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Volume 2

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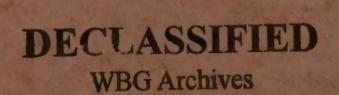
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1818 H Street NW
Washington DC 20433
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Seminars, Conferences, and Workshops, on Transportation - Volume 2

R1992-205 Other#: 1

Port of Gothenburg Consultancy AB

SwedPort = company

Our date 10 July, 1987 Your date

PSj/SBS/L083/87

Mr John R. Lethbridge Ports and Aviation Adviser Transportation Department THE WORLD BANK 1818 H. Street N.W. WASHINGTON D.C. 20433 U S A 16/07/57.

3) JL to kear / reply.

Dear John,

Seminar on Port Management and Operations for World Bank Staff, June 1987

Many thanks for your letter of June 17, 1987, of which contents I have taken pleasure in telling staff of our port as well as others concerned. John, it certainly was a great honour having you all here. Let's see if we can do it again some time.

As you may recall we promised to send to you certain additional information. Therefore, please find enclosed 17 envelopes, each containing:

- Annual Report 1986, Port of Gothenburg Group,

- A compilation of World Bank Staff Officers' Aspects on Port of Gothenburg AB,

- List of Participating Swedish Representatives at Luncheons and Dinners.

We would appreciate if you could distribute the envelopes to the Seminar participants as we presently do not know to what departments they became reorganized. I would personally very much look forward to your kind information about where they can be contacted in the future.

Also, do you think it would be possible as discussed, to put PGC on the mailing list with regard to the World Bank Project Catalogue?

The Friday 5th June farewell dinner restaurant has forwarded to me a camera apparently forgot by somebody of our party. It is a "Vivitar Point'n Shoot PS:30"/in a black cover. Could you please check if anyone from the World Bank team misses his/her camera?

Bert van der Meer mentioned that he would mail a copy of the Bank Annual Report of September 1986. Probably he is out travelling or somehting and has not had the time yet. Could you send one?

Although not at hand when you were here, the Nordic summer now has arrived. In a few weeks I will have my vacation. I hope the summer stays with us until then. I suppose you don't have to have such preoccupations when you go to Jamaica?

John, until we hear from each other again I wish you all the best.

Yours sincerely,

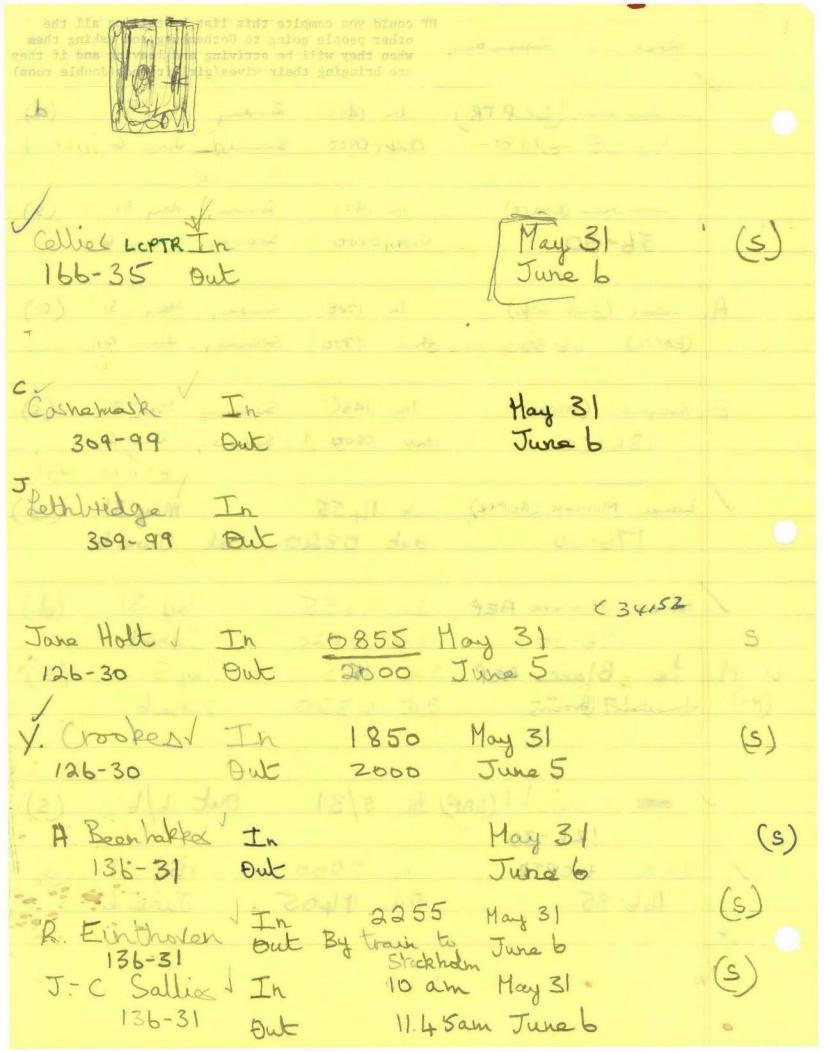
PORT OF GOTHENBURG CONSULTANCY AB

(Per A. Sjöberger)

A fully owned subsidiary of Port of Gothenburg AB

Hetal & Gotten buy. other people going to Gothenburg and asking them when they will be arriving and leaving and if they are bringing their wives/girl friends(double room) R. Augmedi (LCPTR) In 1215 . Surday . May 31 (d) Our 0800 Saludy due 6 Sunday Hay 31 i Sebesti (EMPTR) in. 1455 (s) Saluting June 6. 156-30 am 0800 Suntag May 31 Salinday Jun 6 A. Littree (grad wate) (EAPTC) 126-30 In 1200 (0) ON 0800 Surday May 31 Saturding June 6 E. Vangina (ASPTR) V 12 1455 (5) 186-30 an 0800 I Lance Morrell (AEPTE) 9n 1455 May 31 (5) 176-30 Sat June 6 But 0820 I small Mabarek AEP Hay 31 (du) In 1455 176-30 Juneb Owk 0820 (M) Le Blanc AEP (M) 1-76-30 In 1555 Hay 31 08 (3) out 0820 Juneb Out 6/6 Konishi (EAP) In 5/31 (s) 126-30 / Dick LCPTR Hay 31 June b In 2200 Jul (3) 166-35 Out 1405

HF could you complte this list by calling all the



Seminar on Port Managment and Operations in Gothenburg, June 1987

Dear Alm

It was a great honour to us having you here in Gothenburg at the Seminar. Let's see if we can do it again some time.

As you may recall we promised to send to you certain additional information. Therefore, please find enclosed:

- Annual Report 1986, Port of Gothenburg Group,
- A compilation of World Bank Staff Officers' Aspects on Port of Gothenburg AB,
- List of Participating Swedish Representatives at Luncheons and Dinners.

We hope you will take an interest in the documentation.

Here we are finally experiencing the summer you missed when you were here. The next time you come we will see to it that it arrives in due time. Therefore, please join us in an effort to try to keep in touch in the future so we can meet again (here or at yours).

Not forgetting the rest of the Port of Gothenburg staff I would like to extend special best regards from Mrs Stjernqvist and from Captains Nicolas Du Rietz and Mikael Kjellberg of the PGC. The week with you all is kept in bright memory here.

Yours sincerely,

PORT OF GOTHENBURG CONSULTANCY AB

Per A. Sjöberger

A fully owned subsidiary of Port of Gothenburg AB



556206-1654

763-8273



SEMINAR ON PORT MANAGEMENT AND OPERATIONS

June 1 - 5, 1987

WORLD BANK STAFF OFFICERS' ASPECTS ON PORT OF GOTHENBURG AB

Question:

Following our Seminar, what most important issues would you personally believe the Port of Gothenburg should develop to become more efficient and profitable?

Please try to express your points of view in as few words as possible.

Answers:

- Develop your cargo tracking systems further and tie the railroad and trucking industry to the port this way the cargo owner knows where the cargo is at all times: door to door service.
- Carefully evaluate your needs for the land space could be included in the transfer pricing procedure -this will make operations as efficient as possible.
- Strengthen the port marketing department to increase the exposure of the port to both shipping lines and shippers/consignees this should be far more active and agressive.
 - I do not believe that a ROA should be a port's primary goal -the port plays a much greater role to the economy as a whole. If the goal remains ROA it should be based on the current value of the assets so that all can see the true financial results. A goal of 9 % ROA on assets valued at historic cost will not enable the port to replace its assets. Look at the port's broader goals and objectives, not just the financial.
- Be faithful to your rate of return objective:
 How great a return is appropriate in various profit centres? Do you know the replacement of market value of your assets? Do you include the replacement cost of your assets in the various tariffs you levy? If not, are you doing so consciously? These are key questions.



Mechanical equipment maintenance appears superb but better civil works maintenance planning will yield big dividends. Investment analysis (capital budgeting) is too adhoc and it appears decisions are made on prejudged technical merits or simply because company feels its arm is twisted. This attitude will lead to considerable misinvestments. Revalue captial assets (excluding equipment) taking into consideration alternative uses of main profit centres. Undertake detailed study (in association with City of Gothenburg) of contribution of major port activities (e.g. provision of deep sea container LoLo handling facilities) to local economy, taking into consideration both direct and indirect contributions and extent to which particular industrial actitivies (e.g. Volvo) are geographically mobile in short and long term Review costs/benefit of medium term contracts for provision of dedicated berths to major (container) customers, or groups of customers. Obtain independent review of costs/benefits of provision of equipment maintenance services by internal port department compared with external contract(s) e.g. with a good supplier. Maximize the use of land by moving all of your operations to downstream port. Develop feed-up lands for developments which will yield higher rate of return i.e. similar developments as in the Port of London. Assume landlord position and leave operations and maintenance equipment to private company and participate in profit sharing in terms of equity participation etc. Remove the railway truck from the central location and move it to periphery so land is used much better as is the case in other container terminals.

RR calculations should be carried out on the market value or

replacement value of assets.





The only suggestion I would like to make is that when developing new systems for the Port of Gothenburg consideration be given to the possibility of simplefied versions which could be suitable for developing countries. I am not convinced by your straddle carrier analysis. Value of land should be considered and 18 % maintenance costs. To be a useful management tool costing exercises should be made using replacement asset values -not book value for the results Civil works/infrastructure maintenance should be programmed to include regular inspection. Review and costing - particulary cost of maintenance in relation to use of facility. The port should make more use of private enterprises, both in stevedoring- and maintenance operations. I do not see any advantage in the port diversification thrust (real estate, data processing, etc) in view of letting others do the same things. The uniformity of compensation probably leads to lower than possible productivity. Civil works infrastructure maintenance seems to need better planned inspection. Review and costing should relate to maintenance costs to value and use of facility. Return on assets should be based on replacement costs - not book value. The decision to adopt straddle carrier concept should perhaps be reconsidered, particularly land values and maintenance costs reviewed. Possible conflicts in goals of Board of Directors and goals of manangement reduce Board's involvement in "top" decisions. Vague understanding of pros and cons of present organization versus private port operations.







Tariff-structure - To what extent should we reduce tariffs on "less busy" days (Friday - Monday) to attract more ships and even out work loads.

Impossibility to get an acceptable rate of return based om market (rather than historical) values of land (rate of return = return on assets). How does this effect long-term prospects?

Long-term effects of cross-subsidization among profit centers (if used).

PSj/SBS 870707





LIST OF PARTICIPATING REPRESENTATIVES FROM THE SWEDISH SIDE AT LUNCHEONS AND DINNERS OF THE WORLD BANK SEMINAR WEEK JUNE 1 - 5, 1987

Sunday May 31, 1987

Reception at the Hotel Rubinen (Host: Port of Gothenburg AB)

	TITLE	COMPANY
Capt. Per Bjurström, Licentiate (Econ), and wife	President	Port of Gothenburg AB
Eng. Nils Birgander, and wife	General Manager, Technical Division	Port of Gothenburg AB
Bengt Carlsson, and wife	Executive Vice President, Personnel	Port of Gothenburg AB
Capt. Nicolas Du Rietz, and wife	Consultant, Port Development	Port of Gothenburg Consultancy AB
Capt. Mikael Kjellberg, B.Sc.(Econ) and wife	Project Coordination Manager	Port of of Gothenburg Consultancy AB
Capt. Thomas Lumsden, and wife	General Manager, Inner Harbour	Port of Gothenburg AB
Capt. Åke Olausson, and wife	General Manager, Skandia/Älvsborg Harbour	Port of Gothenburg AB
Per A. Sjöberger, B.Sc.(Law/Soc), M.Sc.(Econ) and wife	Executive Vice President	Port of Gothenburg Consultancy AB
Capt. Werner Stoppenbach, and wife	Executive Vice President with Group responsibility for commercial activities	Port of Gothenburg AB





Monday June 1, 1987

Lunch - M/V Hamnen (Host: Port of Gothenburg Consultancy AB)

	TITLE	COMPANY
Anders Bohlin, M.Sc.(Civ.Eng.)	General Manager Vessel Traffic Department	Port of Gothenburg AB
Nicolas Du Rietz	Consultant, Port Development	Port of Gothenburg Consultancy AB
Capt, Per-Johan Ekelöf	Project Leader, Vessel Traffic Information Systems	Port of Gothenburg AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Lars-Åke Skager, BA	Vice Mayor (Cons.)	City of Gothenburg

Dinner - Liseberg, Wärdshuset (Host: Port of Gothenburg Consultancy AB)

Nils Birgander	General Manager, Technical Division	Port of Gothenburg AB
Nicolas Du Rietz	Consultant, Port Development	Port of Gothenburg Consultancy AB
Mikael Kjellberg	Project Coordination Manager	Port of Gothenburg Consultancy AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Biarne Tyeitan, MBA	Chief Financial Controller	Port of Gothenburg AB





Tuesday June 2, 1987

Lunch - Hemland (Host: TransConsultants AB)

	TITLE	COMPANY
Nicolas Du Rietz	Consultant, Port Development	Port of Gothenburg Consultancy AB
Per Fagerlund, M.Sc.(Naval Architecture)	President	TransConsultants AB
Mikael Kjellberg	Project Coordination Manager	Port of Gothenburg Consultancy AB
John Palm, B.Sc.(Eng)	Consultant	TransConsultants AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Joe Tursten, Engineer	Officer, Marketing/Tariffs	Port of Gothenburg AB
Capt. Calle Westman	Vice President	TransConsultants AB
Åke Åkesson, B.Sc.(Eng)	Consultant	TransConsultants AB

Dinner - Fortress of Marstrand (Host: Scandiaconsult Väst AB)

Anders Alvemo, M.Sc.(Arch.)	President	Scandiaconsult International AB
Mikael Kjellberg	Project Coordination Manager	Port of Gothenburg Consultancy AB
Bengt Kåreby	Master of Engineering	Scandiaconsult AB
Sture Persson	Master of Engineering	Scandiaconsult Väst AB
Gunnar Sillén, M.Sc.(Civ.Eng)	President	Scandiaconsult Väst AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Bengt Troedsson	Master of Engineering	Scandiaconsult AB
Anne Whitton, B.Sc.	Secretary	Scandiaconsult Väst AB





Wednesday June 3, 1987

Lunch - Stallgården (Host: Bohlin & Strömberg)

¥	TITLE	COMPANY
Capt. Torsten Ahle, MBA, B.Sc.	Senior Port and Shipping Consultant	Port of Gothenburg Consultancy AB
Nicolas Du Rietz	Consultant, Port Development	Port of Gothenburg Consultancy AB
Lars Gustavsson, M.Sc.(Econ)	Director	Bohlin & Strömberg
Sven Hedlund, MBA	Consultant	Bohlin & Strömberg
Ann Flyning	Public Relations	Port of Gothenburg AB
Capt.Sven Sandström	Manager Personnel Planning & Development	Port of Gothenburg AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Bertil Strindmark, M.Sc.(Econ)	President	Bohlin & Strömberg

Dinner - Henriksberg (Host: SwedPort Consulting AB)

Lars-Olof Eliasson, B.Sc.(Econ) and wife	President	SwedPort Consulting AB
Per Fagerlund and wife	President	TransConsultants AB
Nils Norrbin, M.Sc.(Civ.Eng) and wife	Senior Consultant	SSPA Maritime Consulting AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Werner Stoppenbach and wife	Executive Vice President	Port of Gothenburg AB
Karin Westlund	Secretary	SwedPort Consulting AB





Thursday June 4, 1987

Lunch - S/S "Marieholm" (Host: Port of Gothenburg Consultancy AB)

	TITLE	COMPANY
Per-Erik Berglund, B.Sc.	Lending Officer	Swedish Agency for International Tech- nical and Economic Co-operation, BITS
Eng. Roger Carlsson	Manager, Maintenance, Technical Division	Port of Gothenburg AB
Mikael Kjellberg	Project Coordination Manager	Port of Gothenburg Consultancy AB
Capt. Jens Lomberg, Master Mariner	Harbour Master	Port of Gothenburg AB
Capt. Jan-Olof (Olle) Nilsson	Manager, Production Development	Port of Gothenburg AB
Per H Olson, B. Sc.	Manager, Safety & Environmental Control	Port of Gothenburg AB
Jan Persson, M.Sc.(Civ.Eng)	Senior Port Strategic Planner	Port of Gothenburg AB
Stefan Samuelsson, MBA	Manager, Administrative Development	Port of Gothenburg AB
Per A. Sjöberger	Executive Vice President	Port of Gothenburg Consultancy AB
Kjell Svensson, B.Sc	Public Relations	Port of Gothenburg AB
Dan-Olof Åberg, MA	Officer, Personnel Planning & Development	Port of Gothenburg AB

Dinner - Sjömagasinet (Host: HT Data AB)

Nicolas Du Rietz	Consultant, Port Development	Port of Gothenburg Consultancy AB
Gunnar Falck, B.Sc.(Eng)	Executive Vice President	HT-Data AB
Margareta Hedlund, B.Sc. (Inform.Syst)	Systems Manager	HT Data AB
Mikael Kjellberg	Project Coordination Manager	Port of Gothenburg Consultancy AB
Tore Stenberg, B.Sc.	Commercial Manager	HT-Data AB



Friday 5 June, 1987

Lunch - Chalmers University of Technology (Host: SSPA Maritime Consulting AB)

TITLE

COMPANY

Willem B. Van Berlekom, M.Sc.

(Naval Architecture)

Lars-Olof Eliasson

Vice President

SSPA Maritime Consulting AB

President

SwedPort Consulting AB

Hans Peder Loid, M.Sc.(Naval

Architecture)

President

SSPA Maritime

Consulting AB

Per A. Sjöberger

Executive Vice President

Port of Gothenburg Consultancy AB

Farewell Dinner - Önnered, Sju Skepp (Host: Port of Gothenburg Consultancy AB)

Nicolas Du Rietz Port of Gothenburg Consultant, Port Development Consultancy AB Margareta Hedlund Systems Manager HT Data AB Gertrud Hultin, B.Sc.(Econ) Financial Manager Port of Gothenburg AB Project Coordination Mikael Kjellberg Port of Gothenburg Manager Consultancy AB Capt. Jan Lindgren General Manager Port of Gothenburg AB Marketing Department

Thomas Lumsden General Manager,

Inner Harbour

Port of Gothenburg AB

Per A Sjöberger

Executive Vice President

Port of Gothenburg Consultancy AB

PSj/SBS 870709



1818 H Street, N.W.

(202) 477-1234 Washington, D.C. 20433 Cable Address: INTBAFRAD Cable Address: INDEVAS

June 17, 1987

Mr. Per A. Sjoberger Executive Vice President Port of Gothenburg Consultancy AB S-403 38 Goteborg Sweden

Dear Per:

Port of Gothenburg Consultancy Training Seminar for World Bank Staff

On behalf of the director and staff of the Transportation Department and also the regional transport staff of the Bank, we wish to express our sincere appreciation for all of the effort, organization, time, manpower and hospitality associated with your presentation of the week-long training seminar held in the port of Gothenburg June 1-5, 1987.

It was a great course in that your staff did an outstanding job of organizing the seminar and arranging the speakers and visits and in keeping so closely to the tight time schedule. The range of topics and subjects was very much in keeping with our suggestions and needs and in almost every instance the competence and experience of the presenters was excellent.

Perhaps, our only criticism - and constructive, we hope - is that the time period allowed for questions after each presentation was too short. As I think some of your staff appreciated, it is from the questions period that the greatest benefits can be obtained - we suggest that for any future seminar that a little more time be allowed.

We hope that the Port of Gothenburg Consultancy also benefitted from these question periods since it was clear in several instances that Bank staff would apply rather different interpretations to the decisions and recommendations made by your staff. We feel that they found these comments thought provoking at times.

Finally, we have to extend our special thanks for your very warm and generous hospitality which we all enjoyed very much indeed. We would particularly like to ask you to pass on our gratitude and appreciation to Per Bjurstrom, Werner Stoppenbach, Capt. Calle Westman TRANSCONSULTANTS AB, Gustav Sillen SCANDIACONSULT, Lars Gustavsson BOHLIN AND STROMBERG, Lars-Olof Liasson SWEDPORT, Gunnar Falck HT DATA, Willem Berlekom SSPA, and Capt. Du Reitz.

We feel that through your personal efforts a strong link has been established between the Bank staff and the staff of the Port of Gothenburg which will be a very valuable asset to us and hopefully to your staff as well.

Thank you.

Yours sincerely,

John R. Lethbridge Ports and Aviation Adviser Transportation Department

cc: Messrs. Pouliquen, Carnemark, Gutman (TRP), Minahan (PMD) Seminar Participants

JLethbridge:hf

WORLD BANK / INTERNATIONAL FINANCE CORPORATION

Rubinen Hotel Kunjsport Avenue 24 P.O. Box 53097 40014 Gothenberg Sweden

Telex: 20837

Tele: 031-810800



Per A. Sjöberger Executive Vice President

Mailing address:
Port of Gothenburg Consultancy AB
S-40338 Gothenburg, Sweden
Visiting address, Norra Hamngatan B

Phone office: +46-31-632184
Phone home: +46-31-197314
Telex: 20057

1850



Port of Gothenburg Consultancy AB



TELEFAX - HEADER

TO: WORLD BANK	ATT:
FM: PORT OF GOTHENBURG CON	OUR REF: DETE: SULTANCY AB/MIKAEL KJELLBERG 1987-05-15

RE SUBJECT: SEMINAR IN PORT OF GOTHENBURG WEEK 723

Thanks for your tlx of May 6, 1987. Hotel bookings are made accordingly.

Please find 5 pages of the preliminar programme for the mentioned week.

With hopes that the programme is to 'our satisfaction, we are looking forward to your visit.

Best Regards,

CABLE SECTION

NO OF PAGES INCL. THIS HEADER: PAGES
SENT FROM P G C - GCTHENBURG TELEFAX NO 031-632251

W 100000 031-03



A PRELIMINARY PROCRAMME FOR A SEMINAR ON PORT MANAGEMENT AND OPERATION

PORT OF GOTHENBURG MAY 51 JUNE 5 1987

Sunday 31/5

19.00 Reception, Hotel Rubinen

"Address of Welcome",

Per Bjuretröm, President, Port of Gothenburg AB

. Mc. 5 .. 1/v

09.30 "The Port of Gothenburg, A Commercial Port", Verner Stoppenback, Executive Vice President, Port of Gothenburg AB

Coffee 10.30

11.50 A tour around the Port from the Seaside onboard the inspection vessel M, S Hamnen

Luncheon served onboard the vessel M/S Hamnen, while 12.00 steaming on the Gota River

Debarkation at the Xlvaborg Harbour. 15.30 "Fort Operations in a modern port - Port of Gothaming Ake Olausson, General Manager, Skandia and Klysidh Harbour, Port of Gothenburg AB

14.30 Guided tour around the Port to continue by bus

15.3-Coffee

"Management Information System - planning of resource 15.00 Borje Applequist, Vice President, Operations, Port

Gothenburg AB

19.30 Dinner

The Municipality of Gothenburg invites to "Verpandia

Villan" Speach:



	Port of Gothenburg
•	Port of Gothenburg Consultancy AB
	Tuesday 2/6

09.00	"Changes in international trade and sh Morgan Williamsson, Ass.Professor Univer	
10.00	Coffee	
10.30	"The Financial resources must be freed the City Council of Gothenburg as being Port of Gothenburg AB", Leif Blomqvist, Member of the Board of Port and Social Democratio Member of the	Directors of the
	of Gothenburg	
12.00	Luncheon at Transatlantio TransConsultants AB	
14.00	"Port information systems and computer users", Gunnar Falk, Executive Vice President,	
* *	and the second s	
15.00	Coffee	
15.30	"Computerized codification of dangerous Per-Johan Ekelöf Capt, Master Mariner, AB	
19.30	Dinner Scandiaconsult International AB . Speach:	

PANASONIC



Wednesday 3/6

09.00	"The Straddle Carrier Concept", Nicolas Du Rietz, Capt, Consultant Port Development
10.00	Coffee
10.30	"The companization of a Port, merging of the Steven doring Company and the Authority in the Port of Gothenburg". Lars Gustaveson, Dr. Bohlin & Strömberg Consultants, in Conganization
12.00	Luncheon at the restuarant "Stallgården" Bohlin & Strömberg
14.00	"Ways of handling personnel in situations of change and the relation to Labour Unions at the time", Sven Sandström, Capt, Manager Personnel, Planning and Development, Port of Gothenburg AB
14.50	Coffee
15.10	"Management information systems - the costs of pert operations and a philosophy when adjusting tariffe", Jan Lindgren, Capt. General Manager, Marketing, Rore of Gothenburg AB Joe Tursten, Marketing, Tariffs, Port of Gothenburg AB
16.00	"Port Operations seen from the angle of the shipperman. Calle Vestman, Vice President, TransConsultants
19.30	Dinner at "Henriksbergs Kajutor" SwedPort Speach: Lare-Olof Eliasson, President, SwedPort: Computation

PANASUNIC

Port of Gothenburg Consultancy AB

Thursday 4/6

09.00	"Environmental protection, port and shipping se vith emphasis on liquified substances", Per H Gleon, Manager, Safety and Environmental. Port of Gothenburg AB	
10.00	Coffee	
10.30	"Vessel Traffic Services - emphasis on the syst working in the Port of Gothenburg", Jens Lomberg, Capt, Harbour Master, Port of Goth	2.1
11.30	Tour in the Traffic Control Station.	į.
12.00	Luncheon onbcard "M/S Marieholm" Fort of Gothenburg AB	* !
14.00	"Civil Works Maintenance - How is it carried ou Jan Persson, M.Sc.Civ.Eng, Manager, Technical D Port of Gethenburg AB	
14.50	Coffee	
15.10	"Mechanical equipment maintenance - overall sysplanning and cost follow-up". Nils Birgander, General Manager Technical Divis Port of Gothenburg AB	
16.00	. "Maintenance and repair of technical equipment, monitoring, stock keeping and systems", Roger Carlsson, Manager, Maintenance, Technical Port of Gothenburg A2	
19.30	Dinner at the restaurant "Sjömagasinet" HT-Data, Harbour and Terminal Data AB Speach:	

PANASCHIC

Port of Gothenburg Consultancy AB Friday 5/6

09.00	"Management information system technically seen and My means of use - decentralization & profit centers, quality vs quantity",
	Stefan Samuelsson, MBA, Manager, Administrative Devalopement, Port of Gothenburg AB
10.00	Coffee
10.30	Transport to SSPA Maritime and Research laboratory.
11.00	"Maritime technology for ports and fairways", Villem van Berlekom, Vice President, SSPA Maritime Consulting AB
12.00	Luncheon at the University of Chalmers SSPA Maritime Consulting AB
14.00	"Computer systems as a mean to plan and accompdate traffic in a port, such as TRAPS (Traffic Planning System)", Margaretna Hedlund, Manager, Systems, Port of Gottonian AB
14.50	Coffee
15.10	"Terminal computer systems, such as TICS (Terminal Information Control Systems) how it operates, Margaretha Hedlund, Manager, Systems, Port of Gothanking
16.00	"Data Transfer, anytime, anyplace - Mobitex in port operations and adjacent areas". Nicolas Du Rietz, Capt, Consultant Port Development
19.30	Farewell Dinner in the archipelage of Gothenburg Port of Octhenburg Consultancy AB Speach: Per A. Sjöberger, Vice President, Port of Gothenburg Consultancy AB



(Info)

Hf. please note time in law.

SALES PERSON: 69 CUSTOMER NER: 010714 ITINERARY

BSEMQT

DATE: 17 APR 87

TO: MR MALISE C DICK STAFF NO \$1889 DEPT LCPTR ROOM 8-808 RIT 76567

FOR: DICK/MALISE MR

REPERENCE: M60653

17 MAY 87 - SUNDAY
AIR LV WASHINGTON DULLES 815P BRITISH AIR FLT:216 BUSINESS
18 MAY 87 - MONDAY
AR LONDON BEATHROW 825A NON-STOP
SERVICE IMMEDIATELY ABOVE NOT YET CONFIRMED

OTHER LONDON HEATHROW OWN ARRANGEMENT

31 MAY 87 - SUNDAY LY LONDON GATWICE 625P SCANDINAVIA FLT:524 BUSINESS AIR COT 1888P 1-370F AR COTHENBURG **SERVICE IMMEDIATELY ABOVE NOT YET CONFIRMED** OTHER GOTHENBURG COT OWN ARRANGEMENT

SATURDAY 06 JUN 87 -ICELANDAIR BUSINESS 2057 FLT:317 LY GOTHENBURG GOT ATR EEF 489P 1-STOP DINNER AR RETEJAVIE **SERVICE IMMEDIATELY ABOVE NOT YET CONFIRMED ** 515P ICELANDAIR PLT:645 BUSINESS AIR LY REYKJAVIE KEP 730P NON-STOP DINNER AR BALTIMORE WASHNIN **SHRVICE IMMEDIATELY ABOVE NOT YET CONFIRMED**

STAYF MEMBER WORLD BANK SECRETARY MANCT TRAVEL COUNSELOR MARY NAJARIAN 1-78288

SPECIAL NOTE ### OPERATIONAL TRAVELERS MUST A. CLEAR ALL MISSIONS WITH PROGRAMS DIVISION CHIEF. B. NOTIFY BANK RESREP/UNDP IN ADVANCE AND UPON ARRIVAL.

John of think the program on Gothenburg is too narrowly focussed on Gothenburg and engineering. I suspect use should also wow. and engineering. ask y they can cover the topics below - which are interrrelated. Mal 4/15 D) Constoms clearance bucedones through bills of lading - Swedich experience and applicability to development of contained tra ((ic

to development of contained tra ((ic

Least point is best point" (the Bell Line philosophy)

15 the concept valid what are the implications

for ICDs and how should ICDs be mm (legal

status board composition operational control independence

from port anthonity?) 3) Determinante 9 Kallie distibution to tuken
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Bulk terminal productivity determinants - critical

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THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION

be sent to ou

OFFICE MEMORANDUM

prespective partingali

DATE: April 14, 1987

TO: Mr. John Lethbridge TRP

FROM: Matt Minahan, PMDDR Web

EXT: 33269

SUBJECT: Port Management & Operations Training Course for Bank Staff Gothenburg, Sweden June 1-5, 1987

- 1. Following up on our conversation of last week, I have agreed that the Skills Mixed Fund can be used to pay for the travel and subsistence of up to 15 Bank staff for the week long course in Gothenburg.
- 2. We have presently budgeted the following amounts:
 - (a) Round trip economy airfare: \$1,750.
 - (b) Hotel and Subsistence: \$1,169.
- 3. The budget code is 843-99; once each travel request is prepared, it should be sent to me in room S-5045 for signature, and I will forward it to Accounting. Please instruct the participants appropriately.
- 4. Please send me the list of participants, with department and division names and codes, so that I can cross check the TRs as I receive them.
- 5. If you have any questions, please feel free to call.

cc: Janice Williams Palenzuela, PMD Howard Polster, PMD INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT INTERNATIONAL DEVELOPMENT ASSOCIATION

1818 H Street, N W Washington, D C 20433 (202) 477-1234 Cable Address. INTBAFRAD Cable Address. INDEVAS

April 10, 1987

Mr. Per A. Sjoberger Port of Gothenburg Consultancy AB S-403 38 Goteborg Sweden

Dear Per:

Port Management and Operations Seminar in the Port of Gothenburg, June 1-7, 1987

Thank you very much for your letter of March 31, 1987 and for the attachments.

We are very pleased with your suggested outline for the proposed weeklong seminar and as we discussed on the telephone on April 10, we see little need to change the list of topics on pages 1 to 3.

With regard to the suggested additional topics we have the following suggestions:

- The Straddle Carrier concept
- Port security
- What parameters of a port have influence on freight rates
- The mooring of ships who is doing what?
- Inland transports problems influence on storage capacity, etc. in the Port
- The wave of privatization

However, to include all of these may make the course too long. Thus we will now leave the final choice to you. As discussed, we would have no objection to the inclusion of evening time presentations in the program.

At this point in time it would seem that the group from the Bank might reach 15 in number. I will forward a list of names and specializations of the participants as soon as it becomes firm. We would ask you to arrange to block book, at this point in time, some fifteen rooms at the hotel for people arriving at noon on Sunday, May 31, and departing Saturday, June 6. Later I will provide you with a complete list of hotel needs.

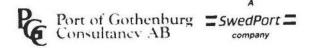
Thank you again for all your help and cooperation,

Yours sincerely,

cc: Messrs. Carnemark,
Peters (TRP)
Minahan (PMDTM)

John R. Lethbridge Ports and Aviation Adviser Transportation Department

MASTER-TOPICS



TENTATIVE LISTING OF TOPICS AT PORT MANAGEMENT AND OPERATIONS SEMINAR IN PORT OF GOTHENBURG JUNE 1 - 7, 1987

The Port of Gothenburg AB as of today and in the future

Mr Per Bjurström, President, Port of Gothenburg AB

Changes in international trade and shipping patterns

Professor Lars Nordström, Rector, Gothenburg School of Business Administration and Economics

The financial resources must be freed - aspects from the City Council of Gothenburg as being the owners of the Port of Gothenburg AB

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Dr Lars Gustafsson, Bohlin & Strömberg Consultants in Organization

The Details of the sale of the Port's real estate holdings to SPP/AMF (The Swedish Staff Pension Society/The National Labour Market Insurance Company) on a sale/lease back basis where Port of Gothenburg AB has right of disposition and redemption - the Architect's views

Mr John Eriksson, MBA, Vice President Finance, Port of Gothenburg AB

The relation with the Labour Unions - is there a surplus of resources due to the merger, due to more efficient cargo handling methods, mechanization, computerization, changes in cargo compositions etc

Mr Bengt Carlsson, Executive Vice President Personnel alt Mr Åke Helleman, Manager Labour Union Negotiations, Port of Gothenburg AB

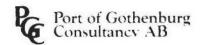
Nordic development aid in Southern Africa with regard to port development and planning

Capt Torsten Ahle, MBA

Management information system technically seen and by means of use - decentratlization & profit centers, quality vs quantity

Mr Stefan Samuelsson, MBA, Information Resources Manager, Port of Gothenburg AB





Management information System - planning of human and technical resources

Capt Werner Stoppenbach, Executive Vice President Commerce, Port of Gothenburg AB alt Mr Börje Appelqvist, M.Sc Civ Eng, Vice President Operations, Port of Gothenburg AB

Management information system - the costs of the Port's operations and the philosophy behind the conversion of these costs into tariffs, how it has been done and why

Eng Joe Tursten, Tariff Expert, Port of Gothenburg AB

Management information system and the application of standard costs

Capt Jan Lindgren, Manager Marketing and Information, Port of Gothenburg AB

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Eng Gunnar Falck, Executive Vice President HT-Data AB (Port and Terminal Data Co Ltd)

Environmental protection and port and shipping safety with particular emphasis on liquid cargoes

Mr Per H Olson, Safety Inspector, Port of Gothenburg AB

Computerized codification of dangerous cargoes

maybe, onit

Capt Per-Johan Ekelöf, Port of Gothenburg AB

Data Transfer, anytime, anyplace - Mobitex in port operations and adjacent areas

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Vessel Traffic Managment System 🗸

Capt Jens Lomberg, Harbour Master, Port of Gothenburg AB

Computerized Traffic Planning System (TRAPS) in the Port

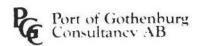
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Mrs Margaretha Hedlund, Bsc, HT-Data AB (Port and Terminal Data Co Ltd)

Mechanical equipment maintenance - overall systems, planning and financial follow-up

Eng Nils Birgander, Manager, Technical Equipment Operations, Port of Gothenburg AB





Maintenance and repair of technical equipment, control, monitoring, financing, spare part stock keeping and systems

Mr Roger Carlsson, Maintenance Manager, Technical Equipment

Civil works maintenance (utvecklas)?

Mr Jan Persson, M.Sc Civ Eng, (Anders Bohlin) Port of Gothenburg Consultancy AB

Development in bulk handling and its application on small bulk quantities - how are quantities of small proportions handled in inter alia bulk containers? Have trading patterns changed?

