been told that many shipping companies had difficulty in getting students for their sponsored courses. The industry, along with, the Administration has indeed organized career workshops and road shows; probably more need to be done in this area and general awareness about shipping needs to be improved.

I may mention here that recently NYK Shipping, Japan inaugurated its training academy in Manila, Philippines. The President of Philippines did the inauguration. This kind of government support is needed to our industry.

Shortages of trained officers remain a serious problem. Studies by BIMCO/ISF forecast that this global shortage will become more serious. Short manning combined with taxing schedules are perennial inspection and visits in ports has resulted in serious psychological problems. Fatigue issue cannot be overlooked. Many studies have been conducted on this, including by P&I Clubs, Cardiff University etc. In spite of this no workable solutions seems to be insight.

Recent incidents on Indian flag ships is a warning that we can no more disregard the question of short manning and taxing environment. INSA, representing about 90% of Indian fleet has indicated a shortage of 834 officers as on 31st March 2007. This problem would grow as, moved by a buoyant market, Indian flag fleet is slated to increase. Industry and the Government need to take a serious view of the situation.

Institute of Marine Engineers (India)

IMEI is a learned professional society with worldwide membership and bilateral and multilateral relations with professional societies in Maritime sector around the world.

It was established in 1977 with its main objective to promote the scientific development of Marine Engineering in all its branches and furtherance of such knowledge.

It holds regular Maritime Conferences the most well known being International maritime Conference (INMARCO). It is held every four years with delegates attending from all over the world.

IMEI has also been entrusted to host the next World Maritime Technology Conference, an event organized by 29 professional Maritime Institutes from around the world. This will be held in Mumbai in January 2009.

Institute is head quartered in Mumbai with eight branches and three chapters spread all over India. Current membership exceeds eightthousand.

Institute publishes a highly informative and extremely useful monthly journal Marine Engineers Review.

The Institute has been rendering a Yeoman service to the development of Marine Engineering and Marine Engineers in India.

Admiral Bose was himself the Vice President of Institute of Marine Engineers (U.K.) and would have been proud of what the Institute of Marine Engineers (India) has achieved.

Convergence of Technologies in Global Maritime Sector

Mr Umesh C Grover

Director, Technical & Offshore Division, Shipping Corporation of India

Background:

The Institution of Engineers (India), Maharashtra State Centre, in association with the Tolani Maritime Institute has arranged this 22nd National Convention of Maritime Engineers and I have immense pleasure to ept the invitation to deliver the prestigious Admiral T.B. Bose Memorial .ure on this occasion.

As you may be aware, Rear Admiral T B Bose started his career as a Lieutenant in the Royal Indian Navy in 1938. He took special interest in the apprentices assigned to the Dockyard of Engineer Cadets to pass out the IMMTS"Dufferin". Admiral Bose was the Principal Officer, MMDat Calcutta in 1952 and then elevated to the Chief Surveyor to the Government of India. Right from the time the new DMET Course was inaugurated in 1949, he identified himself with the new system of training, gave it his full support and became a guiding spirit until his retirement from the service and even afterwards.

In 1957, he was appointed as the Chairman of a Committee to advise the government on the indigenisation of ship ancillaries which lead to the setting up of the Indigenous Development Cell at the Hindustan Shipyard, Vishakapatnam. Admiral Bose was also largely responsible for the development of the Naval College of Engineering at Lonavala. As the Vice President of the Institute of Marine Engineers, UK, Admiral Bose was a beacon light to the marine engineers of India and was always easily essible to the young marine engineers.

Introduction - Convergence of Technologies in Global Maritime Sector

Development of technologies and their convergence has significantly influenced the humanity by synergizing between the various components of knowledge, healthcare, governance and economic development. The maritime sector is no exception. Shipping, especially on a global scale is also affected by this convergence.

Significant developments in the shipping and the port sector especially in the last two decades have taken place around the globe on board the ships as well as on shore. Improved techniques of ship building, equipment design and integrating different technologies have manifested. Ship and port operations along with logistics management, dredging, information technology are taking new meanings with safety, security, air and water pollution and of course optimization being the key issue.

Technological convergence literally means application of latest technology developed in one field ofresearch for use in different contexts. Convergence of engineering, physics, medical science, pharmacy, chemistry, biology and mathematics has resulted in several new technologies such as nanotechnology, biotechnology, bioengineering, etc. Further, it has led to advancements in modern electronics, information and communication technology, tele-rnedicine and alike. Let us take a simple example of diagnostic technology in health care sector. Newer technologies like catscanning, ultra-sound, sonography, endoscopy for delicate surgeries, close monitoring of human parameters etc. were primarily developed healthcare sector, but have subsequently found their usage in Aviati Shipping, Automobile and manufacturing units too.

In the maritime sector, this advanced and proven monitoring and diagnostic technology has brought in a new dimension to the concept of maintenance and operations of the ships. Complete Engine and machinery health-check can now be done without dismantling of heavy and complex components thru' usage of latest technologies using endoscopes, bearing condition monitoring gadgets etc. have changed the "Planned Maintenance" (PM) methodology to "Condition Based Maintenance" (CBM)methodology. These newer technologies have been accepted by various regulatory and inspecting authorities. In a nutshell, overhauling of some components being done on a fiveyear cycle need not be done for as much as 15 years!!!. The tangible and non tangible benefits derived out of such newer technologies by the shipowners would givethem a phenomenal competitive edge over those who resist a change and stick to the older technology.

The interesting part is that quiet a few of the Maritime activities which were independent of each other are now interlinked solely due to extensive usage of newer technologies. The enhanced usage ofInformation Technology led to monitoring of the vessels at the high sea by the owners sitting in that offices, on-line monitoring and tracking of ships and goods at every stage of multi-modal transportation, Port planning & vessel scheduling. Thus with the adoption of newer technologies, several processes and activities in maritime Sector have undergone a sea change and benefits are being enjoyed by the service providers as well as end-users. In fact there is still a great potential for convergence of technologies in several areas of shipping. Continuous up gradation, adoption and absorption of newer technologies has posed tremendous challenge to scientific and engineering community to develop newer and latest technologies.

Need for newer Technologies:

Since the past few years, India has emerged as one of the fastest growing economies in the world. The world focus is currently on Brazil, India, Russia and China referred as BRICnations and the BRIC's economies are likely to become a much larger force in the global economy. Thus there is an urgent need for development of infrastructure which can only be achieved thru' adopting cutting edge technology and meeting the challenges by research and rapid advancement ofnewer technologies.

I would now try and focus on some of the core areas of the Maritime sector, where-in newer technologies have already brought in new dimensions and the older techniques are becoming obsolete.

I. Ship-Building

II. Main Engines and Ancilliary Machinery

III. Navigation & Ship operations

IV. Offshore OilExploration Sector

V. Information technology

VI. Statutory requirements, Research and Development

I. Ship-Building:

Shipbuilding is a highly capital intensive industry which incorporates extensive technology as well as highly skilled labour. Ships have long construction period and the whole construction chain involves shipyard as well as number of ancillary units. In view of the high employment generation provided by shipbuilding directly and indirectly, it is generally supported by sovereign policies. However South Korea and Japan, by far the largest shipbuilding nations catering to about 65 % of the world new building orders have excelled in terms of both quality & time primarily by adopting newer and newer technologies. China which has now emerged as one of the fastest growing ship-building nation has also achieved success by quickly changing over to newer techniques in shipbuilding. There still exists a huge technological gap between Indian shipyards and these world leaders in ship building .

The production techniques adopted in some of the Indian shipyards have not been updated to keep abreast with the latest technology which would help in increased production and cut down the delivery time. In Indian shipyards, at times the structural shell is first installed and then welded together in dry dock and thereafter equipments are installed piece by piece in confined space within the shell. Limited access, cramped space and difficult working conditions leads to long periods of time spent on fitting-out berths. In this regard international shipyards have adopted the principle of pre-outfitting and advanced outfitting well ahead leading to reduced work in the building dock.

I will now briefly touch upon fewofthe shipbuilding processes

* Design * Building Techniques * Planning * Infrastructure

Design of the Ships

In olden days, a designer had to use a large drawing board where he had to manually prepare the vessels lines and manually perform various calculations. The design process used to be very cumbersome and time consuming. Today with the latest advanced design tools, designers can design the vessel dn a computer in a very short time and carry out suitable modifications. Various design tools are available like Tribon, Auto-C Classification software for structural analysis, etc. for carrying out the design work. The complete process from basic design to working drawing can be completed in a very short time.

Building Techniques:

The conventional shipbuilding techniques practiced in the past were cumbersome making assembly of components in congested areas extremely difficult and often resulting in compromise in quality and resulted in delays in construction. The quality of welding depended primarily on the human skills. Fitment of machinery in certain compartments was a major challenge due to working space constraint. The newer building techniques have revolutionized the entire shipbuilding scenario. Some of the newer building techniques are as under:-

- Technological advancement with computerization has given the designers tools to simulate the entire vessel. Each location of the vessel is simulated with all machinery, equipment, pipelines, outfittings etc.
- Blocks are fabricated with all the outfittings, machinery, equipmef . etc. fully installed.
- Increased automation by using robotic welding during panel fabrication saves a lot oftime of block fabrication.
- Depending upon the crane capacities, yards are further cutting erection time in the building dock by making mega blocks in the preerection berths.
- Building dock space is utilized to the maximum by building part of the vessel along with one or two complete vessels and carrying out partial float outs.
- Optimized testing of structure by carrying out fillet air tests, vacuum test, etc. at block stage itself reduces the testing time after erection and thus saves precious time in the dock or quay.
- Preparation of piping modules and testing the pipelines in the shop floor contributes tremendously in cutting the construction time of the vessels.

On Land Construction of Ships The NewTechnology

The tremendous surge in new building orders in recent years coupled with the shortage of building space in the yards has helped as well as forced Korean shipyards to think about the innovative ways and means to improve / increase the no. of vessels delivered per annum. The work procedures / schedules in most of the major shipyards were already optimized to the maximum extent. After exploring all the possibilities of improving the production, it is observed that one critical bottle neck in the existing system construction is the no. of dry docks / building docks available for the - ~?yard for final assembly / erection. The technological development has now given a new method i.e. on land construction and shift the vessel in to a barge / floating dock and float the vessel.

Each shipyard is utilizing their own experience and technology though the basic principle is same i.e. construction on land and shift the vessel to water through floating docks / barges. The main technologies involvedin this are

1. Load out using elevating transporters (ETs)

2. Skid launching using skid shoe orAPSsystem

Planning:

The planning of vessel construction in the past was in-line with the techniques adopted at that juncture. The yards have now adopted "Just in Time" policy in the entire construction activity ofthe vessel which means that machinery, equipment, material received in the yard has to be immediately placed on board / utilized so as to avoid keeping lot ofinventory in the stores.

Infrastructure:

Developing infrastructure required for latest shipbuilding techniques, upgrading the existing infrastructure, scrapping older technologies has been the major contributor in the success of all the world-class yards. The productivity has increased several fold and the yards continue to gear up with the latest infrastructure to meet the newer demands and challenges of the Industry, environmentalists as well as the Statutory Authorities.

- The modern yards have suitable design office, hull, painting, machinery & electrical shops, warehouses, building docks, quay with suitable water depth, etc.
- The hull shops are equipped with shop priming facilities, modern NC (Numerically Controlled) cutting machines, proper welding and testing facilities, adjustable jigs etc. Earlier blasting and shop priming used to be carried out manually. With technological advancement, shop priming machines are used to carryout shop priming of plates. With the advent of NC machines, both time and quality of cutting of plates have improved enormously. Various improved welding techniques adopted from time to time has reduced time and improved the quality of welding/ fabrication work. With the advent of modern jigs, time lost on preparing jigs have been saved as they can be adjusted as per the type of blocks.
- Each and-every shop/ dock/ quay side is equipped with suitable cranes for handling.

II. Mainengines and Ancillary Equipment

The first global oil crisis of 1973 made the shipowners think about "Conservation of Energy" primarily with an intention of reducing operational costs. This led to usage of cheaper inferior grade of fuels with increased NOx, SOx and other pollutants The subsequent oil crisis coupled with environmentalist's concerns for a cleaner planet made Research and developers in improvising designs which could burn inferior fuel but with reduced emissions.

Similarly there has been adoption of newer technologies in other shipboard equipments also. However, I shall limit my paper to one single new concept of "Intelligent" Main Engine which is likely to dominate the next decade. Efficient engines

The first marketable diesel engine was developed in1897 in Augsburg. This single-cylinder, four-stroke crosshead engine (bore 250 mm, strake 400 mm) weighed almost 4.5 tons and had an output of 17.8 HP/154 rpm at full load. At this rating it readily demonstrated an overall engine efficiencyof 26.2 %.

Latest two stroke slow speed engines operate at an overall efficiencyof 52% at SFOC of 121 g/bhp Hr.

Key parameters that necessitated the development of efficient engines

- Stringent regulations: IMOregulations for control of emissions wrt NOx, SOx&Green House Gases (CO2 emission standards expected in MEPC58)
- Higher fuel and Lub oil cost due to sky rocketing petroleum prices and diminishing Oilreserves
- Shortage of man power and manhours available for operation and maintenance
- Higher redundancy requirements
- Higher operational flexibility

Concept of an "Intelligent" engine The concept of replacing camshaft drive with electronically controlled fuel valves and exhaust valves to achieve the flexibility in operation is one of the latest technologies adopted by the Engine makers. The electronic control of the fuel injection system and the exhaust valve operation has resulted in enomenal advantages such as:

• Reduced fuel consumption
• Reduced maintenance costs
• Flexibilityin operation
• Safety ofoperation
• Flexibilityregarding exhaust gas emissions
• Adaptability to future regulations such as Changing to lower emission standards from time to time.