Capt Werner Stoppenbach, Executive Vice President, Commerce, Port of Gothenburg AB alt Capt Calle Westman, Vice President, TransConsultants AB

Port operations as seen from the angel of the shipowner

Capt Calle Westman, Vice President, TransConsultants AB

Materials management and logistics

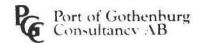
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Professor Dag Ericsson, Chalmers University of Technology, Gothenburg

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PSj/SBS 870331

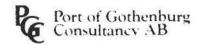




Additional Suggestions

- The Straddle Carrier concept
- Tugboat services
- Port security
- Commercial aspects (marketing, service i the port)
- Agents and ship brokers
- What parameters of a port have influence on freight rates
- The relation between a central port and a feeder port
- Insecticides in ports
- Import of foodstuff and live stock
- Gantry Crane simulators
- World Maritime University
- The operation of a physically "Spread-out" port, aspects on communication and delegation
- The subdivision of the Swedish coast in 12 maritime traffic areas and the conversion of the Swedish National Board of Ports, shipping and navigation from a public authority to a commercial enterprise.
- Repairs of TEU:s
- Insurance matters
- The lease of equipment
- The Stena Ferry Lines Prognosis, how is customs procedures handled, infrastructure, requirements on the port
- Piloting
- The mooring of ships who is doing what?
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- The Volvo Corporation and their aspects on the Port of Gothenburg
- Documentation hilimate
- Aspects delivered by a competing port
- Coastal shipping
- The Lidköping Hamnterminal





- What factors are steering the flow of goods through the Port of Gothenburg by ship, railroad and road?
- Simplified documentary routines without missing legal aspects
- Inland transports problems influence on storage capacity etc in the Port
- The wave of privatization 🗸
- The Swedish Club aspects on developing countries
- Classification societies and aspects on inspections etc in developing countries
- Gothenburg Radio maritex



interface problem.

OFFICE MEMORANDUM

DATE April 8, 1987

TO Mr. M. Minahan (PMDTM)

FROM John R. Lethbridge, Ports and Aviation Adviser, TRP

EXTENSION 61695

SUBJECT Port Management and Operations Training Course for Bank Staff - Gothenburg, Sweden, June 1-5, 1987

- 1. The staff and management of the Port of Gothenburg, Sweden, have very kindly offered to hold a one-week training course for the staff of the World Bank working on port projects and maritime sector studies. They have agreed to 'tailor make' the course to suit the actual needs of the staff and we have proposed the outline and topics to them. A copy of their most recent letter giving the tentative listing of topics is attached for your information. The port have also block booked about 14 rooms in a medium priced hotel adjacent to the port at a negotiated low rate.
- 2. We consider that this course, which is aimed not just at port engineers but at economist and financial analysts and perhaps others who are working on port and shipping activities, is a very unique opportunity for the Bank and should be fully supported. Thus you can imagine our disappointment when we received memoranda from the WAPTR division saying that although they had staff that would like to attend there were no funds available and thus they had to decline the offer. In two instances, we found staff who were prepared to use up valuable PAN-AM points so that they could attend. The port needs a minimum of 8-10 people to make it worth their while to put on the seminar. We have currently identified 14 Bank staff as firm participants.
- 3. The course is free of charge and lunch may be included as well. Thus minimum hotel costs and return airfares at economy level make up the cost. Some staff are planning to couple the seminar with mission travel.
- 4. In view of the extreme value of this unique training opportunity, we would ask that the highest consideration be given to funding the course through the Bank's training budget.

cc: Messrs. Carnemark, Peters (TRP)

JLethbridge:hf

OFFICE MEMORANDUM

DATE April 8, 1987

Transportation Division Chiefs and Distribution Below

FROM John R. Lethbridge, Ports and Aviation Adviser, TRP

EXTENSION 61695

SUBJECT Training Program for Bank Staff at the Port of Gothenburg June 1-5, 1987

Seminar Program and Travel Details

- 1. The proposed program for the week long seminar has now been received from the Port of Gothenburg. A copy of their letter is attached for information and comment.
- 2. We consider that the basic program as outlined is very satisfactory and also that some of the additional subjects proposed could be included. We have ringed the subjects that we in TRP consider could be useful but we would like to receive your ideas and suggestions before firming up the response. Please let us have your suggestions as soon as possible.
- 3. Please also note that the port have tentatively reserved a block of rooms at the Hotel Rubinen but we understand that in order to get the negotiated low rate, the rooms must be reserved through the PELIGRE travel agency in Gothenburg.
- 4. We have been informed by PMD that the costs of travel and accommodation for the seminar will be borne through the skills mix budget of the Bank.

Distribution:

Messrs. Carnemark, Peters

Provisional list of participants:

Messrs. M. Dick

D. Hill

M. Le Blanc

I. Mobarek

L. Nordin

E. Vernigora

R. Bonney

A. Litvak

C. Carnemark

J. Lethbridge

Ms. I. Sebastian

JLethbridge:hf







31 March, 1987 Your date



Mr John R. Lethbridge

Acting Ports and Aviation Adviser THE WORLD BANK Transportation Department, Room N-927 1818 H Street, N.W. WASHINGTON, D.C. 20433 USA

Dear John,

Port Management and Operations Seminar in the Port of Gothenburg, June 1 to 7, 1987

With great anticipation we now are underway making up the preparations for the seminar.

As I already have informed you John, we have made a preliminary booking at the "Hotel Rubinen" for you and your colleagues. It would be fine if you could make your confirmations to the travel agency "Peregre" as soon as possible as to not let the rooms disappear to somebody else.

Thank you for the information about the composition of the World Bank group of participants. We have noted that you will be 14 persons in total. We will also invite one representative from each of the agencies SIDA, BITS, NORAD and FINNIDA.

Enclosed please find a tentative listing of topics for the week. Most lecturers have given definite confirmation that they will be available. A few are still pending.

In addition to the topics suggested by you I have also taken the liberty to suggest a few others. Could you be so kind to let me know if any of the additional subjects are of interest to you. We will then make preparations to include the additionals.

Our ambition will be to have all lectures printed and distributed to the participants.

Should you at this stage have any more ideas about the seminar I would be glad to be of assistance. Otherwise we will carry on organizing the seminar and we will be looking forward to meet you all here in Gothenburg in June.

Kind personal regards,

(Per A. Sjöberger)

Encls.

A fully owned subsidiary of Port of Gothenburg AB





TENTATIVE LISTING OF TOPICS AT PORT MANAGEMENT AND OPERATIONS SEMINAR IN PORT OF GOTHENBURG JUNE 1 - 7, 1987

The Port of Gothenburg AB as of today and in the future

Mr Per Bjurström, President, Port of Gothenburg AB

Changes in international trade and shipping patterns

Professor Lars Nordström, Rector, Gothenburg School of Business Administration and Economics

The financial resources must be freed - aspects from the City Council of Gothenburg as being the owners of the Port of Gothenburg AB

Mr Leif Blomqvist, Member of the Board of Directors of Port of Gothenburg AB and Social Democratic Member of the City Council of Gothenburg

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Capt Calle Westman, Vice President, TransConsultants AB

Materials management and logistics

Professor Dag Ericsson, Chalmers University of Technology, Gothenburg

PSj/SBS 870331



OFFICE MEMORANDUM

March 17, 1987

See Distribution List Below

THOM John Lethbridge, Ports and Aviation Adviser, TRP-

EXTEN ON 61695

SUBJECT Continuing Port-related Training for Bank Staff
One Week Course at the Port of Gothenburg, Sweden
June 1-5, 1987

- 1. Since my memo of February 5, 1987, we have received the majority of the responses expressing interest in the one-week training course. It appears that about fourteen staff are interested in participating.
- 2. The timing has been a problem. Because of diverse mission travel, several staff asked for dates different to those proposed. In discussion with the Port of Gothenburg, they also have constraints concerning the availability of staff and public holidays in the last week of May. Consequently, it seems that the only really suitable date is the first week of June as originally proposed.
- 3. The Port is now forwarding to the Bank a detailed program for the course which I will circulate as soon as it arrives. The program can be modified to some extent to suit our needs and they are inviting our comments and suggestions.
- 4. The port is suggesting that the Bank staff should stay at the hotel RUBINEN which is good class hotel and well situated. They have negotiated a room rate of Kr. 690.00 perday for a 'combi room' which is something between a double and a single apparently.
- 5. The Ports and Shipping unit has two copies of a very comprehensive package of information on the Port of Gothenburg's range of activities and expertise. The CV's of some of the speakers are part of the package. Staff are invited to browse through the package to gain a better impression of the capability of the Port to create an interesting and instructive training course (Room N-924).
- 6. Further information will be circulated in due course.

Distribution:

Messrs. Pouliquen, Carnemark, Bennathan, Blaxall, Fossberg, Gutman, Thompson, Rashid, Peters (TRP)

Van Nimmen, Levy, Malone (EDI)

Regional Transport Division Chiefs

Regional IDF Division Chiefs

Goldberg, Raghavan, Rowat (IND)

Bertrand, Kuffner, Le Moigne (AGR)

Minch, Bose, Hunt, Mustafa, Westmeier (IFC)

Bonney (EMP), Hill (LCP), Le Blanc (AEP), Vernigora (ASP)

Ms. Sebastian (EMP)

JLethbridge:hf



Additional Suggestions

- The Straddle Carrier concept
- Tugboat services
- Port security
- Commercial aspects (marketing, service i the port)
- Agents and ship brokers
- What parameters of a port have influence on freight rates
 - The relation between a central port and a feeder port
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- Aspects delivered by a competing port
- Coastal shipping
- The Lidköping Hamnterminal





What factors are steering the flow of goods through the Port of Gothenburg by ship, railroad and road?

- Simplified documentary routines without missing legal aspects
- Inland transports problems influence on storage capacity etc in the Port
- The wave of privatization
- The Swedish Club aspects on developing countries
- Classification societies and aspects on inspections etc in developing countries
- Gothenburg Radio maritex

PSj/SBS 870331



Our date February 4, 1987 Your date

Our reference PSj/SBS/L014/87

Received 17/02/87

Mr John Lethbridge Acting Ports and Aviation Adviser THE WORLD BANK 1818 H Street, N.W. WASHINGTON, D.C. 20433 USA

Dear John.

I'm just back in office and I can tell, there really is something called "jet-lag". It was a nice trip though and Mr Stoppenbach as well as myself thought it very rewarding to meet with you and Curt Carnemark again. The luncheon was terrific also. Thank you so much for your hospitality and for pleasant talks.

As for my mistake with the bottom plate of the flag pole, please find enclosed such a plate. I hope you hadn't started making one in your workshop at home?

As agreed we will set up a seminar programme to be sent over to you within the next few weeks. We are indeed looking forward to receive you and your collegaues here. We will be awaiting your ideas about the most sufficient time for the seminar.

If you don't mind I would like to come back to the file I handed over to you. As it is in fact as simple to lift the phone and call Sweden as it is to call most other areas we believe it could be a good idea that you just give us a call when you need the kind of expertise exemplified in the file. We would feel honoured to carry out missions for you. Please do not hesitate should anything come up where you think the expertise of the Port of Gothenburg Consultancy and SwedPort would be of use.

We are now looking forward to hear from you again about the seminar. In the meantime I wish to send you my

(Per A. Sjöberger)

SwedPort = company

Encl. Bottom plate

A fully owned subsidiary of Port of Gothenburg AB

Norra Hamngatan 8

ilesmal legards

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+46(0)31-63 20 00

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Svenska Handelsbanken Göteborg

GOTHEN BUCG. Dates preference ASP 1-5 June. Engene Verrigais EAP 3 people. 25 - 29 May 3 public heliday. LAC. 3 people poteren. 3 (Hill +) Dick reserve: Olabi Anonerdi Cellin AEP. Le Blanc. Low whe May. Mabarek. r Nordin - many come for low 3 days only. 1-5 Selseshi 2 EMENA. Benny . 1-5.

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CONFÉRENCE DES NATIONS UNIES SUR LE COMMERCE ET LE DÉVELOPPEMENT



UNITED NATIONS CONFERENCE ON TRADE AND DEVELOPMENT

Télégrammes : UNATIONS, GENÈVE

Télex: 28 96 96

Téléphone: 346011 310211 RÉF. N°: INT/82/All (à rappeler dans la réponse) Palais des Nations CH - 1211 GENÈVE 10

14 April 1987

Dear John,

I would like to thank you for arranging my presentation to your staff on 1 April. The audience seemed interested and made me feel the trip was well worthwhile. I hope there will be some follow-up to the benefit of programmes of both our organizations. Thank you also for a most enjoyable lunch.

You mentioned a planned visit to Sri Lanka. We have a project SRL/84/016 to help the Port Authority get training activities under way, especially in relation to the container terminal. Our expert on the spot is Wouter Kuyck, he splits his time between training and the introduction of a proper operating system for the container terminal. You may like to contact him--either through the Port Authority (telex 21805 PORTS CE) or through UNDP.

Yours sincerely,

Mike Daunt
Ports Section

Shipping Division

Mr. John R. Lethbridge Ports and Aviation Advisor Transportation Department The World Bank

1818 H Street NW Washington, DC

CONTAINER TERMINALS

UNCTAR - SEMINAR FOR DECISION MAICELS.

I APRIL '87

ATTENDING:

	NAME	DEPT./ /DIVISION	PHONE
	John hellbridge	TRP	6.1667
	Coli Cerray	PPD	
1	Mike DAUNT	CATONO	Geneva
	Saced Hassan Rageh	WMUV	MALMO
	LAMBERTO V. PIA	WMUV	MALMO
	E. VERNIGORA	ASPTRV	3 2866
	LI ME IIA	ITESD V	48166
	Richard Leonard	ASPTR V	32999
	MAURICE LE BLANC	AEPTR	61227
	MASA XOSHI TAKAHASHI	INDD3	76866
		INDD3 EDPTRE	34288
	AGUSTIN LITUAK. POTRICIC MISLOUEZ	Ersi,	75538
	D.S. H.L.	LCPV	76576
	J. Cellier	LCCV	76565
	Z. Rajanan	"	76550.
	Lars Nordin	AEPTR	67216
1	CAN Sobren 15 AND	MARITIME Adm.	366-4357
	Mohua Mukherjee	AEAPH V	69391
	gerhard Henckler H	MEPTR J	61223
	Adhemar BYL	LCPTRV	76561
	Malise Dide	LCPTR)	76567
		ETHIOPIA J	3 - ·
	Ephrem Asebe 5. Teravaninthorn	AEPTR 1	15 2 TY
	BARRY VAN WAES	WAPTR!	34540

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PLANNING AND MANAGEMENT OF CONTAINER TERMINALS

UNCTAD announces the availability of materials for a series of training programmes for developing countries

Vast sums of money are being committed by developing countries for the provision of specialized port facilities for the handling of cargo in containers which has grown dramatically in recent years. In view of the scarcity of financial resources, countries have a responsibility to ensure that these investments are backed up by sound organizational and institutional decisions which will create efficient operational and administrative procedures. The new methods of cargo handling need to be co-ordinated with action on labour deployment, on customs procedures and on inland transport systems. Collectively, these developments present complex policy and planning issues which require a multi-disciplinary approach to appreciate and resolve. Experienced and highly trained staff are also required to manage and operate the container terminals once they are developed.

It is in response to these developments that UNCTAD has prepared a series of training programmes for policy makers, planners, and senior and middle level operational staff.

Since 1981 UNCTAD has jointly organized with APEC (Antwerp Port Engineering and Consulting) an annual <u>Container Terminal Management Seminar</u> for senior managers. The programme has been and continues to be financed by the Belgian Government. This seminar is run alternatively in English and in French and covers all aspects of terminal management. A collection of the papers presented at the seminar are available in English and the French version will be published in 1987.

To meet more specific needs in developing countries themselves, two sets of training materials have been developed by UNCTAD. The first of these, developed under the Improving Port Performance training project generously financed by the Swedish International Development Authority, is for a <u>Seminar on Container Terminal Development Policy</u>. The materials for this seminar consist of a series of case studies and exercises covering such subjects as planning strategies, container terminal development, equipment selection and container terminal organization, supported by a set of six video programmes.

This Seminar, which is designed to be run by instructors with broad experience of container terminal development, may be conducted in two modes:

- a 3-day policy seminar for senior civil servants and chairmen and managing directors of ports and other organizations responsible for cargo handling,
- a 5-day strategy seminar for planners and departmental heads of ports.

The same material serves as a basis for both seminars. The main difference is that the policy makers are provided directly with information on which decisions should be based, whereas the strategists are encouraged to determine the information needed for such decisions. In both types of seminar participants work extensively in small groups to develop and compare ideas, and considerable time is reserved for discussion of the various aspects of container terminal development between groups and with the seminar staff.

The UNCTAD secretariat is ready to organize deliveries of these seminars on request. For countries with several ports the normal method of delivery would be at the country level. For small countries, however, sub-regional deliveries would probably be the most appropriate.

The second course entitled Management of Container Terminal Operations, has been developed under UNCTAD's Trainmar project. Work on this course started at the Trainmar centre in Manila in 1983 and further work was carried out by Trainmar centres in Johore, Madras, Mombasa and Penang. The resulting course, which lasts 3 weeks, may be conducted either by UNCTAD staff or by suitably qualified local instructors who have followed an UNCTAD instructors' seminar. It may be conducted for two distinct target populations.

 For senior operational staff who have the responsibility for introducing or improving operating methods at existing or planned container terminals.

In this case the aim of the course is to familiarise the senior staff - in detail - with a standard modern method of controlling a container terminal, and to prepare them for the task of selecting appropriate local methods and advising senior managers of the decisions needed in order that the methods can be implemented.

For middle level operational staff who have to run the terminal.

This second stage can only be effectively carried out after clearcut decisions have been taken on the local methods to be used. In this case the aim of the course is to train terminal staff to carry out the planning and control task and to manage daily operations on a container terminal.

For further details of these UNCTAD training programmes enquiries should be addressed to the:

Director, Shipping Division UNCTAD Palais des Nations CH 1211 Geneva 10 Switzerland

IMPROVING PORT PERFORMANCE

CONTAINER TERMINAL DEVELOPMENT

MANUAL

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INTRODUCTION

Improving Port Performance is a project of the United Nations Conference on Trade and Development (UNCTAD), set up to prepare and disseminate training and seminar materials for use in ports, particularly of, developing countries. The project has received generous financial support from the Swedish International Development Authority (SIDA). The materials in this manual are completed by a series of six video films which are distributed with the manual.

The materials provide a framework for two experienced tutors to organize both a 3-day seminar for policy makers concerned with the provision of container transport and handling facilities, and a 5-day seminar for planners and departmental managers in ports and related organizations. While the materials ensure that such seminars will be comprehensive and well structured, they do not obviate the need for skilled tutors with thorough experience of container handling and transport. The high level of persons attending these seminars will need and expect answers to a very wide range of questions.

Further, the materials do not obviate the need for tutors to have local knowledge. In preparing to run one of these seminars, the tutors must ensure that they are thoroughly familiar with all the seminar materials; equally, they must ensure that they are familiar with developments in the container trades of the country or region hosting the seminar.

This manual is for exclusive use by the tutors. Part One provides detailed instructions for running the 3-day policy seminar. An appendix provides a series of exercises which lead the participants through the various topics. Part Two contains the Handbook which covers the principal themes of both seminars and provides a reference text for participants. Part Three contains the exercises needed to run the 5-day planning seminar. There is no tutor's guide specifically for the planning seminar, so tutors must identify for themselves the steps to be followed, using Part One as a general model. Part Four provides overhead viewfoils for use by the tutor during seminars. Part Five provides mastercopies of all seminar handouts; these are to be used for preparing multiple copies of documents distributed to seminar participants.

The six video films, with duration from 15 to 25 minutes each, support the various seminar activities and their use is described in Part One.

These seminar materials were created by a small team under the direction of Dr. Brian Thomas from the Department of Maritime Studies, UWIST, U.K. They were subjected to trial in various countries before their release for use worldwide. These trials have shown that seminars based on these materials, organised with care and with participants of sufficient seniority, will be highly useful to the countries concerned.

PART ONE

POLICY SEMINAR Tutor's Guide

Appendix 1

Improving Port Performance

CONTAINER TERMINALS: A POLICY FOR DEVELOPMENT

A Seminar for Decision Makers

SUGGESTED PROGRAMME

Session 1: Theme - Planning for Development

- Introductory Case Study
- Video Programme 1: Planning for Development
- Exercise 1: Planning for Development
- Discussion

Session 2: Theme - Planning Strategies

- Video Programme 2: Planning Strategies
- Exercise 2: Planning Strategies
- Discussion
- Exercise 3: Preliminary Terminal Design
- Discussion

Session 3: Theme - Container Terminal Design: Land Area

- Video Programme 3: Terminal Design: Land Area
- Exercise 4: Determining Storage Demand
- Discussion

Session 4: Theme - Terminal Design: Configuration & Layout

- Video Programme 4: Terminal Design: Configuration & Layout
- Exercise 5: Stacking Area Requirements

- Discussion
- Exercise 6: Container Equipment Selection
- Discussion

Session 5: Theme - Container Terminal Organisation

- Video Programme 5: Terminal Organisation: Management & Manpower
- Exercise 7: Manpower Planning
- Discussion
- Exercise 8: Forecasting Skilled Labour Requirements
- Discussion

Session 6: Theme - Container Terminal Operations

- Video Programme 6: Terminal Organisation: Operational Factors
- Discussion
- Exercise 9: Port Paguera Terminal Contract
- Discussion
- Seminar Summary
- Seminar Evaluation

Improving Port Performance

CONTAINER TERMINALS: A POLICY FOR DEVELOPMENT

Introductory Case Study: Jose Perez' Bad Day

Introduction

Jose Perez, the General Manager of the country's main international port, sat nervously in the waiting room of the office of the Minister of Transport. It was very unusual for the Minister to send for a senior port official — and the meeting had been set up so quickly! While Jose waited, the Minister was closeted with his senior advisors and the Chairman of the Port Authority; very ominous!

Perez guessed what the fuss was all about. Recently, the national newspapers and technical journals had published a series of articles and editorials criticizing the performance of the port — and particularly the poor showing of the container terminal. He had also received a flood of complaints from shipping companies, shippers, clearing/forwarding agents, trucking companies — and even the customs authorities and railway corporation. He was well aware of their grumbles: long delays to vessels waiting to berth at the container terminal; empty containers blocking the terminal and the roads leading to it; equipment out of service for long periods; containers being packed and unpacked on every available pocket of space in the port; long queues of lorries at the dock gates; frequent lightning strikes and angry demonstrations by portworkers; a noticeable deterioration in working relationships between port management and their counterparts in customs and the railway corporation. But what had all that to do with him? He had always done his best.

As he sat miserably in the Minister's waiting room, Perez sighed and thought back over the events of the past five years, the headlines in the port's newspaper . . .

1 January 1982: Jose Perez appointed General Manager

The port, when he took over, handled 75% of the country's imports and 59% of its exports. All general cargo, including sizeable quantities of bulk commodities, was handled across 18 conventional berths, while the one specialised terminal handled the import of crude oil and the export of some refined products. Containers and other unit loads had begun to arrive on conventional general cargo vessels — about 5000 boxes the previous year — and were handled by ships' gear and two specially purchased front—end loaders (splendid machines; Jose loved to show them off to visitors!).

Everything seemed very satisfactory - he was sure the port could handle anything its customers turned up with; they were well prepared.

3 March 1983: New terminal opens

Events had moved quickly. For some reason or other, the volume of containers passing through the port had grown much more rapidly than they had expected but Jose was well up to the job. With his advice, the Port Authority had acted quickly and had converted the most recently constructed general cargo berth into a makeshift container terminal. The quayside transit shed had been removed and a multipurpose jib crane had been purchased (at US\$1.5 million!). Two straddle carriers had been bought (second-hand, but in quite good condition, really) to operate alongside the two front-end loaders.

Jose was very pleased with the way he and his superiors had tackled that problem. Now they would be alright for quite a few years . . .

4 July 1983: Port buys more heavy equipment

Some people were never satisfied! In spite of the straddle carriers, some of the port's customers were not happy, it appears. Some of them, it seems, had soon started to bring in their own quay transfer equipment. Jose hadn't noticed until all sorts of operating problems had begun to crop up, but when he was told about it, he acted right away - he asked the Port Authority to buy another four heavy-duty front-end loaders to back up their existing equipment.

That would do the trick, he was sure. He knew his job . . .

10 August 1984: Shipping Conferences impose 30% surcharge!

Why couldn't others do their jobs properly? In spite of his efforts, the makeshift container terminal carried on being a constant problem, with very poor performance. True, container throughput had increased much more rapidly than expected - it had been doubling every year, and had now reached 35,000 boxes a year. Jose remembered his puzzled comment to the Chairman at the time: "If only we'd known the traffic was going to grow like that! We didn't encourage it - it just happened!"

Perez found himself spending his whole working day dealing with one management crisis after another - he was up to his neck in all the tiny details of container handling operations. Why couldn't he rely on other people working the way he did? And now, just when he was about to leave on his holidays, the final blow: the big shipping conferences had announced that they were imposing a congestion surcharge of 30% on the port! What would the powers-that-be do while he was away?

1 September 1984: Minister demands enquiry

So that was it! There on his desk, first day back from his hard-earned holiday, was the curt memo from the Chairman: "See me immediately - the Minister is setting up an enquiry into container handling in the port". The Minister of Transport had demanded an urgent study of future container-handling capacity, and plans to meet the demand were expected on his desk by the following week!

As always, Jose Perez had done everything that anyone could ask of him. All

the stops had been pulled out, and plans for new facilities were drawn up at top speed - gallons of midnight oil were burnt in the process. And they were acted The existing temporary container berth, with its 2.5 hectares of stacking area, was rapidly upgraded to a full container terminal. An extra 2 hectares of land was reclaimed and surfaced (at a cost of US\$4.8 million!) and quickly brought into operation. A transit shed on the berth next to the container terminal was converted to a container freight station and a new office block was constructed nearby. The traffic projections in that plan were for a rise in annual throughput to 75,000 boxes by 1986 and to 100,000 by 1989, so straddle carriers and three three ship-to-shore gantry cranes, three rubber-tyred yard gantry cranes (complete with advanced automation systems) were purchased. The total cost of all that frenzied buying was US\$18 million - a loan agreement had had to be arranged with an international lending agency. Yard tractors and trailers were ordered, too, from the Port's own meagre funds.

Now Jose felt confident again; by putting all that new equipment to work alongside the existing straddle carriers and front-end loaders, they would be able to cope with whatever the traffic would bring - up to 200,000 containers a year, at least.

5 August 1985: Ricardo Emmanuel appointed Terminal Manager

The Port Authority were leaving nothing to chance but had worked things out very carefully; they had decided to manage the reconstructed container terminal within the existing organisational structure. All shipboard work at that time was carried out by three private stevedoring companies, which obtained their dockworkers and supervisory staff from a central labour pool. The quay work, on the other hand, including crane operation, and packing and unpacking of containers at the container freight station, was performed by Port Authority employees, while importers and exporters provided their own labour for handling cargoes into and out of the container freight station. All very neat and tidy, with no loose ends.

Indeed, this time they were really thinking ahead! Although the container terminal was to be managed as part of the existing traffic department, they had appointed, a full two months before the recommissioning of the terminal, a new Terminal Manager. Ricardo Emmanuel had had 25 years' experience in the port, rising from tally clerk to senior traffic officer at the conventional break-bulk berths. A solid guy, with all port working practices at his finger-tips, and well liked by the union leaders, supervisors and shipping company representatives. He was very popular with the dockworkers — in his younger days a star performer in the port football team!

They had done everything they could: they sent Emmanuel overseas for a two-week training visit to three major European ports, observing container handling operations. Then, when he came back, he was fully involved in recruiting the new management team. His cousin, Raul Pavillo, was appointed Operations Manager; 29 years old, he was an engineer by training, but had worked in the port for five years, largely in the planning department. Together, Pavillo and Emmanuel recruited 15 senior traffic officers to key positions on the terminal - strictly by seniority, so that they could not be accused of unfair promotion.

All the managers were given on-the-job training before being assigned as ship planners, shift managers, container yard supervisors, container freight station managers and so on. The necessary clerical and administrative staff were all transferred from the conventional berths - there was no need to train them,

since they were going to carry on using the administrative and documentary systems that they were used to, transferred directly to the container terminal from the general cargo berths. No problems there!

20 September 1985: Management team presents labour plan

Pavillo and his staff had worked hard on new labour agreements and operating procedures and, just before commissioning date, had presented drafts of a new manning agreement and revised terminal operating procedures to senior management, who had approved them for immediate introduction.

The new manning agreement called for radical changes from previous practices, with fewer men to a gang and complete flexibility in deployment. Restrictive practices were to be abolished, but existing systems of payment were to be unchanged. The new conditions of service were presented to top union representatives a full ten days before the terminal was to be officially re-commissioned. There really seemed no justification for the unions' immediate and outright rejection of the scheme and the angry public debate that followed it, but the Chairman felt that the port couldn't risk that sort of bad publicity just when the Minister was due to visit the port, and so he stepped in at the last minute and agreed that the terminal should reopen using existing manning agreements.

Jose thought that there was little else that he could have done, anyway . . .

3 October 1985: Minister officially reopens terminal

That had been a good day! The Minister was on top form, the sun was shining, the flags flying and the first big cellular vessel was at berth, with containers coming off quite smoothly — considering the inexperience of the crane drivers.

Most containers were still arriving on semi-container ships, of course, nearly all of them multipurpose vessels carrying a range of cargoes, including break-bulk commodities, steel and forest products as well as the containers. That year, the terminal had transferred a widely varying number of containers per ship's call, from as few as 20 to as many as 700. They hadn't expected quite as wide a fluctuation, but never mind . . .

Feeder services soon sprang up, too, linking the port with other national and international ports. Things really looked rather promising, and Jose Perez was beginning to really enjoy his job.

2 February 1986: New Labour Agreement hammered out

The terminal had been operating for 5 months and the Port Authority had felt it was a good time to reopen negotiations with the unions and stevedoring companies. The new agreement was to allow for both ship and quay labour to be rotated between the conventional berths and the container terminal, to ensure equal earnings opportunities — apart from the yard gantry crane and straddle carrier drivers, who had independently negotiated a 50% wage increase. After a great deal of hard bargaining, a compromise was reached, with the unions agreeing to a 12% manning level reduction (reducing shipboard gangs from 16 to 14 men per crane), a 25% wage increase all round, and a commitment by the Port Authority to recruit a further 150 men.

Jose Perez felt that this was a reasonable agreement - a good compromise. At least, both the unions and the Port Authority seemed pleased with it, so the labour side of things should run smoothly from now on . . .

10 March 1986: Authority reviews container terminal performance

The terminal was now fully operational, six months after re-commissioning. Jose was reasonably pleased with progress. The first batch of statistics he had asked for showed that Container Yard occupation averaged 95% — couldn't grumble at that! About 60% of the stacked boxes were empties returned to the port before going to a consignor or to the container freight station for repacking. Ship-to-shore gantry crane handling rates had risen as high as 11 moves an hour in the third month of operation, but had now dropped back to 9 moves an hour because of equipment shortage — but still quite good. Terminal records showed that FCL containers were staying on average 15 days in the container yard, LCLs about 22 days. There were more in-terminal moves of containers than Jose had expected — and he knew why! Customs regulations required all FCL containers to be unpacked for inspection before onward delivery; trust them to be awkward — but there was nothing he could do about it, after all.

He was sure that the delays caused by documentation procedures were also undesirable, and would dearly like to see the end of delivery/receipt delays - but the railways just couldn't cope with the demand for container wagons, and road transport was in very short supply. Heavy traffic congestion at the container freight station was a daily feature, and it was definitely interfering with operations; why did so many importers insist on unpacking their FCL containers in the port? He had complained to the Chairman, but these companies had longstanding commercial (and other!) relationships with clearing/forwarding agents and the trucking companies and were reluctant to upset them - and the Chairman hinted that he had no wish to offend them, either!

Why did other people have to make life difficult for him? Jose had done his job magnificently, but there were always these little niggles from areas over which he had no control!

28 April 1986: Carlos Roberto to be new Chief Mechanical Engineer

At last, the Board had listened to Perez' complaints about maintenance and had brought in a new Chief to try to sort things out. Carlos Roberto had had a lot of experience in the local light manufacturing industry and had impressed the Chairman at the interview with his knowledge of automobile engines (particularly the fuel-injected Italian one beloved of the Chairman himself!). Again, the Port had done the right thing and sent Carlos overseas for three months to visit the plants of port equipment manufacturers and some of the big Japanese container terminals.

Roberto had started well, Jose remembered, introducing modern maintenance procedures — against considerable opposition from the old stagers who had occupied the workshops for many years. In fact, relationships had got so bad that several of the better qualified and skilled engineers had requested (and been given) transfers to the conventional berths' workshops. Jose couldn't understand it — Carlos Roberto was such a good engineer.

However, Availability soon dropped below 50%, with equipment out of action

all over the terminal. The engineers claimed that most repairs were caused by accidents during operation, and that the delays in the workshops were because they had long waits for spare parts. That was only part of the problem, Jose knew; the workshop staff just couldn't cope with the new equipment and maintenance schedules, and seemed constantly to be trying to keep up with the repair work. And the subsidence on the terminal didn't help, either! Stacking patterns and equipment manoeuvrability were being upset — and paving maintenance costs were going up dramatically.

Why were all these problems stopping at his door - couldn't the engineers manage their job? Perez was beginning to have doubts as to whether his modestly comfortable salary was worth all these headaches! Was that just indigestion, or was an ulcer developing? He would have to see the doctor . . .

15 January 1987: Big blow to Port trade!

Jose shuddered as he recalled that headline in the leading national daily newspaper. Two of the major shipping lines, the port's biggest customers, had announced that they were withdrawing direct calls at the port and were going to ship via feeder services out of a competing port in the neighbouring country—their longest—standing trade rival, the number two port in a country not on the friendliest terms with the President. The same day, the Accounts Department had reported to the Board that the terminal had made a large loss in its first full year of operation.

That had been a very unpleasant Board Meeting! It reached the inevitable conclusion that the Port Authority would have to approach the Government to ask it to cover its debt repayments on quay construction and equipment purchase, which were now falling due. That wouldn't go down well in election year! To cap it all, the National Association of Freight-forwarders and the Chairmen of all the National Export Boards had gone directly to the Minister of Transport, complaining about the recent increases in freight and transport costs and the dramatic reduction in the quality of service provided by the port. They were backed by the Chamber of Commerce, which had pointed out the damage done to the country's trading prospects and balance of payments. Yesterday, in the National Assembly, the leader of the opposition parties had called publicly for the dismissal of the port's senior management.

. . . Jose Perez held his head in his hands and his heart in his boots. If only people could understand the difficulties of dealing with a technological revolution! He had done his best, hadn't he? And, anyway, all those terrible things that had happened were outside his control, weren't they? How could anyone blame him? Life was so unfair!

His thoughts were disturbed by the opening of the Minister's door. The Minister's Private Secretary beckoned him in, grim of face. As Jose reluctantly rose from his chair, a nightmare picture of tomorrow's newspaper headline suddenly flashed into his mind . . .

17 January 1987: Port General Manager forced to resign!

PART TWO

HANDBOOK

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Container Terminals—A Policy for Development: Wednesday, April 1, 2:30 p.m., Rm. N-955. A seminar prepared by the ports section of UNCTAD, Geneva, given by Michael Daunt of their staff. He will present the materials that have been developed by them as part of the Improving Port Performance series but in this case specifically for decision—makers concerned with the development of container terminals in ports of LDCs. Video and slide presentation included. For further information, call Helen Frost, Ext. 61693. Sponsor: TRP.

Interactive Maintenance Management System: Thursday, April 2, 2 p.m., Spring Valley Center, 4801 Massachusetts Avenue, N.W. The Electricity Supply Board of Ireland will demonstrate its computer-based management system in its offices at the above address. Although designed primarily for identification and control of maintenance activities in power generating plants, it is applicable to any situation involving control of large maintenance programs and inventories such as railways, refineries and process plants. Interested staff are invited. Call Mary Fernandez, Ext. 74492, if you plan to attend. Sponsor: EGYPA.

Management of Unaccounted-for Water: Wednesday, April 8, 10:30 a.m., Rm. N-550. Charles Hurst, Projects Manager, Thames Water International (TWI) will lecture on: services offered by Thames Water Authority in water supply services optimization; and methodology and technology used for investigating and managing unaccounted-for water. He will conduct a presentation of Cyprus case study and there will be a demonstration in the use of technology. For further information, call Ext. 61532. Sponsor: WUD.

Efficient Use of Water in Irrigation: Thursday, April 9, 10:30 a.m., Rm. H-2-300. Daniel Hillel, Professor of Plant and Soil Sciences at the University of Massachusetts, will review modern irrigation technology and advances in irrigation practices related to the improvement of irrigation in arid and semi-arid regions. David Hopper, ASNVP, will chair the seminar which will include visual aids. A technical paper by Professor Hillel is available from AGR--call Ext. 61763. All interested staff are invited to participate. Sponsors: ASNVP and AGRPR.

SPOT Satellite Techniques for Resource Assessment in Developing Countries: Thursday, April 9, 2:30 p.m., Rm. E-315. The Swedish Space Corporation will present the seminar. Specific applications to be discussed include forest inventory and resource degradation, water and land use planning in drought affected areas, and the preparation and revision of topographic maps from SPOT stereo. Examples will be given from a number of applied projects in developing countries. Sponsor: PPDES, Ext. 75914.

"Beyond GDP--Accounting for Sustainable Progress": Tuesday, April 14, 11 a.m. to 12:30 p.m., Rm. E-1244. Presentation by Peter Bartelmus, Chief, Environment Statistics Office of the U.N. Statistical Office. The seminar will review traditional accounting systems as well as alternative proposals for measuring "economic welfare." Background paper is available on a self-service basis from Olivia McNeal, Rm. D-1018, Ext. 75341. Sponsors: PPDES and CPD.

INFORMATION TECHNOLOGY

Lotus Users Group Meeting: Tuesday, March 31, 12 to 1 p.m., Rm. C-1006. Robert Schware, author of 1-2-3 Managerial Worksheets and co-author of All About 1-2-3, will speak on The "Digging In" of Lotus 1-2-3: Frustration, Change and New Programs. For more information, or to be placed on the Lotus Users Group mailing list, call Ext. 75393.

The Computer Learning Center announces a self-paced version of its Beginning LOTUS 1-2-3 course. The course is intended for people who want to learn LOTUS fundamentals at their own pace, in their own timeframe, either in the office, or--if they own an IBM PC or PC-compatible--at home. Nomination forms and complete course descriptions are available through your Training Coordinator. For more information, call Ext. 48041.

The Computer Learning Center announces the third part of the computer literacy series, Systems Development, Monday through Wednesday, April 6, through 8, 12 noon to about 1:30 p.m., Rm. K-1030. This segment addresses the roles of users, analysts and programmers in the development of computer systems. The intended audience are those with a strong foundation in the technical operations of computers who are involved—or about to become involved—in a system development project. Nominations will be accepted by telephone as long as seats are available. Nominations to see the whole series are also welcome. Brochures and forms are available from Training Coordinators or from the Computer Learning Center, Ext. 48041.

COMPASS Training: Week of April 6. Contact Grace Moss, Ext. 76830. Sponsors: PMD/PPD.

<u>DISPLAY Training Workshop.</u> Two 2-1/2-hour sessions. DISPLAY does arithmetic calculations, performs economic and sensitivity analyses and displays the results in tables and graphs. Hands-on time is included.

Increasing Productivity through Expert Systems: Tuesday through Thursday, April 7 through 9, Eugene Black Auditorium, Rm. C-1114. The symposium is from 10 a.m. to 12 noon daily, except Wednesday, April 8, when it starts at 9 a.m. (note: new time). The Symposium will focus on concepts and techniques of building expert/advisory systems and is intended for managers and Bank staff interested in a layman's introduction to artificial intelligence (AI) and its potential impact on the World Bank. The second day will be a live broadcast via satellite of a roundtable discussion by leading authorities on the productivity impact of AI and expert systems. Staff of the Institutional and Financial Systems Unit will demonstrate various expert system tools that are available for micro computers. For more information and a program flier, call Guido J. Deboeck, Ext. 78851. Sponsors: PBDIF and the Leadgroup on AI of the Bank.

Basic FOCUS will be offered Tuesday, April 21, through Thursday, April 23. The course is intended for staff who need an introduction to the FOCUS data management system or who need to write or change queries used to access information stored in FOCUS databases. The cost of the course is \$375. Interested staff should call Pamela Hankin, Ext. 48043. Sponsors: PMD and ITF.

Concordia Apartments. One-bedroom apartments, suitable for double occupancy, and efficiencies with a foldaway bed, suitable for single occupancy, are available for official visitors to the Bank/IFC only. Apartments have fully equipped kitchens; house rules prohibit accommodation of children or pets. Limited maid service is provided. The daily rate for one-bedroom apartments is \$50; for efficiencies, \$40. All telephone and room charges must be settled in full upon checkout. Reservation requests should be received for processing three working days before the guest's arrival and should be directed by Travel Request or memorandum to the Hotel Reservations Unit, Rm. B-200. Note: There are no one-bedroom apartments available until May 1.

SEMINARS AND TRAINING

Presentation on Botanical Pest Control: Tuesday, March 24, 10:30 a.m., Rm. H-2-300. Saleem Ahmed, Research Associate of the East/West Center, Hawaii, who will be visiting the Bank this week, has offered to acquaint staff with the Center's latest work on botanical pest control. All interested staff are invited to attend the meeting, which will include visual aids. Call, Ext. 3-4085 to confirm that the meeting will take place. Sponsors: AGRPR and EAPNA.

Ecology and Development in Ecuador: Tuesday, March 24, 11:30 a.m. to 1 p.m., Rm. E-1244. Yolanda Kakabadse, Director of Fundacion Natura, a private, non-profit organization in Ecuador, will review the state of the environment in Ecuador and discuss the organization's activities. For further information, call Chris Barham, Ext. 75822, or Peter Roesgen, Ext. 72184.

"Pakistan Railways--Policy and Operational Initiatives Required for Survival of the Railway in a Competitive Environment": Wednesday, March 25, 10 a.m., Rm. H-5-072. Presentation by Jim McDonald and Don Porter of Canadian Pacific Consulting Service of the results of a recent study of the institutional, managerial and physical restructuring needed to permit the Pakistan Railway to compete commercially with road transport. The study raises a number of issues common to all the Bank's current policy-based railway projects. For further information and a copy of a paper, call Gillian Ross, Ext. 61707. Sponsor: TRP.

Container Terminals—A Policy for Development: Wednesday, April 1, 2:30 p.m., Rm. N-955. A seminar prepared by the ports section of UNCTAD, Geneva, given by Michael Daunt of their staff. He will present the materials that have been developed by them as part of the Improving Port Performance series but in this case specifically for decision—makers concerned with the development of container terminals in ports of LDCs. Video and slide presentation included. For further information, call Helen Frost, Ext. 61693. Sponsor: TRP.

Management of Unaccounted-for Water: Wednesday, April 8, 10:30 a.m., Rm. N-550. Charles Hurst, Projects Manager, Thames Water International (TWI) will lecture on: (i) services offered by Thames Water Authority in water supply services optimization; (ii) methodology and technology used for investigating and managing unaccounted-for water; (iii) presentation of Cyprus case study; and (iv) demonstration in the use of technology. For further information, call Ext. 61532. Sponsor: WUD.

INFORMATION TECHNOLOGY

Lotus Users Group Meeting: Tuesday, March 31, 12 to 1 p.m., Rm. C-1006. Guest speaker Robert Schware, author of 1-2-3 Managerial Worksheets and co-author of All About 1-2-3, will speak on The "Digging In" of Lotus 1-2-3: Frustration, Change and New Programs. For more information, or to be placed on the Lotus Users Group mailing list, call Ext. 75393.

The Computer Learning Center announces a self-paced version of its Beginning LOTUS 1-2-3 course. The course is intended for people who want to learn LOTUS fundamentals at their own pace, in their own timeframe, either in the office, or, if they own an IBM PC or PC-compatible, at home. Nomination forms and complete course descriptions are available through your Training Coordinator. For more information, call Ext. 48041.

COMPASS Training: Week of April 6. Contact Grace Moss, Ext. 76830. Sponsors: PMD/PPD.

<u>DISPLAY Training Workshop</u>. Two 2-1/2-hour sessions. DISPLAY does arithmetic calculations, performs economic and sensitivity analyses and displays the results in tables and graphs. Hands-on time is included.

Increasing Productivity through Expert Systems: Tuesday through Thursday, April 7 through 9, Eugene Black Auditorium, Rm. C-1114. The symposium is from 10 a.m. to 12 noon daily, except Wednesday, April 8, when it starts at 8 a.m. The Symposium will focus on concepts and techniques of building expert/advisory systems and is intended for managers and Bank staff interested in a layman's introduction to artificial intelligence (AI) and its potential impact on the World Bank. The second day will be a live broadcast via satellite of a round-table discussion by leading authorities on the productivity impact of AI and expert systems. Staff of the Institutional and Financial Systems Unit will demonstrate various expert system tools that are available for micro computers. For more information and a program flier, call Guido J. Deboeck, Ext. 78851. Sponsors: PBDIF and the Leadgroup on AI of the Bank.

Basic FOCUS will be offered Tuesday, April 21, through Thursday, April 23. The course is intended for staff who need an introduction to the FOCUS data management system or who need to write or change queries used to access information stored in FOCUS databases. The cost of the course is \$375. Interested staff should call Pamela Hankin, Ext. 48043. Sponsors: PMD and ITF.

REPORTS/DOCUMENTS/PUBLICATIONS

New publications available in the Bookstore. Complimentary to staff; please complete Form 2011 if requesting copies by mail.

Letitia A. Obeng and Frederick W. Wright, Integrated Resource Recovery: The Co-composting of Domestic Solid and Human Wastes. World Bank Technical Paper No. 57. \$5. Stock number BK-0894.

Jacob Levitsky and Ranga N. Prasad, <u>Credit Guarantee Schemes for Small and Medium Enterprises</u>. World Bank Technical Paper No. 58, Industry and Finance Series. \$5. Stock number BK-0866.

Weekly Bulletin: 16th March 1987

Container Terminals—A Policy for Development: Wednesday, April 1, 2:30 p.m., Rm. N-955. A seminar prepared by the ports section of UNCTAD, Geneva, given by Michael Daunt of their staff. He will present the materials that have been developed by them as part of the Improving Port Performance series but in this case specifically for decision—makers concerned with the development of container terminals in ports of LDCs. Video and slide presentation included. For further information, call Helen Frost, Ext. 61693. Sponsor: TRP.

March 16

Container Terminals: A Policy for Development, Wednesday, April 1, 1987, at 2:30 PM. in Room N-955. A seminar prepared by the ports/of UNCTAD, Geneva, and to be presented by Michael Baumt of their staff. He will present the materials that have been developed by them as part of the Improving Port Performance series but in this case specifically for decision-makers concerned with the development of container terminals in ports of LDC's. Video and slide presentation included. For further information please call Helen Frost, Ext. 61693. Sponsor: TRP.

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Transportation John Lethbridge 61695 3/11/1987

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UNCTAD 001886 JOHN LETHBRIDGE PORTS AND AVIATION ADVISER TRANSPORTATION DEPARTMENT FROM DAUNT. REMY VISIT FIRST APRIL SUGGEST ENTITLE TALK QUOTE CONTAINER TERMINALES: HELPING THE POLICY MAKERS UNQUOTE. I INTEND TO ILLUSTRATE POINTS ON OVERHEAD PROJECTOR AND WITH SHORT VIDEO EXCERPTS. PROPOSE CARRY VIDEO FILM TO VHS-PAL STANDARD. PLEASE SPECIFY ALTERNATIVE IF THIS STANDARD NOT APPROPRIATE REGARDS (UNCTAD GENEVA) COL 440098 001886 VHS-PAL

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sea containers Sea Containers America Inc. 300 Metropolitan Sq., 655

Sea Containers America Inc. 300 Metropolitan Sq., 655 Fifteenth St., N.W., Washington, D.C. 20005 Telephone: (202) 639-4027

11. W. M

21 January 1987

Mr. John Lethbridge Shipping, Ports and Aviation Department Room 927 - World Bank 801 19th Street, N.W. Washington, D.C. 20433

Dear John:

Just a line to thank you once again for allowing Sea Containers to present the seminar on Reefer Containerization to your colleagues last week.

Mr. Fraser and I were both most honored to participate, and look forward to future contacts with the Bank. Please be assured of our continued interest and desire to be assistance.

Please also convey our thanks to Helen Frost and Jim Wilson, who were most helpful in assisting us with the logistics of the presentation.

Hoping to see you soon and with every best wish, I remain

Sincerely yours,

Richard A. Lidinsky General Manager

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	J.A. HAYWARD	AGRPR	61771
	S. Barghouti	AGRPR	61763
	J. Kampen	EAPCA	34133
	J. VAN JER VEN	AEPTR	61225
	ZOSA	CPSCO/IFE /	60402
	LE BLANC	AEPTR	61227
	FENTON	CENE	60484
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	K.J. Lee-O'mara	ASPIDE	32298
	H- PETERS	8PJ- 172P	61678
	JOHN LETHERITORE	TRP /PSAU	61667
	UMAR ALHAJI	TRP TAS	61734
	MADRICE DICKERSON	EMPTR	32629
	QAIL CAMPBELL	CLI DZ	66089
	GEORGE PANAGAKOS	TRP	61718
	EDUARDO ABELLO	IFE/LACI	60577
	ASSA AD JABRE	IFC/EME	61135
	JEAN-FRANCOIS MAQUET	WAPTR 1	75371
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Virginia KORIONOFF	DRDILM	33739
E. A-JAMES	AERTA	buse
MARIA KIWANUKA	AEPTR	61233
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Sea Containers America Inc.

1155 Avenue of the Americas, New York, N.Y. 10036
Telephone: (212) 302-5066 Telex: RCA 235416 (SCI UR)

WORLD BANK PRESENTATION

January 14, 1987

- SH Fraser
- RA Lidinsky

PURPOSE:

To familiarize the relevant World Bank project managers and personnel on refrigerated containerization and the possibilities this technology affords. The presentation shall cover:

- 1) Introduction of SC: Company, equipment, investment, experience.
- Refrigeration technology: reefer containers, power requirements, International standards, reliability/spare parts
- 3) Product preservation through refrigeration
- 4) Refrigerated transportation-alternatives
- 5) Market components: Structures and responsibilities
- 6) Transition from bulk to reefer
- 7) The Leasing Company's role: Advantages and costs.
- 8) Conclusion

I. INTRODUCTION

Nearly half of the world's total food supply is estimated to be in the 'perishable' category. This, combined with growing per capita disposable income and increasing health and health-food consciousness in the developed countries, indicates a rapidly growing appetite for fruits, vegetables and seafoods (the usual and, increasingly the unusual products), year round. This demand is of course a market for all producers, but especially for the developing world which, for the most part, is in the opposite

growing season of the Northern hemisphere. This potential to supply perishable products can earn badly needed foreign exchange, increases employment, and stimulates further infrastructure investment in developing countries — all worthy and profitable results and in accord with your mission to "encourage the development of productive facilities and resources in less developed countries."

Increasingly, as the developing countries move up the curve of self-sufficiency in food production, the need to stimulate economic growth, foreign exchange, infrastructure investment and a proader diet becomes more pressing. In most cases, in South America, the Far East and the West Coast of Africa, the potential for perishable product cultivation and export is great. (Colombia, for example, has pineapple production twice that of the Ivory Coast, and avocado production twice that of Israel --not a ton of which is exported yet. Kenyan seafood (Nile, perch and Indian Ocean shrimp) are another example.)

It is our view that the containerization of perishable products in the developing countries is one of the keys to development. By means of introduction as to who we are and what we are about, we would like to outline briefly the size and position of Sea Containers (SC) in the industry and generally.

A) SEA CONTAINERS LTD.

Sea Containers Ltd. is the world's largest leasing company (i.e., supplier of finance, hardware and expertise) of maritime-related transportation assets (primarily container related), with holdings in container ships (involvement with 23 ships), dry freight containers (310,000 TEU), container cranes (20), chassis (5,000), and the world's largest fleets of refrigerated and tank containers. (Additionally, SC owns Sealink, the premier ferry company between (and in) Britain and the continent, operating on 23 routes.)

Assets as of December 31, 1985 were over 1.3 billion U.S. dollars. Revenue in 1985 was \$573 million, with earnings of \$39.5 million. Stockholders equity (common and preferred) was \$390 million. The stock is publicly traded on the NY, London and Pacific stock exchanges. The company is registered in Bermuda and its principle operating subsidiary is in London. Like the bank, our operations have a global reach. The company operates through owned offices and agencies in over 70 countries.

Essentially, we are the Hertz of the shipping business. Our trade is the lease and finance of marine and related assets primarily to ocean carriers. One of our specialities is also the establishment and development of "turn key projects" involving ships, cranes, chassis and refrigerated containers. Our projects include: the containerization of the banana trade from Central America to the U.S. Gulf and USEC for the food conglomerate Castle and Cooke (Dole brand) from a breakbulk operation; the containerization of pineapple and frozen tuna from the Philippines to the USWC (again for Castle and Cooke); the containerization of Chilean grapes and other deciduous fruits to the USEC; the containerization of frozen and chilled lamb from Australia to Iran (until shortly after the Iranian Revolution). In each case, SC was brought in to develop the entire transportation system, supply the equipment and the training for subsequent turnover to the principle, upon establishment.

We are uniquely positioned therefore, to discuss with you the nature, and various aspects of reefer containerization, and potential applications as a tool for development.

B) SC Reefer Investment

The "Containerization International" world container census (published in September 1986) lists the world population of refrigerated containers at 104,340 units. The industry breakdown is: 71 percent shipping line owned, 27 percent lessor owned and 2 percent other. SC's fleet stands now at 13,000 units which indicates that SC owns 46% of the total world leased fleet of refrigeration equipment. In addition, we own 16 powerpacks, and 900 diesel generators.

SC is also one of the major manufacturers of refrigeration technology with the SeaCold brand of reefer manufactured by SC's wholly-owned, Singapore based company. The refrigeration technology was developed primarily for our own fleet consumption, but is now available for third party purchase.

Our fleet of reefer containers, powerpacks and diesel generators are backed by 12 fulltime reefer engineers each trained in all phases of refrigeration repair, maintenance, operation and qualified to do training to assist in the establishment of reefer projects. (To put this in perspective, this is greater than the next four competitors combined, all of which purchase (rather

than manufacture) refrigeration technology and rely on the manufacturer almost entirely for support.)

Refrigerated container transportation has been in commercial use for over 25 years. SC's involvement in leasing reefer container equipment has been for the last 15 years. The technology is proven and has been perfected - as the world investment in excess of 2 billion dollars is testimony to.

SC's total investment in refrigeration equipment, manufacturing, research and development, spares, repair facilities and personnel now amounts to over a quarter of a billion dollars.

We provide refrigeration technology for lease and for sale.

II. ASPECTS OF REFRIGERATION TECHNOLOGY

- A) Brief overview of Principles of refrigeration
 - Heat transfer from inside container
 - Airflow pattern in reefer
 - Temperature control sensitivity

B) Reefer Containers

1. General

Reefer containers, are generally made of aluminum exterior with either stainless steel or fiberglass reinforced plywood interior liners, are designed to operate in both high and low ambient temperatures, to maintain both frozen and chill cargoes. SC's reefers are also equipped to heat cargoes so should more appropriately be called "temperature control containers". Very simply, they are insulated containers with a slab of machinery on the front which transfers the heat from within the container, to the environment outside, to a predetermined set temperature.

The units are designed to operate in ambients of -40 degrees (F) to +125 degree (F) (-40C-+52C), whilst maintaining internal temperatures of 0 degrees (F) -+60 degrees (F) (-18C-+15C).

2. Applications

Refrigerated containers are designed to meet the requirements of international marine transportation. Older units are

increasingly finding employment in static storage applications (sturdy, mobile, inexpensive and self-sustaining) and as reefer trucks (when linked with a Chassis) in the developing world.

C) Power Requirements

To meet worldwide variances, the refrigeration machinery works on electric power, and can work on both 220V and 440V, 3 phase, 50/60 hertz. While aboard ship and on the dock, the reefer is generally plugged into the electrical power supply. While on a truck or in remote areas where electricity is not available, the reefer can be attached to a portable diesel generator which will supply suitable 220/440 volt power as required. (Note: The clipon and underslung DG are not suitable for ship use.) As a broad generalization, reefer containers draw 10KVA. (The range is from 6-14 KVA.)

In circumstances where electrical supplies are insufficient to power the total number of reefers, a Powerpack (SC registered trademark) can be used with the ability to power up to 36 reefers. SC reefers are equipped with both air-cooled and water-cooled condensors for maximum flexibility aboard ship. (The reefers can be stowed above or below deck.)

D) International Standards

SC's reefer fleet has been built to the highest standards in the industry, to comply with all relevant regulations. Among others, these include: American Bureau of Shipping (ABS), International Standards Organization (ISO), Convention for Safe Containers (CSC), Accord relatif aux Transports Internationaux de Denrees Perissables et aux Engins Speciaux a utiliser pour ces Transports (ATP-EEC), Lloyds, Union International des Chemins de fer (UIC), Transport International Routier (TIR), Australian Department of Quarantine, Australian Department of Primary Industry Regulations for Carriage of Chilled Meat, New Zealand noise requirements, Food Industry standards certified by Classification Society for Taint, Sprenger Institute for Fresh Air Ventilation (Holland) and United States Department of Agriculture (USDA).

E) Reliability/Spare Parts

A three percent failure rate on reefers (which is common also to most industrial products) is considered the rule of thumb, but the initial failure can be corrected in the vast majority of the

cases without resultant product damage. There is a direct correlation between reefer cargo losses and the amount of emphasis the carrier has made in training, investment in spare parts and manuals, regular pre-trip maintenance, and load maintenance.

SC does not supply reefer machinery only. In every case where we are supplying packages of equipment, we supply engineering support at the start up to ensure that the operators and mechanics understand the operating protocols, and are given hands-on instruction on the stowage, maintenance and repair of the equipment. Additionally, ongoing engineering support can be acquired through a service contract, but the intent is to train the personnel to be self-sufficient.

Additionally, a recommended holding of spare parts is available (based on the number of units operating per ship, the availability of spare parts in the product-originating area, the abilities of the mechanics, and the frequency of service). These spare parts kits are supplied on a sale-and-return basis.

III. PRODUCT PRESERVATION THROUGH REFRIGERATION

Perishable cargoes are either live (chill) or dead (frozen). In contrast to frozen or canned goods, all fresh fruits and vegetables are living products. The vital life processes continue long after harvest, the most important of these processes being respiration. Respiration is a complex series of chemical reactions but basically it involves the conversion of starch to sugars and the transformation of these sugars into energy. During the normal process of respiration fruits and vegetables take in oxygen and give off carbon dioxide, water vapour and a considerable quantity of heat. In general, the rate of respiration increases with ambient temperature. The purpose of refrigeration here is to retard this process to prevent over-ripening by removing the atmospheric heat being absorbed by the containers and the heat being generated by the cargo.

With dead (or frozen) cargoes, the aim is simply to create an environment which impedes deterioration and is inhospitable to bacteria infestation through temperature reduction.

Reefer containers carry a wide range of temperature sensitive products including all manner of perishable fruits (vegetables,

meats and dairy products) and frozen cargoes (meat and seafood primarily). Certain temperature sensitive, low and non-hazardous chemicals and films also rely on reefer containers.

IV. REFRIGERATED TRANSPORTATION ALTERNATIVES

Temperature sensitive products are transported in a number of commercial modes, depending on the variety of products to be shipped from a particular location, range of temperature requirements, volume, trading range, etc. Principally, there exist four modes however. (Air transport is excluded from this exercise, as it suits only a very small portion of the highest value products which are of insignificant volume.)

A) Reefer Bulk Chambers In General Cargo Ships

This mode has traditionally been used in older generation tonnage for the carriage of sizeable quantities of similar cargos but is quickly disappearing as the general cargo ships are largely being superceded by modern containerships. One of the many drawbacks with this mode is the lack of temperature sensitivity, and the multiple handling this stowage mode requires of the cargo. (The greater the number of handlings, the greater the product damage will be.)

B) Reefer Bulk Ship

This mode is still in wide use today, primarily in the high-volume, single product trades (such as bananas, meat, etc.). The new technology is fairly sophisticated, but the drawbacks remain: Bulk cargoes require multiple moves which are expensive and damage the fruit; the economics of the ships require vast volumes of similar products moving between a few locations, on a regular basis; the vessels can work only in a restricted number of ports which have the facilities to handle and store the cargo. The advantage of this mode however, is cost -- when calculated on a port-to-port basis only.

C) Central Refrigeration Port Hole Container Ships (Conair)

This technology combines container ship economies with the reefer bulk ship principle of whole-ship refrigeration. A central plant

creates the refrigerated air which is pumped throughout the ship by ducting to which insulated containers with portholes are connected. As in the case of reefer bulk ships, the economics of the vessels are based on large volumes of similiar products moving between a few locations, on regular basis, in a restricted range of dedicated ports (a vast, infrastructure is required to handle conair ships). The advantages are the premium outturns which containerization affords and lower cost on a port-to-port basis than integral containers. The disadvantages are strong limitations in flexibility (operating range, products, volumes), an enormous capital outlay, and less than ideal temperature control. The main trades for conair ships are Australia/N. Europe for the meat and fruit business, and both coasts of South America to N. Europe (Meat off the East Coast and fruit and seafood off the West primarily).

D) Refrigerated Containers - Integral, or Self-Sustaining

Reefer containerization takes all the advantages of conventional containerization:

- Reduction in handling (reducing cost and damage)
- Reduction in theft potential
- Reduction in down time as product moves from plantation to destination in one mode
- Unitization for easier, quicker and cheaper handling to/from ship, truck and rail.

.... And adds:

- Higher temperature control sensitivity (.02 Degree C. range) than other modes
- Higher quality outturns than other modes
- Flexibility in trades which haven't sufficient volumes to warrant bulk shipments (which rely on regular and large volumes moving on restricted trade routes)
- Flexibility in moving both frozen and chill cargoes
- Reduction in cargo loss -- claims
- Greater potential for achieving return cargo.

The integral refrigerated container is the ideal tool for development in LDC's where minimal investment is required (in equipment and port infrastructure) where maximum flexibility in terms of product, trade range and volume are the rule, and where premium quality product is essential in establishing the new product (or export origin point) in the market.

V. MARKET STRUCTURES

The market is complex in its multitude identities and interrelationships, but can be simplified to the following:

A) Growers/Farmers

This is the basic production unit which usually sells its product to a cooperative, or exporter, which in turn arranges the transportation from the country of origin to destination. In some cases, the larger farmers themselves contract with shipping lines, and even own the shipping tonnage (i.e., the meat producers in Australia and grape/apple producers in Chile). The grower/farmer needs thorough familiarization with the special harvesting, packaging, and stowage requirements of container shipping. Generally, the grower/farmer is not responsible for the refrigerated equipment except during the time the equipment is in the grower's care.

B) Shippers

The entity contracting for the shipment is referred to as the shipper. Depending on the product and market strategy of the shipper, the product may be sold F.A.S. (meaning that the buyer takes delivery at the port of arrival, directly from the ship) in which case the buyer/distributor has to arrange the trucking, warehousing, and distribution chain or the shipper may sell directly to the customers' premises. In other cases, the Shipper handles all the logistics from plantation to supermarket either with its own organization or by subcontracting the various elements of the operation.

C) Shipping Lines

The types of services offered by shipping lines varies considerably from company to company. Some offer port-to-port shipment only, others contract to provide through-transportation service from the point of origin to destination. In most cases the supplier of the transportation service contracts with the lessor for the supply of the equipment, expertise and training.

D) Leasing Companies

Again these come in many shapes and forms but in this context, supply the capital assets which the transportation project

requires. In the case of refrigerated containers and the related hardware (diesel generators, powerpacks, chassis, spare parts) many lines choose to lease this equipment to get the most financed leverage, to acquire the technical expertise which they may not possess, and to gain flexibility in rapid supply of equipment from multiple locations.

The lessee - be it the shipping line, Shipper, or Importer/ Distributor is ultimately responsible for: the lease rental; acceptance, possession and return of the equipment; repairs; maintenance; performance; container control and the like. The lessee may choose to perform the functions on their own, or subcontract it.

VI. TRANSITION FROM BULK TO REEFER

The majority of reefer cargoes (in volume) are still moved in bulk reefer ships which "tramp" the world's seas, moving fruits and frozen meat. Bulk transport is generally cheaper than containerization when analysed on an ocean transportation basis only. However, the premium outturns which integral reefer containers deliver, achieve a premium in the market -- especially when used as the sole transportation medium from the plantation to the supermarket. The premium is due to the higher quality, the faster turntime of the equipment and the reduction in handling.

It is important to stress that reefer containerization is the single most effective way to reduce damage and loss to perishable products during transportation.

There really is no intermediate stage between bulk shipments (or no shipments), and containerization of reefer products. Generally, it is done in one quantum leap, when the technology (containers, ships, cranes, chassis, diesel generators) are brought together with the expertise (mechanics, operators and growers).

VII. THE LEASING COMPANY'S ROLE

A) Leasing Advantages

A Container Leasing Company can help both large and small organizations. The main advantages are as follows:

- 1. The Container Leasing Company has in-depth knowledge of all aspects of containerization and will have already selected the most suitable equipment based on practical experience.
- The Leasing Company can usually provide a consultancy 2. service, and possibly arrange a management service after equipment has been installed.
- 3. Equipment provided is likely to be practical, simple and robust since high quality and longevity will be a prime requirement when leasing, since the Leasing Company owns the equipment and will naturally want it to operate efficiently over a long period.
- The Leasing Company will ensure that equipment is provided quickly since it will not begin to earn money until it is in service, and that the best possible relationship is maintained with the Lessee throughout the period of the Lease. The Leasing Company will necessarily remain interested in its customer, be it the shipper, the steamship line, or the marketing company.
- 5. No capital is required to buy equipment thus freeing cash.
- 6. Initial payments do not normally become due until the equipment is delivered and ready to earn money thus cash flow is protected.

These latter two factors are particularly important for poorer countries. The most important financial advantage of leasing however is that the out-goings on lease payments and the low cost of installation of suitably selected leased equipment as well as the operating and maintenance costs can be recovered from revenue earned and at the same time make profits.

Equipment Costs

Refrigeration technology is available from SC on lease, sale, and in some cases lease purchase.

As a ball park indication of reefer equipment prices for sale (new) would be:

> - \$ 21,000 - 26,000 20' Reefer

40' Reefer

Diesel Generator - 11,000 Powerpack - 200,000

Lease rates vary depending on the length of lease, quantity and type of units, delivery/redelivery locations, specifications, and training/support requirements.

C) How To Start

After first identifying the product, the market and the basic economics of a particular perishable product's (or group of products from a particular area) exportation, an organization can contact Sea Containers for feasibility studies and assistance in identifying the technical problems and solutions, as well as the essential costings for the transportation portion of the project. We offer our expertise as a resource to the Bank in this regard. If the studies are positive, the organization can contract with SC for the supply of all or part of the technical services and equipment described herein.

VIII. CONCLUSIONS

- A) The cultivation and exportation of perishable products from developing countries is one of the potential keys to development resulting in stimulation of foreign exchange, infrastructure investment and development, employment and improved diets/standards of living.
- B) Refrigerated containerization leasing offers the fastest and most cost-efficient means of translating this potential into reality by combining new but proven technology (which allows flexible and gradual expansion of projects), with low start up costs.
- C) SC provides refrigeration technology

- start-up expertise

- engineering and technical assessment

- finance.

We appreciate having had this opportunity to address you today on these matters. We hope this has been of some use to you and offer ourselves as a resource to the Bank on these related matters.

SC has an office here in Washington directed by my colleague Mr. Lidinsky who is available to assist the Bank in any way we can.

1/14/87 SH FRASER SEA CONTAINERS

Sea Containers America Inc.

1155 Avenue of the Americas, New York, N.Y. 10036
Telephone. (212) 302-5066 Telex: RCA 235416 (SCI UR)

January 12, 1987

Mr. John R. Lethbridge Ports and Aviation Adviser Transportation Department The World Bank 1818 H Street, N.W. Washington, D.C. 20433

Dear John:

Promoting Export Opportunities Through The Use Of Reefers (Refrigerated Containers) - Seminar on Wednesday,

January 14, 1987

Please find attached a copy of the intended speech for our presentation. If you have any comments or changes which you would like included, please advise urgently.

I intend to bring 75 copies of the speech with me for general distribution along with our brochures, slides and a brief film of an actual project from start to finish.

Rick Lidinsky and I look forward to meeting you for lunch Wednesday and to making the presentation. Thank you again for this opportunity.

Sincerely,

Stephen H. Fraser Vice President

Sales and Marketing

cc: R. Lidinsky

Sed Containers America Inc. 1155 Avenue of the Americas, New York, N.Y. 10036 Telephone. (212) 302-5066 Telex: RCA 235416 (SCI UR)

WORLD BANK PRESENTATION

January 14, 1987

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- SH Fraser - RA Lidinsky

PURPOSE:

To familiarize the relevant World Bank project managers and personnel on refrigerated containerization and the possibilities this technology affords. The presentation shall cover:

- Introduction of SC: Company, equipment, investment, experience. 1)
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- Refrigerated transportation-alternatives
- Market components: Structures and responsibilities 5)
- 6) Transition from bulk to reefer
- The Leasing Company's role: Advantages and costs. 7)
- 8) Conclusion

INTRODUCTION

Nearly half of the world's total food supply is estimated to be in the 'perishable' category. This, combined with growing per capita disposable income and increasing health and health-food consciousness in the developed countries, indicates a rapidly growing appetite for fruits, vegetables and seafoods (the usual and, increasingly the unusual products), year round. This demand is of course a market for all producers, but especially for the developing world which, for the most part, is in the opposite

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sea containers

growing season of the Northern hemisphere. This potential to supply perishable products can earn badly needed foreign exchange, increases employment, and stimulates further infrastructure investment in developing countries -- all worthy and profitable results and in accord with your mission to "encourage the development of productive facilities and resources in less developed countries."

Increasingly, as the developing countries move up the curve of self-sufficiency in food production, the need to stimulate economic growth, foreign exchange, infrastructure investment and a proader diet becomes more pressing. In most cases, in South America, the Far East and the West Coast of Africa, the potential for perishable product cultivation and export is great. (Colombia, for example, has pineapple production twice that of the Ivory Coast, and avocado production twice that of Israel -- not a ton of which is exported yet. Kenyan seafood (Nile, perch and Indian Ocean shrimp) are another example.)

It is our view that the containerization of perishable products in the developing countries is one of the keys to development. By means of introduction as to who we are and what we are about, we would like to outline briefly the size and position of Sea Containers (SC) in the industry and generally.

A) SEA CONTAINERS LTD.

Sea Containers Ltd. is the world's largest leasing company (i.e., supplier of finance, hardware and expertise) of maritime-related transportation assets (primarily container related), with holdings in container ships (involvement with 23 ships), dry freight containers (310,000 TEU), container cranes (20), chassis (5,000), and the world's largest fleets of refrigerated and tank containers. (Additionally, SC owns Sealink, the premier freeze sampany between (and in) Britain and the continent, operating on 23 routes.)

Assets as of December 31, 1985 were over 1.3 billion U.S. collars. Revenue in 1985 was \$573 million, with earnings of \$39.5 million. Stockholders equity (common and preferred) was \$390 million. The stock is publicly traded on the NY, London and Pacific stock exchanges. The company is registered in Bermuda and its principle operating subsidiary is in London. Like the bank, our operations have a global reach. The company operates through owned offices and agencies in over 70 countries.

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Essentially, we are the Hertz of the shipping business. Our trade is the lease and finance of marine and related assets primarily to ocean carriers. One of our specialities is also the establishment and development of "turn key projects" involving ships, cranes, chassis and refrigerated containers. Our projects include: the containerization of the banana trade from Central America to the U.S. Gulf and USEC for the food conglomerate Castle and Cooke (Dole brand) from a breakbulk operation; the containerization of pineapple and frozen tuna from the Philippines to the USWC (again for Castle and Cooke); the containerization of Chilean grapes and other deciduous fruits to the USEC; the containerization of frozen and chilled lamb from Australia to Iran (until shortly after the Iranian Revolution). In each case, SC was brought in to develop the entire transportation system, supply the equipment and the training for subsequent turnover to the principle, upon establishment.

We are uniquely positioned therefore, to discuss with you the nature, and various aspects of reefer containerization, and potential applications as a tool for development.

B) SC Reefer Investment

The "Containerization International" world container census (published in September 1986) lists the world population of refrigerated containers at 104,340 units. The industry breakdown is: 71 percent shipping line owned, 27 percent lessor owned and 2 percent other. SC's fleet stands now at 13,000 units which indicates that SC owns 46% of the total world leased fleet of refrigeration equipment. In addition, we own 16 powerpacks, and 300 dlesel generators.

SC is also one of the major manufacturers of refrigeration technology with the SeaCold brand of reefer manufactured by SC's wholly-owned, Singapore based company. The refrigeration technology was developed primarily for our own fleet consumption, but to now avair. C for third party purchase.

Our fleet of reefer containers, powerpacks and diesel generators are backed by 12 fulltime reefer engineers each trained in all phases of refrigeration repair, maintenance, operation and qualified to do training to assist in the establishment of reefer projects. (To put this in perspective, this is greater than the next four competitors combined, all of which purchase (rather

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sea containers

than manufacture) refrigeration technology and rely on the manufacturer almost entirely for support.)

Refrigerated container transportation has been in commercial use for over 25 years. SC's involvement in leasing reefer container equipment has been for the last 15 years. The technology is proven and has been perfected - as the world investment in excess of 2 billion dollars is testimony to.

SC's total investment in refrigeration equipment, manufacturing, research and development, spares, repair facilities and personnel now amounts to over a quarter of a billion dollars.

We provide refrigeration technology for lease and for sale.