III. Ship Navigation &Operations

Ship Navigation

During the early days the navigation was mainly based on the celestial and terrestrial observations which had several limitations during adverse weather conditions. There has been vast improvement in reliability in ship's navigation achieved by using Satellite navigation techniques and IT interface. The ships exact location, speed made good, istance to next port can be accurately available at any giventime by using GPS/DGPS.

In earlier days the paper charts were used for navigation with manual corrections. With the development of electronic charts (ECDISCS) navigation is very accurate and safe. The chart corrections can be downloaded from satellite signals and corrected on ECDISCS at a click of button. Whereas the same was dome earlier manually and was very time consuming and also prone to human errors.

By adding electronic equipments like Ship Security Alert System (SSAS), Automatic Identifying System (AIS)and VoyageData Recorder (VDR)greater safety and security is assured.

Weather routingl passage planning

Better weather predictions are available by using satellite pictures at very short intervals. Entire Ocean passage planning can now be done from shore and guidance can be given to the Master resulting in better fuel efficiency, improved safety and accurate ETAcan be achieved through this.

Ship Operations

With adoption of newer technology in ship's equipment and design, the ship Operation has automatically undergone drastic changes. Some of the changes are highlighted below.

Maintenance system improvement

Planned Maintenance System (PMS)can be monitored more closely by shore base office by ne~ channels of communications and hence can be mo effective. There has been continuous upgradation of PMS by using vari tools.

Early warning of failure can be obtained by using Condition Monitoring Tools. Cylinder combustion process monitoring Ability of the engine diagnosis system can give early warning of faults, thus enabling proper countermeasures to be taken in due time.

Better inventory control

- Integrated planned maintenance and inventory control system to achieve lower inventory carrying cost.
- Just in time concept for spares and stores other than critical items
- Inventory planning complementary to predictive maintenance concept

Hull Painting and related issues:

Overall efficiency of the ship improves with more efficient hull form and its condition. The Hull condition has direct impact on speed of the vessel and smooth hull reduces friction while moving in water and hence reduces the fuel consumption.

Earlier, paint used for corrosion protection used to be coal tar based epoxy systems, which have been banned by many administrations due to the pollution hazards. The antifouling system used for underwater hull was earlier tin based. However, due to the pollution hazards of tin based system, tin free anti-fouling system has been developed which was adopted at AFS convention in 2001 and has come under force from 2008. Further, developments in anti fouling system: have taken place with biocide free Anti fouling system being developed by paint makers which helps in fuel savings. Painting schemes are available with 5 years warranty. DGSalso has relaxed the interval between two statutory Dry docks and now requirement is one DO in entire survey cycle of the vessel with interval between two DO not exceeding 3 years.

IV. Offshore Oil Exploration Activities

The ever increasing demand for energy has forced the E&P companies to expand their activities away from land in deeper waters. The prevailing high oil prices have encouraged field development, which in times of low crudeprices, might have not occurred. In addition, new drilling and production technologies have been developed to enhance reservoir recovery.

Advanced techniques used in the deep water offshore fields for oil exploration activities are as follows:

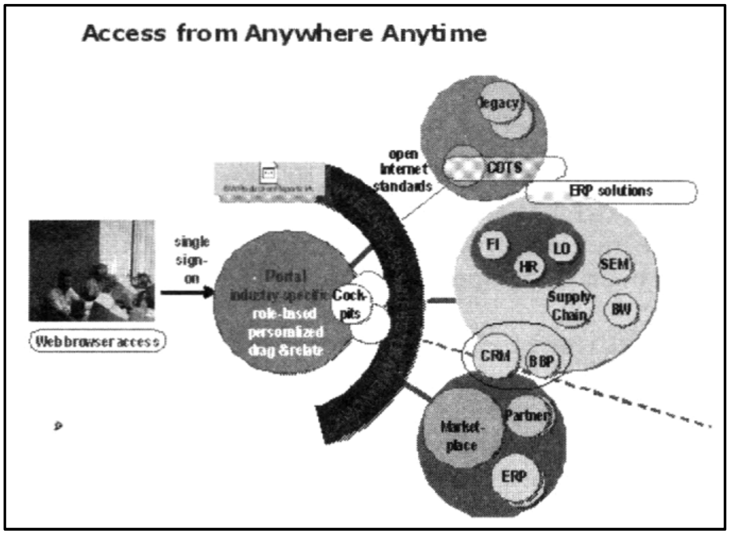
- Dynamic positioning vessels using DGPS
- Remote controlled underwater operations
- Under water constructions, maintenance carried out by using remotely Operated Vehicles (ROV)
- Use of pre-fabricated blocks for underwater structures
- Fast and reliable data transfer of Seismic survey, geotechnical survey data etc. by using satellite communications

v. Information Technology

Applications of IT have percolated almost in all segments of industry including the maritime industry. Communication by Email and Internet including by satellite is daily activities in the maritime world. The implementation of standard ERP packages like SAP and Oracle and the specialized packages for PMS (Planned Maintenance System), Dry docking, Spare parts management, Crew Management, ISM, ISPS, container management, ship scheduling etc. have become the need of the day. IT systems are thus enabling shipowners for controlling and monitoring the entire gamut of maritime operations and the benefits of implementing various IT hardware and softwares on ships and shore are as follows:

i. Stakeholders like agents, suppliers, customers, partners can access information anywhere at anytime in transparent manner by using web based technology
ii. Cargo and containers could be directly tracked and monitored across the globe.

iii. Various management reports and analytic could be generated by using business intelligence tools.
iv. Freight and expenses could be managed by using ERP and COTS packages.
v. Better management ofmanpower and capital employed.
vi. Controlling of bunker cost and repairs and maintenance cost
vii. Settlement ofpayments and accounts ofsuppliers
viii. Instant availability ofright information for decision making



VI. Statutory requirements. Research and Development

After each marine accident there has been lot of analysis on the likely cause which results into enforcing new regulations to prevent occurrence of similar incidences in future. Some of the recent regulations concerning vessel safety and environment are as under:

<u>Restriction on single hull tankers</u>

Many pollution incidents associated with accidents involving single hull tankers led to the formation of IMO rules making double hull tankers mandatory for carriage of liquid cargo in bulk. Single skin tankers are being phased out in a phased manner by 2015, after which no single hull tankers willbe allowed to operate.

<u>Pollution control measures</u>

To minimize air pollution regulations are imposed on the exhaust gases (NOx & SOx)let out by the ships. To control air pollution emphasis is given our quality offuel (low sulfur fuel), adding catalyc converters on the exhaust sider.

Halon & Freon gases used in fixed Fire fighting systems & refrigeration systems respectively are known to have damaging effect on the Ozone layer thereby accelerating process of global warming. Similarly asbestos used for insulation in ships have severe health hazards while handling. Therefore use ofthese gases and asbestos has been restricted worldover.

Various accidents related to structural failure and subsequent loss of bulk carriers have led to imposing regulations such as water ingress alarm systems fitted in each cargo hold, periodical enhanced inspections of internal structures of the bulk carriers etc.

Ballast water management - The undesirable spreading of alien species has been described as the biggest threat to biodiversity and as the next big pollution challenge for the shipping industry, causing irreversible processes affecting human health, industrial activities as well as the ecological balance of the seas. In view of the adverse affect of disposal of ballast water IMO has adopted BWM convention in 2004. Continuous research is going on to develop a ballast water treatment plant and presently one system named SEDNA OCEAN system has been granted final approval by IMO.

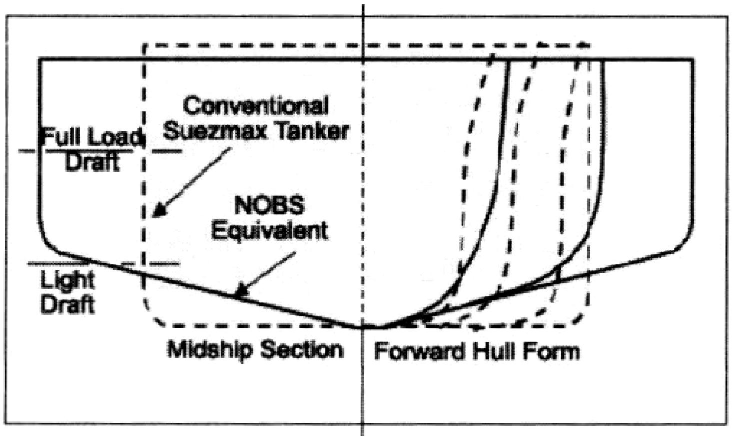
Ship recycling System, Green passport of ships etc. - The shipbuilder are now required to issue certificate at the time of delivery stating various types and quantity of the materials used during construction and the ship owner is re uired to declare plans for disposal of the vessel after completion of ecnomic life.

Research and Development in Shipbuilding I Ship Repair:

The indirect role of electronic media in last three decades, coupled with the satellite tracking has made it possible to generate awareness amongst the developed and developing countries and have been highlighting sensitive issues like Safety, pollution, environmental, global warming etc. This has led to innovation and emergence of newer technologies. Some of them are enumerated below.

The Non Ballast Water Ship (NOBS)

The NOBS concept, introduced by the Shipbuilding Research Center of Japan, circumvents the need for ballast to maintain a sufficient draft to preclude bow slamming and propeller emergence in the light condition by providing a transversely raked hull bottom. This design is reported to afford a sufficiently deep enough transit draft without ballast water when the ship is light. The decreased displacement and reduced deadweight is compensated for by widening the ship's breadth.



Sandwich plate Concept for Ship Construction & Repair:

The sandwich plate system consists of two metal plates bonded to a solid elastomer core. The elastomer provides continuous support to the plates and precludes local plate buckling and the need for stiffeners. The flexural stiffness and strength of the sandwich plate is tailored to meet particular static and dynamic structural requirements by selecting appropriate thicknesses for the sandwich elements. SPS is used both for new construction and, as SPS Overlay, for permanent repair and conversion purposes. In new buildings, fabrication, performance and safety benefits stem from structural simplification and the properties of the composite material. In repair, SPS Overlay is fast, non-intrusive and low risk. As SPS structures eliminate the need for stiffeners, they are less complex and time consuming to manufacture than their all-steel equivalents. As an example, the system would eliminate some 32km (50 percent) of stiffeners in a 10,000 dwt double-hull coastal tanker.

Conclusion:

The convergence of technology in the Maritime sector has played a very important role in advancement in almost all the segments of this industry right from the designing stages to ship construction, operation and environmen tal safety concerns.

As DNVTechnical Director MR. Nortun has stated in one of the Forums, "There will be a need for technology innovation throughout the maritime industry and for investment in environmental technology on board each and every ship. This necessitates a change of mind set. However, not all challenges can be solved through technology or regulations alone. Human factors and organisational factors also have to be addressed if we are to achieve the desired results."

While there has been considerable focus on developingnew technology in the Maritime sector, it is far more important that the end users ofthis technology are abreast with the latest development in order to reap the benefits of the development. I am happy that the Institution of Engineers (India), Maharashtra State Centre and Tolani Maritime Institute have taken this effort to share and pass on the experience of the industry on this topic of immense importance during this convention. Thank You.

Transforming Indian Shipbuilding — A Vital Necessity

Vice Admiral (Retd) B S Randhawa, *PVSM, AVSM, VSM*

Former Chief of Material, Indian Navy

1. Following the economic reforms of the 90s, India has witnessed tremendous growth in several sectors in commerce and industry. This has manifested into an exponential increase in the country's internal and external trade. To enable smooth flow of goods a focused effort has been made to improve transportation infrastructure, particularly in the highways, railways and port sectors. However, such effort is not reflected in the field of ship building, despite its potential to vastly transform India's industrial landscape.

2. It can be said that the world's economy "rides on the sea". This is borne out by the fact that approximately 80 % of international trade is moved by sea. However, India's share in income generated by world-wide sea freight, which was 380 Bn USD in 2005, is a mere 0.55 %. The total world shipping tonnage as on 1st January 2006 was 643 Mn GRT of which Indian owned tonnage accounted for 1.2 % only. Of this, the Indian built tonnage was only 10%.

3. It would be observed that leading economies of the world have had long periods of supremacy in ship building at some stage of their growth. European and US ship yards dominated world .,ship building in the three decades after World War II. The last three. decades have seen the rise of Asian economies led by Japan, followed by Korea and now China. Thesethree countries have cornered ashare of 86 % of the world's 'Ship building by 2005 as against a mere 8% in 1975. In contrast, India, though ranked 13th has a share below 1.5%. For a predominantly peninsular country with a coastline of about 7500 Km and 1197 islands; lndia's ship building capabilities have not kept pace with its economic development, and market demand.

4. With India having enjoyed an unpreceeded high growth in GDP, and the long term prospects remaining bright, notwithstanding the present situation, there is a requirement for enormous increase in capacity of our transportation network, especially for our maritime sector, considering that 90% of our international trade volume is being carried by sea. The freight income generated by sea trade constitutes about 1.8 % - 2 % of the value of goods. Increase in India's share in world freight would be possible only with an increase in ships owned by Indian companies. However, the overall share of Indian shipping in the country's overseas seaborne trade has been declining over the years. From 40 % in the late 80s, it is now only 13.7 %. In the international context, India owns less than 1.2% of the world fleet and is ranked zo" in terms of fleet size. Smaller counties such as Singapore, Norway and Greece, with no significant cargo of their own, have a fleet size of almost 4 times the size of the Indian fleet and therefore carry a major share of the world's seaborne cargo.