II. ASPECTS OF REFRIGERATION TECHNOLOGY

- A) Brief overview of
- Principles of refrigeration
- Heat transfer from inside container
- Airflow pattern in reefer
- Temperature control sensitivity

B) Reefer Containers

1. General

Reefer containers, are generally made of aluminum exterior with either stainless steel or fiberglass reinforced plywood interior liners, are designed to operate in both high and low ambient temperatures, to maintain both frozen and chill cargoes. SC's reefers are also equipped to heat cargoes so should more appropriately be called "temperature control containers". Very simply, they are insulated containers with a slab of machinery on the front which transfers the heat from within the container, to the environment outside, to a predetermined set temperature.

The units are designed to operate in ambients of -40 degrees (F) to +125 degree (F) (-40C-+52C), whilst maintaining internal temperatures of 0 degrees (F) -+60 degrees (F) (-18C-+15C).

Applications

Refrigerated containers are designed to meet the requirements of international marine transportation. Older units are

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sea containers

increasingly finding employment in static storage applications (sturdy, mobile, inexpensive and self-sustaining) and as reefer trucks (when linked with a Chassis) in the developing world.

Power Requirements

To meet worldwide variances, the refrigeration machinery works on electric power, and can work on both 220V and 440V, 3 phase, 50/60 hertz. While aboard ship and on the dock, the rector is generally plugged into the electrical power supply. While on a truck or in remote areas where electricity is not available, the reefer can be attached to a portable diesel generator which will supply suitable 220/440 volt power as required. (Note: The clipon and underslung DG are not suitable for ship use.) As a broad generalization, reefer containers draw 10KVA. (The range is from 6-14 KVA.)

In circumstances where electrical supplies are insufficient to power the total number of reefers, a Powerpack (SC registered trademark) can be used with the ability to power up to 36 reefers. SC reefers are equipped with both air-cooled and watercooled condensors for maximum flexibility aboard ship. reefers can be stowed above or below deck.)

International Standards D)

SC's reefer fleet has been built to the highest standards in the industry, to comply with all relevant regulations. Among others, these include: American Bureau of Shipping (ABS), International Standards Organization (ISO), Convention for Safe Containers (CSC), Accord relatif aux Transports Internationaux de Denrees Perissables et aux Engins Speciaux a utiliser pour ces Transports (ATP-EEC), Lloyds, Union International des Chemins de fer (UIC), Transport International Routier (TIR), Australian Department of Quarantine, Australian Department of Primary Industry Regulations for Carriage of Chilled Meat, New Zealand noise requirements, Food Industry standards certified by Classification Society for Taint, Sprenger Institute for Fresh Air Ventilation (Holland) and United States Department of Agriculture (USDA).

Reliability/Spare Parts

A three percent tailure rate on recfers (which is common also to most industrial products) is considered the rule of thumb, but the initial failure can be corrected in the vast majority of the - 0 -

sea containers

cases without resultant product damage. There is a direct correlation between reefer cargo losses and the amount of emphasis the carrier has made in training, investment in spare parts and manuals, regular pre-trip maintenance, and load maintenance.

SC does not supply reefer machinery only. In every case where we are supplying packages of equipment, we supply engineering support at the start up to ensure that the operators and mechanics understand the operating protocols, and are given hands-on instruction on the stowage, maintenance and repair of the equipment. Additionally, ongoing engineering support can be acquired through a service contract, but the intent is to train the personnel to be self-sufficient.

Additionally, a recommended holding of spare parts is available (based on the number of units operating per ship, the availability of spare parts in the product-originating area, the abilities of the mechanics, and the frequency of service). These spare parts kits are supplied on a sale-and-return basis.

III. PRODUCT PRESERVATION THROUGH REFRIGERATION

Perishable cargoes are either live (chill) or dead (frozen). In contrast to frozen or canned goods, all fresh fruits and vegetables are living products. The vital life processes continue long after harvest, the most important of these processes being respiration. Respiration is a complex series of chemical reactions but basically it involves the conversion of starch to sugars and the transformation of these sugars into energy. During the normal process of respiration fruits and vegetables take in oxygen and give off carbon dioxide, water vapour and a considerable quantity of heat. In general, the rate of respiration increases with ambient temperature. The purpose of refrigeration here is to retard this process to prevent over-ripening by removing the atmospheric heat being absorbed by the containers and the heat being generated by the cargo.

With dead (or frozen) cargoes, the aim is simply to create an environment which impedes deterioration and is inhospitable to bacteria infestation through temperature reduction.

Reefer containers carry a wide range of temperature sensitive products including all manner of perishable fruits (vegetables,

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sea containers

meats and dairy products) and frozen cargoes (meat and seafood primarily). Certain temperature sensitive, low and non-hazardous chemicals and films also rely on reefer containers.

IV. REFRIGERATED TRANSPORTATION ALTERNATIVES

Temperature sensitive products are transported in a number of commercial modes, depending on the variety of products to be shipped from a particular location, range of temperature requirements, volume, trading range, etc. Principally, there exist four modes however. (Air transport is excluded from this exercise, as it suits only a very small portion of the highest value products which are of insignificant volume.)

A) Reefer Bulk Chambers In General Cargo Ships

This mode has traditionally been used in older generation tonnage for the carriage of sizeable quantities of similar cargos but is quickly disappearing as the general cargo ships are largely being superceded by modern containerships. One of the many drawbacks with this mode is the lack of temperature sensitivity, and the multiple handling this stowage mode requires of the cargo. greater the number of handlings, the greater the product damage will be.)

B) Reefer Bulk Ship

This mode is still in wide use today, primarily in the highvolume, single product trades (such as bananas, meat, etc.). new technology is fairly sophisticated, but the drawbacks remain: Bulk cargoes require multiple moves which are expensive and damage the fruit; the economics of the ships require vast volumes of similar products moving between a few locations, on a regular basis; the vessels can work only in a restricted number of ports which have the facilities to handle and store the cargo. The advantage of this mode however, is cast -- whom calculated on a port-to-port basis only.

C) Central Refrigeration Port Hole Container Ships (Conair)

This technology combines container ship economies with the reefer bulk ship principle of whole-ship refrigeration. A central plant - 8 -

sea containers

creates the refrigerated air which is pumped throughout the ship by ducting to which insulated containers with portholes are connected. As in the case of reefer bulk ships, the economics of the vessels are based on large volumes of similiar products moving between a few locations, on regular basis, in a restricted range of dedicated ports (a vast, infrastructure is required to handle conair ships). The advantages are the premium outturns which containerization affords and lower cost on a port-to-port basis than integral containers. The disadvantages are strong limitations in flexibility (operating range, products, volumes), an enormous capital outlay, and less than ideal temperature control. The main trades for conair ships are Australia/N. Europe for the meat and fruit business, and both coasts of South America to N. Europe (Meat off the East Coast and fruit and seafood off the West primarily).

D) Refrigerated Containers - Integral, or Self-Sustaining

Reefer containerization takes all the advantages of conventional containerization:

- Reduction in handling (reducing cost and damage)

Reduction in theft potential

- Reduction in down time as product moves from plantation to destination in one mode
- Unitization for easier, quicker and cheaper handling to/from ship, truck and rail.

.... And adds:

Higher temperature control sensitivity (.02 Degree C. range) than other modes

- Higher quality outturns than other modes

 Flexibility in trades which haven't sufficient volumes to warrant bulk shipments (which rely on regular and large volumes moving on restricted trade routes)

- Flexibility in moving both frozen and chill cargoes

- Reduction in cargo loss -- claims

- Greater potential for achieving return cargo.

The integral refrigerated container is the ideal tool for development in LDC's where minimal investment is required (in equipment and port infrastructure) where maximum flexibility in terms of product, trade range and volume are the rule, and where premium quality product is essential in establishing the new product (or export origin point) in the market.

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sea containers

V. MARKET STRUCTURES

The market is complex in its multitude identities and interrelationships, but can be simplified to the following:

A) Growers/Farmers

This is the basic production unit which usually sells its product to a cooperative, or exporter, which in turn arranges the transportation from the country of origin to destination. In some cases, the larger farmers themselves contract with shipping lines, and even own the shipping tonnage (i.e., the meat producers in Australia and grape/apple producers in Chile). The grower/farmer needs thorough familiarization with the special harvesting, packaging, and stowage requirements of container shipping. Generally, the grower/farmer is not responsible for the refrigerated equipment except during the time the equipment is in the grower's care.

B) Shippers

The entity contracting for the shipment is referred to as the shipper. Depending on the product and market strategy of the shipper, the product may be sold F.A.S. (meaning that the buyer takes delivery at the port of arrival, directly from the ship) in which case the buyer/distributor has to arrange the trucking, warehousing, and distribution chain or the shipper may sell directly to the customers' premises. In other cases, the Shipper handles all the logistics from plantation to supermarket either with its own organization or by subcontracting the various elements of the operation.

C) Shipping Lines

The types of services offered by shipping lines varies considerably from company to company. Some offer port-to-port shipment only, others contract to provide through-transportation service from the point of origin to destination. In most cases the supplier of the transportation service contracts with the lessor for the supply of the equipment, expertise and training.

D) Leasing Companies

Again these come in many shapes and forms but in this context, supply the capital assets which the transportation project

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sea containers

- The Container Leasing Company has in-depth knowledge of all aspects of containerization and will have already selected the most suitable equipment based on practical experience.
- 2. The Leasing Company can usually provide a consultancy service, and possibly arrange a management cervice after equipment has been installed.
- 3. Equipment provided is likely to be practical, simple and robust since high quality and longevity will be a prime requirement when leasing, since the Leasing Company owns the equipment and will naturally want it to operate efficiently over a long period.
- The Leasing Company will ensure that equipment is provided quickly since it will not begin to earn money until it is in service, and that the best possible relationship is maintained with the Lessee throughout the period of the Lease. The Leasing Company will necessarily remain interested in its customer, be it the shipper, the steamship line, or the marketing company.
- No capital is required to buy equipment thus freeing cash. 5.
- Initial payments do not normally become due until the equipment is delivered and ready to earn money thus cash flow is protected.

These latter two factors are particularly important for poorer countries. The most important financial advantage of leasing however is that the out-goings on lease payments and the low cost of installation of suitably selected leased equipment as well as the operating and maintenance costs can be recovered from revenue earned and at the same time make profits.

Equipment Costs B)

Refrigeration technology is available from SC on lease, sale, and in some cases lease purchase.

As a hall park indication of rector equipment prices for sale (new) would be:

> 20' Reefer - \$ 21,000

> 40' Reefer -26,000

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sea containers

Diesel Generator -11,000 200,000 Powerpack

Lease rates vary depending on the length of lease, quantity and type of units, delivery/redelivery locations, specifications, and training/support requirements.

C) How To Start

After first identifying the product, the market and the basic economics of a particular perishable product's (or group of products from a particular area) exportation, an organization can contact Sea Containers for feasibility studies and assistance in identifying the technical problems and solutions, as well as the essential costings for the transportation portion of the project. We offer our expertise as a resource to the Bank in this regard. If the studies are positive, the organization can contract with SC for the supply of all or part of the technical services and equipment described herein.

VIII. CONCLUSIONS

- The cultivation and exportation of perishable products from developing countries is one of the potential keys to development resulting in stimulation of foreign exchange, infrastructure investment and development, employment and improved diets/standards of living.
- Refrigerated containerization leasing offers the fastest and most cost-efficient means of translating this potential into reality - by combining new but proven technology (which allows flexible and gradual expansion of projects), with low start up costs.
- C) SC provides refrigeration technology

- start-up expertise

- engineering and technical assessment
- finance.

We appreciate having had this opportunity to address you today on these matters. We hope this has been of some use to you and offer ourselves as a resource to the Bank on these related matters.

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sea containers

SC has an office here in Washington directed by my colleague Mr. Lidinsky who is available to assist the Bank in any way we can.

1/14/87 SH FRASER SEA CONTAINERS

W. Please till

THE WORLD BANK/INTERNATIONAL FINANCE CORPORATION OFFICE MEMORANDUM

-d

DATE:

December 31, 1986

TO:

IFC Department Directors and Division Managers

FROM:

Michael O'Farrell, IFC Personnel and Administration

EXTENSION:

60761

SUBJECT:

Presentation on Refrigerated Containers

- 1. IFC is joining the Transportation and Agriculture and Rural Development departments of the Bank in sponsoring a presentation by Sea Containers Ltd. on "Promoting Export Opportunities Through the Use of Reefers (Refrigerated Containers)". The presentation will be held on Wednesday, January 14, 2:30 p.m. in room I-4-030.
- 2. The presentation will be made by the staff of Sea Containers Ltd. led by Stephen Fraser, Vice President for Sales and Marketing. Mr. Fraser will describe the use of reefers for the efficient and cost-effective transport of fruits, fish, meat and other perishable commodities and the advantages to LDCs trying to control the quality of their products. The presentation will cover all the various factors associated with the use of reefers cost, leasing, failure rate, power consumption, maintenance, handling, port requirements, benefits, etc. Practical examples of where the use of reefers has opened up opportunities for agricultural exports will be presented. Slides and a short film will be shown.
- You and your interested colleagues are invited to attend. For further information, call Helen Frost at TRP, Ext. 61678.

cc: Mr. J.R. Lethbridge, TRP

Promoting Export Opportunities Through the Use of Reefers (Refrigerated Containers): Wednesday, January 14, 2:30 p.m., Rm. I-4-030. Presentation by staff of Sea Containers, led by Stephen Fraser. Slides and a short film will be shown. The use of reefers for the efficient and cost-effective transport of fruits, fish, meat and other perishable commodities is growing and may have many advantages for LDCs trying to control the quality of their products. The seminar will present all the various factors associated with the use of reefers—costs, leasing, failure rate, power consumption, maintenance, handling, port requirements, benefits, etc. Practical examples of where the use of reefers has opened up opportunities for agricultural exports will be presented. For further information, call Helen Frost, Ext. 61678. Sponsors: PSAU/TRP; AGR; and IFC.

AGRES Brown Bag Lunch-"Rural Finance, Experience and Future Strategies":
Thursday, January 15, 12:30 p.m., Rm. N-1121. Brian Argyle will present a
paper, reviewing the experience in rural credit--why it has not been generally
successful in establishing self-sustaining institutions or reaching a wide
segment of the rural population, and proposals for future strategies to improve
this performance. Contact: Peter Hazell, Ext. 60085.

Society for International Development (SID) Agricultural and Rural Development Workshop—"Monitoring and Evaluating Agricultural and Rural Development":

Wednesday, January 21, 12 noon to 2 p.m., Suite 1100, 1401 New York Avenue,

N.W., Washington, D.C. 20005. (Closest metro stops: Metro Center and

McPherson Square). Dennis Casley of the World Bank will be the speaker.

Assorted sandwiches and soft drinks will be provided at a cost of \$6 for SID members, \$8 for non-members. Reservations and advance payment are required.

Send a check, payable to SID, to their office by Friday, January 16. For further information, Call Thierry Sagnier, Ext. 73651.

Technological Change in Vulnerable Indigenous Cultures—An Update from Ladakh: Wednesday, January 21, 1 p.m., Rm. D-1056. Informal presentation and brown bag lunch with Helena Norbert-Hodge and Bruce Rich, who, respectively, organized and participated in the international conference on this topic in Ladakh, India, last year. Everyone is invited and background materials are available from Chris Hennin, Ext. 76823. Sponsor: PPDES.

AGRES Brown Bag Lunch--"Land Ownership Security and Rural Credit in Thailand": Thursday, January 22, 12:30 p.m., Rm. N-1121. Gershon Feder will present a paper, focusing on factors characterizing formal and informal credit transactions in rural Thailand. The implications of legal land ownership and use of land collaterals will be highlighted. A paper is available by calling Ext. 60361.

Adjustment Lending--Its Demands and Its Influence on Bank Occupations. A CIC Roundtable: Thursday, January 22, 3 to 4:30 p.m., Rm. C-1006. Panelists Elkyn Chaparro, Claudio Frischtak, John Joyce, Millard Long, Katherine Marshall, Gerard Rooney and others will discuss adjustment lending's impact on Bank occupations. A question-and-answer session will follow. To reserve a place, call Elvi Bangit, Ext. 75725.

Concordia Apartments. One-bedroom apartments, suitable for double occupancy, and efficiencies with a foldaway bed, suitable for single occupancy, are available for reservation. All apartments are furnished with a fully equipped kitchen. House rules prohibit accommodation of children or pets. Limited maid service is provided. The daily rate for one-bedroom apartments is \$50; for efficiencies, \$40. All telephone and room charges must be settled in full upon checkout. Reservation requests should be received for processing three working days before the guest's arrival. All requests should be for official visitors to the Bank/IFC only and should be directed by Travel Request or memorandum to the Hotel Reservations Unit, Rm. B-200.

Development Business

Issue	Deadline for Receipt of Material	Publication Date
216	January 26	February 16
217	February 9	February 28

When close to deadline, hand-carry procurement notices to Rm. E-1055. Include your extension and room number with the material. 1987 schedules are available from the Development Forum Unit.

SEMINARS AND TRAINING

GATT and the Developing Countries: Tuesday, January 13, 9:15 a.m. to 12:45 p.m., Rm. E-1244. Paulo Barthel-Rosa, Director of GATT's Development Division, and Richard Blackhurst, Director of GATT's Economic Research and Analysis Division, will give a seminar for interested Bank economists to familiarize them with GATT's principles and rules and to discuss the upcoming Uruguay Round of multilateral negotiations. Topics to be covered are:
(1) "The GATT System, An Overview of the Rights and Obligations of Contracting Parties"; and (2) "The Uruguay Round: How Issues of Particular Interest to Developing Countries Will be Addressed." For information, contact Paula Holmes, Ext. 3-3977.

USAID Briefing--School Quality and Efficiency: Tuesday, January 13, 12 noon, Rm. N-550. Joan Claffey and Gary Theisen from USAID will discuss current projects aimed at improving school quality and efficiency. New efforts by USAID include the development of planning models for micros, application of empirical research within policymaking, and improvement of classroom teaching. Ms. Claffey and Mr. Theisen will address the differences in their efforts and those being undertaken in the Bank on school efficiency and educational quality. Bring your lunch. Further information from Bruce Fuller, Ext. 3-3818. Sponsor: EPDCA.

Writing and Editing Occupations at the Bank/IFC and Their Impact: Tuesday, January 13, 3 to 4:30 p.m., Rm. H-2-300. This roundtable is now fully booked and no further reservations can be accepted. A tape of the proceedings will be available in the Career Information Center a few days after the event.

Seventh Agriculture Sector Symposium—"Sustainability Issues in Agricultural Development": Thursday and Friday, January 8 and 9, Key Bridge Marriott Hotel, Rosslyn, Virginia. All interested staff are invited. Sponsor: AGR/PMD. The agenda is:

Thursday, January 8

- 9:15 a.m. Opening Speaker: Mr. Conable
- 9:30 a.m. A View of Sustainability: Policy, Natural Resources and Institutions
- 10:45 a.m. Policy Issues for Sustainability
- 1:30 p.m. Institutional Requirements for Sustained Agricultural Development
- 3:00 p.m. Simultaneous Small Groups on Institutional Development
- 5:00 p.m. Reception

Friday, January 9

- 9:30 a.m. Managing Natural Resources for Sustainability
- 10:45 a.m. Simultaneous Small Groups on Natural Resource Management
- 1:30 p.m. Diversification Issues in Sustainable Production Systems
- 2:45 p.m. Simultaneous Small Groups on Diversification
- 4:30 p.m. Some Thoughts on Economic Development, Sustainability and the Environment

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Physical Security in the Field. The Bank has procedures for controlling operational travel to countries where hazardous conditions are known to exist. But sometimes lower levels of risk exist that may not be known except by Programs Division staff working on the countries concerned. Therefore, Programs Division Chiefs and their staff are reminded that, when clearing terms of reference for missions, they have an obligation to inform travelers of any appropriate precautions to minimize risk while in a particular country or countries. Similarly, all potential operational travelers must consult with staff of the responsible Programs Division prior to travel and notify the Bank's field office of the proposed visit.

Updating Telephone and Room Numbers. To ensure prompt distribution of mail and accurately routed telephone calls, it is important that each staff member is listed in the telephone directory correctly. Please update your extension or room number, when necessary, on Form No. 23, and return to Telephone Directory Coordinator, Rm. C-225.

Room Changes for Newspaper and Periodical Subscriptions. Staff members receiving newspapers or periodicals ordered through the Joint Library should notify Mrs. Casella, Joint Library, IMF-530, Ext. 57032, when they move or change their room numbers. Otherwise, the newspapers or periodicals will not be delivered to the correct address. Since publishers require 8 to 10 weeks to make an address change, prompt notification is essential.

Concordia Apartments. One-bedroom apartments, suitable for double occupancy, and efficiencies with a foldaway bed, suitable for single occupancy, are available for reservation. All apartments are furnished with a fully equipped kitchen. House rules prohibit accommodation of children or pets. Limited maid service is provided. The daily rate for one-bedroom apartments is \$50; for efficiencies, \$40. All telephone and room charges must be settled in full upon checkout. Reservation requests should be received for processing three working days before the guest's arrival. All requests should be for official visitors to the Bank/IFC only and should be directed by Travel Request or memorandum to the Hotel Reservations Unit, Rm. B-200.

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215	January 9	January 31	

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SEMINARS AND TRAINING

"The Channel Tunnel Project": Wednesday, January 7, 12 noon to 12:45 p.m., Rm. N-955. Presentation of a 12-minute video tape and 10-minute introduction to discussions. This project has original features on financing, procurement and intermodal transport. Contact: J.M. Lantran, Ext. 61560. Sponsor: TRP.

SEMINARS AND TRAINING

"The Channel Tunnel Project": Wednesday, January 7, 12 noon to 12:45 p.m., Rm. N-955. Presentation of a 12-minute video tape and 10-minute introduction to discussions. This project has original features on financing, procurement and intermodal transport. Contact: J.M. Lantran, Ext. 61560. Sponsor: TRP.

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- 4:30 p.m. Some Thoughts on Economic Development, Sustainability and the Environment

Writing and Editing Occupations at the Bank/IFC and Their Impact: Tuesday, January 13, 3 to 4:30 p.m., Rm. H-2-300. This roundtable is now fully booked and no further reservations can be accepted. A tape of the proceedings will be available in the Career Information Center a few days after the event.

Promoting Export Opportunities Through the Use of Reefers (Refrigerated Containers): Wednesday, January 14, 2:30 p.m., Rm. I-4-030. Presentation by staff of Sea Containers, led by Stephen Fraser. Slides and a short film will be shown. The use of reefers for the efficient and cost-effective transport of fruits, fish, meat and other perishable commodities is growing and may have many advantages for LDCs trying to control the quality of their products. The seminar will present all the various factors associated with the use of reefers--costs, leasing, failure rate, power consumption, maintenance, handling, port requirements, benefits, etc. Practical examples of where the use of reefers has opened up opportunities for agricultural exports will be presented. For further information, call Helen Frost, Ext. 61678. Sponsors: PSAU/TRP; AGR; and IFC.

INFORMATION TECHNOLOGY

The ITF Office Systems Studio, Rm. H-3-320, will be closed December 29, 30 and 31. If you need user assistance or have questions, please call Customer Service, Ext. 3-2121. All studio services, user assistance, demonstrations, home computer consulting, etc., will resume January 5.

The ITF Library, Rm. E-125, will be closed December 29, 30 and 31. Computer documentation and software distribution services provided by the library will also not be available during this time. The library will resume its regular hours of 9 a.m. to 5:30 p.m., January 5. For further information, call Angie Nash, Ext. 75393.

Burroughs Screen Design Facility: Tuesday, January 6, 2 p.m. This seminar will provide an overview of the Burroughs Screen Design Facility (SDF) which is a tool to help programmers design and process screen forms for applications. Topics include: editing, validation, and input-output mapping features, and the use of SDF by a COBOL74 program (both directly and via COMS). Intended for analysts and programmers involved with applications requiring data to be entered interactively by users. Approximate length: two hours. Led by Barry Johnson, ITFBD. To register, call Helene Yip Hoi Yen, Ext. 3-2830.

Protecting Your Data with RACF: Thursday, January 8, 9 to 10 a.m., Rm. H-3-220. Ben Boyle of the IBM Division will demonstrate how to use the advanced features of RACF (Resource Access Control Facility) to increase the security on your minidisks, reader files, and RSCS printers. If you wish to attend, call Ext. 3-3083.

COMPASS Training: Week of January 12. Contact: Nancy Mattson, Ext. 76831. Sponsors: PMD/PPD/

COSTAB Training Workshop for Project Analysts. Four 2-1/2-hour sessions. COSTAB produces detailed and summary project cost tables, financing plans, and disbursement schedules. The workshop includes hands-on training.

REPORTS/DOCUMENTS/PUBLICATIONS

The Bookstore will be closed December 29, 30 and 31, to allow staff to take inventory.

Manual Statements and Circulars. The following were issued recently and are available from the Internal Documents Unit, Rm. A-124, on a self-service basis from 9 a.m. to 3 p.m.:

Operational Manual Statement 3.30, Annex A: Appropriate Exchange Rate for Disbursements Against Local

Currency Expenditures

Administrative Manual Statement Adm 14.20: Public Statements of Staff Members Administrative Manual Statement Adm 14.30: Attendance at Meetings

- 10:45 a.m. Policy Issues for Sustainability
- 1:30 p.m. Institutional Requirements for Sustained Agricultural Development
- 3:00 p.m. Simultaneous Small Groups on Institutional Development
- 5:00 p.m. Reception

Friday, January 9

- 9:30 a.m. Managing Natural Resources for Sustainability
- 10:45 a.m. Simultaneous Small Groups on Natural Resource Management
- 1:30 p.m. Diversification Issues in Sustainable Production Systems
- 2:45 p.m. Simultaneous Small Groups on Diversification
- 4:30 p.m. Some Thoughts on Economic Development, Sustainability and the Environment

Writing and Editing Occupations at the Bank/IFC and Their Impact: Tuesday, January 13, 3 to 4:30 p.m., Rm. H-2-300. What skills, knowledge and experience are necessary to be a successful editor or writer at the Bank? How can the Bank/IFC make the best use of writing and editing skills? Panelists William Brannigan, Jane Carroll, Mark Cherniavsky, Richard Herbert, Jill Roessner, Bruce Ross-Larson, Terrance Lindemann and Rachel Weaving will exchange views and discuss issues and trends in a roundtable sponsored by the Career Information Center. A question-and-answer session will follow. To reserve a place, call Ext. 75725.

Promoting Export Opportunities Through the Use of Reefers (Refrigerated Containers): Wednesday, January 14, 2:30 p.m., Rm. I-4-030. Presentation by staff of Sea Containers, led by Stephen Fraser. Slides and a short film will be shown. The use of reefers for the efficient and cost-effective transport of fruits, fish, meat and other perishable commodities is growing and may have many advantages for LDCs trying to control the quality of their products. The seminar will present all the various factors associated with the use of reefers—costs, leasing, failure rate, power consumption, maintenance, handling, port requirements, benefits, etc. Practical examples of where the use of reefers has opened up opportunities for agricultural exports will be presented. For further information, call Helen Frost, Ext. 61678. Sponsors: PSAU/TRP; AGR; and IFC.

INFORMATION TECHNOLOGY

"The Education Utility": Monday, December 22, 11 a.m. to 12 noon, Rm. G-1011. Presentation by Jack Taub and Terry Steichen on The Education Utility, a delivery system for an array of information resources. Anyone interested in attending should call Jennifer Clark, Ext. 72761. Sponsor: EDIET.

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REPORTS/DOCUMENTS/PUBLICATIONS

Principles of Staff Employment (August 1983) states: "All rights in any work produced by staff members as part of their official duties shall belong to the World Bank or the IFC unless such rights are explicity relinquished." (Page 6, Section 3.2) This principle will shortly be expanded and issued as a Staff Rule.

Manuscripts of more than journal article length should be submitted for publication in the first instance to Mr. James Feather, Ext. 48061, or Mr. Goddard Winterbottom, Ext. 48091.

The Bookstore will be closed December 29, 30 and 31, to allow staff to take inventory.

New publications available in the Bookstore (corner of 19th and G Streets, N.W.) Complimentary to staff; please complete Form 2011 if requesting copies by mail.

John R. Nellis, <u>Public Enterprises in Sub-Saharan Africa</u>. World Bank Discussion Papers No. 1. \$5. Stock number DP-0001.

Status Report on Concessional Flows April 1986 in French. Development Committee No. 9. Free. Stock number BK-0790.

Strategy for Restoration of Growth in Middle-Income Countries That Face Debt-Servicing Difficulties in French. Development Committee No. 10. Free. Stock number BK-0812.

Promoting Export Opportunities through the Use of Reefers (Refrigerated Containers) - Seminar on Wednesday, January 14, 1987, Room at 2.30 pm.

The use of reefers for the efficient and cost effective transport of fruits, fish, meats and other perishable commodities is growing and may have many advantages for LDC's trying to control the quality of their products. The seminar will present all of the various factors associated with the use of reefers - costs, leasing, failure rate, power consumption, maintenance, benefits, etc. The presentation will be made by the staff of Sea Containers led by Mr. Stephen Fraser. Slides and a short film will be shown. Call Helen Frost, Ext. 61678, for further information. Sponsor: PSAU/TRP; AGR and IFC.

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Thick terming 1987.

Sea Containers America Inc.

1155 Avenue of the Americas, New York, N.Y. 10036
Telephone: (212) 302-5066 Telex: RCA 235416 (SCI UR)

October 21, 1986

Mr. John R. Lethbridge Senior Port Engineer Transportation Department The World Bank 1818 H Street, N.W. Washington, D.C. 20433

Dear Mr. Lethbridge:

Thank you again for the opportunity to address you and your colleagues last week on the matter of reefer containerization and the advantages which this technology can bring to developing countries. We look forward to hearing further from you on the comments on the draft presentation and will work to include various considerations which were voiced during our meeting.

Both Mr. Lidinsky and I are excited about the prospect of making a presentation to the various individuals of the World Bank in January and await your confirmation of the details.

In the meantime, if either Mr. Lidinsky or I can be of any assistance to you please do not hesitate to contact us.

Sincerely,

Stephen H. Fraser Vice President

Sales and Marketing

cc: R.A. Lidinsky

Sea Containers America Inc. 1155 Avenue of the Americas, New York, N.Y. 10036 Telephone: (212) 302-5066 Telex: RCA 235416 (SCI UR)

WORLD BANK PRESENTATION (DRAFT)

PURPOSE: To familiarize the relevant World Bank Personnel on SC and SC's interest in reefer containerization, covering:

- A) SC who we are, credentials and reefer investment
- B) Refrigeration Technology
- C) Pros and Cons
- D) Damage to Fruit
- E) Transition from bulk to containerization
- F) Costs
- G) Applications

I) INTRODUCTION

By means of introduction, I would like to outline the size and position of SC in the industry and generally.

AA) Sea Containers Ltd.

Sea Containers Ltd. is the world's largest leasing company of maritime-related transportation assets (primarily container related), with holdings in container ships (involvement with 23 ships), dry freight containers (300,000 TEU), container cranes (20), chassis (7,000), and the world's largest fleets of refrigerated and tank containers. Additionally, SC owns Sealink, the premier ferry company between (and in) Britain and the continent, operating on 23 routes. (In 1985, Sealink carried 19 million passengers, 3.2 million cars, and 200,000 railcars and containers.)

Assets as of December 31, 1985 were over 1.3 billion U.S. dollars. Revenue in 1985 was \$573 million, with earnings of \$39.5 million. Stockholders equity (common and preferred) was \$390 million. The stock is publicly traded on the NY, London and

HK stock exchanges. The company is registered in the U.S., with the assets owned in Bermuda and operating headquarters in London.

Essentially, we are the Hertz of the shipping business. Our trade is the lease and finance of marine and related assets primarily to ocean carriers. One of our specialties is also the establishment and development of "turn key project" involving ships, cranes, chassis and refrigerated containers. Our projects include: the containerization of the banana trade from Central America to the U.S. Gulf and USEC for the food conglomerate Castle and Cooke (Dole brand) from a breakbulk operation; the containerization of pineapple and frozen tuna from the Phillipines to the USWC (again for Castle and Cooke): the containerization of frozen and chilled lamb from Australia to Iran (until the Shah's departure), and others. In each case, SC was brought in to develop the entire transportation system, supply the equipment and the training for subsequent turnover to the principle, upon establishment.

We are uniquely positioned therefore, to discuss with you the nature, and various aspects of reefer containerization.

BB) SC Reefer Investment

The "Containerization International" world container census (published in September 1986) lists the world population of refrigerated containers at 104,340 units. The industry breakdown is: 71 percent carrier owned, 27 percent lessor owned and 2 percent other. SC's fleet stands now at 13,000 units which indicates that SC owns 47% of the total world leased fleet of refrigeration equipment. In addition, we own 16 powerpacks, and 900 diesel generators.

SC is also one of the major manufacturers of refrigeration technology with the Seacold brand of reefer manufactured by SC's wholly-owned, Singapore based company. The refrigeration technology was developed by SC primarily for our own consumption, but is now available for third party purchase.

Our fleet of reefer containers, powerpacks and diesel generators are backed up by 12 fulltime reefer engineers each trained in all phases of refrigeration repair, maintenance, operation and qualified to do training to assist in the establishment of reefer projects. (To put this in perspective, this is greater than the next four competitors combined, all of which purchase (rather

than manufacture) refrigeration technology and rely on the manufacturer almost entirely for support.)

SC's total investment in refrigeration equipment, manufacturing, research and development, spares, repair facilities and personnel now amounts to over a quarter of a billion dollars.

II) ASPECTS OF REFRIGERATION

- A) Heat Transfer
- B) Airflow in bottom, out top
- C) Means of temperature control

Reefer containers, are generally made of aluminum exterior with either stainless steel or FRP interior liners, are designed to operate in both high and low ambient temperatures, and to maintain both frozen and chill cargoes. SC's reefers are also equipped to heat cargoes so should more appropriately be called "temperature control containers". Very simply, they are heavily insulated containers with a slab of machinery on the front which transfers the heat from within the container, to the environment outside, to a predetermined set temperature.

The units are designed to operate in ambients of -40 degree (F) to +125 degree (F) (-40C-+52C), whilst maintaining internal temperatures of -21 degrees (F) -+86 degrees (F) (-29.9C-+29.9C).

It is important to keep in mind that perishable cargoes are either live (chill) or dead (frozen). With chill cargo, (live) the physiological/biological metabolic processes of converting calories to starches are continuing and therefore giving off heat. The purpose of refrigeration here is to retard this process to prevent over-ripening, and to prevent biological/bacteriological deterioration.

With dead (or frozen) cargoes, the aim is simply to create an environment which impedes deterioration and is inhospitable to bacteria infestation through temperature reduction.

Reefer containers carry a wide range of temperature sensitive products including all manner of perishable fruits (vegetables, meats and dairy products) and frozen cargoes (meat and seafood primarily). Temperature sensitive, low and non-hazardous chemicals and films also rely on reefer containers.

In addition to the use of reefer containers for transportation requirements, increasingly we are seeing some of the older generations of reefer containers being used for static storage applications in places where quick and dependable reefer storage is required (at a cost less than building purpose-designed reefer warehouses). Static storage applications are being discussed currently in parts of West Africa, Colombia, Chile, Peru, and in South East Asia.

The refrigeration machinery works on both electric and diesel power, and can work on both 220V and 440V, 3 phase, 50/60 hertz. While aboard ship and on the dock, the reefer is generally plugged into the electrical power supply. While on a truck or in remote areas where electricity is not available, the reefer can be attached to a portable diesel generator. (Note: The clip-on and underslung DG are not suitable for ship use.)

In the cases where electrical supplies are insufficient to power the total number of reefers, a powerpack (SC registered trademark) can be used with the ability to power up to 36 reefers. SC reefers are equipped with both air cooled and water cooled condensors for maximum flexibility aboard ship. (The reefers can be stowed above or below deck.)

SC's reefer fleet has been built to the highest standards in the industry, to comply with all relevant regulations. Among others, these include: ABS, ATP-EEC, Lloyds, ISO, UIC, TIR, CSC, Australian Dept. of Quarantine, Australian DPI Regs of Carriage of Chilled Meat, NZ noise requirements, Food Industry standards certified by Classification Society for Taint, Sprenger Institute for Fresh Air Ventilation, and USDA.

III) PROS AND CONS

Reefer containerization takes all the advantages of conventional containerization:

- Reduction in handling (thus reducing cost and damage)
- Reduction in theft
- Reduction in down time as product moves from plantation to destination in one mode
- Unitization for easier, quicker and cheaper handling to/from ship, truck and rail.

.... And adds the ability to maintain a constant temperature throughout the course of voyage -- something which is not possible by any other mode.

In all respects reefer containerization presents only pros.

The only difficulties in moving towards a reefer container operation is the need for infrastructure development and investment into either the equity of the equipment, or into the lease obligation.

This is compensated for however, by the premium which reefer containerized products bring on the market, a reduction on losses, and a quicker receivables receipt due to faster turn time.

IV. DAMAGE TO FRUIT/LOSSES

It is important to stress that reefer containerization is the single most effective way to reduce damage and loss to fruit.

A three percent failure rate on reefers (which is common also to most industrial products) is considered the rule of thumb, but the initial failure can be corrected in the vast majority of the cases. There is a direct correlation between reefer cargo losses and the amount of emphasis the carrier has made in training, investment in spare parts and manuals, regular pre-trip maintenance, and load maintenance.

SC does not supply reefer machinery only. In every case where we are supplying packages of equipment, we supply engineering support at the start up to ensure that the operators and mechanics understand the operating protocols, and are given at least three days of hands-on instruction on the stowage, maintenance and repair of the equipment. This is built into the container rental. Additionally, ongoing engineering support can be acquired through a service contract, but the intent is to train the personnel to be self-sufficient.

Additionally, a recommended holding of spare parts is available (based on the number of units operating per ship, the availability of spare parts in the product-originating area, the abilities of the mechanics, and the frequency of service). These spare parts kits are supplied on a sale-and-return basis, whereby SC sells the spares to the operator, but agrees to buy back at the end of the lease all unused and good condition spares at the original price, minus 15 percent for handling and administration. (It is intended that the spare parts kit sets will be replenished on a regular basis from the existing spare parts networks worldwide.)

V. TRANSITION FROM BULK TO REEFER

The majority of reefer cargoes (in volume) are still moved in bulk reefer ships which "tramp" the world's seas, moving fruits and frozen meat. Bulk is cheaper than containerization when analysed on an ocean transportation basis only -- which is the way many operators, due to the market configuration, chose to look at it. (In most markets, the grower is concerned only with the transportation to the destination country port, not the final inland distribution leg. The growers also have a major investment in the bulk operations and are not eager to have to write this investment off.)

Reefer containerization on the other hand is more economical when the entire journey from the plantation to the end distribution point, and the premium for containerized products can be realized.

Increasingly, however, reefer containers are being used due to:

- Higher temperature control sensitivity (.02 Deg C.)
- Higher quality outturn
- Flexibility in trades which don't have sufficient volumes to warrant bulk shipments (which rely on regular and large volumes moving on restricted trade routes)
- Flexibility in moving both frozen and chill cargoes
- Reduction in cargo loss -- claims
- Reduction in through-transportation costs.

There really is no intermediate stage between bulk shipments (or no shipments), and containerization of reefer products. Generally, it is done in one quantum leap, where the containers, ships, cranes, chassis, diesel generators, are all brought together, and the mechanics, operators and plantations are coordinated towards this end.

VI) COSTS

Refrigeration technology is available from SC on a sale or lease purchase (for restricted ranges of equipment), but primarily for lease.

As a ball park indication of reefer equipment prices for sale (new) would be:

20' Reefer - \$23,000 40' Reefer - 26,000 DG - 11,000

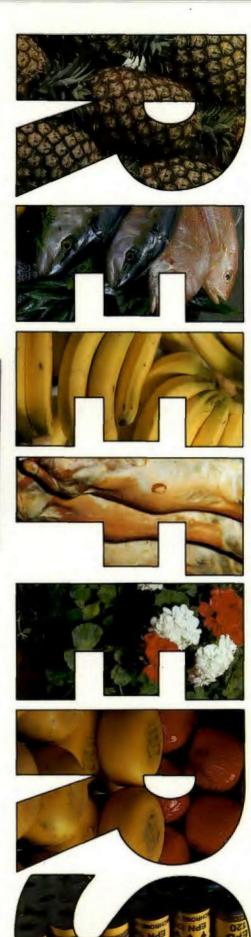
Lease rates vary depending on the length of lease, quantity and type of units, delivery/redelivery specifications, and training/support requirements.

VII) SLIDE SHOW

We have now for your viewing, a brief slide show which illustrates the various equipment types, handling operations, stowage operations, cargo and use applications, etc.

We also have a brief film documentary on SC's successful containerization of the Phillipine pineapple and frozen tuna business, for Castle and Cooke.





Refrigerated container equipment

sea containers

ea Containers is the world's largest lessor of marine container equipment, owning over 300,000 TEU of containers including many specialized types, as well as chassis, containerships, container gantry cranes, fork lift trucks, and other container related equipment.

The company is also the largest lessor of refrigerated containers, having over 12,000 TEU in its fleet. Sea Containers' factories in the UK and Singapore manufacture refrigerated container equipment for leasing and for direct sale to shipping lines. As part of Sea Containers'

containerized banana service between Central America and the US Gulf using a Sea Containers' Strider-class refrigerated vessel and Shifter

terminal crane, 40ft chassis and 600 40ft refrigerated containers.

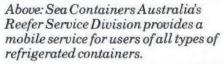
Right: A Sea Containers' engineer carrying out a pre-delivery check to SeaCold refrigerated container machinery fitted to a customer's own

unmatched international back-up service, specialist reefer engineers, based in London, are on call 24 hours a day to support operators and endusers. This back-up includes full training on all aspects of reefer operation, vital for the start-up of new services. In addition, regional engineers are stationed in New York, Singapore and Melbourne, Australia. Parts and service support is provided through authorized depots at strategic locations throughout the world.

Sea Containers'reefers are held available at key ports handling large volumes of refrigerated and temperature sensitive traffic.

Depending on circumstances, one-way, round trip, short term and long term leases of any quantity of units are offered.







Above: Canadian lobsters being unloaded from a 40ft SeaCold reefer in Hamburg.



△ Engineering Support Centres

■ Authorized reefer depots

Parts and Service depots





Left: Bananas being packed into railmounted 40ft refrigerated containers at the plantation. The fruit is constantly ventilated and maintained at a precisely controlled temperature through rail, sea and road transit, and is not handled until it reaches the ripening warehouse at the eventual destination. This reduces wastage and improves quality, allowing premium retail prices to be obtained.

container.

ea Containers'refrigerated container fleet consists of five different types, all with particular advantages and applications. The latest is the SeaCold unit with maximum cubic capacity, minimum tare weight and optimum machinery reliability, developed after many years of research and testing by Sea Containers'own engineers. Other types include reefers manufactured by Carrier Transicold (USA), Daikin (Japan) and Email (Australia).

Sea Containers'reefers are suitable for the carriage of all cargoes requiring temperature control and/or ventilation. Typical cargoes include

chilled and frozen meat and poultry, bananas, citrus and soft fruits, fresh vegetables, chemicals, photographic film, chocolate, frozen fish, dairy goods, plants and flowers. Sea Containers' reefers are versatile in operation, with heaters to protect cargoes against extremely low ambient temperatures. Durable construction means that reefers can also carry dry freight cargoes on return journeys.

All Sea Containers'reefers have integral refrigeration units: depending on reefer type, units can be operated on land with either clip-on diesel generators or generators accommodated within the ISO frame.

On chassis-mounted units, underslung diesel generators can also be fitted. Steel and aluminium clad containers are available and most are lined internally with stainless steel. For maximum operator convenience, remote monitoring is usually provided and all have dual voltage facilities.

In addition to air cooling, water cooled condensers are fitted as standard for under deck stowage. Containers are provided with symmetrical bottom air delivery systems for the best air distribution, and have heaters, automatic defrost systems and 31 day temperature recorders.

All Sea Containers'reefers are built to full ISO recommendations under the supervision of Lloyd's, Bureau Veritas, ABS or other classification societies. The entire fleet meets Australian Department of Quarantine and DPI regulations. Units approved by the USFDA for taint and by the United States Department of Agriculture can be supplied, and all meet the Auckland, New Zealand Harbour Board noise level requirements. Sea Cold units have European ATP approval for carriage of perishable products.



Above: A 40ft Carrier reefer, with a cargo capacity of 1956 cu ft (55.39 cu m) being loaded on to a container chassis for onward delivery by road.

Right: Deep-frozen lamb from Australia being inspected on arrival in the Middle East.







A new 20ft Daikin reefer in Japan.



SeaCold units being loaded with butter for export to the Middle East.

Right: A 20ft SeaCold reefer laden with tropical plants for shipment from Africa to Europe. To maximize use of the container, staging has been installed so that two layers can be accommodated.

Left: A 40ft SeaCold reefer in the livery of a major deep-sea container line at Houston, Texas, USA.



Two 20ft refrigerated containers in a transit depot. The diesel engines fit within the ISO perimeter.



Diesel generators

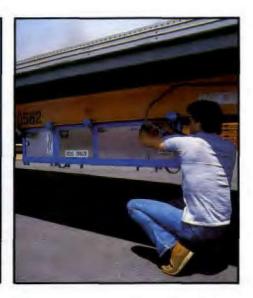
Clip-on diesel generators providing 460v/60 Hertz, 3-phase power to refrigerated containers are available for use during road or rail transit, in terminals or in other land based applications where a power source is not available. They do not impede access to any of the controls when mounted on the container.

Also available for lease in certain countries are underslung diesel generators which can be mounted under the container chassis rather than on to the container itself. Use of underslung diesels spreads the

weight of the generator evenly over the chassis wheelbase, increasing the permissible gross weight of the container, and therefore the payload.

All diesel generators are provided with starting batteries and a fuel tank allowing continuous operation of about 60 hours.





Above: A 40ft High Cube reefer fitted with a clip-on diesel generator during road transit from Galveston to Houston, Texas.

Above right: Checking the controls of an underslung diesel generator mounted on a chassis.

Power Pack

The Sea Containers Power Pack is a transportable generating station in a 20ft ISO container which can be handled in the same way as standard 20ft ISO units. It can be used on any type of ship as well as on land, and generates either 460v or 230v to supply all types of integral refrigerated containers. It can also be used as a convenient power source to supply other electrical equipment such as heated ISO tanks and ships' machinery.

The Power Pack's two diesel generators can operate a number of reefer containers simultaneously. With a fuel tank of 4523 litres capacity (995 imperial gallons, 1195 US gallons), the Power Pack can run for more than three days without refuelling. Fittings are provided to enable the Power Pack to be automatically or manually topped-up from an ISO tank container.



Right: A Sea Containers' Power Pack being connected to reefers on board ship.

















Refrigerated container equipment

ea Containers, as the world's largest lessor and manufacturer of reefer containers and related equipment, offers its customers:

More reefers

The world's largest fleet of reefers available for lease gives lessees better availability and flexibility.

More equipment types

Reefers from four manufacturers, three types of diesel generator and three types of Power Pack can be combined to meet virtually any customer requirement.

More depots

32 depots provide the broadest distribution of equipment for convenient delivery and return.

More spares

Millions of dollars worth of parts are available from major ports worldwide.

More engineers

A team of full time reefer engineers is on call to provide training, assistance and technical support far beyond the resources of other suppliers.

More options

As both a lessor and a manufacturer, finance packages involving lease, deferred purchase or straight sale can be arranged to suit the customer.

Sea Containers is uniquely qualified to provide any quantity of reefer equipment on terms tailored to suit a customer's specific requirements.

Regional offices

UK, Scandinavia, Europe, Africa, Middle East, India, Pakistan, Bangladesh, Sri Lanka and South America Sea Containers Services Ltd. Sea Containers House 20 Upper Ground London SE1 9PF England Tel: (01) 928 6969 Telex: 8955803

South East Asia and the Far East

Sea Containers Asia Ltd. 3201 Connaught Centre GPO Box 701, Hong Kong Tel: (5) 224191 Telex: 74017

USA, Canada, Mexico, Central America and the Caribbean

Sea Containers Office/Agent

Sea Containers America Inc. 1155 Avenue of the Americas New York, NY 10036 Tel: (212) 302 5066 Telex: RCA 235416

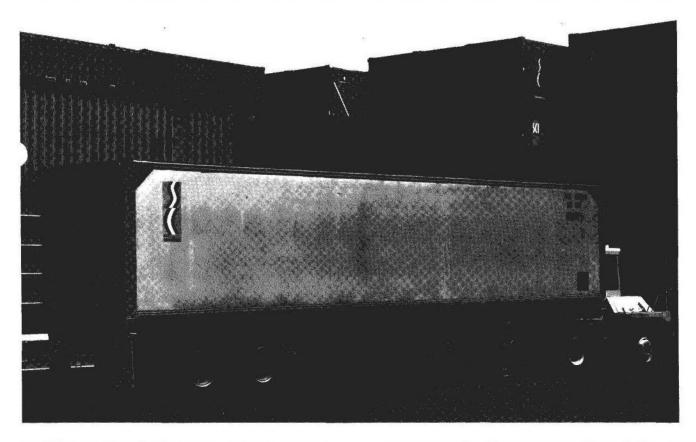
Australasia

Sea Containers Australia Ltd. Unit 12, Pymble Grove 33 Ryde Road, PO Box 457 Pymble, NSW 2073, Australia Tel: (612) 498 8088 Telex: 25776

Sea Containers is represented by offices and agents in over 60 countries.

sea containers

UNDERSLUNG DIESEL GENERATOR



Land Transportation of refrigerated containers requires a constant power supply to ensure the best quality outurn of perishable cargo.

To meet this criteria and permit the highest possible payloads the Sea Containers Underslung Diesel Generator is designed to fit on the underside of the I beams of most chassis. It can be accurately positioned to the front or rear for maximum payload under the Federal Bridging Laws. The Underslung Generator herefore permits the carriage of more cargo than the use of a

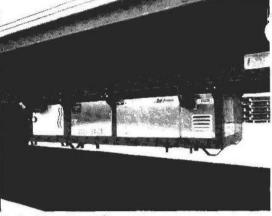
nose mounted or clip on generator. Clip on fuel modules are available in 25 or 50 US gallon sizes and the underslung generator can be used overland on the road on TOFC or in RO/RO applications. Routine servicing can be performed with the unit in place on the chassis and costly time consuming switching of container mounted generators is eliminated.

The underslung generator will supply power to most refrigerated container specifications and designs particularly those requiring higher than normal starting current.

Sea Container Underslung Diesel Generator – Chassis

SPECIFICATION

Engine Type	Deutz air cooled diesel 31 BHP cont. @ 1800 RPM			
Generator Type	Lima brushless type M.A.C. 15 KW A.C. 3-phase 60 Hertz. 230/460 Volts.			
Dimensions	Overall length incl. fuel tank Overall width incl. support arms Overall width excl. support arms Overall height Ground clearance from bottom of unit	7 ft 6 ins 4 ft 3 ins 3 ft 5 ins 3 ft 2 ins 1 ft 6 ins		
Weight	Weight incl. fuel and oil	1,860 lbs		
Fuel System	50 gallon insulated fuel tank. Fuel consumption approx. 0.9 gallons per hour. Fuel No. 2 diesel (under extreme low temps use No. 1 diesel). Primary and secondary fuel filters/water separator fitted in addition to normal fuel filter.			
Lubrication	Total oil capacity 6 US gallons Engine sump capacity 2 US gallons Tubular frame contains an additional 4 US gallons			
Construction	All aluminum lightweight tubular frame with attached bolt on fuel tank module. Engine and alternator are shock mounted to frame, readily removeable aluminum covers fitted over engine and frame. Seven hinged side doors provide access to gen set whilst mounted on chassis.			
Battery charging	12 volts, 35 amp alternator			
Power Outlets	1 x 220 volts, 634 FC, 60 amp 1 x 460 volts *CEE 32-3H, 32 amp *333 FC, 32 amp *Interchangeable			
Safety devices				
Shutdown	Cooling fan drive belt failure. Low oil pressure. High head temp. Manual "pull" stop.			
Electrical protection	230 volts, 50 amp circuit breaker. 460 volts, 25 amp circuit breaker.			
Installation	Unit mounts longitudinally between chassis main rail "I" beams and cross members. It accommodates 12 inch beams and centers from 36 to 40 inches (40 to 44 inch O.A.W.). It is attached to the lower rail flange by means of special clamps. Installation can be completed within approximately 20 minutes using			
Notes These average measurements, values and other	a forklift. performances are measured on the basis of three production units out of each series.			



Underslung Diesel Generator showing locating brackets.



Underslung Diesel Generator Control Panel

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sea containers



Introducing the Power Pack

The Power Pack is a transportable generating station in a 20ft ISO container. It is suitable for use on any type of ship as well as on land and can be handled and carried in the same way as any standard 20ft ISO container. Its many applications include supplying power to refrigerated containers, container cranes, and electrically heated tank containers (all available from Sea Containers), for lighting and heating temporary on-site accommodation, and for any other situation where electrical power is either inadequate or unavailable.

The Power Pack has been developed specifically for the refrigerated container carrier and the terminal operator. It is capable of generating either 460V or 230V and can therefore supply power to all normal types of electrically powered refrigerated containers.

The Power Pack's two diesel generators supply power to 36 receptacles. The number of receptacles that can be used at any one time will depend on:

- 1 Ambient conditions.
- 2 The temperature range which must be maintained.
- 3 The electrical power demand of the type of refrigerated container being used.

The integral fuel tank has a capacity of 4523 litres (995 Imperial gallons, 1195 US gallons) enabling the Power Pack to operate for more than three days without refuelling.

Front Cover:

A Power Pack in use at Oakland, USA.

Right:

Loading a Power Pack on board a Sea Containers Deckship to provide additional reefer power points.

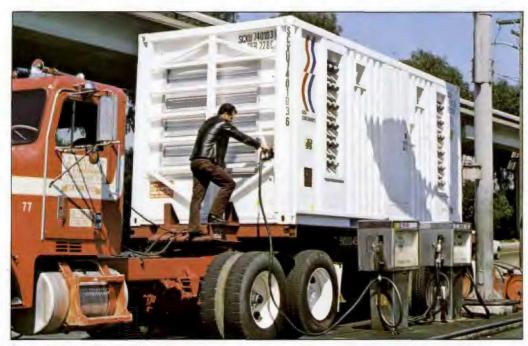




Moving a Power Pack to recently discharged 40ft refrigerated containers.



The Power Pack being moved by a straddle carrier.



Refuelling a Power Packer a standard chassis at an automobile service station.



A tunical terminal operation.



Starting

The generators are started by two heavy duty 24V DC batteries. These batteries are charged either by the generators when operating or the external 230V AC electrical supply system.

Operator Instruction

To ensure the best performance from the Power Pack, Sea Containers provide a thorough training programme in the operation of the unit. Operator instruction manuals are supplied.

Lubrication

A 94.6 litres (20.8 Imperial gallons, 25 US gallons) tank supplies lubricating oil to the engine sumps. Automatic level controllers maintain the correct engine oil levels at all times, particularly advantageous whilst operating at sea.

Diesel Generators

Two 4-cylinder turbo-charged diesel generators operate independently, each supplying 18 power receptacles (9 on each panel). Detachable exhaust pipes are stored within the container whilst it is in transit.

Internal Lighting

Internal lighting is provided from either of the two generators and the external 230V AC electrical supply system. The 24V DC batteries provide secondary lighting which will be turned off automatically by a time switch to prevent battery run-down.

Spare Parts

A comprehensive spare parts kit for which secure storage points are provided can be supplied with the Power Pack.

Fire Detection and Fire Fighting System

A fully automatic fire sensing and CO₂ drenching system is an integral part of the Power Pack.

In the event of a fire, sensors will automatically stop the diesel engines and shut the air intake and air discharge louvres. Following engine shut down the emergency alarm will sound and CO₂ drenching will begin.

1 Power Receptacle Panel

Each receptacle on both panels has its own interlocked circuit breaker for protection against overload and short circuit. The circuit breakers also ensure that the power output is switched off and on automatically as the power plugs are withdrawn or inserted. The receptacles will receive: 460V, 4 pin - 32 amp plugs, or 230V, 4 pin - 50 amp plugs. Different receptacles can be fitted to meet individual requirements.

2 Control Panel

A free standing control panel contains all the control and indication equipment of the electrical system and generator shut-down control. All indicators are easily visible from the side access door of the unit.

3 Electrical Power Input Requirement

When the Power Pack has not operated for a long period it may be necessary to supply electrical power from an external source. A socket is fitted to the outside of the Power Pack for receiving and distributing this power to:

1. the battery charger;

2. the engine water jacket heaters;

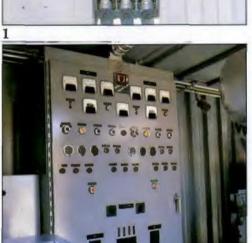
3. the anti-condensation heaters in the alternators, control cabinet and receptacle panels;

4. the internal lighting system;

5. the internal sockets for operating hand power tools.

230V AC power is required.

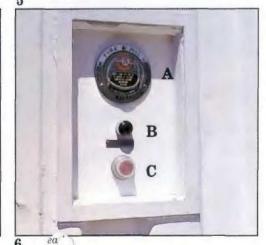












4 Methods of Refuelling

Two methods of refuelling the Power Pack are available:

A. From a tank container using an armoured hose fitted with quick release couplings. (This hose is supplied with the Power Pack.)

B. Through a filling pipe with a 3" BSP screw connection for refuelling by other methods.

5 Remote Monitoring

The Power Pack has its own remote monitoring system with a remote indicator box which can be positioned away from the unit in a location convenient for the operator. If any of the warning lights are activated on the remote indicator box an alarm will sound. There are four warning lights to indicate the following:

1. Generator shut-down. (The cause of the shut-down can then be established by examination of the control panel in the Power Pack itself.)

2. Low fuel level.

3. Fire.

4. Main circuit breaker trip.

6 Emergency Control Panel

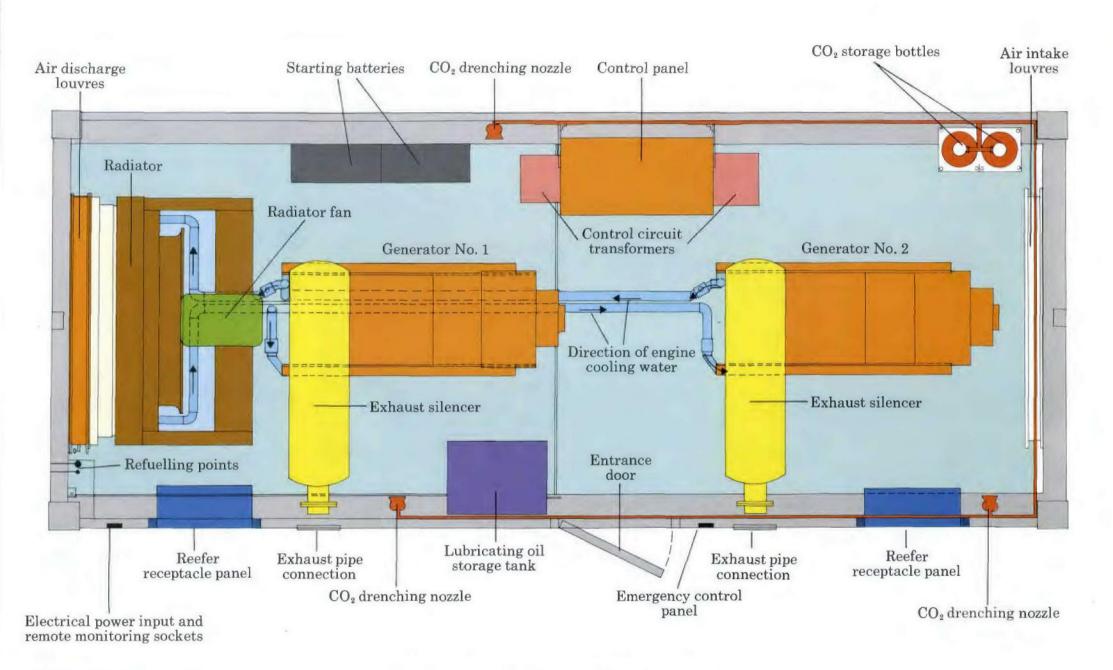
An external emergency control panel, next to the Power Pack's side access door, provides for the following:

A. Manual starting of the fire fighting system.

B. Indication that CO₂ has been discharged inside the Power Pack. (The operator must take suitable precautions before entering the Power Pack in this situation.)

C. Emergency shut-down of diesel generators.





The fuel tank covers the floor area.

GENERAL ARRANGEMENT PLAN

20'Power Pack Specification

Measurements	Length Width	mm 6058 2438	ft 19 8	in 10½ 0
	Height	2591	8	6
Weight (including bat without fuel and lubric with fuel and lubricati	eating oil	s) kgs 12038 15758	lbs 265- 347-	
Entrance One side door	Width Height	mm 711 2057	ft 2 6	in 4 9
Fork pockets One set – heavy lift	Centres Width Height	mm 2082 355 114	ft 6 1	in 10 2 41
Stacking	9 high at 2032	0 kgs, 44800 lbs	gross	
Approvals Container Engines Systems engineering Fire detection and fighting system	ISO 1496 – Lloyds – CSC Lloyds – batch and line Lloyds to USCG regulations and Lloyds witness test			
Exterior constructio Cladding End walls Side walls	Corrugated C Picture frame louvres at one other. Refuell lower part of Two separate	corten steel type, with air is e end and air dis ling points rece air discharge en receptacle pan nd engine exhau	scharge ssed on id. els, side	9
Roof	Flat Corten s			
Fuel and oil tanks Fuel tank Capacity Fuel draw	Litres 4523 3785	Imp Galls 995 833	1198	
Lubricating oil tank	pressure of 0-2 Litres	l accept a maxir 246 kgs/sq cm, 3 Imp Galls	·5 lbs/s US	q in. Galls
Capacity Diesel engines	94·6 20·8 25 2 water cooled GM Detroit 4/71T continuously rated at 165 BHP each at 1800 RPM.			

Exhaust outlets	A detachable exhaust pipe is provided for each of the two outlets on the door side of the container. These pipes project outside the ISO dimensions of the container and should only be connected when the generators are operating. Storage points are provided for them in the container.
Alternators	2 LIMA S.E.RR 100 KW. Prime duty brushless – self excited – externally regulated – drip proof enclosure – class F insulation.
Lubrication	By wet sump. Storage tank 94.6 Litres (20.8 Imp Galls, 25 US Galls). Transfer of lubricating oil to engine sumps by automatic level regulators.
Cooling system	Copper and brass core radiator, with dual speed 7.5 HP electric fan. The fan speed is controlled by a temperature thermostat in the radiator inlet pipe. The system is permanently filled with a 50/50 anti-freeze and water mixture.
Power output	Constant rating with a 110% overload capability for 1 hour. Each generator provides a constant independent output of 124 KVA at 0.8 PF giving a total power output of 248 KVA at 0.8 PF at 50°C. The generators operate independently and cannot be run in parallel. The neutral point is not earthed.
Voltage output	460 V 3 phase 60HZ. Each generator can be converted to give 230 V 3 phase 60HZ.
Power outlet	Two panels, each with 18 receptacles. Each generator supplies nine receptacles on each panel.
Receptacles	Each receptacle is fitted with an interlocked circuit breaker incorporating overload and short circuit protection. Receptacles to most standards can be made available upon request.

Ambient condition operating range	-20°C (-4°F) to +50°C (+122°F)		
Fuel consumption One generator kgs/hr lbs/hr	Full load 23.5 51.7	Half load 15·1 33·3	
Litres/hr Imp Galls/hr US Galls/hr	28·8 6·3 7·6	18·6 4·1 4·9	
Fuel type	Diesel oil to BS 2869 (1970). Class A1 or A2 only.		
Remote monitoring	supplied with a co 30.5 metres (100 for The panel gives a	visual and audible f the following events: t-down	
Auxiliary services Emergency lighting, fed switched on in the event	external 230V sin supply can be con following: 1. Battery charge 2. Engine water j 3. Anti-condensa alternators, coreceptacle pan 4. Internal lighti 5. Hand power to off the 24V DC sta	acket heaters tion heaters in the introl cabinet and els ng ol sockets rting batteries, can be	
Fire detection and fighting system 1. Automatic operation	detection and CO the event of fire, t shut-down and air discharge louvres	a drenching system. In he diesel engines will intake and air will close. An alarm ortly thereafter CO ₂	
2. Manual operation	An emergency fire container on the p activates the syst	e handle outside the panel next to the door em.	
An external warning lig	nt indicates that C	O_2 has been discharged	

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ecognized by the professional container lines as the preferred unit for reefer container leasing, SeaCold is also available for sale from Sea Containers - the innovative giant of the container leasing industry.





Hapag-Lloyd

SeaCold reefers are in use with major shipping lines worldwide.

Background

After fifteen years' experience in operating proprietary reefer equipment, Sea Containers realised it could get better results by designing its own integral refrigeration units. Employing leading consultants in the USA and UK to back its own expertise, Sea Containers designed SeaCold to meet parameters which set performance and reliability above all else.

Manufacture

SeaCold has now been in production for over four years by Singapore Marine Containers Pte Ltd, a Sea Containers' group company. With thousands of units operating in the field and with demand increasing, SMC has recently moved to a larger 10,000 sq m factory site, where the worldwide parts organisation is based. SeaCold units are produced at the rate of 200 per month.

Purchase and lease

Container lines can now buy fully field-tested SeaCold units for their base requirements either alone, for fitting into their preferred containers, or as complete reefers. They can then lease identical equipment from Sea Containers' huge fleet to meet temporary increases in market demand. Common reefer equipment means simpler operation, lower spares inventories and easy servicing.

Design concept

Designed for truly international use, SeaCold can operate reliably in any part of the world on land or at sea and can control the environment inside a container to protect all perishable cargoes.

This is achieved by:

- High performance
- Accurate temperature control
- Durability and reliability
- Wide operating range
- Ease of operation and service
- Extensive technical support
- Worldwide spares availability

full width inclined evaporator coil with a surface area of 27 square metres and twin centrifugal fans

provide ample capacity even in equatorial environments.

A special model for 20ft containers is available, with a 5 HP two cylinder compressor and lower output fans which match precisely the lower demands of the 20ft box, resulting in better control of cargo temperature and significant power savings.

Temperature control

A unique two stage combination of compressor capacity reduction and fine control by modulated injection of hot gas into the evaporator enables SeaCold to hold air temperatures to within ± 0.2°C of set point. Thus, delicate commodities can be safely transported without risk of chill damage. The solid state electronic controller constantly monitors temperature and responds quickly to minute changes to achieve this outstanding accuracy of control.

Durability

Many years of operating experience all over the world showed considerable scope for extending the life of reefer machinery.

The SeaCold frame structure is wider and more robust so that it

comfortably exceeds ISO racking and vibration standards.

Copper/aluminium finned condensers deteriorate through corrosion after about five years service: so a special all copper coil is used which will last the useful life of the unit. Similarly, all fan blades and shafts are made from stainless steel as lesser materials can fail prematurely.

All refrigeration valves are constructed with non-ferrous components to avoid corrosion problems, while the frame and all external structural components are painted with a sophisticated protective coating system. GRP, which is non-corroding, is used extensively for non-loadbearing parts and its lower conductivity also improves the unit's insulation.

Reliability

SeaCold is already an established standard in the reefer container world. Continuous flow line production, a dedicated and conscientious workforce and ruthless quality control throughout is the formula for consistency of production. For example, all SeaCold temperature sensors are 100% tested prior to

factory calibration to achieve identical settings from all three components. In addition:

- all threaded fasteners are tightened under torque control.
- all compressors are trial run to prove performance, output and oil pressure readings.
- all motors have class F insulation and are rated for continuous duty.
- all motors have overload protection.

Operating range

SeaCold can operate anywhere in the world within an ambient temperature range of -40° C to +52°C. It will continue to operate reliably in extreme marine environments, even under attack from salt spray and vessel movement in storm force winds.

To extend its flexibility still further, a water cooled condenser can be fitted for use under deck and a transformer and cable for low voltage operation are also available as optional extras.

Ease of service

SeaCold was designed with major input from the team of Sea Containers service engineers to

ensure that the machinery is simple to put into service and easy to maintain.

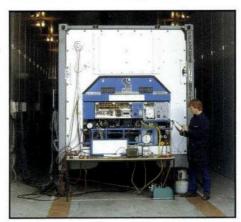
Drop down doors over the electrical and control equipment compartments give convenient access to components at working level; servicing is further assisted by an easy-toread wiring diagram used in conjunction with colour coded and individually numbered electrical cables throughout.

Technical support

A team of experienced service engineers is employed full time to give support to SeaCold in the field. Whether it be training courses for new operation, advice on cargo stowage or any untoward problem in operation, an engineer is on hand to assist 24 hours a day.

Spare parts

In advance of its release on to the market, millions of dollars worth of spare parts for SeaCold were distributed into key depots around the world to ensure global availability of SeaCold spares and service. This support remains totally comprehensive.



Left and inset A new, bigger factory in Singapore has been acquired to increase production of SeaCold units.

Above Sea Containers' own thermal test chamber is used to verify SeaCold performance.

Above right SeaCold units are supplied complete and ready for installation into containers.

Right Drop-down doors provide easy access to simplify both installation and service.







A 7.5 HP three cylinder compressor, a



sivomar

SeaCold system layout

Unit depth

SeaCold depth of 360 mm is the minimum consistent with high performance.

Fan motors

Identical motors and fans are used on both evaporator and condenser to simplify servicing.

Return air control and recorder sensors

Control and record temperature in the frozen mode.

Thermostatic expansion valve Meters precise quantities of refrigerant into the evaporator to

Heating elements

match demand.

Radiate 4.5 kW for rapid defrost of evaporator coil and for maintaining container temperature in the heating mode.

Evaporator coil

Full width inclined coil gives maximum cooling performance in minimum volume.

Fresh air vents

Allow unwanted gases to be ventilated from sensitive cargo.

Gas sampling point

Allows internal atmosphere to be monitored.

Condenser coil

All copper tubes and fins last the life of the unit.

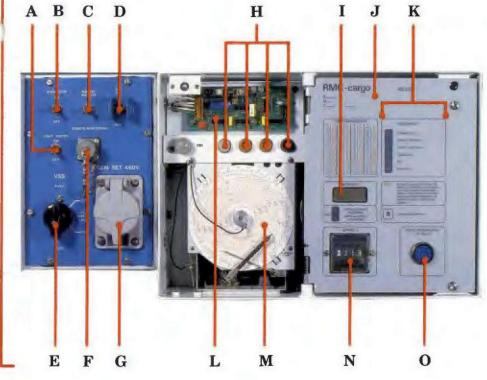
Supply air sensor

Controls temperature in the chilled mode.

A SeaCold reefer carrying delicate fruit under precise temperature control.



Control compartment



Manual controls

- A Indicator lights on/off switch
- B Start/stop switch
- C Manual defrost switch
- D Power saving switch
- E Voltage selection switch
- F Remote monitoring socket
- G Generator set receptacle

Controller/recorder

- H Status indicator lights
- I LCD read-out of temperature
- J RMC controller
- K Control system indicator lamp panel
- L Defrost timer
- M-Partlow 31 day recording chart
- N Set point selector
- O Check instrument socket

Hot gas modulating valve

Meters precise quantities of hot gas into the evaporator to achieve ± 0.2°C control of set point.

Receiver/water cooled condenser

The receiver is standard and an optional condenser for under deck use is available, fitted with Hansen quick connectors for water supply and return.

Filter drier

Removes moisture and other contaminents from the liquid refrigerant.

Liquid line sight glass

Indicates presence of moisture in the refrigerant and system.

Compressor

Copeland semi-hermetic unit, fully proven with over 10 million in service.

40ft: 7.5 HP, three cylinder; 20ft: 5.0 HP, two cylinder.

Liquid quench valve

Ensures that the compressor receives adequate cooling gas at all times.

Suction control valves

Give staged capacity reduction in the chilled mode.

A 40ft SeaCold being discharged from a Barber Blue Sea vessel in Houston, Texas.



Specifications

		20ft container	40ft container	
1.	Model S-98-4-	010A series	009 series	
2.	Description	All electric, picture frame, thin line refrigeration/heating units.		
3.	Unit depth	360 mi	m (14·17ins)	
4.	Net weight	645 kg (1422lb)	655 kg (1444lb)	
5.	Compressor		3 cyl.7·5 HP uction-cooled, hermetic	
6.	Refrigerant	Freon R12	2 5·4 kg (12lbs)	
7.	Power source with optional transformer	360/460v 3 phase 50 Hz 400/500v 3 phase 60 Hz 180/230v 3 phase 50 Hz 200/250v 3 phase 60 Hz		
8.	Cooling capacity* at 50 Hz, 0°F (-17.8°C) return air temperature, 100°F (38°C) ambient Electrical power	10325 BTU/hr 2600 K/Cal/hr	11905 BTU/hr 3000 K/Cal/hr	
	consumption	5-0 kW	6.6 kW	
9.	Heating capacity Including evaporator fan heat	20000 BTU/hr 5040 K/Cal/hr 5·86 kW		
10.	Evaporator fan performance at 60 Hz 12·7 mm (0·5 ins) WG	3144 cu m/hr (1850 cu ft/min)	4250 cu m/hr (2500 cu ft/min	
11.	Fresh air make-up at 50 Hz (0 mm) 0 ins WG	100 cu m/hr (59 cu ft/min)	150 cu m/hr (88 cu ft/min)	
12.	Temperature control	RMC solid-state electronic controller, range -29.9°C to 29.9°C (-21°F to 86°F)		
13.	Temperature recorder	Partlow 31 day chart, range -29·9°C to 26·5°C (-21°F to 80°F)		
14.	Remote monitoring	Receptacle equivalent to MS 3102R-14s- 2S with waterproof cap.		
15.	Diesel generator receptacle	to accept power from Clip-on Generating Set. Receptacle to accept 534 FP plug.		

^{*}Performance is measured with SeaCold fitted to an ISO container: these figures would be enhanced by approximately 20% if taken under laboratory conditions.