5. India's foreign trade is expected to maintain a healthy growth, in the long term. For Indian shipping to even maintain its present share in India's overseas trade, taking into account the expected scrapping of ships over 20 years of age, by one estimate 15.8 million GT would have to be added. This would require an investment of approximately 20 bn USD. Most of this would be spent in foreign shipyards due to inadequate shipbuilding capacity in the country.

6. Shipbuilding acts as a catalyst for overall industrial growth due to spin offs to other industries, including steel, engineering equipment, port infrastructure, trade and shipping. The potential of shipbuilding industry in employment generation and contribution to GOP is therefore tremendous. The dynamics of India's economic growth has created and will continue to create a demand for new ships, most of which will have to be built abroad due to inadequate capacity within the country. On the other hand, the benefits to Indian industry and potential for employment generation from shipbuilding and the associated ancillary industry would grow manifold if India build ships for meeting its entire tonnage requirements.

7. Apart from economic considerations, the strategic significance of the Indian Ocean and its littoral waters cause the region to remain an area of interest to extra regional powers. The region holds 40% of offshore oil reserves, 65% of strategic raw materials, 31% of gas etc. It is home to 30% of the world's population, is a potentially large consumer market and has strong economics to match. The control of choke points to the Red Sea, Persian Gulf and of the Malacca Straits, along the energy flow routes is of strategic importance to extra regional major powers, who maintain a significant naval presence in the area.

8. Littoral and neighbouring states in the Indian Ocean region, over the last two decades, have embarked on ambitious naval modernization programmes and their navies are increasingly visible. Of particular interest and concern is the growth of the Chinese Navy and the growing naval co-operation between China and Pakistan. India

has considerable and diverse maritime interests in the EEZ, including fishing and extraction of hydrocarbons, minerals. and other seabed resources. These factors, together with the need to safeguard our coastline and sea routes, point to the requirement fora strong Navy. Warship design and construction are therefore vital activities which need to be aggressively promoted.

9. The importance of the Indian Ocean for India's long term economic growth, strategic interests and security concerns clearly brings out that the growth of Indian shipbuilding, in both, the commercial and naval sectors is' a-stratepic imperative. The importance of a strong maritime capability was realized by the ancient kingdoms of Southern India, whose fleets promoted Indian commerce and spread Indian culture all over Indian Ocean, notably in South East Asia. The requirement of a strong maritime capability is all the more important for modern day India, especially in view of the resources flowing across these waters and the continuous naval presence of extra regional powers in the Indian Ocean region. These considerations mandate the need for putting Indian shipbuilding, in both, the naval and commercial sectors on the path of rapid growth. To achieve this, a synergetic effort would be essential in all related areas including shipbuilding technology, ship design capability, research and experimental facilities involving all stakeholders.

10. Indian shipbuilding is mainly concentrated in 27 shipyards. Of these, 08 are in the Public Sector, 6 yards being under the Central Government and 2 under State Government with a capacity of 2.54 lakh DWT. In addition, there are 19 Private Sector yards with an established capacity of about 27000 OWT, to which are being added the large capacities of 03 green field projects. The major share of the present capacity is held by 08 public sector yards, with Cochin Shipyard Limited and Hindustan Shipyard Limited having capacity and infrastructure to built vessles of 1.1 lakh and 80,000 OWT tonnes respectively. Barring two notable exceptions, the majority of private sector shipyards are limited in respect of capacity and size of the vessels they can presently build. Our capabilities in respect of technologically advanced ships, notably LNG carriers are non existent, which is a strategic shortcoming.

11. Our shipbuilding industry has been characterized by low capacity, poor productivity and obsolescent infrastructure. Despite these constraints, the industry has shown, that it is capable of increasing its market share in commercial shipbuilding. In the IXth plan the target of 0.3 million OWT was achieved. A modest target of 0.4 million OWT was set for the Xth plan, but contrary to expectations the order book exceeded 1.3 million DWT, as a result of the world wide shipbuilding boom, which enabled Indian yards to secure orders despite their poor record. The growth during the Xth plan period was averaging 15 % per year as against 4.5% per year during the IXth plan. As a result, India's share of the world market rose from 0.1% at the beginning of the Xth plan to about 1.5%. The Xth plan also witnessed an increase in investments in shipyard infrastructure, though investment in technology, R & D, Design etc. remained low.

12. The increased growth has largely resulted form export orders, the bulk of which have been in the small ship segment comprising Offshore and Platform Supply Vessels and Anchor Handling Tugs, although CSL has exported some large and medium ships. This also indicates that the prospects for the export are highly favourable but is relatively negative for domestic construction of ships for Indian owners. Hence, while overseas owners are building their small and medium commercial ships in India, Indian shipping companies are purchasing their ships from abroad, both big and small, but more big than small. The fiscal and statutory rules governing domestic shipbuilding are heavily loaded in favour of export and tend to discourage construction of ships by Indian yards for Indian Owners.

13. The increase in export orders obtained by Indian shipbuilding industry, despite its shortcomings clearly indicates that in the long term, there is a large market available for tapping. Our capacity however needs to be increased, else other shipbuilding nations such as Korea, Japan and China will benefit. A proactive approach by the industry and the government is required to create a favourable climate for investment in the shipbuilding industry, which would be in our national interest. According to a study carried out by the Indian Shipbuilders Assoclatton, the industrycan grow at a rate of more than 30% and this momentum can be maintained, to achieve a world share of 2.2% and an annual turnover of Rs. 18000 Cr (2.5 bn.USD), by the last year of the XIth plan. By the same projection, the industry would have the potential to attain more than 7.5% of the global. order book and achieve a turnover of Rs. 40500 Cr (9 bn USD), by 2017. While these projections may appear impressive when compared with past performance, they pale in comparison with China, which has already achieved our targets for 2017, and aims to corner more than 30% of the global share by 2015. India certainly has the potential to match Chinese prices, given our present low labour wage rates and our industrial base for manufacture of equipment.

14. In the Naval sector, warship building is largely confined to the, three Public Sector shipyards functioning under the Ministry of Defence i.e. Mazagaon Docks at Mumbai, Garden Reach at Kolkata and Goa Shipyard. There is no dearth of demand from the Indian Navy which would need 95 ships and submarines by 2022 and the Indian Coast

Guard which requires 158 ships till 2017. However, with the exception of Goa Shipyard, warship building programmes have been characterized by large time overruns. These overruns result from outmoded facilities, unwieldy administrative procedures and suboptimal HR policies. As a result, the Navy is compelled to place some orders abroad, so as not to jeopardise its force levels. A compelling need therefore exists to increase capacity, through modernization, creation of additional capacity including new greenfield yards, improvement in productivity and management practices.

15. In both the naval and commercial sectors, mere increase in infrastructure will not ensure achievement of desired results. For integrated growth of the industry, there is also a need to create an R & D base, develop in house design capability, infuse new technology, develop skilled workforce, adopt appropriate fiscal measures and remove administrative hurdles, so that Indian shipbuilding can achieve credibility as a source for delivering quality ships in time. Whereas the Indian Navy has established and nurtured a vibrant design organisation, and taken the initiative to develop indigenous sources of equipment, for strategic reasons, the same measures need to be taken in the commercial sector, in order to bring about synergetic economies of scale. The JV route with larger share of FDI offers an avenue to meet this objective. If we are able to develop ship designs which offer greater operational efficiencies i.e. lower running costs and longer service life than their peers, we be able to attract international customers.

16. A distinctive feature in the commercial sector is the provision of subsidy to Indian shipyards by the Government. The continuation of this measure at least over the Xlth plan is essential because of the high incidence of taxation and the high cost of capital. Without this subsidy, Indian commercial shipyards would find if difficult to remain financially viable and would not attract the investments necessary for high growth and achieving economies of scale. Once economies of scale are realized, the issue of subsidies can be reviewed.

17. Our shipbuilding industry requires the focused attention of the government to create conditions required for its growth. Our geo-strategic and geo-political concerns underline the need for a strong and capable Navy and Coast Guard, fully capable of safeguarding our security and economic interests. Our commercial shipbuilding sector has demonstrated its ability to compete successfully in the international market in several niche segments. This competitiveness, if extended across the board, including in high technology sectors would yield substantial returns. There is, therefore, a need to remove structural weaknesses and to create a fiscal, commercial and statutory environment, conducive to the sustained growth and self sufficiency of our shipbuilding industry. An integrated approach is necessary as half-measures would not result in any headway.

18. Firstly, both existing and future shipyards need to be considered as Special Economic Zones i.e. given a full SEZ status. This is necessary because ships imported by Indian owners are given full exemption of customs duty and presently custom duty of about 35% is levied-on all capital equipment required for shipbuilding, even though this measure does not protectany industry in India. A need therefore exists to accord export status for ships built in India for Indian owners. SEZ status should also be accorded to any other ancillary industry that may come up to enable-the industry to grow in clusters. This measure would attract much needed investment, and would also nurture the growth of the in land water and coastal sectors.

19. Secondly a 'single window clearance' system needs to be brought into place for according clearance to new shipyard projects covering land acquisition, environmental clearance, power and water etc., so that project implementation is not delayed. An empowered professional authority could be set up to accord such clearances. The present requirement to obtain multiple clearances from various departments acts as a deterrent to investment.

20. Investment in R&D should be appropriately incentivized by according fiscal benefits analogous to those given to the pharmaceutical industry.

21. Rationalisation of taxes and duties and elimination of the inappropriate service tax, which only help foreign shipbuilders, should be effected, Taxation models followed by leading shipbuilding nations for their industry should be adopted.

22. Custom bonded warehouse rules need to be amended, including the period for which materials can be stored, commensurate with the requirements of the industry.

23, An expanding shipbuilding industry would require a large trained work force, covering all areas in the techno-economic spectrum of shipbuilding. At least two universities for shipbuilding technology should be created, in collaboration with universities of leading maritime nations in order to provide well trained and capable human resource.

24. The constraints on our shipbuilding industry as well as the opportunities available have caught the attention of government agencies and some initiatives are visible to improve the situation. However, in order to achieve concrete results within a short timeframe it is important that a high level empowered Group of Ministers be created to implement corrective measures. This GoM would need to be supported by a permanent Task Force, composed of representatiives from all stakeholders to draw up specific plans, draft suitable rules and regulations, obtain approvals and oversea implementation. Unless such measures are enforced with the urgency that they merit, the vision of seeing India emerge as a major shipbuilding nation would remain a mirage. However, on the other hand,the proposed measures are implemented with full vigour, the transformation of Indian shipbuilding into the top league would be assured, resulting in widespread benefit to the nation.

Delivered during the Twenty-sixth National Conventions of Marine Engineers on 'Economic Meltdown : Overcoming Effects on the Maritime Industry' organized by Belapur Local Centre, September 22-23, 2012

Economic Meltdown — Overcoming Effects on the Maritime Industry

Mr M V Ramamurthy

It is an honour bestowed on me for delivering the "Admiral T.B. Bose Memorial Lecture" today at this 26th National Convention of Marine Engineers hosted by the Institution of Engineers ofIndia and the Institute of Marine Engineers of India. My lecture is on the very theme of the Convention, "Economic Meltdown - Overcoming its effects".

The global economic cycle rules the fortunes of any global industry, and more so, the maritime industry. When economy booms, trade follows it and vice versa. The growth in economy translates into demand in consumer goods and services and the logistics associated with it. The economic meltdown during the latter half of 2008 and the first half of 2009 had a catastrophic effect on the maritime industry. Being the carrier of about 90 percent of world's cargo, it was no surprise that Shipping was the worst affected.

Before we delve into the global economic meltdown and understand the situation, it is only appropriate that we first devote our attention to the global shipping boom preceding it. Till then, shipping and port sector had been the greatest beneficiary of the global boom and they reaped the harvest in full. Almost every sector in the maritime industry thrived in that period - the ship owners, shipyards, bankers, sale & purchase companies and investors. During the boom years, due to the availability of abundant cash at low interest rates, tax saving avenues and comparatively high returns in shipping, banks and investors pumped in hundreds of billion dollars into shipping, which consequently developed the shipbuilding industry and also the port infrastructure to cater to the boom in shipping trade. New port complexes were planned to red-carpet the global highway for accommodating the giant container ships and thus to prevent clogging of ports and provide them adequate berthing capacity.

We are all aware that the shipping and the financial industries have very close links from the Ages. The risks associated with the shipping were also mitigated by the insurers belonging to the fmance industry, be it for the Hull & Machinery or for the Protection & Indemnity cover. Thus, before the boom period, the financial industry was used to leverage the opportunities of international shipping. However, when the unprecedented boom occurred in shipping after the year 2000, the positions changed. The international shipping in fact became a means to leverage financial opportunities; the reason being that, unlike in the past, the finances were used not only for the capital requirements, but it also provided for amortization of funds for the operations over a long period with more direct involvement of the fmance companies in shipping operations unlike the passive roles played by them earlier. In fact, the financial companies also took a stake in the ownership of shipping as well as port facilities and other intermodal assets and their operations. For the international transactions, the "letter of credit" became the global means. Thus there evolved a complex relationship between the financiers and the international shipping operators, with as much as 90 percent of global shipping operations being controlled by the fmanciers.

And, all the above happenings were due to globalization and the free-trade agreements all over the world. The 1948-initiated General Agreement on Tariff and Trade (GATT), followed by the establishment of the Organization for Economic Co-operation and Development (OECD), the United Nations Conference for Trade and Development (UNCTAD), the World Trade Organization (WTO) and the North American Free Trade Agreement (NAFTA) brought-in the trade closer among the nations of the world. Meanwhile the GDP of nations all over the globe rose continually. The technological advancements, the larger sizes of ships, the organizational improvements in port management and the intermodal transport made the economics of scale possible. The "Just-in-time" production philosophy and "Zero-inventory" principle made the necessity of timely and swift movement of goods across nations. The open Registries prospered by avoiding costly national regulations and accounted for 55 percent of global merchant fleet in 2008 compared to a mere 5 percent in 1950. Together with low labour costs of seafarers from developing countries and low capital costs from industrialized nations, shipping became a true global economic sector. In year 2009, the total ships grew to about 53,000 in numbers, comprising of general cargo vessels 31 percent, tankers 27 percent, bulk-carriers 13 percent, container ships 9 percent and other vessels 5 percent, totaling to dwt of about 1190 million, wherein in dwt terms the tankers and dry bulk-carriers contributed at 35 percent each.

For the global shipping boom, let us consider as an example the container shipping. China became a global economic power mainly due to the ever increasing sizes of the container vessels, trading hi-tech materials and machineries from Europe to the manufacturing plants in China and in return finished products of all sorts from China to every comer of the world. To take advantage of the low cost of production, the European countries shifted their production facilities to China, from where the manufactured goods directly went into the containers at a terrific pace without the necessity of even interim warehousing at China. Large container ships of 100,000 BHP carrying more than 11,000 TEU, with containers arranged at 18 across, 85 along and in 18 tiers were making high-speed return-voyages from China to Europe with full cargo one way from China and about half the cargo and empty containers on their return. These were the days of the global boom and nearly 500 million standard containers were transported by sea across the world in early 2008, which was twice the number as in the year 2000. The effect of container shipping boom with its economics of scale on sea transportation of consumer products was amazing - only Rs.50 for a TV set and Rs.5 for a vacuum cleaner for shipping from china to India.

The cash crisis in the United States brought in the global recession. The US dollar has the status for world reserve currency and the funds were available from USA in large amounts without much needed screening of the creditors to ensure their ability to service the debt. This advantage was heavily abused and the underlying dynamics of this situation eventually brought-in the 2008-09 economic crises. Towards the end of 2008, credit became suddenly very scarce and debt-servicing totally defaulted. The economics just collapsed rapidly due to the emergence of acute imbalances, which the world could not endure anymore.

This was the triggering factor for the economic melt-down, as the demand for goods from Asia dwindled due to the recession in the western countries. Decline of consumer consumption in the West and the cascading effect of lower production in the East made the shipping trade surplus. The business that kept on boosting at a tremendous rate till the first half of the year 2008 in shipping trade, shipbuilding, port infrastructure, multi-modal transportation and associated facilities, just melted away and that too at a very steep gradient and this resulted in huge surplus in the shipping tonnage. Plummeting consumer demands combined with overcapacity in ships due to new-building orders during the boom period initiated the worst economic crisis during the second half of year 2008. The same globalization, which created the boom, turned out to be the culprit for the economic meltdown.

The excess numbers in shipping tonnage affected the freight rates and thus the profits of the shipping companies. The charterers could not pay the charter-hire to the shipping companies and in turn the shipping companies could not pay their bankers; the net result was that many banks collapsed. The vast number of ships on order in mostly the Asian shipyards had to be cancelled. But the shipyards were not in a position to accept cancellation of the orders from the ship owners. The remedy for the ship owners was either to delay the construction of the new ships with the consent of the shipyards in the hope that situation would improve or to forfeit the already paid amounts of up to 40 percent of price of ships.

This was one of the worst crises in the history. Shipping line operators went into the verge of bankruptcy and they alone suffered losses to the tune of USD 20 billion in 2009. Drewry Shipping Consultants remarked that "The industry is looking at the edge of a deep abyss." and Lloyds List wrote that "Container shipping was thrown into a full scale panic." We considered the example of the container shipping in the economic boom period. In the economic meltdown scenario, let us take the case of dry-bulk carriers - the carriers of grain, coal and ore. The trades in these commodities reflect the sensitivity of the global economic activity as they serve as the feed stock for the people world over for their daily necessities - food, energy and manufactured goods. The greater the demand of these goods around the world, the greater is the dry-bulk shipping trade. In May 2008, the Baltic Dry Index was 11,793 points, but towards the end of the year, it dropped to 663 points, nearly a drop of 94 percent. Even today the dry-bulk shipping is facing the headwinds due to reduced cargo flow and more new-building deliveries, as per the report in the recent "Fairplay" magazine. Apart from dry-bulk carriers, containers and car carriers too became very vulnerable.

Though the world GDP declined only by 0.7 percent in the year 2009, The new-building orders declined from 11657 ships in Sept 2008 amounting to 588 million dwt to 7821 ships amounting to 422 million dwt in Dee 2010. The newbuilding price index came down to 78.1 in 2009 year-end from 113.2 a year before. Second-hand ship price-index in 2009 also slumped to 49.2 from 136.8 in 2007. However, though the demolition levels, which were low since the year 2005, picked-up in 2009 and 2010 with higher prices, due to the large pending orders for new-building vessels, the total world fleet for tankers, containers, dry- bulk carriers and other type of vessels did increase.

The immediate result of the economic meltdown was cut-throat competition and price-war. The big shipping companies weathered the storm to some extent; whereas there was a bloodbath among the smaller ones and many perished. The fight for the survival could only be possible if all the stakeholders could come together to share the pain. This did happen by limiting the number of global shipping companies to a handful through mergers and acquisitions in Europe and the Far East - shipping companies like Maersk, NOL, COSCO, China Shipping and NYK for example. Mergers, joint ventures and acquisitions are a means to consolidate on vessel types to counter difficult trading conditions, make improvements in fleet and consider alternative shipping. The shipping companies took steps to control capital outflow and operational costs and to stop ordering new tonnage. They delayed the orders already placed, wherever the existing and comparatively younger ships could continue in operation with acceptable operational costs. As an alternative, they also demolished the older ships having higher operational costs to maintain the existing tonnage level and thus earn cash for making the balance payment for the new building orders. Vessels were also decommissioned temporarily for preplanned periods at anchorage in ports, estuaries and bays around the world at important trade arteries.

Slow-steaming of the vessels was also practised by ship owners as well as the charterers to continue to employ an increased number of reasonably younger vessels in the fleet. For example, for the same quantity of cargo movement between two locations, 10 vessels could be employed instead of say, 8 vessels. Slow-steaming no doubt increases indirect operating costs and port charges of the additional vessels for the same amount of cargo transported over a period, but at the same time it saves direct operational costs on fuel to compensate for this loss as well as keeping the vessels in operation.

In these difficult circumstances, it was important to save on the indirect operational costs on the vessels, even if this may contribute to sayings only in smaller percentages. Crew costs forms a major portion ofthe indirect operational costs and can be optimized by reducing the crew to the minimum as admissible by the Flag legislation, replacing the crew from nationalities of lesser cost, increasing their contract period and thus reducing their frequency of travel and the associated costs on their periodical replacements, fixing their wages in their local currencies to offset the foreign currency fluctuations, maintaining the unmanned machinery spaces on vessels for reduction in engine crew and outsourcing crewing and technical management to specialized and cost-effective management companies. It is also important to fix proper HR policy for the intakes of cadets and trainees and on the benefits to the crew other than their wages. Optimization on shore-staff also was necessary to reduce the overall costs. Planning for savings on spares and stores procurement, running repairs to the ships with onboard crew instead workshops, dry-docking repairs, insurance payments and survey costs were also part of this exercise.

For Liner shipping, changes in sailing schedules with fleet capacity optimization to counter over capacity along with rerouting on alternative and more economical lanes were cost saving avenues. Improvement in fleet operation efficiency and the services provided to the customers can control the overall fleet costs. Increasing single vessel deadweight; coordination among shipping companies to cut unfair competition to have win-win situation; strengthening of information exchange and cooperation among key players in this sector; and pruning the fleet to reduce uneconomical over capacity and to stay young have all brought positive effects on shipping.

China, the world's largest shipbuilder, addressed the issue of economic crisis in their new-building shipyards by curtailing the regular two shifts to a truncated single shift and also reduced the wages of workers by about 30% voluntarily or otherwise. The on-going large projects were still continued on the above basis, which were acceptable to both sides - the shipyard and the ship owner. The national bail-out strategy played a significant part with the government backing on funds. The bankers did not allow the yards to die-down by continuing to finance the yards on conditional measures. Mergers and acquisitions were adopted to exercise economy in operations. With these measures, they could wait for the situation to improve and be ready for the new opportunity. In many cases, the Chinese shipping companies or the shipyards themselves bought at lower prices the ships, the orders of which were cancelled by the ship owners on forfeiting the initial payments. Shipyards also took up to ship-repairing and demolitions as an alternative means of keeping the shipyards occupied. The essence of these measures was keep the industry alive with break-even or minimized losses and be ready for the new phase.

Indian shipping companies are no exceptions in facing the global economic crisis. They also have the problems of cash flows, low charter-hires and freight-rates in all segments of shipping barring probably for the offshore sector. The situation has continued generally all through these periods, except for smaller intervals of relief. Indian shipping companies also diversified for Indian cargoes as a relief measure. They generally refrained from buying new ships and opted for second hand ships to keep the capital costs down. However, the Indian companies on offshore sector could breathe better; and in fact the number of offshore vessels increased by about 100 to 182 in 2012.

The recent more stringent environmental regulations for shipping also played a part in enhancing the difficulties of the maritime sector during the crisis situation. So is the case with Somalia piracy. The irresolute crude oil prices and thus the marine fuel costs have also come in the way of earlier recovery of the crisis situation. At the same time Tsunami in Japan came as a relief to the LNG sector.

The economic crisis is still not over, though the demand in the trade did pick-up in 2010. However, the sovereign debt crisis still continues in Europe. I understand that Drewry Shipping Consultants have predicted that the container shipping may not return to its levels of2008 until 2012 and hence we need to wait and watch. Each nation or group of nations will definitely find its own political solution to achieve a sustainable recovery from the crisis sooner or later. Brazil, Russia, India and China still remain resilient showing a higher GDP growth than the developed nations. Supporting trade finance, Institutional support for commodity exporters and FDI in developing countries to stimulate economic activity, regional cooperation for economic activity, improving productivity, quality assurance and competitiveness and evolving long-term strategies keeping-in mind the shipping cycles will help to tide over the crisis. However, there is a danger of bringing-in pretectionism to mitigate the effects of the economic crisis. Similarly keeping on hold the projects on port capacity expansion will also seriously affect trade when the trade returns again to growth.

Shipping is cyclical and historically the shipping cycles are about 7.S years. We are now on the half-way mark of this cycle and the upward trend is on its way. When many perished in the economic meltdown, we also need to acknowledge that many others did also take advantage of this situation and prospered. Let us hope for the best in the near future.

I gratefully acknowledge the reference I made and for information I gathered for this lecture from the periodical reports of UNCTAD , WTO, IMO, World Bank, Drewry, Lloyd's List, Clarkson, The Journal of Commerce, Fairplay and INSA.

Jai Hind!

Delivered during the Twenty-seventh National Conventions of Marine Engineers on 'Opportunities / Challenges in Design/Construction of Vessels for Navy, Coastguard and Offshore-Oil & Gas Industry' organized by Visakhapatnam Local Centre, August 16-17, 2013

An Insight into The Present Leading Trends in Maritime Frame Work with Respect to Indian Navy/Coast Guard/ Oil & Gas Industry

Shri G V L Satya Kumar, *IRTS*

Chairman (IIC), Visakhapatnam Port Trust, Visakhapatnam

1. Introduction:

The major component of national economic growth is Oil & Gas industry while geo political situation in and around South East Asia is attracting severe concern on the coastal security resulting in high national budget allocations for augmenting the efficiency and capacity of Indian Coast Guard.

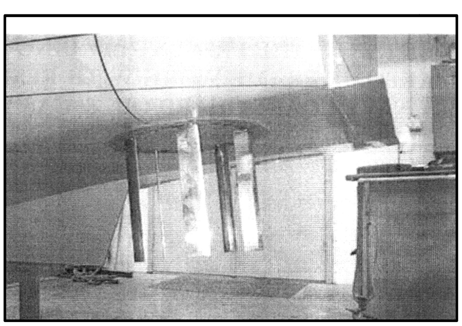
2. Oil & Gas Industry:

This industry which takes the front seat in almost all countries in the absence of replaceable energy resource which is viable and economical. Irrespective of the international trade fluctuations this is one industry which is going to thrive for years to come. In this back drop it is easy to comprehend the utmost importance given to this sector in every nation. This sector has mainly two segments viz. transportation of raw and finished products and oil&gas exploration and extraction. For operation and maintenance of these segments the involvement of Marine Technologies and their constant up keep and competitiveness is paramount. This opens up large areas of opportunities in both designs and constructions. Some of the marine equipment that required to be further developed and constructed in consonance with ever changing demands and challenges of the industry are ESC0l1and Berthing Tugs, Oil Tankers(VLCC&ULCC), DP vessels, Drilling Platforms etc.