These average measurements and values are measured on the basis of three production units out of each series. Actual measurements and values and other details may vary from those shown.

SeaCold unit description

The SeaCold unit is an all-electric, slimline integral refrigeration and heating unit. designed to control temperatures from -29.9°C (-21°F) to $+29.9^{\circ}C$ ($+86^{\circ}F$) inside an insulated ISO container.

Modes of operation

1.Frozen mode

Using its full refrigeration capacity, SeaCold controls temperatures in the container down to -18°C (0°F) to within 0.5°C.

2. Chilled mode

On reduced capacity, SeaCold controls set point temperatures above -4.5°C (24°F) to within 0.2°C.

3. Heating mode

The refrigeration cycle shuts off and heat from the evaporator fan and the six resistance heaters (either separately or together dependent on demand) supply heat to the container.

4. Defrost mode

The evaporator coil is automatically defrosted at pre-selected intervals by closing down the refrigeration cycle and switching on the heating elements; the defrost mode terminates automatically when the coil is free of ice.

SeaCold operation

Cooling of the container is achieved by blowing air through the evaporator coil, whose temperature is reduced by the simultaneous evaporation of liquid refrigerant (R12) inside the coil.

The refrigerant gas is passed to the compressor which raises its pressure and temperature, and thence to the air cooled condenser which removes both the heat received by the evaporator and the heat gained on compression, returning the refrigerant in liquid state to the receiver ready for the cycle to be repeated.

In the frozen mode, the solid state electronic controller senses air temperature returning from the container and switches the compressor on and off to maintain set point.

In the chilled mode, as set point is reached, the controller compares delivery air temperature with set point and when they are equal, the

controller signals the suction solenoid to reduce the capacity of the compressor. At the same time the controller signals a high resolution modulating valve that meters small quantities of hot gas into the evaporator to balance accurately any excess cooling capacity.

Should the temperature of the gas entering the compressor become excessive, small quantities of liquid refrigerant are metered into the gas stream via the liquid quench valve to cool the compressor.

SeaCold is supplied complete with

- All-copper condenser coil
- Power-saving switch
- Fresh air make-up vents
- LCD digital display of supply or return air temperatures
- Extra deep oil sump on compressor
- Remote monitoring receptacle
- CO₂ sampling point ■ In/out range status indicator lights
- Automatic phase correction
- Receptacle for clip-on diesel generator set
- Voltage selection switch ■ 18m power supply cable
- Stainless steel fans
- 31 day chart recorder
- Automatic defrost
- Filter drier
- Full charge of refrigerant

In fact, SeaCold comes ready to put into full scale operation after commissioning.

Optional extras include:

- Water cooled condenser
- Transformer and cable for dual voltage operation
- Hour meter

Approvals

SeaCold units are designed and manufactured to satisfy the world's most stringent regulatory standards and, when fitted to containers, are available to satisfy the following approvals.

American Bureau of Shipping (ABS) ATP-EEC Inland Transport Committee Bureau Veritas

Lloyd's International Standards Organisation

European Railways (UIC) Customs (TIR) Convention for Safe Containers (CSC)

Australian Department of Quarantine (Timber Treatment) Australian DPI regulations for carriage of chilled meat New Zealand noise requirements Food industry standards certified by

Classification Society for Taint Sprenger Institute for fresh air

ventilation

Delivery

SeaCold is in continuous, volume production at Singapore Marine Containers' modern factory, usually enabling Sea Containers to offer very early delivery of refrigeration units or complete reefers in either 20ft or 40ft modules.

Other equipment from Sea Containers

SeaCold is a registered trade name of Sea Containers Ltd, one of several registered designs of specialized containers including SeaVent 20ft ventilated containers and SeaDeck a combined 40ft collapsible flat rack and platform flat. Other specials in

Sea Containers' 300,000 TEU fleet include Tank containers, Open Tops, Half Heights, Flats, Flat Racks and Bulks as well as containerships, container cranes, chassis and related equipment - all of which are available for lease.



Above Loading a SeaCold reefer with dairy produce for shipment to Eastern Europe.

Below Final commissioning of SeaCold reefers purchased by a major European shipping line.



Regional offices

UK, Scandinavia, Europe, Africa, Middle East, India, Pakistan, Bangladesh, Sri Lanka and South America Sea Containers Services Ltd. Sea Containers House 20 Upper Ground London SE1 9PF England Tel: (01) 928 6969 Telex: 8955803

South East Asia and the Far East

Sea Containers Asia Ltd. 3201 Connaught Centre GPO Box 701, Hong Kong Tel: (5) 224191 Telex: 74017

USA, Canada, Mexico, Central America and the Caribbean Sea Containers America Inc. 1155 Avenue of the Americas New York, NY 10036, USA Tel: (212) 302 5066 Telex: RCA 235416

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Sea Containers Australia Ltd. Unit 12, Pymble Grove 33 Ryde Road, PO Box 457 Pymble, NSW 2073, Australia Tel: (612) 498 8088 Telex: 25776

Printed in England 5m.2/86 Score Print.

Sea Containers is represented by offices and agents in over 60 countries.

Factory

Singapore Marine Containers Pte Ltd 7 Tuas Avenue 3 Jurong Industrial Estate Singapore 2263 Tel: 8621116 Telex: 39501

Sea Containers Office/Agent		
*		

OFFICE MEMORANDUM

DATE:

December 16, 1986

TO:

Distribution

FROM:

Graham Smith, Acting Head, Policy Unit

EXTENSION: 61709

SUBJECT: Visit to ICAO Headquarters, Montreal, December 8, 1986

1. On December 8 a delegation of seven Bank staff members visited the headquarters of the International Civil Aviation Organization in Montreal, to familiarize ourselves with ICAO's activities and see how the Bank could make use in our operations of the services ICAO offers. Our visit suggested that ICAO is in fact both able and willing to be useful to us in several ways that are not at present being exploited to any significant degree.

- Three areas are good candidates:
 - (a) ICAO's computerized roster of aviation technical assistance experts (individual consultants)
 - (b) their Civil Aviation Procurement Service (CAPS)
 - (c) documentation and statistics.

Experts Roster

- 3. ICAO has some 5,000 individual consultants in their data base, in a system similar to our DACON roster. The Bank has recently used it three times to find short-term consultants, with good results: they came up with the right man for the job each time. Two of these assignments were for people to join a Bank team undertaking a sector work mission (Turkey and Cyprus); the third a project preparation facility (Guinea SAL, which has an airport component).
- An issue arises as to the basis on which the Bank should have access to this service. ICAO's Technical Assistance Bureau has to be financially self-supporting, and is used to supplying consultants direct to governments with UNDP (or other financing source) paying a commission of 13% on the expert's entire costs: salary plus travel and per diem. In contrast we are used to making our own travel arrangements for consultants and paying actual expenses rather than per diem. Also as regards precedents, the Bank makes its DACON roster available to UNDP and other UN Specialized Agencies without fee. For sector work missions, there are obvious disadvantages if a consultant does not regard himself as a member of the Bank team (staying in a different hotel, acting independently of the mission leader, etc.). On the other hand the fees that ICAO typically pays (about US\$250 per day) are low by our standards, and the 13% compares very favorably with the overhead charged by consulting firms.

- The best arrangement for us might be to agree with ICAO on a standard lump sum finder's fee, on the understanding that the Bank assumes responsibility for all administrative arrangements (including paying the consultant directly). Feedback on this proposal would be welcome. John Lethbridge as Aviation Adviser is the man to speak to.
- ICAO procures aircraft, air traffic control equipment, navigation aids and other aviation-related equipment on behalf of member governments, taking advantage of both its expertise in evaluating technically sophisticated specifications to ensure good quality and its market power to achieve lower prices than a small occasional buyer could obtain. It does not bind itself to accept the lowest bid. It charges a 6% commission on orders worth US\$10,000 \$100,000. On larger contracts it charges 6% on the first \$100,000 and 4% on the remainder up to \$500,000, and 1% on any remainder above \$500,000 up to \$5,000,000. On contracts exceeding \$5,000,000 charges are negotiated. They also perform inspection and reception testing services and prepare detailed specifications at a charge of 1-3%, and prepare detailed design for systems at a charge of 2-5%.
- 7. Their procedures and requirements are set out in a small manual available in English, French and Spanish. I brought back a copy of each.
- 8. This service has been used at least once in recent years for equipment financed by a World Bank loan, namely the Bolivia Aviation Project. Its availability may make it feasible to include minor aviation components in mixed-mode transport loans, even though we have no technical capability for supervision in-house.

Statistics and Documentation

9. The Technical Assistance Bureau deals primarily with individual countries. The remainder of the organization, known as the regular program, deals primarily with international conventions on technical standards, laws and pricing. It publishes many reports on these topics, as well as statistics on international aviation. We will arrange for the Bank's Sector Library to keep informed of ICAO publications. Attached is a list of those we brought back.

GSmith:psc

Distribution:

cc: Transport Division Chiefs and Deputies Messrs. Boya, Cheryan, Hansen, LeBlanc, Van Der Ven, Weckerle

ICAO Publications Brought Back (Available in World Bank Sector Library)

1. "Catalogue of ICAO Publications, 1986 edition".

Consultants roster

 "Directory of Occupational Classifications and Job Descriptions for ICAO Technical Assistance Field Personnel".

Equipment procurement

- 3. "Civil Aviation Purchasing Service"
 - (a) English
 - (b) French
 - (c) Spanish

Statistics

- 4. "Civil Aviation Statistics of the World, 1985".
- 5. "Manual of the ICAO Statistics Programme (Third Edition 1984)".

Technical Studies

- "Regional Differences in Taxes, Rates and Costs for International Air Transport, 1984".
- "Survey of International Air Transport Fares and Rates, September 1985".
- 8. "International Air Passenger and Air Freight Transport, Asia and Pacific."

Working Papers

- Working papers on the current status of noise standards for civil aircraft. (Reports to the Executive Committee of the 20th Session of the ICAO Assembly, July 1986).
- 10. "Abusive Use of Computer Reservation Systems", working paper for Panel of Experts on the Machinery for the Establishment of International Fares and Rates, Ninth Meeting, Montreal, 24 November - 5 December 1986.

General publicity brochures

- 11. "Memorandum on ICAO (The Story of the International Civil Aviation Organization)".
- 12. "Development and ICAO".

ICAO Officials Met

Yves Lambert

Secretary General

Technical Assistance Bureau

Kenneth Wilde Chief, Field Operations Branch
Russell Robinson Chief, Management Support Office
M. H. Foley Chief, Field Personnel Section
R. Sergerie Chief, Field Recruitment Unit
Arnold Schwatschko Chief, Procurement Section

Air Transport Bureau

Vladimir Zubkov Director

John Gunther Economist (Policy and Regulation)

Richard Smithies Economist

ICAO Visit - Dec. 8

Mr. Weckerle (OED) Ext. 32916 - Is returning on Presidential 149 flight

Mr. Boya (WA2), Ext. 74562 - Is leaving Montreal on Eastern flight at 5 pm. & changing in La Gardia as he wants to arrive at Nat'l Airport in Washington.

Messrs. Neuner & Einthoven NOT going

Mr. Le Blanc (AEP), 61227, will be staying an extea day.

J. van der Ven (AEP), 61225, will change to Presidential 149 flight, if a limo is laid on to Mirrablelle Airport.

P.O. Che ryan (EMP), 32568, is taking Presidential 149 flight to return to D.C.

H. Hansen (WAP), 74814, is taking Presidential 149 flight to return to D.C.

I've told them to meet at the ground floor level of the ICAO offices at 8.50 am. on Monday morning.

Roller Compacted Concrete Used in Dam Construction: Friday, December 5, 10 a.m. to noon, Rm. D-658. Messrs. Price and Moler of Morrison-Knudsen Company will discuss design, construction and economics with reference to alternative methods illustrating the theme with case histories of projects designed and constructed by M-K. Applicability to the developing country environment will be considered. Sponsor: EGYPA.

Visit to International Civil Aviation Organization's (ICAO) Headquarters:

Monday, December 8. The management and staff of ICAO are planning a full-day seminar to introduce Bank staff, who work in the transport sector and require assistance in aviation-related issues, to the capabilities and information resources of ICAO. IACO's offices are located in Montreal, Canada. Anyone interested in attending this seminar should call Helen Frost, Ext. 61667, as soon as possible.

"Low Input Agricultural Development—A Nepal Case Study": Tuesday, December 9, 12 noon to 2 p.m., Society for International Development (Board Room). Dr. Richard Harwood, a farming systems expert and Deputy Director of Winrock International, will discuss his experiences with this project in the context of his broader experiences with low input agriculture. Assorted sandwiches and soft drinks will be provided at \$6 for SID members, and \$8 for non-members. Advance reservations and payment are required. Send check payable to SID Office, by Friday, December 5, 1401 New York Ave., N.W., #1100, Washington, D.C. 20005.

Higher Education and the Markets for Educated Labor in LDCs--Recent Theoretical Approaches and Implications: Tuesday, December 9, 12:30 to 2 p.m., Rm. N-955. Professor Ake Blomqvist, University of Western Ontario, Canada, will review recent theoretical developments in the literature of the economics of labor markets and discuss their implications for the analysis of educational policies in developing countries. A draft copy of the paper is available from Teresa Hawkins, Ext. 61638. Bring your lunch. Sponsor: EDTRS.

"Effects of Budget Deficits on the World Economy"--Monthly Seminar in the Frontiers of Economics Series: Tuesday, December 9, 2:30 p.m., Eugene Black Auditorium, (C-1114). Jacob Frenkel, Professor of Economics, University of Chicago, who will become the designated Economic Counselor and Director of Research, IMF, January 2, will discuss his most recent work on fiscal policies in world economy. A background paper is available from Jennifer Meade, Ext. 69738. Sponsors: CPD and WAN.

Two-Stroke, Slow-Speed, Diesel Engines: Wednesday, December 10, 10 a.m. to noon, Rm. D-658. A team of engineers, a fuel specialist and a specialist in the economic and commercial operation of engines made by Burmeister and Wain will give a presentation based on operating experience of this type of plant in land-based installations. There will also be a discussion of this plant in comparison with medium-speed engines made by MAN (B+W Associates). Sponsor: EGYPA.

Construction Contract Management--Claims Avoidance: Wednesday, December 3, 2 to 4 p.m., Rm. E-1244. Senior Managers from High Point Services Group and Hill International, international firms in construction contract management, will describe common situations leading to construction claims and how they can be avoided. The presentation will include cases relevant to procurement specialists, project officers, and lawyers. A discussion will follow. For handout materials and more information, call Central Procurement Unit, PPD, Ext. 76921. Sponsor: PPDPC.

Political Economy of Structural Adjustment and Sustainability of Reform—an EDI Workshop: Wednesday through Friday, December 3, 4, and 5, Rm. C-1006. Edward V.K. Jaycox, ESAVP, will address the opening session and Wilfried P. Thalwitz, WANVP, will give a presentation at the closing session. Twelve political science experts (Africanists), based in the U.S., will participate. If you wish to attend the workshop and for copies of the papers, call Sofia Mendoza, Ext. 73471/2. Sponsor: EDI.

A number of simultaneous presentations will be given by the Irish Export Board (CTT): Thursday, December 4, 9 a.m. to 5:30 p.m., Rms. D-1356 and C-1114. The topics to be discussed will include institutional development, agricultural services, education and training, infrastructural development, transportation and energy. For more details and a program, call Ext. 76538. Sponsor: EDS.

Research and Development in Latin America: Thursday, December 4, 10 to 11:30 a.m., Inter-American Development Bank (1300 New York Ave., N.W.). All LAC Projects and Programs staff are invited. The presentation, given by Rhone-Poulenc Agrochimie, the largest agro-chemical company in Latin America, will include discussions on crop protection, the environment and crop diversification. A shuttle bus will be provided from 1818 H Street at 9:30 a.m., and will return to the Bank at noon. Sponsor: AGRDR.

Pacific Petroleum Supply Model: Thursday, December 4, 2 to 5:30 p.m., Rm. H-3-230. The Energy Department will demonstrate a Petroleum Supply Model which was prepared during the petroleum supply study of the South Pacific to assist in developing low-cost petroleum supply and transport options. The model was developed for the World Bank by the Policy Modeling Workshop of the Wharton School, University of Pennsylvania. For more information, call Zia Mian, Ext. 76273. Sponsor: EGYS1.

Recent Developments in Power Tariffs--Spot Pricing: Thursday, December 4, 2:30 p.m., Rm. I-3-080. Dr. Richard Tabors of the Energy Laboratory, Massachusetts Institute of Technology, will be the speaker. Spot pricing is the natural extension of traditional marginal cost pricing principles. It is becoming an increasingly implementable approach, given continuing advances in solid state metering, switching, and telecommunications equipment. It has considerable relevance to power interchanges, system control and load dispatch, load management, and in providing precise price signals to consumers. Sponsor: EGYPA.

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INFORMATION AND RESOURCE TECHNOLOGY

Disaster Planning for Burroughs Systems: Tuesday, December 2, 2 p.m. (approximately 2 hours). Intended for managers and users with responsibility for application systems support. This seminar will present the disaster recovery plan for the Burroughs mainframes, and will discuss the alternatives

SEMINARS AND TRAINING

"Ten Meter Detail"--A Closer Look at the Earth Through SPOT Imagery: Tuesday, November 25, 9:30 to 11 a.m., Rm. E-1244. As part of the Land Information Systems (LIS) Short Seminar Series, a presentation will be made by staff from SPOT Image, Toulouse, France, on preliminary results from the French SPOT satellite launched earlier this year. The discussion will focus on applications to agriculture, irrigation, hydrology and urban areas. For more information, call John McKenna, Ext. 76526. Sponsors: PPDES/AGR/WUD.

Preshipment Inspection Services--SGS Experiences in Preventing Illegal Capital Flight: Tuesday, November 25, 2:30 to 4 p.m., Rm. N-550. Oscar J. Kneubuehler, Executive Vice President, and Fred J. Herrin, Vice President of Societe Generale de Surveillance, will speak and answer questions about SGS experiences--how to avoid over-invoicing, and the implications for World Bank SALs and project procurement. For more information, call Gene Tidrick, Ext. 61078. Sponsor: CPDDR.

Natural Resource (Environmental) Assessment in Country and Project Planning—IUCN's Global Conservation Data Base: Wednesday, November 26, 11:30 a.m., Rm. H-5-160 (brown-bag). The Conservation Monitoring Centre of the International Union for the Conservation of Nature and Natural Resources will give another on-line computer demonstration accessing its comprehensive database on major international wildlands and protected areas, endangered and threatened species, and their habitats. If you missed the first demonstration, this is your opportunity to learn firsthand about this useful and readily available tool for project environmental planning and the preparation of CPPs. For more information, call Robert Goodland, Ext. 75341. Sponsor: PPDES.

Framework for Analyzing Portfolio Substitution and Revenue Effects of Differentially Taxed Capital Income: Tuesday, December 2, 2:30 p.m., Rm. A-530. Jacob Dreyer from the Congressional Budget Office will analyze the different classes of capital income which are often subject to different statutory and effective marginal tax rates affecting pre-tax returns and the size of governments' tax revenues. Sponsor: INDFD.

Construction Contract Management--Claims Avoidance: Wednesday, December 3, 2 to 4 p.m., Rm. E-1244. Senior Managers from High Point Services Group and Hill International, international firms in construction contract management, will describe common situations leading to construction claims and how they can be avoided. The presentation will include cases relevant to procurement specialists, project officers, and lawyers. A discussion will follow. For handout materials and more information, call Central Procurement Unit, PPD, Ext. 76921. Sponsor: PPDPC.

Political Economy of Structural Adjustment and Sustainability of Reform—an EDI Workshop: Wednesday through Friday, December 3, 4, and 5, Rm. C-1006. Edward V.K. Jaycox, ESAVP, will address the opening session and Wilfried P. Thalwitz, WANVP, will give a presentation at the closing session. Twelve political science experts (Africanists), based in the U.S., will participate. If you wish to attend the workshop and for copies of the papers, call Sofia Mendoza, Ext. 73471/2. Sponsor: EDI.

subsidies, and the options for policy change to reduce fiscal costs and/or increase the benefits for the poor. A paper will be available at the seminar. Sponsor: AGRES.

Occupational Roundtable--Economists in the Bank and IFC: Thursday, November 20, 3 to 4:30 p.m., Rm. H-2-300. Panelists Basil Kavalsky, Nissim Ezekiel, Guy Pfeffermann, Salem Gafsi, Carlo Castelli, Mansour Farsad, and Michael Sharpston, will open a discussion on careers of Economists in the Bank/IFC. The discussion will include views and issues about opportunities, trade-offs, responsibilities and trends. A question-and-answer session will follow. To reserve a space, call Jim Carey, Ext. 75725. Sponsor: CIC.

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A number of simultaneous presentations will be held in cooperation with the Irish Executive Director's Office: Thursday, December 4, 9 a.m. to 5:30 p.m., Rms. D-1356 and C-1114. The topics to be discussed will include institutional development, agricultural services, education and training, infrastructural development, transportation and energy. For more details and a program, call Ext. 76538. Sponsor: EDS.

Visit to International Civil Aviation Organization's (ICAO) Headquarters:

Monday, December 8. The management and staff of ICAO are planning a full-day seminar to introduce Bank staff, who work in the transport sector and require assistance in aviation-related issues and problems, to the capabilities and information resources of ICAO. IACO's offices are located in Montreal, Canada. Anyone interested in attending this seminar should call Helen Frost, Ext. 61667, as soon as possible.

SEMINARS AND TRAINING

Land and Water Resources Management: daily through Friday, November 21, 9:15 a.m. to 12:15 p.m., and 1:45 to 4:45 p.m., Rm. G-1070. Executive Directors, Bank, Fund and Inter-American Development Bank staff are welcome. If you wish to attend any of the sessions, call Seminar Directors E. Zimmer-Vorhaus and Jacques Kozub, or Seminar Secretary Lucienne Orosch, Ext. 75420. Sponsor: EDI.

Finnish Mining Technology Seminar: Tuesday, November 18, 9:30 a.m. to 5 p.m., Rm. I-4-270, and Wednesday, November 19, 10 a.m. to 5 p.m., Rm. N-550. The seminar will be given by the Embassy of Finland and the Finnminers Association. For more information and reservations, call T. Beltran, Ext. 72725. Sponsor: IND.

Private Sector Power Generation--Recent Developments in Northern Ireland:
Tuesday, November 18, 11 a.m., Rm. E-855. Keith Palmer, N.M. Rothschild & Sons
Ltd., London, will discuss the financing and other related issues of the
operation of a lignite-fired mine mouth power plant in Northern Ireland. For
more information, call Ext. 72293. Sponsor: EGYPA.

"Agricultural Policy Reform in Latin America": Tuesday, November 18, 12 noon to 2 p.m., Society for International Development (SID) (Board Room, 1401 New York Ave., N.W., Suite 1100). Dr. J.B. Penn, President of Economic Perspectives, will be the speaker. Assorted sandwiches and soft drinks will be provided at \$6 per person. For further information and reservations, call Bobbie van Haeften, 653-8685.

"The View from the Department of the Treasury": Tuesday, November 18, 5 p.m., The Madison Hotel (Executive Chambers, 15th and M Streets, N.W.). The Washington Center of The Asia Society invites Bank staff to a lecture in its "Washington Perspectives on Asia" series to delivered by The Honorable James Baker III. Cost: \$7 for Asia Society members; \$10 for non-members. For reservations, call 387-6500.

Soil Bioengineering: Wednesday, November 19, 11 a.m., Rm. H-2-300. Robin B. Sotir, President of Soil Bioengineering Corp., will be the speaker. Soil bioengineering is an applied science which combines mechanical, biological, and ecological concepts to construct living structures for erosion, sedimentation and flood control, using native plants as the major structural components. The final objective is to cause the land to become its own self-supporting structure. For copies of articles on the subject, call William Beattie, Ext. 75247. Sponsor: LCPAB.

AGRES Brown-bag Lunch-"The Costs and Benefits of Consumer Food Subsidies in Developing Countries: Thursday, November 20, 12 noon, Rm. N-1121. Dr. Per Pinstroup Andersen, Director of the Food Consumption and Nutrition Program at the International Food Policy Research Institute (IFPRI), will be the speaker. His presentation will address the economic and political issues of food

INLAND WATER AND COASTAL BARGE TRANSPORTATION

Review of An Underutilized Mode of Transport With Major Potential for Developing Countries

Ernst G. Frankel Massachusetts Institute of Technology

Prepared for the International Bank for Reconstruction and Development

November 12, 1986

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INTRODUCTION

Inland water transportation is the least expensive transportation mode for bulk commodities in terms of costs/ ton mile, energy consumption/ton mile, and requires rather inexpensive interface/terminal operations. As a transport mode it allows quite flexible operations and demands comparatively low investment costs and low maintenance and operating skill requirements. Inland water transport has revived in recent years.

In the U.S. and Western Europe for example, inland water transport use grew by 7.8% and 6.6% compounded annually in ton-miles between 1978 and 1985, more than double the growth rate of road transport or three times that of rail. It is interesting to note that inland water transport also provided a large percentage of transport requirements in Africa where 39% of ton miles of material goods transport was by inland water in 1955 before independence. Today though less than 6% of ton-miles in African freight transport are provided by inland transportation.

Inland water transport ton-miles have doubled in the U.S. between 1970 and 1985 and now amount to over 300 billion ton-miles. Similarly Chinese and European inland water transport has grown by 85% and 112% respectively during that period. At the same time inland water transport in developing countries continues to decline, and has all but vanished in countries such as Brazil, Nigeria, Egypt, and India. On the other hand it does maintain an important role in Zaire, Bangladesh, and Thailand. It is the purpose of these notes to describe inland water transportation and coastal shipping technology and operations.

Inland water transportation requires less energy per ton-mile than any other method of transport (350-700 BTU per ton-mile versus 750-1500 BTU per ton-mile for pipeline, 1000-1800 BTU per ton-mile for rail transport, and 2200-3000 BTU per ton-mile for road transport.) Inland and coastal transport requires a much smaller equipment and even smaller infrastructure investment than any competing mode. Similarly both fixed and variable operating costs are significantly lower than those of other methods of transport. It is therefore curious why so little use is made of inland water transportation, particularly in developing countries with some rare exceptions such as the People's Republic of China, where inland water transportation and coastal shipping carries over 30% of the nation's ton-mile output in freight transportation.

Inland water transportation also offers operational and technical advantages. Outsize loads weighing thousands of tons can be handled as single loads. Cargo can be lifted, rolled, skidded, or floated on and off barges and coastal vessels. Terminal and transfer facility requirements are simple and can be designed for relocatability. Similarly operating skill requirements are low and craft are easily maintained. It is therefore curious why such a low cost mode of transport which uses low-cost right-of-ways, and low-cost terminals and transfer methods and which is flexible, safe, and cheap has been ignored in many developing countries. One reason may be that it is an old, traditional, low prestige, comparatively slow method of transport which provides cheap storage and simple handling opportunities.

Inland and coastal traffic developed largely because population historically settled along water ways. Even today:

- 85% of the population of Africa lives within 50 km of navigable waterways, coasts, or inland lakes.
- 82% of the population of China lives within 100 km of navigable waterways or coasts.
- 80% of the South Asian population lives within 100 km of navigable waterways or coasta.

In other words, the majority of the world's population lives within a short distance of water. The investment in tug-barge systems is similarly significantly lower than that of road transport. For example:

Vehicle	Capacity	Cost
Truck	10 ton	\$36,000
Barge	600 ton	\$80,000-120,000
Tug	5000 hp	\$500,000

Since early civilization, water transport was the principal mode of freight transport and in many parts of the world its role has diminished only in the last 20-30 years as part of the rush towards industrialization which was usually accompanied by a rush towards urbanization and road transport.

TECHNOLOGICAL DEVELOPMENTS

Inland and coastal barging has developed over a long time, yet it is only in the last 20-30 years that towing techniques were introduced which allowed effective push-towing of fleets of integrated inland barges or of one or more coastal or oceangoing barges.

Hawser-line towing of one or more barges had been the standard procedure for centuries. When barges on inland waterways were fleeted (rigidly connected in sets of 2-4-6-9 or more), alongside towing was often adopted for more effective control of the tow. Push towing, the next step, required a change in the design of the bow of the tugboat from streamlined to blunt. Similarly tugs were designed for multiple propulsion units to improve maneuverability of the tow. The configuration of the tow and attachment of the tug affects the tows:

- 1. resistance
- 2. maneuverability
- 3. propulsive efficiency, and
- 4. directional stability as well as turnability.

The choice of tow and fleeting is often affected by river or waterway width, currents, tides, channel depths, wind conditions, and traffic.

Barges come in many different forms. Flat-top barges are designed for RoRo, railcar, container, or dry bulk carriage. Tank barges are for liquids of all sorts. Hopper barges are for dry bulk commodities and may be designed for split operations which allow the barge to hinge open and drop its load. There are also open hold or multi-deck and various types of specialized barges. Barges usually have one longitudinal and several transverse bulkheads.

Most barges are not designed with a double bottom or double skin, although some recent designs incorporate such features. Tank barges usually use independently driven (diesel) deep well pumps to discharge their cargo and have, as a result, no tank bottom piping.

Propulsion of barges is generally provided by tug or tow boats although barge driven systems such as harbormaster, etc. right angle diesel driven stern drive systems are sometimes used. These systems are usually removable. Tug or tow boats generally use diesel-driven propellers which are often ducted (Kort Nozzle) to increase the low speed and shallow draft thrust of the propellers. Jet pump propulsion is sometimes used in shallow waters and when a lot of solid debris is in the water.

Barge Terminals

Barge terminals are usually much simpler than oceangoing ship terminals. They can be fixed terminals using piled, gravity caisson, sheet bulkhead, or wall-type piers, use floating or elevated pontoon piers, or employ floating or gravity caisson catamaran piers. Some barge terminals are based on barge slips similar to ferry slips, while others use barge lifts, lock/dock type of terminals or barge dumpers. Barge terminals may use fleeting barges as floating storage or silos.

Equipment used in barge terminals varies from traditional cranes, ship/barge loaders, conveyors, chutes, and sliders to scissor-lifts and various types of mechanical loaders/unloaders. Barge dumpers, similar to railcar dumpers, are also under consideration now. These are based largely on floating catamaran terminals. Many barges are designed to float-on/float-off operations when barges are submerged and the load is floated on before the barge is deballasted. Typical handling rates achieved at inland water barge terminals are:

	Tons/h			
Commodity	Loading	Unloading		
Coal	700-900	300-400		
Liquid Bulk	400-900	400-500		
Iron/Steel	100-150	50-100		
Dry Bulk	200-600	100-300		
General Cargo	100-120	40- 80		

Basic Costs of Inland Water Transport

Inland water barge investment costs are \$800-2000/DWT. A 3500 DWT barge for example has an average construction cost of \$300,000, while a 300 DWT barge would cost about \$60,000. Towboat costs are largely a function of horsepower. A 1000 BHP towboat costs \$380-480,000, while a 10,000 BHP towboat costs \$2.4-3.5 million. Much depends on the draft, the number of screws, and size of the towboat, as well as the degree of sophistication (automation, etc.) of the equipment aboard.

Considering typical inland water barge operation (fleeting):

Barge capital productivities of 100 ton-miles/\$ are obtained (Capital Productivity (ton-miles/year) : Investment). For trucks capital productivities are usually 17-20 ton-miles/\$, while railway capital productivities are 44-46 ton-miles/\$. These measures are not really comparable, as barges and railways have economic lives about three times those of trucks (Table 1).

Typical labor productivities are 7800 ton-miles/manhour for barges versus 180 ton-miles/manhour for trucks and 1600 ton-miles/manhour for railways (Table 2). Other factors that should be considered are:

- Cargo densities on water 1.3 times rail and 3.2 times truck cargo densities.
- Truck costs include pickip, delivery, and consolidation.
- Useful life: truck 4-8 years, water and rail 20 years.
- Inflation therefore affects truck costs more.
- As value of \$ decreases, ton-mile productivity per unit investment will decline without a true change in capital productivity.

Also equipment use (U.S.) is quite different for the three modes (based on loaded/unloaded vehicle mileage.)

Barge - 64.5% of miles loaded
Rail - 56.8% of miles loaded
Truck - 58.1% of miles loaded (intercity)

Total line haul capital and labor productivities are shown in Table 3, while energy productivities are listed in Table 4.

The mileage of navigable waterways (depth 9' plus) has increased significantly in most developed countries and China in recent years and is now:

Miles of Navigable Waterways

U.S.	27,826
France	4,887
West Germany	2,675
China	14,824

TABLE 1 Aggregate Capital Productivity for Water, Rail, and Truck: 1955-1979

	Property and Equipment Ton-Miles Per Dollar*			Total Assets Ton-Miles Per Dollar						
Year	Water	Rail	Truck	Water/Rail	Water/Truck	Water	Rail	Truck	Water/Rail	Water/Truck
1955	83.0	55.1	48.6	66.4	58.5	86.3	21.2	48.4	24.5	56.1
1960	73.0	43.8	25.8	60.0	35.3	79.7	19.3	27.6	24.1	34.5
1965	80.5	48.8	23.3	60.6	28.9	81.6	23.0	23.1	28.2	28.3
1970	130.2	46.2	17.1	35.5	13.1	144.4	23.0	15.5	15.7	10.7
1975	91.1	41.8	21.1	45.9	23.2	87.5	20.1	10.3	23.0	11.8
1976	99.1	44.7	21.8	45.1	22.0	88.1	22.2	10.5	25.2	11.9
1977	85.9	43.5	21.7	50.7	25.3	76.2	21.7	10.4	28.5	13.6
1978	85.7	44.2	20.7	51.6	21.8	74.6	22.3	9.95	29.9	13.3
1979	86.4	44.0	17.6	50.9	20.4	65.9	22.0	8.78	33.4	13.3

^{*} Excluding reserves for depreciation.

Note: All financial data taken from ICC Transport Statistics in the United States: Part 5-Carriers by Water, Part 1-Railroads, and Part 2-Motor Carriers, for respective years.

TABLE 2 Aggregate Labor Productivity for Water, Rail, and Truck: 1955-1979

	Thousand Employe		-Miles per		
Year	Water	Rail	Truck	Water/Rail	Water/Truck %
1955	2010	524	222	26	11
1960	2817	654	147	23	5.2
1965	5040	965	173	19	3.4
1970	9097	1230	162	13	1.8
1975	8627	1411	144	16	1.7
1976	9557	1515	155	16	1.6
1977	9718	1632	184	17	1.9
1978	8280	1622	140	19	1.7
1979	7805	1658	180	21	2.3

Note: Average annual growth is 12 percent for water, 9 percent for rail, and -0.1 percent for truck.

TABLE 3 Transport Productivity

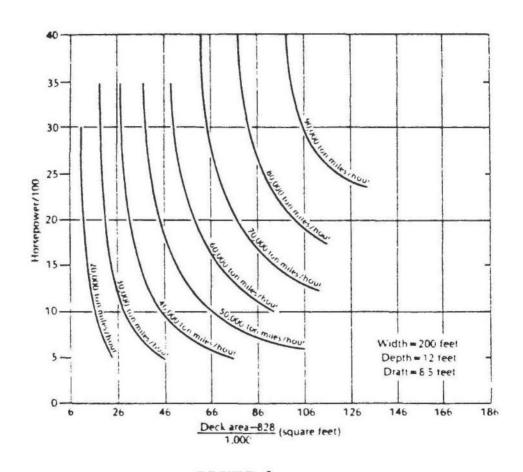
Mode	Data	<pre>Capital (Ton-Miles/\$)</pre>	Labor (Ton-Miles/Manhour)
Waterway	Line-haul	1091	48,703
	ICC	86.4	4,460
Truck	Line-haul	262	617
	ICC	17.6	103

TABLE 4 Energy Productivity

	BTU	per Ton-M	lile	Ton-Mi	les per	Gallon
Case	Barge	Truck	Rail	Barge	Truck	Rail
Best	103	3220	396	1347	38	350
Average	270	7980	686	514	24	202

Productivity of tows in ton-miles per hour is shown in Figure 1, while Table 5 indicates typical towboat operating costs.

For fleeted tows, flotilla deck area in sq. ft. is found to be a good measure of performance as shown in Table 6, from which marginal productivities of tows are obtained. The total product is presented in Figure 2, while Figure 3 provides a complete family of cost functions, computed for a 200 ft. wide channel of 12 ft. depth and a flotilla with a 8.5 ft. draft.



 $\begin{array}{c} {\tt FIGURE\ 1} \\ \\ {\tt Production\ Isoquants\ for\ Waterway\ Transport} \end{array}$

TABLE 5 Towboat Operating Costs U.S. (\$12.0/barrel)

Horsepower	Cost per Day
500	\$ 750
1,000	900
1,500	1,050
2,000	1,200
2,500	1,330
3,000	1,480
3,500	1,625
4,000	1,775
4,500	1,920

TABLE 6 An Illustrative Marginal Productivity Schedule for the Barge Input*

Flotilla deck area (eq. feet)	Ton miles/hour	ΔTon miles/hour	
6,825	13,030	-	
16,825	27,149	14.119	
26,825	38.653	11,504	
36,825	48,579	9,926	
46,825	57,356	8,777	
56.825	65,201	7,845	
66,825	72,223	7,022	
76,825	78,499	6,276	
86,825	84,011	5.512	
96,825	88,807	4,796	
106,825	92.832	4,025	
116,825	95,911	3,079	
126,825	97,989	2,078	
136,825	98,817	828	
146,825	98,126	-69 1	
156,825	95,412	-2,714	
166,825	90,153	-5,259	

W = 200, D = 12.0; H = 8.5; HP = 4,000; L/B = 5.5714.