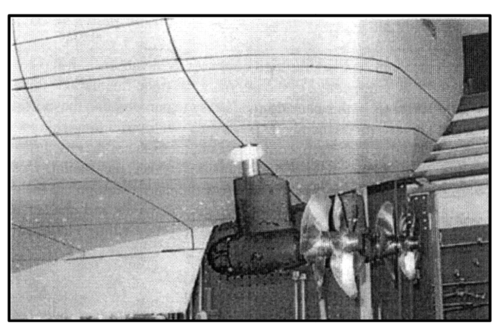
1.1 Tugs:

Tugs are the equipment normally utilized by all Ports for berthing and un-berthing of various vessels, whose reliability and efficiency should be maximum. A robust design suiting to all conditions is still a long way. Certain aspects which require attention at design level are enumerated here as discussed in respect of Oil tankers.Demand & capability of the tanker escort requires the consideration of what size and / or number of tugs are required to prevent a powered grounding or allision if there is a disabling incident on a transiting tanker in a restricted waterway?The performance of a tug in an emergency maneuver depends on its ability to apply corrective forces to the disabled vessel either through a line or through direct contact with the tanker's hull. There are two distinct assist strategies to be considered; one in which the tug is required to stop the ship in the shortest possible distance and the other in which a tug is required to steer the disabled ship away from a hazard. There are fundamental differences in the application of these assist modes between conventional and tractor type tugs. Conventional tugs apply braking force by backing down on a headline while being dragged by the ship through the water. The braking force is developed by the reverse thrust generated with the propellers rotating at the maximum achievable reverse RPM and is augmented by the hull resistance. Conventional Escort Tug, VSP Tractor Tug, ASD Tractor Tug etc. needs redesign for more reliability especially with respect to control failures as these conditions would be detrimental both to property and environment.

Arrangement of VSP



Arrangement of SRP



2.2 Oil Exploration Vessels:

As stated by a company which has good participation in Visakhapatnam Port Trust with respect to marine diesel engines, "The marine business is facing challenging market conditions, but there are still many opportunities. The oil and gas industry is solid. The days of "easy" oil exploration are gone, and we believe that rock-bottom oil prices are behind us. In the future, more marine operations will be performed in deeper water,further from shore and even in arctic areas. ULSTEIN is well positioned and ready to deliver the advanced technology that such operations require, " say CEO Gunvor Ulstein and deputy CEO Tore Ulstein of Ulstein Group."

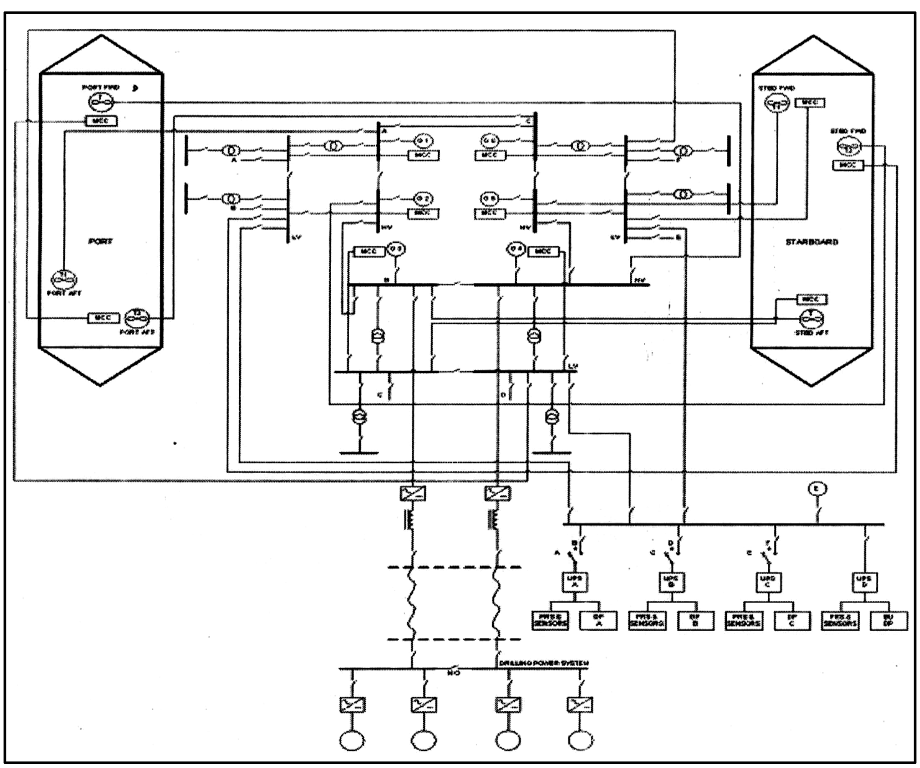
National and international standards and demands for efficiency, safety and green responsibility are getting stricter. Marine operations are becoming more complex and international. By taking a systematic approach to innovation and R&D, the need of the hour is to get equipped to meet these future needs of the industry.

2.2.1 Dynamic positioning (DP):

Dynamic Positioning requires the following conditions which needs to be still perfected. Step less control of thrust in magnitude and direction according to X- and Y-coordinates, Thrust and efficiency are equal in all directions, Extremely fast and precise thrust changes, Thrust control corresponds with the main ship's axis, Main engines can be operated with constant or variable revolution, optimally adapted to the operation conditions. This is achieved at present by a computer program containing a mathematical model of the vessel that includes information pertaining to the wind and current drag of the vessel and the location of the thrusters. This knowledge, combined with the sensor information, allows the computer to calculate the required steering angle and thruster output for each thruster. This allows operations at sea where mooring or anchoring is not feasible due to deep water, congestion on the sea bottom (pipelines, templates) or other problems. Dynamic positioning may either be absolute in that the position is locked to a fixed point over the bottom, or relative to a moving object like another ship or an underwater vehicle. One may also position the ship at a favorable angle towards wind, waves and current, called weather vaning.

The DP control system will consist of a triplex system in the main bridge area, a simplex system in A60 separated back up room and an independent joystick system. A stand alone simulator, capable of providing training for operators on all key features of the DP system, will be installed. Handling of the input/outputs for thrusters will be by means of totally independent outstation for each thruster. The independent joystick will use totally separate means of communication to the thrusters or thruster outstations. Systemic faults common to sensors or position reference equipment will be avoided by installing adequate equipment.

A typical situation of equipment control on a DP vessel represented below:



2.2.2 Certain insights into some sophisticated equipment which are going to see lime light in oil exploration are reproduced as published by Mis Rolls Royce.

The versatile UT 737 CD vessel will support the most demanding subsea projects, including constructing and servicing oil and gas wells on the sea bed, up to 3,000 metres below sea level. In order to support such challenging missions the vessel will include specialfeatures, including two independent systemsfor launching and recovering Remotely Operated Vehicles (ROV), a 125 tonne offshore crane that compensates for wave movements and an advanced offshore tower which handles subsea equipment through a large opening in the hull of the vessel, called a moon pool. Anders Almestad, Rolls-Royce, President - Offshore said: "This high tech vessel will showcase a combination of innovative technology and world-class, energy efficient design. It demonstrates our position as the market leader in high specification offshore vessels and our ability to meet the challenges of the demanding deep water oil and gas industry." The design and fit out of the vessel enables it to perform almost any duty in a deepwater oil field. In addition to supporting subsea operations it can transport cargo to and from offshore oil and gas platforms and act as a rescue and oil spill response vessel. The vessel will also include a diesel electric propulsion system incorporating four Bergen engines. These will drive two Aripull thrusters an~ two side thrusters, which will work in unison with a dynamic positioning system to enable the vessel to maintain position when undertaking subsea activities. A diesel electric propulsion system will significantly improve fuel efficiency and lower the vessel's emissions. The Rolls-Royce designed UT 737 CD will be built at STX OSV's shipyard in Brevik, Norway and is scheduledfor delivery in early 2014.

3.0 Indian Navy and Coast Guard

As already asserted the importance of Indian Coast Guard and its augmentation cannot be undermined, not only for the counter terrorism activities but also to safeguard the coast lines against illegal pollution by merchant vessels either due to ignorance or to cut costs of operations. The Defense Ministry has initiated action to place "Air Enclaves" and Regular Marine Patrol Stations and also ordered related equipment for manufacture for this purpose.

Current order book of Indian Navy, Indian Coast Guard and recent deliveries as published in © India Strategic By CmdeRanjit Rai (Retd)

Two aircraft carriers, Three Krivacks, Three Type-I 7 Shi valiks, Seven Type-I7 A stealth frigates, Three Type- I5A destroyers, Six Scorpene submarines, Two-pIus-two nuclear submarines, Six submarines of Project-75 (I), Four Indian Navy-designed OPVs, Four Type-28 ASW Karnorta-class corvettes, Two Indian-designed merchant ship configuration training ships, Two tankers, Six Catamaran survey ships, Four Mistral-class LPDs, Eight MCMVs, Two submarine support ships, Two DSRVs, Three Coast Guard oil pollution control vessels, Seven OPVs, 145 interceptor boats for Coast Guard, 80 FIVs.

Indian Coast Guard Ship 'Rajdoot', the sixth in the series of eight Inshore PatrolVessels (IPVs) displaces 300 tons and can achieve a maximum speed of34 Knots. It is capable of undertaking multifarious tasks such as surveillance, interdiction, search and rescue and medical evacuation. The ship is fitted with state-of-the art communication and navigation equipment like Integrated Bridge Management System and 30 mm CRN-91 gun as main armament. The ship will enhance the Indian Coast Guard's capability to undertake operations to further Maritime and Coastal Security on theWestern Seaboard.

It can be surmised by the above activity of hectic procurement that there exists a tremendous scope for Marine fraternity to participate in both design and construction of Naval and Coast Guard vessels.

Remote Sensing and GIS Applications in Marine Studies

Dr (Mrs) Usha Natesan

Advisor (Approval Bureau) On Deputation, AICTE, New Delhi
& Professor, Anna University, Chennai
u_natesan@yahoo.com

1. Satellite Oceanography

Remote sensing is the science and art of obtaining information about an object, area or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area or phenomenon under investigation. It is a technique to observe the earth's surface at a distance and to interpret the images or numerical values obtained in order to acquire meaningful information of particular objects on earth. The characteristics measured by devices called 'sensors' are the electromagnetic energy reflected or emitted by the earth's surface. This energy relates to some specific parts of the electromagnetic spectrum, usually visible light but it may also be infrared light or microwaves. There are a wide range of remote sensing sensors. Due to the repetitive, multi-spectral, multitemporal and synoptic nature of information, remote sensing data has proved to be extremely useful to address a wide variety of management and scientific issues in the coastal zone.

Oceanography, despite its rich scientific history, is far from being a well understood science. Before the advent of wellestablished remote sensing techniques, it was difficult to acquire oceanographic data since its availability was limited to observations from ships/buoys and coastal stations. Also, traditional field-based collection of information about shorelines had been expensive and time consuming. Moreover, the information available to the end users was often incomplete and inadequate.

Utilizing the advantages offered by satellite remote sensing, significant progress has been achieved in data retrieval as well as their applications including coastal zones over the last decade. Thus, remote sensing has over the years, proved to be a better alternative to the traditional methods. Detailed study of open water phenomena are best done with sensors designed for oceanographic observations, while coastal studies can often be done with satellites designed for land applications.

The quality of the information from synoptic coverage of vast extents of shorelines depends on the sensors used. The capabilities of sensors, the 'powerful eyes' which 'sense' the earth and its features are critical in deciding the applications of its data. The main sensors that are being used for satellite oceanographic observations occupy visible, thermal and microwave (both passive and active) spectrum, viz. Ocean Colour Monitor, Thermal Infrared Radiometer, Scatterometer, Synthetic Aperture Radar, Altimeter, Microwave Radiometers, Imaging Spectrometers and High Resolution Imagers. These instruments provide a wealth of information on a diverse range of geophysical and biological parameters, such as surface or near surface colour, sea surface temperature, wave fields, surface roughness, large-scale surface topography, wind fields, etc. Measurements of these features and their variations over space and time can be interpreted to provide information relating to biological productivity, fish location, currents, sea state, surface winds, water quality, sedimentation patterns, pollution and other phenomena. Integration of complementary data from different instruments is often used to increase the information content of the data collected.

2. Geographic Information System

Geographic Information System (GIS) is a computer-based information system used to digitally represent the geographic features, present on the earth's surface and the events that are taking place on it. GIS is defined as "set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world for a particular set of purposes". Hence GIS is a tool to assist in decision-making and management of attributes that need to be analysed spatially.

Effective management of the coastal zone depends on the availability of accurate information on the distribution of natural resources in both time and space. GIS can be effective in analyzing the dynamics of the coastal zone and its resources. The shoreline is an inherently difficult landscape to store digitally because of its varying spatial resolution and the temporal dimension to many of its attributes. Due to these limitations, temporal polyline representation and analysis in GIS is still a challenge.

3. Remote Sensing Applications

3.1. Shoreline Changes

A qualitative and quantitative understanding of the shoreline response to the coastal environment is important for coastal engineers. The shoreline changes are nonlinear and have great variability in space and time. The shoreline is commonly plotted and measured to provide a rate of change, but it is as important to understand the geomorphic patterns of change. Shore analysis provides the basis to know how a particular coast has changed through time and how it might proceed in the future.

The study area about 70 km south of Chennai covers approximately 15 km of coastal tract from Sadurangapattioam (Sadras) to Mahabalipuram. It hosts one of India's nuclear power plant built by Department of Atomic Energy (DAE).The rate of shoreline change was computed based on a time series of Linear Imaging Self Scanning Sensor LISSIII satellite data using Digital Shoreline Analysis System (DSAS) software with toposheet of 1965 as reference. In order to understand the seasonal variations in shoreline changes, the shorelines during Post Monsoon, Pre Monsoon and Monsoon in 2010 and 2011 were compared. To ascertain if there are impacts of the shore protection measures taken up by IGCAR on the shoreline dynamics, the shorelines prior to and after construction were evaluated. The erosion/accretion pattern from Sadras to Mahabalipuram may be attributed to both human interference and natural features lying close to one another. The shoreline changes can also be influenced by coastal processes at any particular time, cross-shore and alongshore sediment movement in the littoral zone which in turn is influenced by tides, waves and relative sea level rise. If the down coast movement of the sediment is higher than the up coast movement, then the net sediment budget would be negative and the shoreline experiences retreat. Even though high rate of change is noticed in short term analysis when compared to longterm shoreline change, the variations can be characteristic feature of sediment cycle in beaches which eventually results in dynamic equilibrium. The southeastern coast of India is such that during northeast monsoon when the longshore current is towards south, erosion takes place, and in rest of the year when the longshore current is towards north, accretion dominates compensating the local erosion hotspots. Further, it is possible to compute Coastal Vulnerability Index (CVI) based on

• Geological variables - shoreline change rate, beach width, coastal regional elevation, slope, bathymetry and geomorphology

• Physical variables - sea level change rate, mean tidal range and significant wave height

3.2. Coastal Dynamics

The suspended sediments in the ocean are mainly derived from rivers, aeolian dust, coastal and seabed erosion, estuarine and creek actions. The estimation of Suspended Sediment Concentration (SSC) over large areas of water using insitu sampling is time consuming, expensive and often inaccurate. Remotely sensed spectral radiant measured by satellite or aircraft sensors can provide an alternate, synoptic, speedy and economic method for assessing SSC in coastal waters. Such information are useful for management of water quality, monitoring of water pollution, modeling the sediment distribution in estuarine environments and sediment budgets in coastal zone.

Visible wavelength images can be particularly useful in coastal studies SInce their penetration of water column enables measurements of water quality parameters such as turbidity, suspended sediment concentration and chlorophyll, while infrared observations can be important in studying the dispersion of outfall plumes and offshore circulation. Ocean colour radiometry has been successfully applied to the retrieval of phytoplankton biomass indices, such as chlorophyll-a concentration, and other water quality parameters, in various geographical locations and environmental settings. This is done by virtue of empirical bio-optical algorithms based, for example, on the inverse dependence of pigments concentration on the ratio between water-leaving radiance or reflectance, measured in the blue and green parts on the light spectrum for deriving a chlorophyll-a estimate. Measurements in the red and near-infrared may also be involved, in applications where the water quality parameter of interest is water transparency and/or turbidity.

Using sediment as an indicator coastal process can be inferred. Direction of sediment movement can be predicted from satellite data which in turn helps to know the direction of littoral drift. In the absence of any protuberances, sediments follow the coastal configuration. Manmade structures or projecting headlands alter the sediment distribution pattern. The various sources of sediments such as lagoons, estuaries and rivers, and their influence on the sediment concentration during various seasons can be studied effectively using the remote sensing data. Changes taking place in the sediment distributions due to monsoons can be monitored accurately from the image. From the conventional data, seasonal sediment distribution patterns in nearshore/offshore are almost impossible to obtain.

Satellites play a significant role in monitoring the sediment dynamics. Potential of satellites in monitoring coastal sedimentation:

• Direction of sediment movement can be predicted from satellite data which in turn helps to know the direction of littoral drift.

• In the absence of any protuberances, sediments follow the coastal configuration. Manmade structures or projecting headlands alter the sediment distribution pattern.

• Various sources of sediments such as lagoons, estuaries and rivers, and their influence on the sediment concentration during various seasons can be studied effectively using the remote sensing data.

• Changes taking place in the sediment distribution due to monsoons can be monitored accurately from the image. Satellite is the only source of providing such information.

• Sediment movement is controlled by bathymetry.

3.3. Assessment of the Impact of Sea Level Rise

Climate change and sea level rise (SLR) are two major environmental concerns of today. Continued growth of greenhouse gas emissions and associated global warming could promote SLR of 1m in this century. It poses a challenge to humanity as a whole, the available evidence suggest that the developing countries are more vulnerable. The study predicted the land loss due to inundation and identified the high risk zones that could be affected due to projected sea level rise for Kanyakumari District. GIS was used to assess the SLR scenarios. To build Digital Elevation Model (DEM), contour of Sm intervals were used. Landuse map was collected to estimate the land loss due to inundation and tourist map was used to identify the high risk zones. The ecologically sensitive areas and tourist spots under threat were also identified. The analysis was done by overlaying thematic maps with DEM for projected SLR of 0.5 m, 1 m, l.5 m and 2 m. It is observed that beaches, coconut plantations, villages are getting affected due to SLR. The tourist spots likely to be affected by 0.5 m sea level rise are Gandhi Mandapam and 16 Leg Mandapam ill Kanyakumari. The recreational and archaeological sites to be affected by 0.5 m sea level rise are Thengapattinam beach, Kovalam beach, Muttom beach and Vattakottai fort. From this study, the mitigation measures (engineering measures) can be taken to protect human life and property from sea level rise and Coastal Zone Management practices.

3.4. Wetland Monitoring

Coastal wetlands play a significant role as a transition water body between land and the sea. Like estuaries, they exhibit unique hydrological conditions ranging from freshwater to seawater. Most of them act as a silt trap and facilitate growth of salt marshes and mangroves. Their nutrient richness often enhances productivity and support good fishery. However, due to human interventions like discharge of untreated sewage and industrial effluents either directly or indirectly through water bodies draining into them. Such activities change the characteristics of the ecosystem. Understanding the characteristics of the ecosystem and the impact of human interventions help in preventing adverse impacts that may arise due to future activities. This can be best achieved through the method of ecosystem modelling. Muthupet lagoon (Vedaranyam) located along the coromandal coast is one of the least disturbed ecosystem and it would be the ideal location for ecosystem modelling.

The lagoon is connected to the Palk Strait by a wide mouth located at the southern part of the mangroves. Twenty years before, the mouth was about 2.5 km wide and 2-2.5 m deep; today the mouth is just 1 km wide and not even 1 m deep. Though the mouth is about I km wide, seawater enters the lagoon only through a narrow passage about 100-200 m wide. Also the mouth never closed completely, but there is a fear that this may happen soon, considering the rate at which the width of the mouth is shrinking. It is found that no sand is deposited in the mouth region, it is only the fine silt brought from the sea that is being deposited. The seawater exchange is predominantly by tide which is semi-diurnal in nature. A two dimensional hydrodynamic model using MIKE 21 was constructed. Because of the weak tidal currents, there is no sufficient driving force to transport the suspended matter out of the lagoon. Hence, the lagoon remains turbid for most part of the year and this has a major role in controlling the chemistry and biology of the lagoon. Hydrodynamic simulations were carried out with different bathymetries for various dredging conditions and observed tide as open boundary condition at both existing and new mouths. The predicted tide for existing condition as well as for the simulated cases for the lagoon clearly indicate that the tidal amplitude increased to a maximum. Lagoon volume and water flux also improved to a great extent with the scenarios which will result in significant improvement of nutrient influx into the lagoon.

3.5. Thermal Imaging

Coastal power plants employing once-through cooling systems discharge large amounts of warm water into the sea. Though the outfall temperatures are within limits permitted by the regulatory agencies, there is an apprehension among the general public that thermal discharges originating from power plants are harmful to environment and affect the livelihood of fishermen community. Movement of thermal plume and its dispersion in the sea can be studied by means of physical mapping and mathematical modeling. The former costly, labour-intensive and do not produce data that can be visualized in real-time. Only from field studies, the dispersion of temperature at the mixing zone (where thermal discharge from a plant mixes with the ambient sea) is monitored at power stations. For e.g., at MAPS, the mixing zone is shallow and highly turbulent, accessing by boats or by foot is very difficult. Thermal IR (TIR) imaging is a viable alternative in such situations.

Generally, thermal imaging is done using an air-borne platform, which is expensive. Use of handheld cameras for this purpose has not been attempted earlier. Temperature is the master ecological factor that determines the functioning of an ecosystem. Coolant water discharge from nuclear power plants alter the temperature of the discharge zone by 7°C as compared to ambient water temperature. The study was to standardize the thermal infrared imaging technique for monitoring the power plant outfall sites, and generation of database and thermal dispersion maps of coolanj water. The method combines TIR image analysis with GIS and image processing techniques and is expected to be a low-cost alternative to physical mapping of the temperature dispersion. The output, which will be in the form of colour-coded temperature contours, can be easily understandable by the general public about the actual temperature scenario at the outfall site. This method also has the feasibility of continuous temperature monitoring, resulting in a robust database of the temperature dispersion. The successful demonstration of the technique can be extended to all existing/proposed power plants as a standard, mandatory feature for monitoring outfall temperature. Data obtained using this costeffective method can be further analysed not only for sustainable management of the ecosystem but also for public visualization.

3.6. Microwave Applications

The study aims to hindcast waves in offshore and nearshore areas using National Centre for Environmental Prediction (NCEP) wind components and numerical modelling. North Indian Ocean was selected as study area for offshore wave prediction, while nearshore wave climate was estimated for Pulicat region. Downloaded and validated NCEP winds and bathymetry from Etopoz were used for offshore wave model. The offshore wave climate predicted using Offshore Spectral Wind Wave module (OSW) of MIKE 21 was validated. The accurate wave predictions not only for normal conditions, even during monsoon season and cyclonic conditions encourage the coupling of satellite data and numerical model to hindcast the offshore wave climate. The bathymetry required for the nearshore model was obtained from Naval Hydrographic charts. Extracted offshore wave climate and bathymetry were given as input to the nearshore model. Thus predicted nearshore waves were validated with buoy data.The model is capable of depicting the wave climate, not only for normal conditions, better results are obtained even during monsoon as well as in cyclonic conditions. The study demonstrated the potential of satellite data coupled with numerical modelling can be a powerful tool in the prediction of wave and sediment dynamics. Hence this approach which is cost effective, less time consuming and involves less manpower, can be considered as an effective substitute for conventional method of marine data collection.

Inland Water Transport – Technical Challenges & Opportunities

Amit Bhatnagar

Senior Principal Surveyor & Vice President, Indian Register Of Shipping

Key words: Inland water transport, inland vessel bill, national waterways, ship, vessel, crew, bulk carrier, car carrier, LNG Carrier, RO-RO vessel, Push Boat, container carrier, dumb barge, multimodal, terminal.

"In several countries, INLAND WATER TRANSPORTATION accounts for a substantial share as a percentage of the total: 32 per cent in Bangladesh, 20 in Germany, 14 in the U.S. and 9 in China. In China, much of the increase has occurred in recent decades, in tandem with its phenomenal industrial-agricultural growth. By contrast, in ***India only 0.15 per cent of domestic surface transport is accounted for by IWT,*** *compared with 68 per cent for road and 30 per cent for rail*." – (The Hindu)

India is a vast country with large difference in the landscapes all across. The abundance of rivers has been a big boon for the country and has not been used effectively for any purpose so far. The large water bodies including few of the longest rivers have been left untapped for river navigation.

The inland waterways in India was by and large kept out of the development goals by the successive governments after independence. The inland waterways operating till independence also lost their importance, perhaps due to the importance was not realised by the savant policy makers for many decades. The rail & road took the major lions share in the development budgets. The simple principle of low resistance in water when compared to land allows more cargo transportation with less power can be game changer for cargo transportation within the country.

The country has concentrated on the most expensive means of transportation for many years. The large-scale road projects have been successfully completed in last few years.The British, before leaving the country left railways, which continued to bear the load of transportation of both passengers and cargo for many decades. This left the inland waterways sector unattended. Many of the waterways active till independence exhausted due to lack of maintenance for decades.

1. Reasons for Underdeveloped Inland Water Transport in India

1.1. Braiding and Meandering

One of the major challenges to the development of National Waterways 1(NW-1) is braiding and meandering characteristics of river Ganga and the large fluctuation of the water volume during the summer and monsoon months. Due to the braiding and meandering characteristicsof river, large fluctuation of the water level are observed from 16.5 m (54 ft) at Allahabad to 2 m (6.6 ft) at Farakka. This also createfluctuation of water velocity from 4 m/s (14 km/h; 8.9 mph) during flood season to 0.2 m/s (0.72 km/h; 0.45 mph) during dry seasons. Due to braiding and meandering poss many navigation challenges in the river. Such as:

1.1.1. High Silt Load

The river Ganges carries huge silt load of about 1,600 million tonnes of slit annually, which caused Shoal and island formation leading to splitting of main channel. The splitting of main channel leads to changes to navigation line due to the lateral migration of the river.

1.1.2. Power Line Pylons

The infrastructure development earlier must nothaveaccommodated for any inland navigation feasibility. This existence of power line pylons at various locations causes serious challenge for creation of navigation route at few locations.

1.1.3. Pontoon Bridges

The previous infrastructure development possibily had concentration on land based transportation and movement of personnel, therefore, pontoon bridges were developed without realisation that such bridges will be detrimental in development of the inland waterways. The existence of pontoon bridges are a significant threat to navigation. About seven pontoon bridges are present between Buxar and Allahabad which are in use.

1.1.4. Critical Bridges With Less Clearance

Many locations on NW1 pose another challenge of the road/rail bridges with extremely less horizontal or vertical clerance. There is existence of critical bridges with horizontal clearance less than 70 m (230 ft) and vertical clearance less than 9 m (30 ft).