An Illustrative Marginal Productivity Schedule for the Towboat (Horse-power) Input^a

Нотверошет	Ton miles hour	△Ton miles: how	
500	46.683	-	
1,000	63,024	16,341	
1,500	73,756	10.732	
2,000	81.299	7.543	
2,500	86,594	5,295	
3,000	90.118	3,524	
3,500	92.144	2,026	
4,000	92,832	688	
4,500	92,276	-556	
5,000	90,520	-1.756	

^{*} W = 200; D = 12.0; H = 8.5; B = 138.5; A = 106, 825.

An Illustrative Marginal Productivity Schedule for the Towboat Input with a Larger Flotilla

Нотверошет	Ton miles hour	△Ton miles hour	
500	43.517	-	
1,000	59.169	15,652	
1,500	69.659	10.490	
2,000	77,209	7,550	
2,500	82.682	5.473	
3,000	86,515	3,833	
3,500	88.957	2.442	
4,000	90,153	1.196	
4,500	90,186	3 3	
5,000	89,092	-1,094	

[•] W = 200, D = 12.0; H = 8.5; B = 173.0; A = 166, 825.

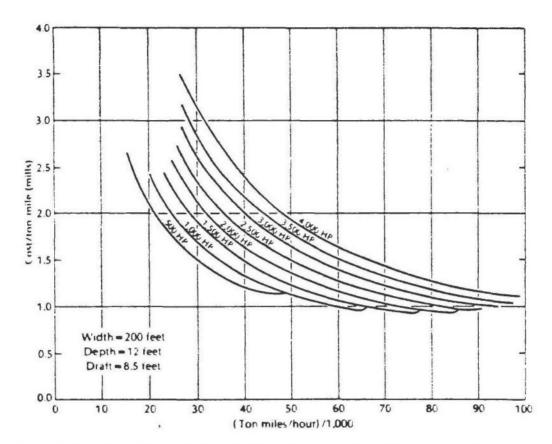


FIGURE 2 Family of Cost Functions for Waterway Transport

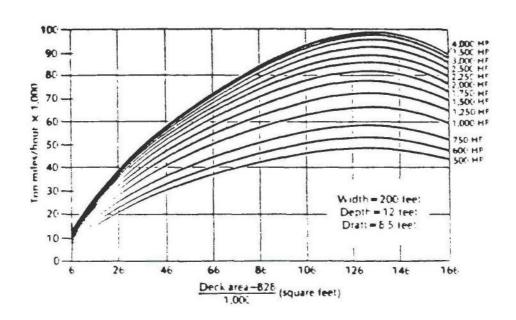


FIGURE 3 Total Product Curves

COST MODEL FOR INLAND WATER BARGE OPERATION

The operating performance and cost of barges and tugs is obtained from the design of standard tugs and barges (Appendix A). Standard design parameters and performance characteristics were developed for the range of variables such as length, beam, depth, draft, and various form coefficients and dimensional ratios representing good practice and acceptable values within the range acceptable to classification societies. Families of designs for inland water barges, tugs, and self-propelled barges were developed. The design and operating parameters developed should be used as inputs in the design and cost model which serves to establish the tug/barge operating performance and costs.

The results of the tug-barge design and cost program provides the inputs to the fleet design model which allocates barges and tugs to the desired trade routes with or without backhaul cargo and which determines the optimum size, speed, and number of barges and tugs to be used on the desired trade routes based on lowest fleet costs (fixed and variable costs). The resulting preferred tug and barge fleet cost performance is then compared with that of alternate modes or the use of existing inland water cost performance. New investments for tug-barge design which show the most significant cost improvements over existing inland water transportation and/or competing alternative transport modes are then reviewed and adjustments are made to converge on a standard design.

The cost model for the determination of tug-barge (or self-propelled barge) design parameters, operating performance and cost is described in the Flow Chart. program starts by computing the Section Modulus, Cross-Sectional Areas, and Required Plate Thickne-ses using classification rules as a function of beam as the independent The results are then fed to the structural design program, which develops the midship section structural configuration and weight. Generating first the basic barge configuration in terms of dimensional parameters, ratios and coefficients, it then calculates the fully loaded draft. Next, actual plate thickness and frame spacing including frame scantlings are determined. After calculating the volume, displacement, and block coefficient of the barge, the structural design is refined to minimize structural or light ship weight while assuring simplicity and producibility of the design.

After computing resulting steel weights, hull construction manhours are established. Outfitting weight and costs are next determined. In parallel, crew costs

Flow Chart for Tug-Barge Design and Cost Program

1	Calculate the
am T	Beam Table: Section Modulus, Cross Section
-	and Plate Thickness
	I all I Frate Threamess
•	Pass File to Structural Design Program
	Trass Tite to Berucedia Design Flogram
1	Input tug costs and bollard pull as a function of velocity
esign	Generate Barge Configuration
7	Length 60, 80,300; L/B Ratio 4, 5, 6, 7;
	L/D Ratio 10, 1220, 75 > Beam > 15'
	22 > Depth > 6
	Calculate the Fully-loaded Draft
1	
	Calculate required plate thickness and
	frame spacing for bottom, side and deck
	plating
	plating
	(6)
	Calculate required section modulus for
	longitudinal and transverse beams for
	bottom, sides, top
	¥
	Input Outfitting Table
	ý .
	Input Outfitting Table Calculate volume, displacement and block
	ý .
	Calculate volume, displacement and block
	Calculate volume, displacement and block coefficient of the barge
	Calculate volume, displacement and block
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table
	Calculate volume, displacement and block coefficient of the barge
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom,
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge Compute manhours required to assemble
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge Compute manhours required to assemble barge
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge Compute manhours required to assemble
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge Compute manhours required to assemble barge Input crew cost as function of DWT
	Calculate volume, displacement and block coefficient of the barge Input Resistance Table Compute A displacement A draft ratio Select beams of minimum cross section and sufficient section modulus for bottom, sides and top, transverse and longitudinal Compute the weight of the steel in the barge Compute manhours required to assemble barge

B-

Sum the costs of construction labor, steel, & outfitting as a monthly payment with 25 year life and 15% discount factor & add crew costs to determine fixed monthly cost for the barge

For the chosen activity (M.P.H.), look-up: the resistance of the fully-loaded barge

Look-up: tug bollard pull as a function of velocity and select the minimum size (H.P.) tug able to pull the fully-loaded barge at 85% power at 1 mph faster than the chosen yelocity

Compute the velocity of the same tug pulling an unloaded barge

Look up: the fixed costs (monthly) and variable costs (operating hour) of the selected tug

Input the information on this tug barge combination to a file for transfer to the Commodity Flow Program

Repeat for each desired loaded velocity

->-0

Return to

Repeat for each size barge

Return to

Pass file to fleet Allocation Program

Fleet

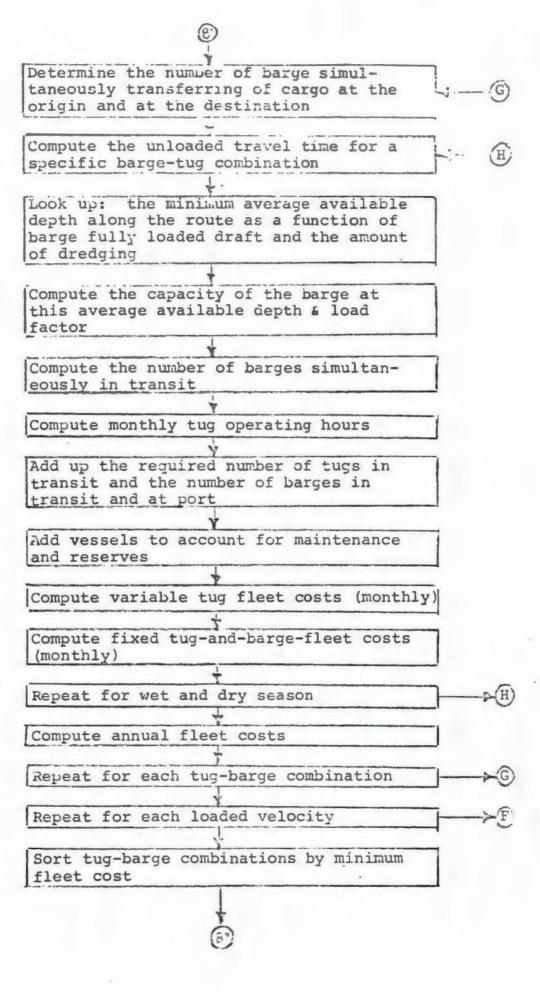
Input: network data, link lengths and currents, node names

Input: Average available depth (wet & dry season) as a function of vessel draft and dredging for each link

Input: Commodity flow data; O-D, monthly flow (tons), load factor, fixed delay at the nodes, node cargo handling rates

Compute one-way loaded travel time for the selected velocity (wet & dry)

←®





Printout least expensive combinations

Add fleet costs to running total for each tug-barge combination

Repeat for each commodity flow

Printout final total for each tug-barge combination for fleet serving all commodities

are next calculated to permit summation of construction cost, crew, and other fixed operating costs to compute total fixed monthly cost of a barge.

Using input resistance data, speed/resistance relationships are obtained from which bollard push or pull is computed as a function of velocity. This serves to select the minimum size (HP) tug able to push or pull the fully loaded barge (or barge train) at the chosen speed.

Next the velocity of the saem tug pushing or pulling an unloaded barge (or barge train) is determined.

Tug fixed and variable costs are next computed. The resulting combination and its operating performance (DWT, velocity, etc.) are then transferred to the Commodity Flow and Fleet allocation program. The above is repeated for the whole range of desired loaded velocities, barge size, and barge dimensional combinations until all possible acceptable parameter combinations have been exhausted. The results of the tug-barge design and cost model thereby provide the whole range of tug-barge and self-propelled barge performance and cost inputs required to determine the optimum vessel allocation and therefore fleet determination to each trade route.

This cost model can be used to determine the performance and cost of inland water barge operations under the desired conditions of service. It similarly serves to derive the required design, performance, and cost parameters of the associated tugs.

Barge Tow Performance

Barge tow performance involves the following factors:

- 1. Resistance of barge (or flotilla) as a function of speed, length, beam, draft...
- Push (tow) generated by towboat as function of size, BHP, speed...
- Environmental effects on above factors such as waterway depth, width, current, and wind.

At constant speed, the resistance can be computed as follows:

$$R = 0.07289e^{1.46/(D-H)} S_H^{0.5} + (50/W-B)L^{0.38}B^{1.19}$$

where

D = Waterway depth in feet

H = Barge (flotilla) draft in feet

S = Still water speed in mph W = Width of waterway in feet

B = Beam of barge (flotilla) in feet

L = Length of barge (flotilla) in feet

$$EP = 31.82 \text{ HP} - 0.0039 \text{ HP}^2 + 0.38 \text{HP} \times D - 172 \text{S}^2 - 1.14 \text{S} - \text{HP}$$

where

HP = Brake Horse Power (operating)

A = Total Desk Area of Barge (flotilla)

- * In addition to resistance tow must overcome or is assisted by slope drag. Force R_d (incline force)
- * Actual speed must also be corrected for water flow velocity Sw and EP for Rd

Over ground tow speed Sm

$$S_T = S^* + (-1) \delta S_W$$

Similarly the effects of channel width and depth must be considered as shown in Table 7.

Effects of channel width and draft are great as B only slightly larger than H and W only slightly larger than B.

But:

- Channel deepening decreasing returns to scale (no RTS after D > 4H)
- Channel width no RTS beyond W > 2B

Channel width and depth costs must be included in economic analysis of transport costs and benefits.

TABLE 7 Joint Effects of Channel Width and Depth on Line-Haul Costs per Ton-Mile*

	Width (Feet)								
Depth (Feet)	150	200	250	300	350	400	450	500	550
12	23.71	1.21	1.07	1.03	1.00	0.99	0.98	0.98	0.97
18	19.64	1.02	0.90	0.87	0.85	0.84	0.83	0.83	0.82
24	18.11	0.94	0.83	0.80	0.78	0.77	0.77	0.76	0.76
30	17.05	0.88	0.78	0.75	0.73	0.72	0.72	0.71	0.71
36	16.22	0.83	0.74	0.71	0.69	0.68	0.68	0.67	0.67
42	15.52	0.79	0.70	0.67	0.66	0.65	0.65	0.64	0.64
48	14.91	0.76	0.67	0.64	0.63	0.62	0.62	0.61	0.61

^{*} H = 8.5; B = 144.8; A = 116,825; HP = 4,500.



Oceangoing Tug-Barge Systems (OGTB)

Recent advances in push-tow linkage technology have resulted in oceangoing barges being developed capable of carrying large cargoes (more than 85,000 dwt) of various types (petroleum, oil, dry bulk, wheeled, and containerized) at moderate speeds (up to thirteen knots) in either transoceanic or coastal trades. services now operate along the U.S. East and West Coasts, in U.S.-South American trades, in the West Coast-Alaska trades, and more. The transition from the small deck barges shown in Figure 4 to ship-like ocean/coastal capable pushed-towed OGTBs shown in Figure 5 in just two decades is remarkable. case, the OGTBs of today not only are as capable as ships of equivalent size and speed but they exhibit the added advantage of separable propulsion and cargo units. Furthermore there are advantages due to the lower capital cost of OGTB systems as compared to ships of equal capacity and performance as well as their lower loaded draft, which is usually only 65-75% of that of a comparable ship.

Many modern OGTBs have linkages that give them the same capability as ships of the same size and speed in transocean, coastal, or inland operations. It is this linkage that also gives them the added flexibility that is the result of separate propulsion and cargo components. Such versatility results in significant advantages over ships in operational flexibility.

Operational Flexibility

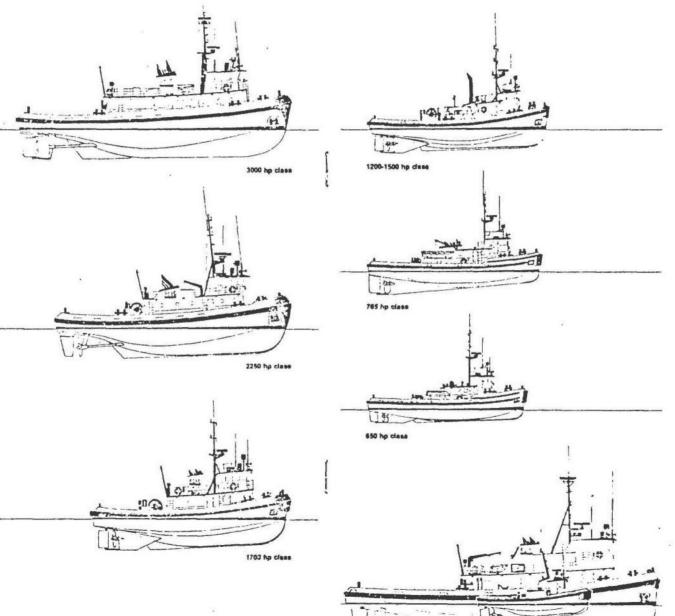
The primary advantage of propulsion and cargo unit separability is the ability of OGTBs to operate in a drop-and-swap mode. In this method of operation the tugboat drops off the barge at a port to be unloaded and then proceeds independently or with an empty/loaded barge to another port or operating area. This allows the costly tug and its crew to be utilized more efficiently since they will be spending more time transporting cargo rather than awaiting cargo operations. On the other hand, in many commercial operations, this also results in lower barge utilization since it has to await the return of a tug before it can be moved. This lower barge productivity may make drop-and-swap operation uneconomical in commercial trades where port times are short compared to sea times and/or where only a few large OGTBs or ships can handle the cargo movement requirements.

Ocean-going tugs and barges make up a major component (40%) of our U.S. flag domestic fleet capacity.

Fossituds in the 3000 horsepower class range in length from 90° overall to more than 111° beams range from 31° to 34° with norsepower ratings from 2850 hp to 3000 hp.

Tugs in the 2250 horsepower class inc. Lide Verse's with lengths from 97 to 107°, beams from 26° to more than 29° — all with a horsepower rating of 2250 hp.

All tags in the 1700 horsepower class are 80' long and 25' wide and are rated at 1700 np.



Fossitugs in the 1200-1500 horsepower class are 72' long and 24' wide and range in horsepower from 1200 to 1500 hp.

All 765 horsepower Foss tugs are 70° in length with beams 21° wide Horsepower ratings are 765 hp

The 650 horsepower tugs are 65' iong, 21.5' wide and are rated at 650 hp.

Other Foss vessels available for the myriad of jobs on Puget Sound range in length from 341 to 1501 with beams ranging from 101 to 4 nearly 331 and with horsepower ratings starting at 160 hp and ranging up to 6500 hp. In short, there is a Fosa vessel available to meet every tug and harge need on Puget Scund.

K =

FIGURE 4 (continued)

Typical Small Pull-Towed OGTBs: Barges Foss 300 Foss 240 Open deck multi-product barge Foss 199 Special purpose barge Foss 111 Petroleum barge Foss 174 Sand and gravel barge Fors 244 Foto 183 Worst roip harges Miscellaneous general cargo barges

Page 252 Page 252

Dernok barges are available up to 116' in length. Booms range to 125' with lift capacity up to 75 ST

Foss special purpose barges. including dump scows hauf even,thing from molasses to cement Lengths range from 130" to 200'. Capacities range to 6500 bbls or 1700 ST for the cament barges, and 500 yds for dump SCOWS.

Sand and gravel barges range from 700 ST or 465 yds to 1500 ST or 1000 yds. Lengths are 110' 10 170".

Foss wood chip barges are devoted exclusively to the shable wond products industry on Puget Sound These barges range in length from 130' to nearly 200' Capacities range from 300 units up to nearly 1,000 units

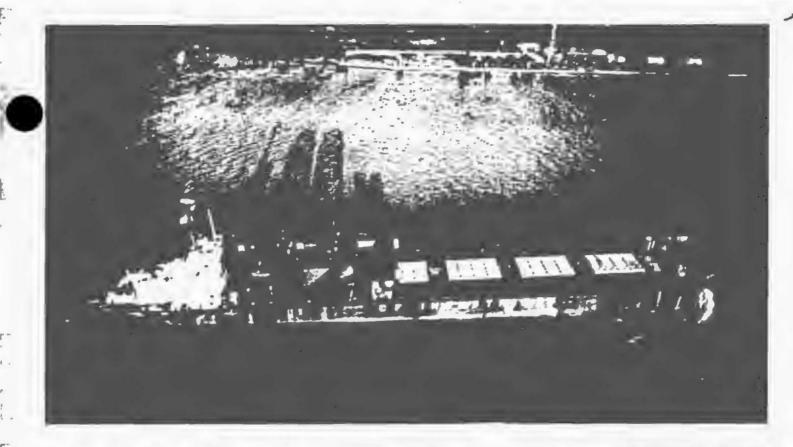
Fors maintains a substant at number of miscellaneous and general cargo barges to meet almost every need. These barges range in length from 32 to 236. Capacities start at 100 ST and range up to 7000 ST.

Fast Launch & Two Company rizer-ness, multi-product barges are uses for a moreodicticarges are uses great to anocommodate gent is not diand deck cardo frese barges range up to 2401 in anoth with cardo capacities up to 4010 ST.

Foss compliate line of petroleum cornes range in length from 165" 13 3 3 5 Ferro e im barge nament es me from 650 i oblis to 38 000 rors

Chemical barges are available with paparates up to 20,000 bbls or 4160 AR Lengths range from 180 to 3171.

Foss Laurich & Tug Company rulicar bar insigan appoinmodate trom 15 to 24 railbars. Lengths rance froin 260" to 320".



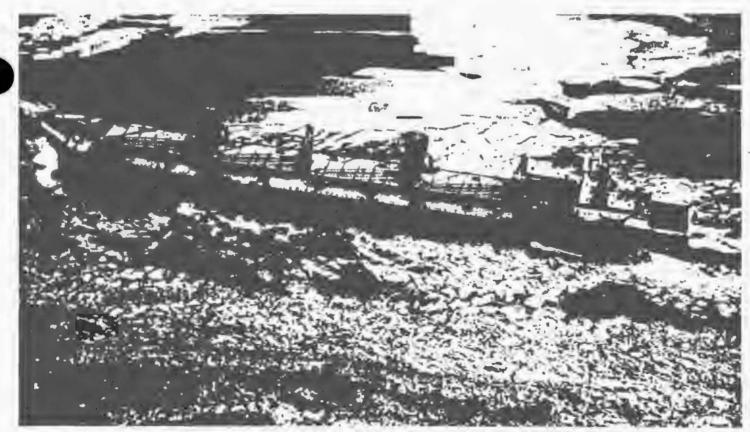


FIGURE 5

Typical Modern Large Push-Towed OGTB's

Source: Tug Barge Systems, Inc. Company Brochure

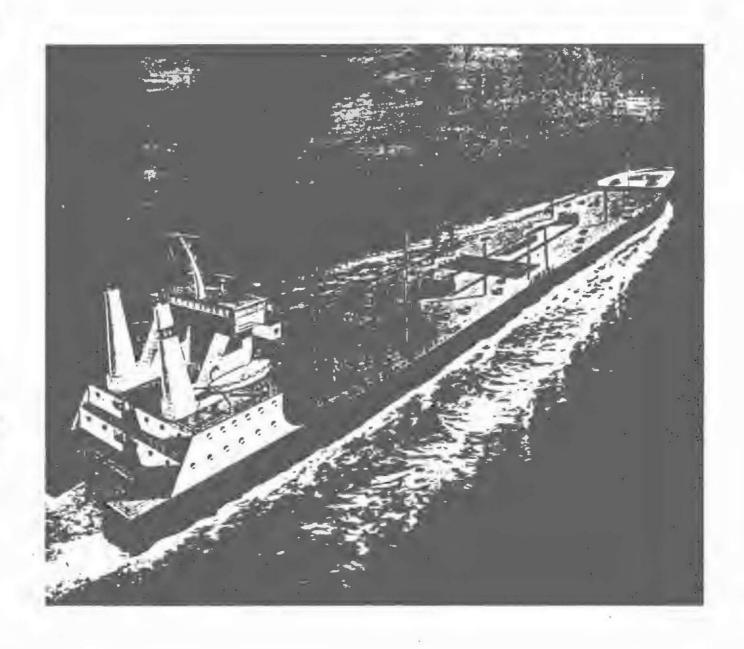


FIGURE 5 (continued)

Source: Seabulk Corporation Company Brochure Some of the last statistics point out a very important trend. More and more of the coastal liquid bulk traffic is being carried in barges. OGTBs, especially those of the mechanically-linked variety, have the same operating capabilities as the ships they replace. Others, such as loose-linked push-tow type barges, have at least ship-type capabilities in coastal trades.

Description of Various OGTB Systems

In this section many of the OGTB systems currently in use, operation or under active development will be discussed. Each system will be first described and then evaluated with respect to its commercial and military potential. The systems will be presented in the chronological order of their development. That is,

- A. Pull-Towed OGTBs: Tug-barge systems designed for towline operation only
- B. 1st Generation Push-Towed OGTBs: Tug-barge systems primarily designed for offshore work on a towline, but the barge will usually have a stern notch with the intention of the tug pushing in rivers, sounds and during good weather, in the open sea.
- C. 2nd Generation Push-Towed OGTBs: Tug-barge systems primarily designed for offshore work with deeper notch and hardware to permit the tug to push over half the time while offshore.
- D. 3rd Generation Push-Towed OGTBs: Tug-barge systems designed to permit the tug to push 100% of the time.*

These 3rd generation systems can be further sub-categorized with respect to their type of linkage. Specifically, they can be divided into rigid mechanically-linked (or integrated), semi-rigid mechanically-linked (or articulated), flexibly-linked, and loosely-linked systems.

Information additional to that given below can be obtained from the system operators, owners, or designers listed in Table 8.

Pull-Towed and 1st Generation Push-Towed OGTBs

Description and Commercial Potential

Most of the smaller and older barges were designed for hawser towing in which the barge follows the tug on a wire that is controlled by a winch on the after end of the tug. Some of the newer barges have been provided with a shallow stern notch which allows the barge to be push-towed in sheltered areas. These 1st generation push-towed OGTBs can be maneuvered much more safely in and out of port than hawser towed systems.

Although most existing OGTBs are of the pull-towed type because they were built prior to the development of the more so-

^{*} This categorization of 1st, 2nd, and 3rd generation push-towed OGTBs was first presented in Wright (1973).

TABLE 8

OGTB Owners, Operators and Designers

Pull-Towed and 1st Generation Push-Towed OGTBs

Crowley Maritime Corporation One Market Plaza San Francisco, CA 94105 (415) 546-2500

Foss Launch & Tug Co. Division of Dillingham Corp. 660 West Ewing Street Seattle, WA 98119 (206) 281-3800

McAllister Brothers, Inc. 17 Battery Place New York, NY 10004 (212) 269-3200

2nd Generation Push-Towed OGTBs

Deep Notch Design

Bulkfleet Marine Corporation 4600 Post Oak Place Suite 161 Houston, TX 77027 (713) 840-1100

Interstate & Ocen Transport Co. Three Parkway Philadelphia, PA 19102 (215) 864-1200

Notchless Design

Krupp International, Inc. Plants Division 550 Mamaroneck Ave. Harrison, NY 10528 (914) 381-2000

3rd Generation Mechanically-Linked OGTBs

Breit/Ingram Design

Tug Barge Systems Inc. (An Ingram Company) 4100 One Shell Square New Orleans, LA 70139 (504) 588-2400

TABLE 8 (continued)

CATUG DESIGN

Hvide Shipping Incorporated 1900 S.E. 17th Street Causeway P.O. Box 13038 Port Everglades Station Fort Lauderdale, FL 33316 (305) 527-1712

ARTUBAR DESIGN

ANDUL Engineering Inc. 2801 Sombrero Blvd. Marathon, FL 33050 (305) 743-6800

Transway International Corporation 747 Third Avenue
New York, NY 10017
(212) 371-6464

Sea-Link Design

L.R. Glosten & Associates, Inc. 610 Colman Building 811 First Avenue Seattle, WA 98104 (206) 624-7850

3rd Generation Loosely-Linked OGTBs

Bludworth Design

Mr. Robert Bludworth
Bludco Barge and Towing, Inc.
P.O. Box 12424
Houston, TX 77017
(713) 644-1595

Breit & Garcia Design

Belcher Towing Company P.O. Box 011751 Miami, FL 33101 (305) 858-3400

Breit & Garcia 441 Gravier Street New Orleans, LA 70130 (504) 581-5636

TABLE 8 (continued)

CABLE-LOC

ANDUL Engineering, Inc. 2801 Sombrero Blvd. Marathon, FL 33050 (305) 743-6800

3rd Generation Flexibly-Linked OGTBs

Barge-Train Design

Barge Train, Inc. 555 E. Ocean Boulevard Long Beach, CA 90802 (213) 436-0218 phisticated push-towed OGTB designs, there are still reasons for their construction today. As explained in the next chapter, they are especially suited for short distance trades such as the movement of oil from East Coast refineries to nearby metropolitan ports or the movement of containers from major to minor ports. Barges used in this type of trade are shown in Figure 6.

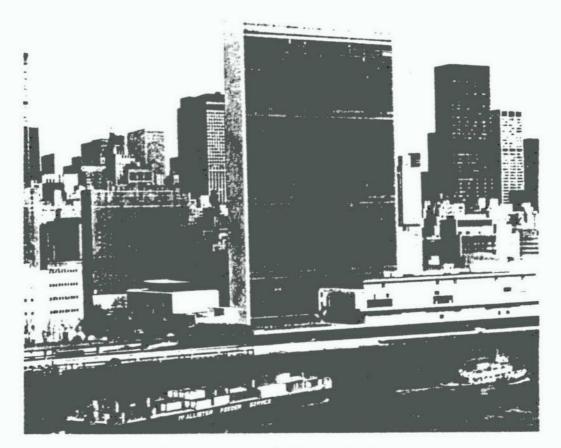
Pull-towed systems also are the most flexible. They allow any tug of sufficient power to pull any barge or pair of barges in tandem. This enables separate ownership of tug and barge fleets which may provide economies due to specialization. This flexibility is also important to large multi-purpose fleet operators who must operate construction equipment barges, RO/RO barges, container barges, train barges, tank barges, pipe barges, and Arctic resupply barges, all with the same tugs. Pull-tow operation is a necessity in some of these operations since the line of sight from the tug's pilothouse would be blocked by the cargo during push-tow operation.

2nd Generation Push-Towed OGTBs

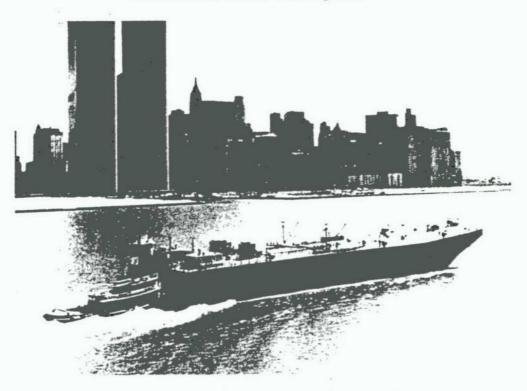
Deep-Notched Designs

Before the recent development of the 3rd generation loosely-linked OGTB designs, many coastal tankship operators, especially on the East and Gulf Coasts, pushed their barges with 2nd generation linkages. Amost all of these designs consisted of the tug pushing the barge in a deep stern notch while tensioned by cables to prevent separation from the barge. Such systems allowed push-towing more than 50% of the time. However, since the development of the loosely-linked designs, very few coastal operators are constructing 2nd generation designs except for those with linkages that allow pushing at least 90% of the time and so are approaching 3rd generation status.

A representative of these new 2nd generation systems is shown in the Interstate and Ocean Transport patent drawings presented in Figure 8. This system uses a pin with a hemispherical convex frontal surface that fits into a corresponding concave hemispherical surface in the barge notch to restrain heave. Additionally, the linkage uses chain cables that provide the tension that prevents tug and barge separation. Relative roll between tug and barge is prevented by fenders installed at the after end of the tug. This linkage allows the tug to remain in the notch in up to nineteen foot seas although voluntary separation normally occurs when 12-15 foot seas are expected. Interstate has three barges (Ocean 262, Ocean 190, and Ocean States) and three 5600 HP tugs (Enterprise, Honour, and Valour) fitted with



Modern Pull-Towed OGTB System



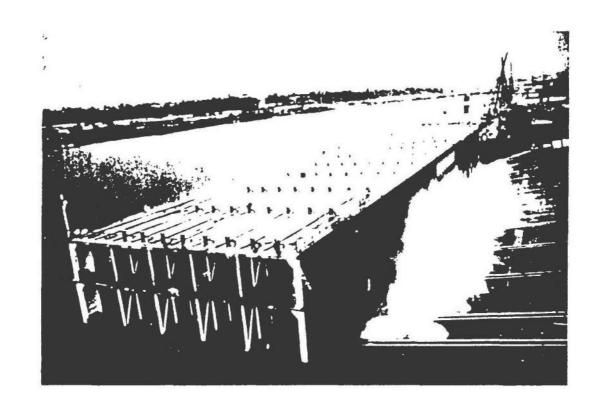
Modern 1st Generation Push-Towed OGTB System

FIGURE 6

Source: McAllister Brothers, Inc.

Advertisements in

"Maritime Reporter and Engineering News"



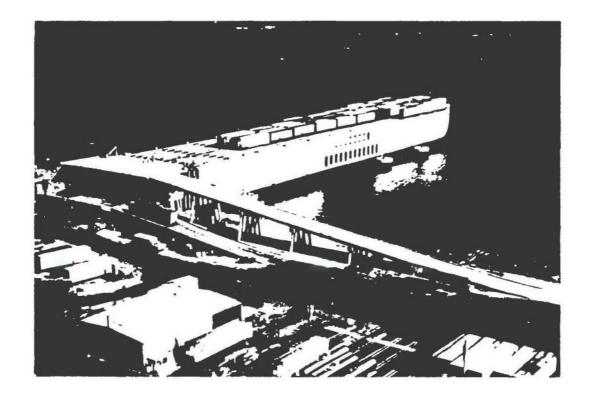


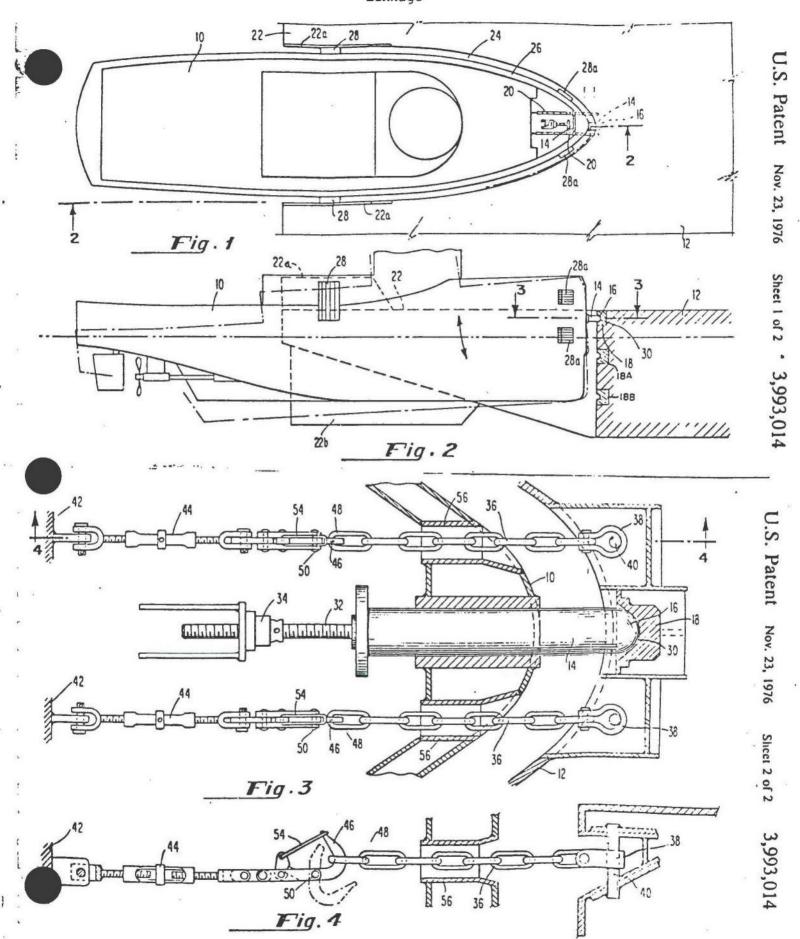
FIGURE 7

Crowley TMT Tri-Deck RO/RO Barge

Source: Trailer Marine Transport Corp.

FIGURE 8

Patent Drawings for I.O.T. 2nd Generation
Linkage



this linkage. One of these OGTBs operating with this linkage is shown in Figure 9. Additionally, two new single-skin 20,000 DWT tank barges currently under construction for this company will be equipped with it. The linkage should be less expensive to install than most of the 3rd generation designs and provide almost the same capability.

Another deep-notched 2nd generation linkage system has been recently developed by Bulkfleet Marine Corporation, a subsidiary of McAllister. At least two and possibly five 25,000 DWT tank barges are expected to be built with this linkage. As shown in preliminary line drawings of Figure 10, the tug maintained in the close fitting notch by two sets of cables, one pair leading from the tug's forecastle and the other pair from its stern deck. Linkage forces are distributed over a area of the notch through an extensive system of fenders so that the system may operate in 12-13 foot seas difficulty. In greater sea states the tug must separate from the barge. The first two tank barges will be powered by 7000 HP MAN medium speed diesel engines and are expected to average 12 knots in their Gulf Coast service.

Other barges with 2nd generation linkages are noted in Appendix B. As explained in the next chapter, it is not expected that many new systems will be constructed with this type of linkage. Some pull-towed systems, however, may be retrofitted with a 2nd generation linkage since it provides these OGTBs with the advantages of push-towing for the majority of operating time at little cost. This has been the case with the Crowley Maritime tank barges $\frac{450-1}{1}$ through $\frac{450-5}{1}$ on which deep notches were installed in the last year to allow them to be almost continuously push-towed on their West Coast and Pacific river trades.