1.2. Poor Infrastrcture

The inland waterways in the country has not been the area of interest for many decades, therefore necessary infrastructure for river navigation could not be developed. The entire stretch between Haldia to Pryagraj baring few berthing facilities for passenger/RO-RO vessels for crossing of river does not have cargo handling facility. The absence of the facility to handle cargo, storage and evacuation has not encouraged the enterpreneours to invest into this cheapest and most efficient mode of transportation.

1.3. Insufficient Depth/ Shortage Of Water

Ganges is a very long river, which has more than 900 dams. River fragmentation has caused serious damage to the CSI (Connectivety Status Index) the index for free flowing of a river. Whilst the CSI addresses the availability of water for flora and fauna, it has direct implication on navigable vailability also. Furthermore, dumping of garbage for decades has reduced the flow of water to reduce the availability of water for navigation.

1.4. Non Availability Of Cargo / Passenger Terminals

The inland water transportation requires large scale infrastructure for berthing of decent size vessels, availability of cargo handling facilities, storage of cargo and evacuation. However, over the years no such facility was developed along the longest Indian river. The non availability of Cargo and passenger terminals has not allowed the inland waterways to develop and florish in the country.

1.5. Rail/ Road Connectivity

The area along the Ganges river is well developed and densely populated. National Waterways 1 covers four large states of Uttar Pradesh, Bihar, Jharkhand and West Bengal. It also covers large number of industries along Ganges basin. There are 3 major Coal Power Plants operating in Ganges basin area. Another 6 more power plants are proposed to be set up along the NW1. The Ganges basin is major agricultural belt of the country with extremely high yield of crops. The road and rail infrastructure along the Ganges is well developed. Probably due to this reason it was never felt that the inland water utilisation to be developed.

1.6. Industry Concerns

The transport industry has so far concentrated only on road and rail infrastructure in absencia of efficient inland water infrastructure. Whilst few entrepreneures tried to venture into the field, the lack of infrastructure and non availablity of depth were stated as main reasons by most of the entrepreneures. Whenever the efforts were made in recent times the time taken to carry cargo has taken long time. At the same time addressing the vintage inland water rules is need of the hour.

1.7. Outdated Rules

At addressed above the brazen reality is that inland water rules in the country are extremely old with very little efforts made to update them. The inland water rules in different states have different requirements to be followed. The businesses intending to operate their vessels in different state after registration in one state need to take the vessel back to the state of registry within specified time frame for inspections, sometime due to business compulsions it is not feasible or abornarmaly expensive. The safety and other operation rules are different from state to state, which creates serious issues for operation of vessel built to the rules of one state to operate in another state.

1.8. Lack of Underwriting Support

Any business has many risks related to it and uncertainities, which are normally covered under insurance. In the absence of proper local P & I (Protection and Indemnity) coverage, the underwriting support to the companies operating their vessels is limited. The efforst were made to create Indian P & I club, however, the project could not actually take off, leaving the inland vessel operators without specialised underwriting support. Any such support overseas makes it difficult to the investors as they loss precious foreign exchange to carry Indian cargo on Indian vessels operating within Indian shores.

1.9. Non-Availability Of Certified Crew

Whilst the rules are made for operation of inland vessels and qualification criteria is available for certification of the crew, however, most of the states having riverine traffic do not have a system for certification of the inland crew. The absence of certified crew a major hinderance in the investors interest in inland water transportation, despite being extrely cheap in comparison to the other modes. The states of West Bengal & Assam are known to be certifying the crew members for inland transportation. However, even in these states the certification is carried out by surveyors involved in survey of vessels. The surveyors arevery few in number. Since the examination and susequent certification is an additional activity, there is always shortage of certified staff to operate inland vessels. The inland vessel of a size of about 30-50 truckloads also costs a lot, unsureness about the competency of the crew onboard it is difficult to entrust such a high value asset.

1.10. Lack Of Interest

The road and rail are visible modes and have been developing since independence, however, the river routes have not been so popular to transportation of passengers. At the same time the river navigation had been limited to horizontal transportation for ferrying of passengers. The parallel travel along the river flow or in opposite direction was never tried or envisaged. The road transporters were never encouraged to invest in the inland water transportation being most efficient. Despite the fact road being the most inefficient mode is considered most favourable to the business operators as it gives the freedom to the transporter to operate the vehicle at their will, though traffic jams definitely cost both time and money. At the same time no infrastructure had been another deterrent for inland water operations. Successive governments have given priority to the road and to an extent rail infrastructure after independence and inland transportation was neglected. It was difficult to create interest for businesses to invest in the floating assets without any cargo handling & storage terminals without the political will.

2. Development of National Waterways

The road and rail infrastructure along the Ganges are already saturated. Over used roads are major cause of accidents due to excessive traffic. Both road and rail being less efficient in comparison to waterways and cause humungous carbon emissions, thus causing serious damage to the environment. Traffic jams are another deterrence for road transportation. Similarly, although the rail cargo does move on the route, however, not much scope for enhancement of capacity is possible due to heavy passenger traffic. When the country is keen to be developed into a manufacturing hub for the work, it is important that the cargo movement into hinterland is hassle free and smooth.

The central government has realised that with human settlements all over the country, finding it difficult to acquire land easily for development of roads, need to look at other alternatives and inland waterways was realised to be most efficient. The waterways do not require large scale land acquisitions at the same time operates at lowest cost. Initially 111 national waterways were notified by the central government in the year 2016, however, till such notification only 3 waterways were in operation. It can be clearly understood that the government has a gigantic task to develop the infrastructure at another 108 waterways, to be exploited. Notwithstanding that the existing waterways also need huge investment push to be improved for large scale exploitation. The existing waterways not only need large scale terminal and cargo handling facilities but also require better depth for operation of bigger size vessels to improve the economics. Whilst plans are in place for the other national waterways, maximum impetus has been placed on NW1 between Prayagraj and Haldia.However, presently more focus is between Varanasi and Haldia. Efforts are in place for improve the efficiency of NW1 and make the waterway operational through the year.

2.1. Efforts Made

The waterways since no investments were made for decades, requires huge investments for development of passenger and cargo terminals, cargo handling facilities, storage of cargo, evacuation of cargo and last mile connectivity to the industrial destination by rail/ road. Out of Rs 4200 Crore investment (about USD 375 Million) through loan from World Bank for a duration of 17 years with grace period of 7 years has been arranged. The navigation system is being overhauled to improve the day-night navigation. River Information System (RIS) on the lines of ATC for airports and Port Signal Control, being developed. In order to reduce the efforts by the investors, the regulatory authority Inland Waterways Authority of India (IWAI) has been on vessel buying spree to create trust among the investors regarding operation related reservations.

The IWAI has appointed leading global design firm M/s DST from Germany to develop designs for the vessels of size between 1500 – 2000 DWT to plyin inland waters of India. Indian Register of Shipping (IRCLASS), the international classification society of Indian origin has reviewed the concept design and approved for confirmation to the inland waterways rule requirements. Detailed designs are available on IWAI website for download free of cost. This will save huge design cost for construction of shallow water vessels and likely to encourage the businesses to invest into inland water transportation with extra ordinary efforts being made by IWAI.

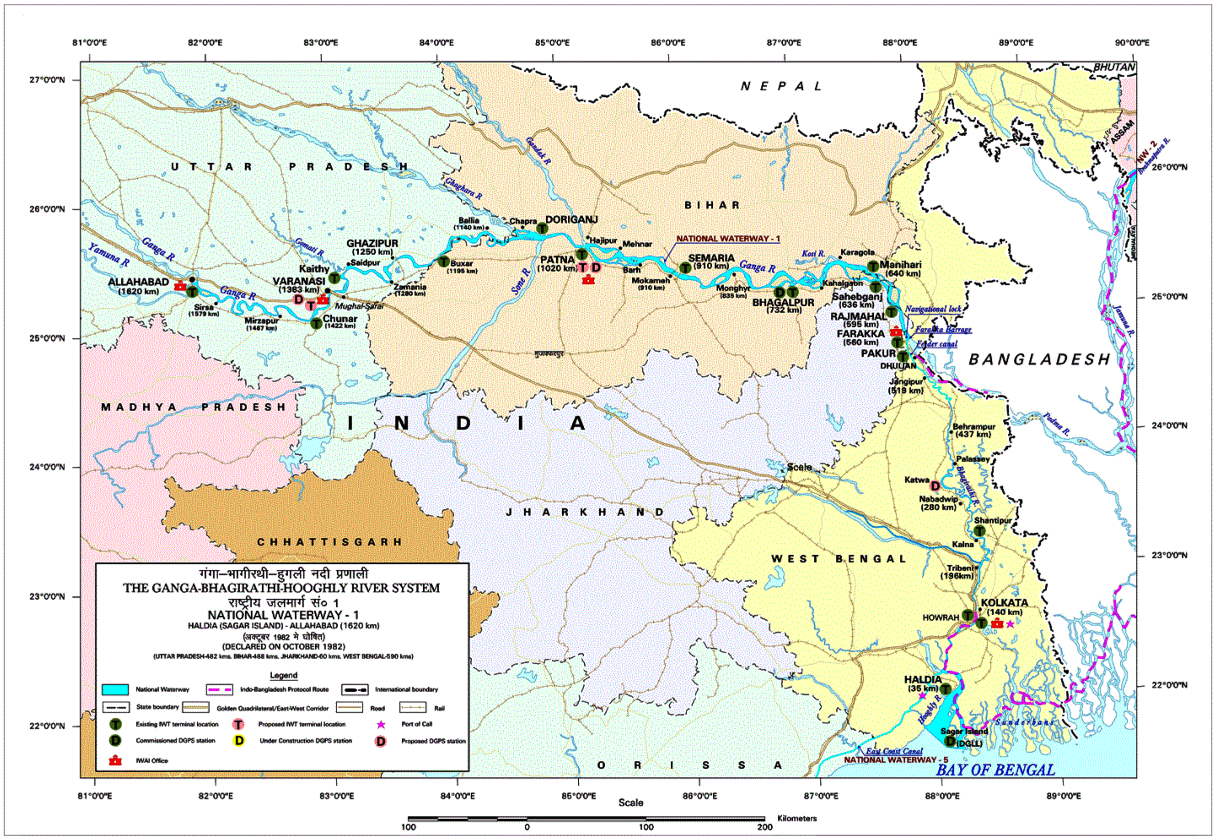
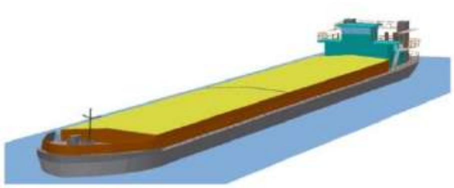


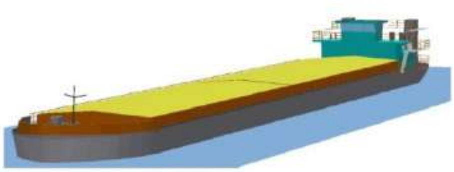
Fig. 1. National Waterways 1

Designs for Modern IW Vessels



BULK CARRIER I
LOA:110M
BREADTH: 12M
DRAUGHT MAX: 2.80M
CAPACITY: 2500 +T

Fig 2.

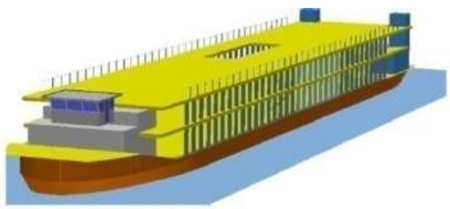


BULK CARRIER II
LOA: 110M
BREADTH: 12M
DRAUGTH MAX: 2.8M
CAPACITY 2500+T
TWIN SCREW

Fig. 3.

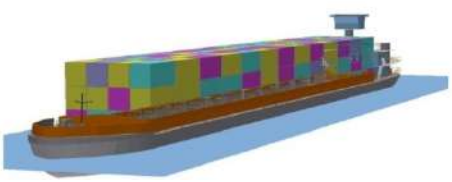
BULK CARRIER III
LOA: 92M
BREADTH: 12M
DRAUGTH MAX.:2.80M
CAPACITY: 2100T+

Fig. 4.



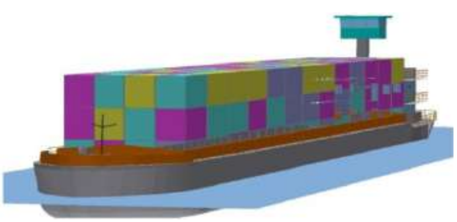
CAR CARRIER
LOA:110M
BREADTH:12M
DRAUGTH MAX.: 2.8M
CAPACITY: 2400T+

Fig.5.



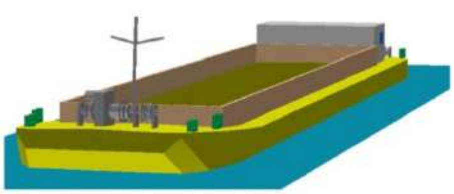
CONTAINER CARRIER I
LOA: 110M
BREADTH:12M
DRAUGHT: 2.8M
CAPACITY: 2400T (200TEU)

Fig. 6.



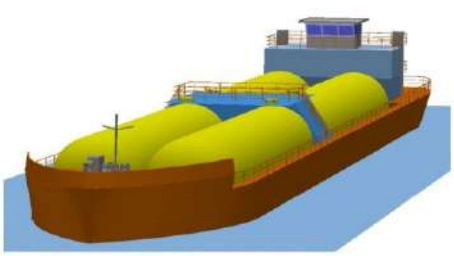
CONTAINER CARRIER II
LOA: 110M
BREADTH:12M
DRAUGHT: 2.6M
CAPACITY: 2400T (200TEU)

Fig. 7.



DUMB BARGE
LOA: 42M
BREADTH: 8M
DRAUGHT MAX:2.5M

Fig. 8.

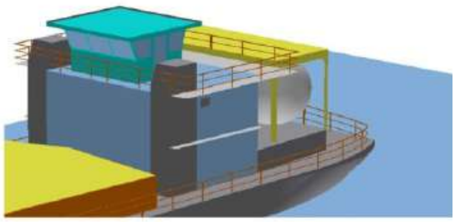


LNG CARRIER I
LOA:90M
BREADTH: 14.5M
DRAUGHT MAX.: 2.30M
CAPACITY: 1050 T +

Fig. 9

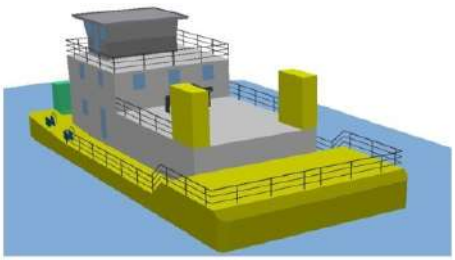
LNG CARRIER II
LOA:92M
BREADTH: 12M
DRAUGHT MAX.: 2.10M
CAPACITY: 1050 T +

Fig.10.



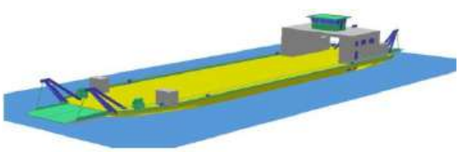
LNG PROPELLED BULK CARRIER
LOA:110M
BREADTH: 12M
DRAUGHT MAX.: 2.80M
CAPACITY: 2500 T +

Fig.11.



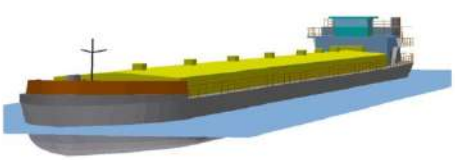
PUSH BOAT
LOA:26M
BREADTH: 12M
DRAUGHT MAX.: 1.60M

Fig.12.



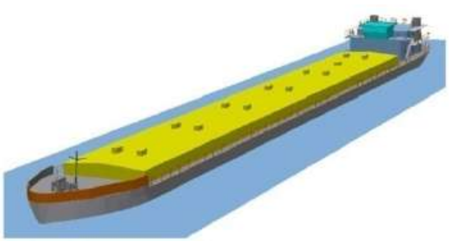
RO RO VESSEL
LOA:70M
BREADTH: 14.5M
DRAUGHT MAX.: 1.70M
CAPACITY: 750 T +

Fig.13.



TANKER I
LOA:110M
BREADTH: 12M
DRAUGHT MAX.: 2.80M
CAPACITY: 24000 T +

Fig. 14.



TANKER II
LOA:110M
BREADTH: 12M
DRAUGHT MAX.: 2.80M
CAPACITY: 2400 T +

Fig. 15

Following is planned for maintaining least available assured depth at the specific locations on NW1:

Table 1. Source: IWAI website

Stretch	Distance	Least available Depth
Prayagraj to Ghazipur	370 km (230 mi)	1.2 to 1.5 m (3.9 to 4.9 ft)
Ghazipur to Barh	290 km (180 mi)	2 m (6.6 ft)
Barh to Farakka	400 km (250 mi)	2.5 m (8.2 ft)
Farakka to Haldia	560 km (350 mi)	3 m (9.8 ft)

In addition to the depth arrangement massive efforts are being made to develop the cargo and passenger handling terminals. The below mentioned table provides the information on the facilities available at the terminals:

Table. 2 Source: IWAI Website

Name of Terminal	Land Area	Size of Berth	Type of Terminal
Bhagalpur	1,000 m2 (11,000 sq ft)	35 m (115 ft)	Floating Terminal
Munger	13,759 m2 (148,100 sq ft)	35 m (115 ft)	Floating Terminal
Patna	13,112 m2 (141,140 sq ft)	46.6 m (153 ft)	Fixed RCC Jetty
Barh	-	27 m (89 ft)	Floating Terminal
Buxar	Pontoon placed on water front	-	Floating Terminal

In addition to the above facilities 2 multimodal terminals have been developed at Varanasi and Sahibganj. The Varanasi terminal has estimated cargo handling capacity to be 1.2 million metric tons per year (MTPA). The Port was completed in 2018. The port has the ability to berth two ships at a time simultaneously. The port also has other facilities which include deposit area, commodity transit shade, parking area etc. It also has floating jetty with terminal for passenger transport.

The multi-modal terminal at Sahibganjhas providedaccess of industries in the states of Jharkhand and Bihar to the global market and added Indo-Nepal cargo connectivity through waterways route. The terminal plays an important role in transportation of domestic coal from the local mines in Rajmahal area to various thermal power plants located along National Waterway-1.

The third multimodal terminal is under construction at Haldia. This terminal is exclusive for inland waterways and only inland vessels shall be able to call on this port.This shall eliminate hassles related to custom notified area.

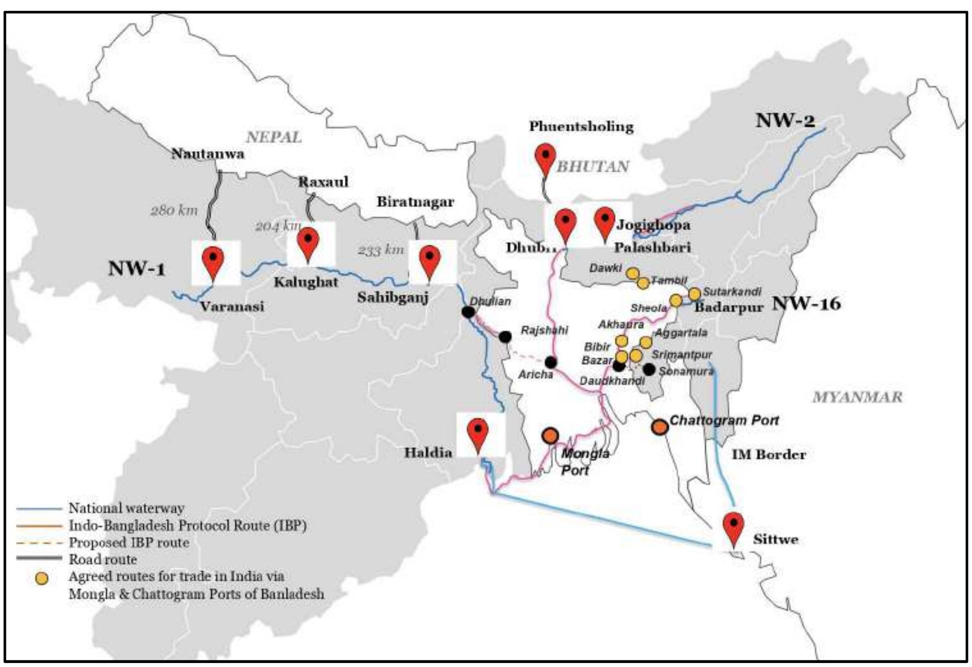


Fig. 16.

2.2. Inland Water Act

The Inland Water Act has been developed after consultation with many stake holders. The draft bill is likely to be passed shortly, which shall ease out many of the concerns of the business community interested in investment in the most efficient mode of transportation in the country. The bill being passed by the parliament is likely to boast private investments in the field of inland waterways in the country.

2.2.1. INLAND WATER Bill 2020: SALIENT FEATURES

2.2.1.1. Covers entire India without any exception, which will create level playing field for all stake holders.

2.2.1.2. The bill has 17 parts, which clearly defines applicability of the Act. The basic details of the Act are as follows:

Part I: Application, scope and definition;

Part II: Administration provisions covering the power, roles and functions of central & state governments, competent authority, advisory committee and department of local administration;

Part III: Covers the details of surveys

Part IV: Registration

Part V: Manning, Qualification, Training, examination and certification;

Part VI: Special Category vessels;

Part VII: State Transportation Services;

Part VIII: Navigation Safety Signals;

Part IX: Prevention of collision;

Part X: Inland vessel-based pollution;

Part XI: Wreck and salvage;

Part XII: Liability and limitations;

Part XIII: Insurance;

Part XIV: Casualty investigation;

Part XV: Regulation and trade practice;

Part XVI: Non self-propelled vessels;

Part XVII: Miscellaneous provisions.

The above parts in the bill provides easy understanding to the business and the bill has been developed based on the latest practices being followed around the world. Some of the salient parts of the bill may be understood as follows:

a. Part I, II, IX, XV & XVI Shall apply to all inland vessels plying within inland waters of India.
b. Part III, IV, V, VII, VIII, X, XI, XII & XIII shall apply to all mechanically propelled vessels.
c. PART VII, VIII, IX, X, XI & XII apply to vessels registered in any country but recognised under this Act.
d. Part VI, VII, VIII, IX, X, XI, XII & XIII apply to special category vessels
e. Part XIV apply to non-mechanically propelled vessels
f. Inclusion of insurance by general insurance firm covering all types of accidents and the vessels shall possess certificate of insurance.
g. Central data base of all vessel details, crew, manning certificates, reception facilities.
h. All shall be required to be classed and issued with classification certificate.
i. Dangerous goods can be carried onboard after compliance with the IMO conventions.
j. Hull identification number to each vessel shall be issued by the shipyard

k. The bill covers the details related to:

   Provision of Inland port(s), Passenger terminal(s); Certificate of compliance for construction; Central Registry of Vessel, which shall bevalid in all states & UTs, Single certificate of survey shall be valid throughout India

i. Minimum age for employment is mentioned as 18 years, however, 16-year olds can be inducted as trainee.

m. Identification of area of operation, which shall be

   Zone 1: wave height upto 2.0m

   Zone 2: wave height upto 1.2m

   Zone 3: wave height upto 0.6m

n. Manning scales have been standardised in the bill for the entire country.

o. LSA. FFA & Communication Requirements Standardised

p. Light & Sound Signals Standardised

q. Prevention of Pollution Certification

r. Reception Facilities for the polluting items, garbage etc shall be provided at the terminals atcost specified by Govt.

3. Conclusion

India intends to become self-reliant, which will need large scale manufacturing activity across the country. In order to become self-reliant, the manufacturing sector needs exponential growth in development of industrial parks, which would require humongous logistics infrastructure. The present road and rail infrastructure are not able to take any further load for the large-scale movement of cargo. At the same time in order to remain cost effective, the manufacturing of goods require low cost movement of raw material and finished products.Whereas, smooth multimodal cargo operation is essential to ensure timely low-cost transportation of the cargo, at the same time the last mile connectivity is extremely essential. Therefore, the inland water transportation is effective only when the goods is transported through water, handled and stowed well at the terminal and loaded into train or trucks for last mile connectivity without any wastage of time and extra cost. Effective Inland Water Transportation coupled with last mile connectivity will save on India's huge fuel bill and carbon emission, which is incurred due to extensive usage more expensive modes of road and rail.

About Marine Engineering Division Board

The Institution of Engineers (India) has established Marine Engineering Division Board in the year 1978. This Division consists of quite a large number of corporate members from Government, Public, Private sectors, Academia and R&D Organizations.

Various types of technical activities organized by the Marine Engineering Division Board include All India Seminars, All India Workshops, Lectures, Panel Discussions etc., which are held at various State/Local Centres of the Institution. Apart from these, National Convention of Marine Engineers, an Apex activity of this Division is also organized each year on a particular theme approved by the Council of the Institution. During the National Convention, several technical sessions are arranged on the basis of different sub-themes along with a Memorial Lecture in the memory of '**Rear Admiral T B Bose**', the renowned Marine Engineer, which is delivered by the experts in this field.

In order to promote the research and developmental work in the field of Marine Engineering, the Institution also publishes **Journal of The Institution of Engineers (India): Series C** in collaboration with M/S Springer which is an internationally peer reviewed journal. The journal is published six times in a year and serves the national and international engineering community through dissemination of scientific knowledge on practical engineering and design methodologies pertaining to Mechanical, Aerospace, Production and Marine Engineering.

Due to multi-level activities related to this engineering discipline, this division encompasses the following emerging and thrust areas:

- Recent Technological Development of Marine Diesel Engine
- Control System and Platform Management System on Marine Platforms
- Environmental Protection, Initiatives and Implementation through International Regulations
- Application of Electronics, Hydraulics and Workshop Practice related to Shipping
- Super Conducting Materials related to Marine Applications
- Greater Manpower Availability with thrust on Training and Regulation
- Piracy and Security at Sea
- Innovative Design for Under Water Vehicles
- Safety of Life at Sea (SOLAS) Requirements
- Port Safety and Traffic Simulation at Ports
- Innovations in Ship Building Technology
- Development of Fuel Efficiency Engines and Energy Saving Devices
- Sea-Plane/Hydro-Plane/Hovercraft
- Inland Water Transport
- Indian Maritime Heritage
- Ocean Observation System
- Offshore Engineering
- Curriculum Development in Marine Engineering
- Marine Propulsion System
- Navigational Problems and Solution

In order to promote different contemporary issues related to Marine Engineering discipline, Annual Technical Volume of the Division is published every year with a defined theme under the aegis of Marine Engineering Division Board.

The Institution of Engineers (India)

8 Gokhale Road, Kolkata 700020
Phone : +91 (033) 2223-8311/14/15/16, 2223-8333/34
Fax : +91 (033) 2223-8345
e-mail : technical@ieindia.org; iei.technical@gmail.com
Website : http://www.ieindia.org