Notchless Design

The SEEBECKWERFT 2nd generation linkage of A-G Weser, a subsidiary of Krupp International, Inc., is included here even though it is not of American origin because it has some features that make it of commercial and military interest. The linkage as shown in Figure 11 is different from the other 2nd generation linkages in that it does not require a barge notch. Instead, the tug has a double roller fendering head at the bow that can either rotate or roll up and down in a semi-cylindrical slide that is attached to the barge stern. This linkage allows the tug to roll, pitch or heave freely, yet retain its own buoyancy so there is no tendency for the tug to become submerged at the stern or lifted out of the water. The tug is kept in the slot by

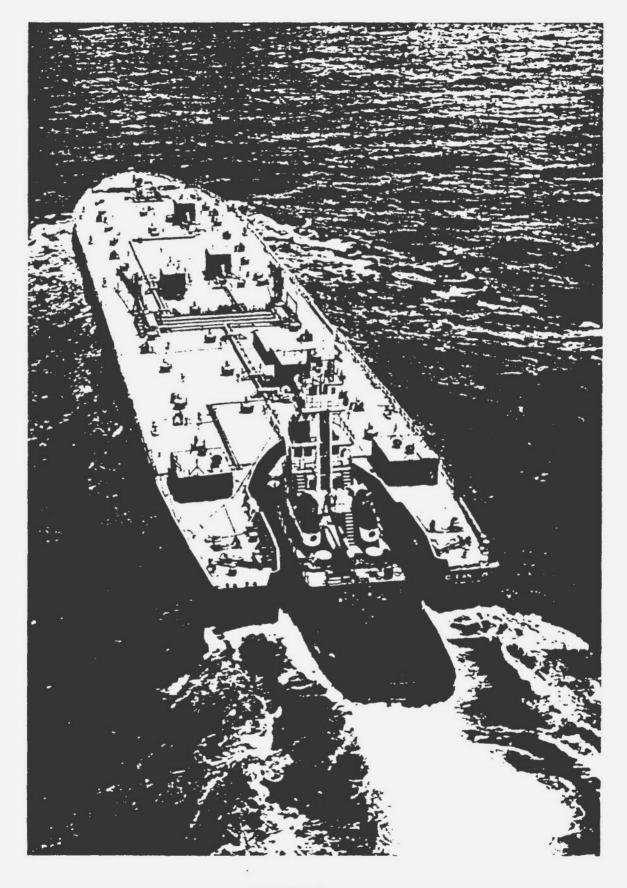
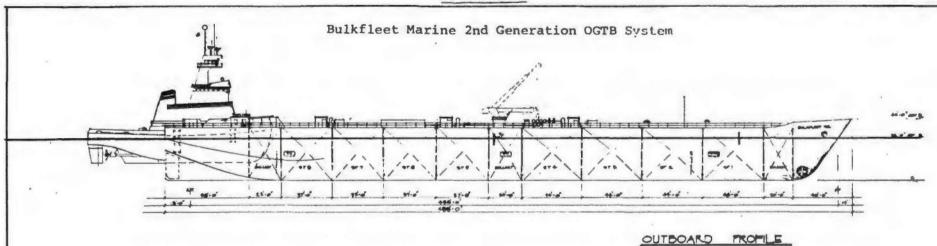
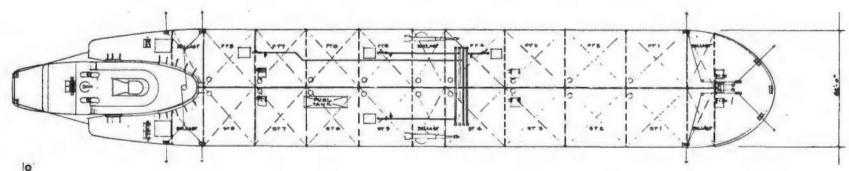


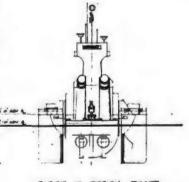
FIGURE 9

I.O.T. 2nd Generation PUSH-Towed OGTB

Source: Interstate and Ocean Transport 1978 Company Brochure







PLAN AT VAIN DECK

PRINCIPAL CHARACTERISTICS

BARGE: TUG:

LENGTH QA. 486'-0' LENGTH QA. 186'-0'
LENGTH B.P. 446'-0' LENGTH B.P. 116'-0'
DREADTH BE:-0' BREADTH SC:-0'
DRAFT BE:-0' DRAFT ST:-0'
DRAFT ST:-0' DRAFT ST:-0'

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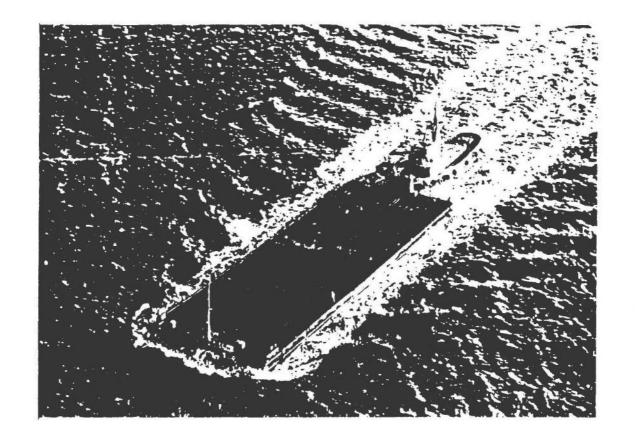
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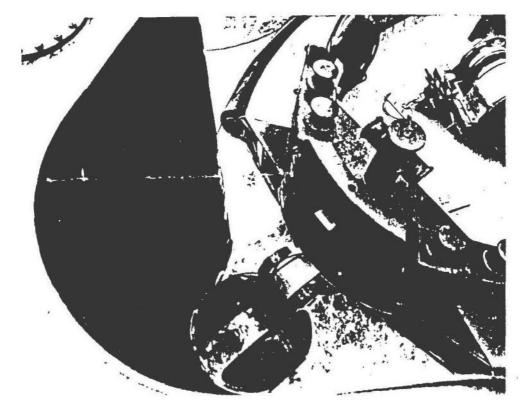


FIGURE 11

Seebeck 2nd Generation OGTB System

Source: A.G. Weser Seebeckwerft Brochure

tensioned cables that lead from a twin-head towing winch on the after part of the tug to the corners of the barge stern. The lack of a notch also allows the tug to be used as an active rudder since it can push at an angle with respect to the barge centerline.

The reason that this design is included here is that it provides the ultimate in tug and barge interchangeability with push-tow operation. Any tug having the fender installed can push any notchless barge that has the slot installed. The cost of such an installation for an OGTB with a 20,000 DWT barge pushed by a 5000 HP tug is estimated by the local distributer to be approximately \$350,000.

Although this system has never been used in U.S. trade, it has been successfully operated by several foreign operators. It is very useful for coastwise service where seas no greater that state seven will be encountered. The only apparent disadvantage that this design will have compared to a deep notched 2nd generation OGTB is that it will likely develop greater linkage drag and so will require more horsepower to be propelled at the same speed. The local distributor believes that this is probably not the reason for its lack of acceptance in this country. It is more likely due to its precise fabrication requirements and its foreign origin. Nevertheless, it seems economically beneficial for retrofitting on pull-towed barges that operate on coastal trades.

3rd Generation Mechanically-Linked OGTBs

There are currently three mechanically-linked OGTB system designs being used in U.S. trades at this time. Two, the Breit/Ingram and CATUG, have rigid linkages. The third, the ARTUBAR, has a semi-rigid linkage. Additionally, another semi-rigid design, SEA-LINK, is being used by a foreign operator in coastal service. A summary of the particulars of the U.S. flag mechanically-linked OGTBs is presented in Table 9. More detailed information about their design and their commercial and military potential is presented in the following subsections.

Breit/Ingram--Rigid Linkage Design

Description: The Breit/Ingram design was the first to be used in $\overline{\text{U.S.}}$ flag trades after $\overline{\text{Car-Port}}$ and $\overline{\text{SEA-LINK}}$ had left the scene. The linkage system is $\overline{\text{similar}}$ to the $\overline{\text{Car-Port}}$ in that the tug is rigidly wedged into the sides and bottom of the barge stern notch. However, the Breit/Ingram design has the additional capa-

TABLE 9

U.S. Flag Third Generation OGTBs

Linkage Design	Barge Type/ Service	<u>Name</u> : Tug Barge	<u>Dimensions (LxBxD):</u> Tug Barge	Tug-Barge: Draft Length	Tug-Barge: HP/Design Speed DWT	When Built: Tug Barge	Where Built: Tug Barge	Owner/ Operator
Breit/Ingram	Taconite Dry Bulk/ Great Lakes	Presque Isle Presque Isle	140.33'x54.0'x31.25' 974.5'x104.58'x46.50	29' 1000'	14,840/16mph 52,000	12/73	Halter Marine Erie Marine	Crocker National Bank/ U.S. Steel
Breit/Ingram	Clean Products Tank/Ocean	Martha R. Ingram 10s 3301	145.84'x46.0'x30.25' 584.5'x87.0'x46.33'	37'5" 620'	11,128/14.1 Kts 36,500	7/71 3/71	Southern Shipbuilding Alabama Drydock	Ingram Corp.
Breit/Ingram	Clean Products Tank/Ocean	Carole G. Ingram 10S 3302	145.84'x46.0'x30.25' 584.50'x87.0'x46.33'	37'5" 620'	11,128/14.0 Kts 37,500	3/72	Southern Shipbuilding Levingston Shipbuilding	Ingram Corp
Breit/Ingram	Rice Phosphate Dry-Bulk/Ccean	Valerie F Valerie F	150.67'x54.0'x34.0' 620.0'x85.0'x45.0'	30'8" 656'	16,000/15.5 Yts 25,000	12/76	Southern Shipbuilding Maryland Shipbuilding	
Breit/Ingram	Fertilizer Dry-Bulk/Ocean	Jamie A. Baxter CF-1	125.0'x45.0'x27.75' 500.0'x75.25'x46.5'	32' 600'	7200 /12.5 Kts 22,500	6/76 12/77	Peterson Builders Avonsdale Shipyard	C.F. Industries
CATUG	Oil Tank/ Ocean	Seabulk Challenger SSC-3901	116.08'x90.44'x38.42' 581.0'x95.0'x46.0'	37' 629'	14,000/15.5 Kts 35,000	1/75	Galveston Shipbuilding (Kelso Marine)	Hvide Shipping/ Shell Oil
CATUG	Chemical Tank/Ocean	Seabulk Magnachem SSC-3902	116.08'x90.44'x38.42' 582.17'x95.0'x52.0'	40'1" 615'	14,000/15.5 rts 40,000	2/77	Galveston Shipbuilding (Kelso Marine)	Hvide Shipping/ Diamond Shamrock
CATUG	Superphosphoric Acid/Ocean	Two or Three Systems to be Named	126'5"x90'4"x39' 626'6"x99 x50'	36' 677'10"	18,200 /15.5 Kts 41,250	80+	Avondale Shipyard	Occidental Oil
CATUG	Oil Tank/ Ocean	Two Systems to be Named	127'7"x90'4"x39' 645'x95.0'x61.6"	40'6" 699'4"	18,200/15.5 Kts 47,075	80-81	Halter Marine Bethlehem Steel	Amerada Hess
ARTUBAR (2-units)	Ro-Ro/ Ocean	JJ Oberdorf GR Moir Barge Names Unknown	140'x40'x 568'x85'x41'6"	19' 605'6"	7,500/-16 Kts 6450(165 40' containers	79-80	Marinette Marine Seatrain Shipbuilding	Coordinated Caribbean Transport

58 cars)

bility of rapid emergency tug-barge separation and safe independent tug operation. The details of the linkage system are shown and explained in Figure 12.

U.S. flag Breit/Ingram OGTBs in operation, the following information is of interest:

The Martha R. Ingram/IOS 3301 tank OGTB has six product segregation with fourteen epoxy coated tanks. The barge can be discharged in less that 24 hours by the use of six deep-well pumps that can pump a total of 20,000 Bbl/Hour. The barge has a 800 HP bowthruster and the tug has twin controllable-pitch propellers.

The Carole G. Ingram/IOS 3302 tank OGTB has four product segregation with twelve epoxy coated tanks. The barge can be discharged in less than 24 hours by the use of four deep-well pumps that can pump a total of 20,000 Bbl/Hr. The barge has a 800 HP bowthruster and the tug has twin controllable-pitch propellers.

The Jamie A. Baxter has two 40-ton gantries with clamshell buckets onboard which are capable of unloading two separate grades of cargo (phosphate fertilizer) simultaneously. The 25,000 tons of cargo can be unloaded into barges on either or both sides of the vessel in a total of 17 hours.

The <u>Valerie F</u> has four center holds designed to self-unload phosphate rock with four cranes and eight wing holds designed for rice carriage on backhaul voyages. These holds can be discharged via four spouts at a rate of 300 LT per spout per hour.

Considerable other information about the Breit/Ingram design is provided in Hukill (1972) and (1974), Pickersgill (1973), MARINE ENGINEERING/LOG (1976a), and SHIPPING WORLD AND SHIPBUILDER (1974b).

Commercial Potential: This design was an early commercial success. Since the construction of the Martha R. Ingram/IOS 3301 in 1971 four other systems have been put in U.S. trade, the latest being delivered in 1977. Additionally, three systems have been put into foreign flag service. One of these, for Japanese operation, consists of two tugs and six barges which are used in two drop-and-swap mode trades. This proves the ability of the design to operate in the drop-and-swap as well as integral mode. Also, one foreign flag system has the tug designed for high speed independent operation for salvage work. This proves

PUTTING IT TOGETHER...

The barge portion of the unit is built with a large notch in the stern into which the forward two-thirds of the tug fits with a minimum of clearance. Within the confines of the notch on the barge are two large box girders tapered at the stern end.

There is a hydraulic ram on the tug's bow, and aft on each of its aldes are large wedge-shaped receptacles, integral parts of the entire hull. These wedge-shaped structures are lined with steel pads mounted on blocks of laminated elasticized material.

The taper of the barge's box girders fit the tug's wedge structures and are pulled by the hydraulic ram to a predetermined point that provides the required preloading to keep the tug motionless in relation to the barge.

The tug enters the notch under its own power and goes forward until grounded on the bottom of the notch. The hydraulic ram extends forward, locks to a structure on the barge and then retracts, pulling the tug wedges into a solid connection with the barge's box girders.

To detach the tug from the barge, the foregoing procedures are reversed. Disconnect time generally is accomplished in less than two minutes, and the entire operation is handled by one man operating a control console on the bridge.



FIGURE 12

Source: Ingram Ocean Systems
Company Brochure

Title: Breit/Ingram Linkage

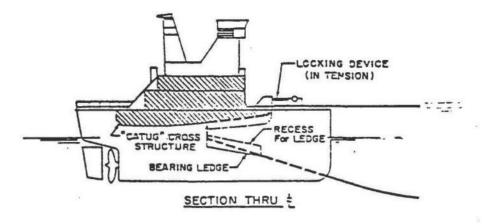
that the tug, although not conventional in bow shape, has the flexibility to be used in non push-tow operations.

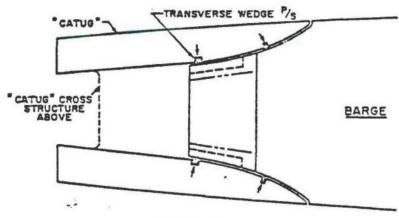
Currently no Breit/Ingram design OGTB is under contract or construction. Internationally, this may be due to the general downturn in ship construction; and domestically, it may be due to the tougher competition from other designs. The Breit/Ingram design does have some disadvantages in addition to those generally applicable to mechanically-linked OGTBs as discussed in Chapter 2. The primary disadvantage is that in order for the linkage to remain rigid while withstanding ocean forces, the hull scantlings heavier than for a comparable ship. designed Specifically, the tank barges have bottom scantlings deck scantlings 3.3% greater than those for a ship of equivalent size. These scantlings are also 12% greater than for a simple barge. These heavier scantlings, the five million pound force hydraulic ram, and the complex tug bow and barge notch lines make the linkage system quite expensive. These factors may have led to the recent interest in the CATUG design for transoceanic trades and the new loosely-linked designs for coastal trades.

CATUG--Rigid Linkage Design

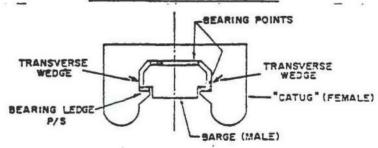
Description: The CATUG design followed the Breit/Ingram linkage by four years, the first CATUG OGTB being delivered in 1975. The linkage is practically the inverse of the Breit/Ingram design. That is, rather than having the tug bow wedged into a barge notch, the CATUG has a protruding barge extension wedged between a catamaran tug's twin hulls and under the connecting platform. The details of the linkage are shown in Figure 13.

In the linkage, the CATUG uses a gathering type wedge fit, in that the extension from the barge is tapered. Two tensioned hydraulicly operated latches are provided on the tug which engage adjustable sockets on the barge afterdeck. latches hold the tug on the barge extension and preload topside and bottomside bearing points in compression. There are four of these bearing points between the tug and barge units. between the top of the barge and the underside of the catamaran cross structure platform, each off to the side. The other are beneath, between the barge extension and a ledge-like extension on the inside of the CATUG hulls. These bearing points are surfaced with greenheart, a very dense and moisture-stable wood, and prevent relative transverse movements of the hulls. tion of tug and barge can be accomplished in less than two minutes.





SECTION THRU LOWER HULL



SECTION THRU CATUG" B BARGE

SOURCE: Waller (1972)

FIGURE 13

CATUG OGTB LINKAGE DESIGN

In addition to the particulars given in Table 9 about the U.S. flag CATUG OGTBs in operation or under construction, the following information is of interest:

The <u>Seabulk Challenger</u> tank OGTB has five product segregation with eighteen epoxy coated tanks. The barge can be discharged rapidly by five 4500 gpm diesel-driven deep-well pumps plus a 2500 gpm special products pump. The barge is equipped with a 920 HP bowthruster and each of the catamaran hulls of the tug has a 17 foot propeller.

The Seabulk Magnachem is a special products tank OGTB and thus has a sophisticated cargo arrangement to handle caustic soda, chlorinated hydrocarbons, and solvents. The barge has herent advantages in the CATUG design. The two principal advantages resulting from twin vice monohull construction are (1) provides better propulsive efficiency and maneuverability due to the wide spacing of the propellers, and (2) it results in smaller transverse and vertical tug-barge interface loads and barge rake torsional loads because the barge and tug rolling periods are more closely matched. This second advantage allows the tug-barge interface to be built with less reinforcement than that needed in the rigid-linked monohull designs. The money saved for this reason and because of the simplicity of the barge extension compared to a notch will at least equal the additional cost that results from the complex catamaran hull construction Thus, the CATUG capital construction costs are for the tug. found not much different than those of monohull designs.

The CATUG design does have less flexibility than the Breit/Ingram design. Its tug, although seaworthy, cannot be used for towing or any other independent mission satisfactorily. The barge could be towed independently if necessary, but it was not really designed for such operation. Besides the above comments, all the information concerning the commercial viability of mechanically-linked OGTBs discussed in Chapter 2 apply.

ARTUBAR--Semi-Rigid Linkage Design

Description: The ARTUBAR (ARticulated TUg BARge) linkage design was developed in the late sixties. However, it will not be until late 1979 that the first ARUTBAR system will be in U.S. flag operation even though a Japanese system has been operating since 1975. Reasons for this delay will be presented later.

The linkage is conceptually simple. It consists of two large transverse pins that are hydraulicly extended from both sides of the tug's bow into corresponding sockets in the barge's notch. The pins allow the tug to pitch in the notch so that the

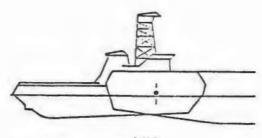
linkage forces are substantially smaller than those produced by a rigid linkage design. Also, there are fenders installed at the bow and side of the tug that prevent damage to the notch during pin alignment. The pins may be retracted in seconds and the tug and barge can be separated in any sea state. Additionally, the system can be designed so that the tug can link with the barge in up to 15 foot seas in just a few minutes. This is beyond the capability of the rigidly-linked designs. It should be noted that several sets of sockets can be installed to match the normal operating drafts in ballast and loaded conditions. This will reduce the need for expensive ballasting equipment for the tug. Besides the pin linkage, the ARTUBAR design may also include wing-wall skegs that make up the barge notch. Such wing-wall skegs reduce" the barge's pull-tow frictional resistance by at least 50% compared to barges with standard skegs. Details of the ARTUBAR linkage including wing-wall skegs are shown in Figure

The ARTUBAR linkage was originally designed to be installed onboard the Gulfcoast Transit Company's Betty Wood/Marie Flood in 1972. However, when the operator learned that the U.S. Coast Guard refused to reconsider its decision to require the tug to be inspected and have licensed crews, he decided to build the tug and barge with an ARTUBAR system without pins. It operates as a 2nd generation push-towed system with tug and barge linked together by cables. However, in seas greater than twelve feet, the tug must leave the notch and take the barge on a hawser.

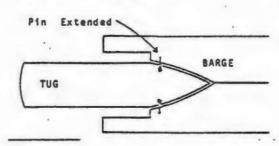
Currently there are two RO/RO OGTB.systems being built with MARAD CDS funds for Transway International's subsidiary Coordinated Caribbean Transport (CCT). The twin screw tugs have a very high pilot house sightline, 59 feet above the water, to allow good visibility over the light displacement RO-RO barge. The tug-barge profile is shown in Figure 15. The barge has the capability of carrying 165 40-foot trailers and 58 automobiles on its spar, upper, and main decks and tank top. It is loaded via a bow ramp and three side ports to the main deck and then through internal fixed ramps to the other decks. The barge is also equipped with a 1200 HP bowthruster.

More information about the ARTUBAR design can be found in Fletcher (1968), (1969), (1970), (1974), (1975), MARINE ENGINEERING/LOG (1976e), and SHIPPING WORLD AND SHIPBUILDER (1969).

Commercial Potential: As the first units of this design will be put in U.S. flag operation in 1980, their commercial potential in U.S. foreign trades will only be learned later on. However, there are some points that can be made concerning their commer-

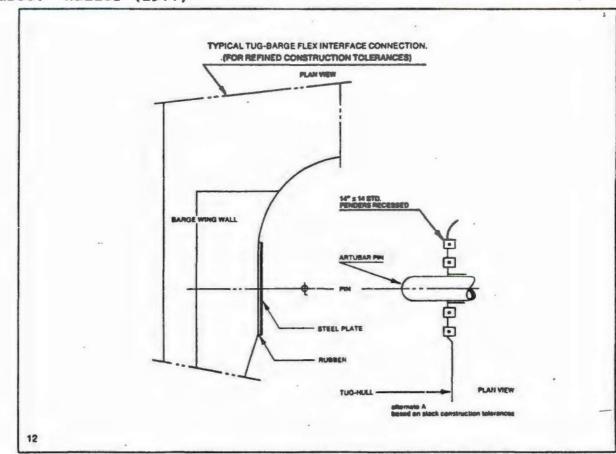


. Deep Notch-Pinned "Artubar"



From the tug, port and starboard pins are extended toward the barge. The bullet shaped pins aid alighment. In the extended position, the pins fit into lubricated sockets within the barge.

Source: Waller (1977)



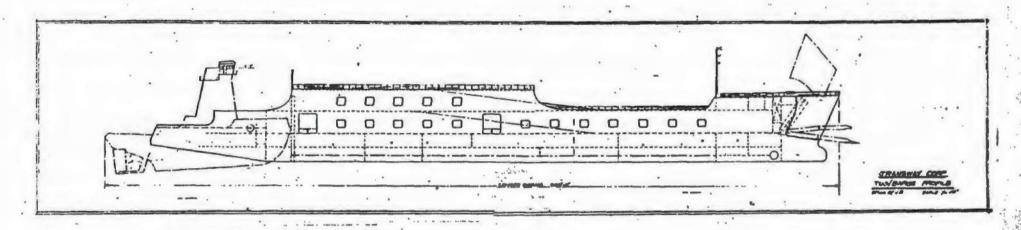
Source: Fletcher (1974)

FIGURE 14

ARTUBAR Semi-Rigić.
OGTB Linkage

FIGURE 15

Profile of RO/RO ARTUBAR OGTB



cial viability compared to the rigid-linked designs discussed previously.

First, the ARTUBAR design should be significantly less expensive to construct than either of the two rigid designs. This is primarily because the barge scantlings and, consequently, its hull weight can be made quite a bit lighter. This is the result of the ABS rules requiring that the scantling length be determined from two-thirds of notch length forward of the barge stern to the barge bow rather than from the tug stern to barge bow as required for rigid designs. Additionally, the ARTUBAR system should be less expensive to build because it is essentially made up of a standard ocean-going tug and a deep notched barge with only a hydraulic pin assembly added. The designer estimates that the cost of such hardware for a 15-20,000 HP tug and a barge of up to 60,000 DWT would be about \$1,000,000.

The use of standard tug and barge units makes the ARTUBAR more flexible than the rigid designs. The tug could be used for any normal tug function including pushing or pulling (if towing winch is installed). The barge, with wing wall skegs, is especially designed for good steerability with less than usual resistance when pull-towed. Also, since the linkage connection is made via pins only, any ARTUBAR tug could operate with barges of various size and function. For example, the CCT tugs could operate with up to 60,000 DWT barges, if only slow speeds are required. And, as the system can link in moderate seas, it is also more suited for drop-and-swap operations. The Japanese system with two barges and one tug operates in this mode.

The ARTUBAR system does have the disadvantage of being more expensive to operate than the rigid designs since its hull lines are not as smooth. The additional resistance and fuel cost may be as much as 10%, although this might be reduced substantially if fairing flaps are added to smooth over the linkage area.

SEA-LINK -- Semi-Rigid Linkage Design

Description: The SEA-LINK linkage design was first proto-type tested on some standard tugs and barges in the mid 1960's. At that time, the linkage failed due to problems in fabrication and design. After extensive analysis and investigation, an improved linkage was developed that also restricted rolling movements between the tug and barge as well as yaw, sway, and surge which was restricted in the original design. In 1973 this new linkage was installed on a 1450 HP tug and three 800 DWT barges operated by the San Miguel Corporation (SMC) of the Phillipines. This system allows the tug to push either one barge or two barges in tandem.

The linkage was designed to approximate the ease of operation and rugged simplicity or a railroad coupler. This is of importance in the routine coupling and uncoupling of barge flotillas in port as well as for emergency disconnect capability for safety.

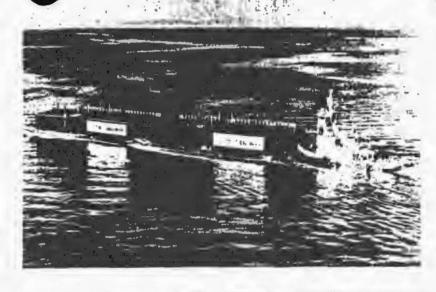
The linkage between tug and barge is provided by a pushing frame hinged to the stern of the barge and pinned to the tug amidships. The frame acts essentially as a double pinned hinge with the hinge pin axes horizontal and transverse to the vessels. The tug and barge can be separated by either manually or hydraulicly releasing the frame from the barge or the tug. The connection between the barges is the equivalent of a single pin hinge permitting relative pitch only. Thus, the barges must either be at nearly the same draft for linkage or the barges must be provided with a series of fittings at different heights. The linkage as intalled on the SMC tugs and barges is shown in Figure 16.

More information about the SEA-LINK system can be found in Glosten (1967), (1972), (1973), (1975), San Miguel Corporation (1977?), MARINE ENGINEERING/LOG (1976d), and SHIPPING WORLD AND SHIPBUILDER (1974d).

Commercial Potential: The SEA-LINK installation for the San-Miguel Corporation has been so successful that additional units were recently added to the flotillas. The linkage is capable of being installed on any conventional tug and barge, notchless or not. The cost of the installation depends on the forces expected which is a function of the sea states, speed of operation, and barge size. The SMC linkage weighs about 30 tons and would cost \$100-150,000 to construct. It operates without difficulty in 12 foot seas. Costs for the linkage on larger barges designed to operate in rougher seas are hard to predict, but the designer feels that systems of less than 8,000 DWT operating in non trans-ocean trades would be economically feasible.

The system can also operate with two barges in tandem. More barges are considered impractical due to the lateral bending moments generated at the linkages in long flotillas of linked barges. However, two tandem barge operation has been successful in the Phillipines and might be appropriate for certain coastal trades in the United States.

SEA-LINK has not been successful in U.S. trades probably because the proper conditions for its use were not found--rather small barges operated at low speeds in moderate seas. However, it is certainly an inexpensive system that allows 100% push-towing in trades for which it is suited.



Pig. 1 - 1450 horsepower tug SAN MIGUEL MOPSTER pushing two barges in tandem.

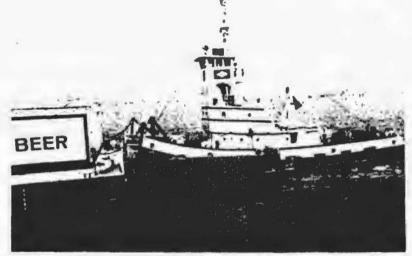


Fig. 2 - Sea-Link installation on SAN MIGUEL HOPSTER.

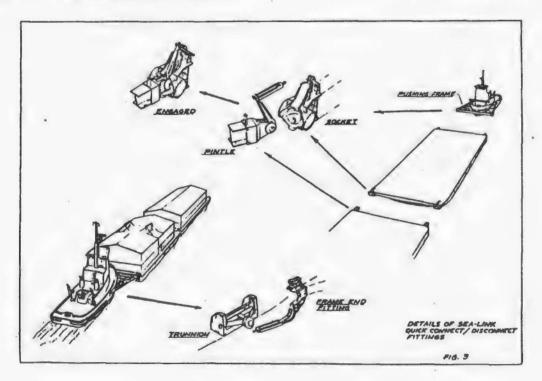


FIGURE 16

Sea-Link Semi-Rigid 3rd Generation OGTB System

Source: Glosten (1975)

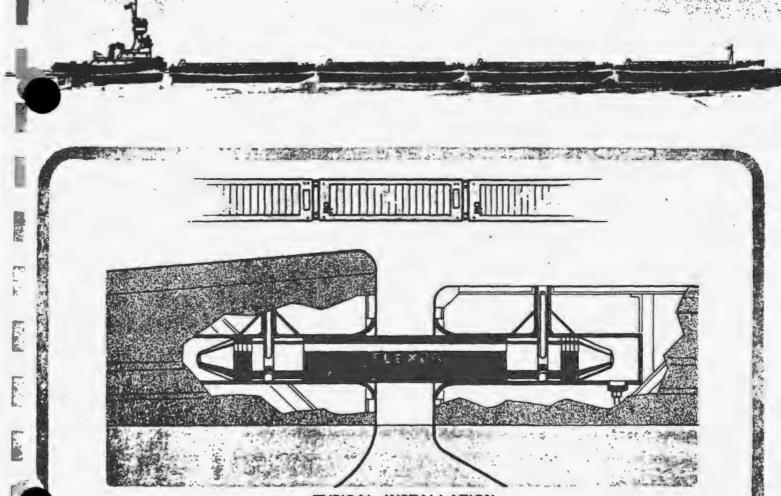
3rd Generation Flexibly-Linked OGTBs

There is only one flexibly-linked OGTB system under development in the U.S. at this time. Although not currently in commercial use, it has sufficient commercial and military potential to be mentioned here.

FLEXOR--Flexibly-Linked OGTB

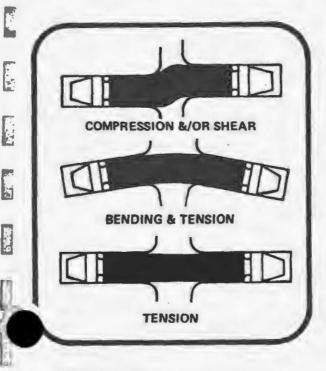
Description: The FLEXOR linkage concept has been under development since the early 1970's. Although it is not used yet in commercial service it has been successfully full-scale proto-type tested and is being used as the new U.S. Navy pontoon bridge connecting device. The normal FLEXOR ocean-going installation consists of up to four barges of up to 8000 DWT per barge, a bow unit, and a tug unit, connected to each other by a pair of longitudinal steel/rubber pins called FLEXORs. The pins fit into recepticles that have been designed with a quick release guillotine mechanism. The FLEXORs have heads made of cast steel which are separated by a urethane body interdisposed with steel plates. This method of construction makes these devices extremely strong and flexible. The body is pretensioned by cables connecting the The flexibility of the FLEXORs allow the different components to have some relative motions in all degrees of freedom which prevents build up of excessive force at the linkage Details of the linkage is shown in Figure 17 and illustrations of how a commercial FLEXOR system might look is More information about the FLEXOR linkage shown in Figure 18. system can be found in Marriner (1968) and (1972), Barge Train, Inc. (1971), (1973a), (1973b) and (1978), Appenbrink (1974), Brown (1977) and Hautanen (1975).

Commercial Potential: The FLEXOR system has been developed for a different type of commercial operation than that suited for the loosely and mechanically-linked designs. Instead of being used to push a single large barge in a point-to-point coastwise trade, it has been designed to push a series of smaller barges (<8000 DWT) in a train type operation. In this type of trade the barges would be dropped off and/or picked up at a series of ports during a single voyage. The advantages of such a type of operation are obvious. It has been used for quite some time on the great rivers of this country. It allows trains of different types of barges of various origins and destinations to be moved along the coast. The barges could be owned by the consignor, consignee, or barge company, and could be kept for storage as well. Essentially, FLEXOR allows the typical multibarge river system to become ocean capable.

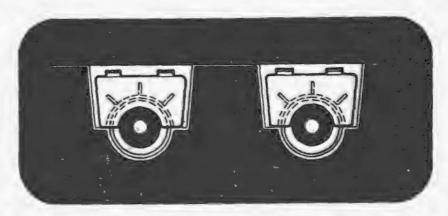


TYPICAL INSTALLATION

BARGE TRAIN, INC. FURNISHES FLEXORS AND FLARED CONNECTOR PIPES COMPLETE WITH LATCH MECHANISM.



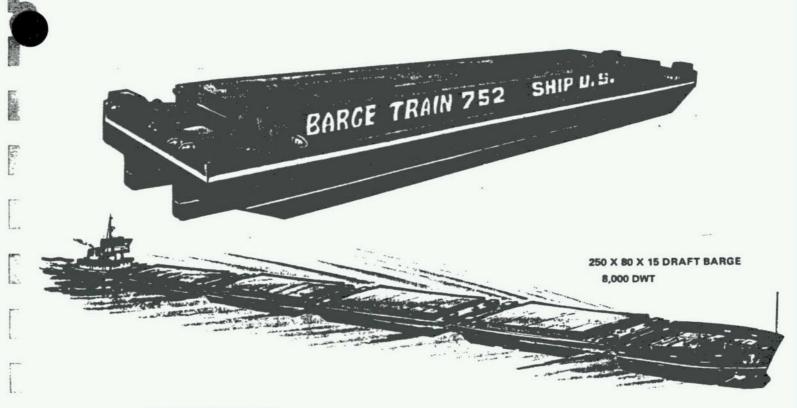
Source: Barge Train (1971)



SECTION THRU LATCH MECHANISM

FIGURE 17

FLEXOR Linkage



AT SEA WITH BOW UNIT

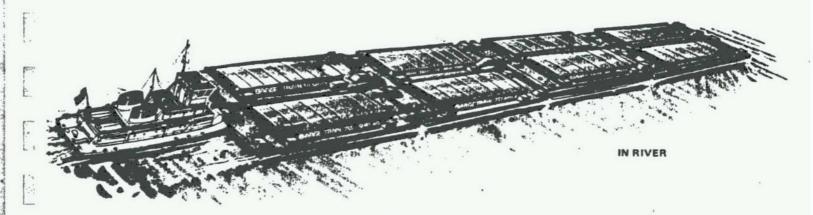


FIGURE 18

Artist Drawing of FLEXORS in Commercial Flexibly-Linked OGTB Systems

Source: Barge Train (1974)

There are several reasons why the FLEXOR has not yet been used in commercial trades. Probably the major one is that its use demands a type of operation radically different from the usual coastwise tug-barge operation. As the maritime industry is very conservative, such novelty is slow to be accepted. Additionally, in order to implement the barge train concept, several barges have to be built concurretly for diffent shippers who would be willing to coordinate their capital investments and movements. This might be a very difficult task for most U.S. coastal trades. Thus, FLEXOR might be first developed in a Great Lakes-river or river-coastal trade which would allow river barge systems to be moved on rougher waters.

3rd Generation Loosely-Linked OGTBs

There are several 3rd generation loosely-linked OGTB system designs under development at this time. One has been in operation for a few years and others are being installed on or contracted for new construction. The reasons for such a flurry of interest in these types of linkages are explained in detail in the next chapter. But to summarize, they are being built because they can be operated with 100% push-tow operation in coastal trades at less capital and operating cost than for the mechanically-linked systems and at little additional capital cost than for the 2nd generation OGTBs.

Since these OGTB designs are so new, there has been essentially nothing published about them in the professional journals or the trade literature. Therefore, the information presented in the following subsections has been obtained directly from the designers or operators, either through telephone conversations or company brochures/documents. Consequently, the data presented may not be complete for all designs, but it should be closely representative of the type of linkages that are now under development.

All of these loosely-linked OGTB linkages have the same purpose: to reduce the tug motion in the notch so that separation of the tug from the barge will not be required in any sea state expected during the voyage. Almost all of the designs utilize the same principles:

- (1) to restrict tug heave and pitch motion by the use of some non-jamming restraining device at the tug bow and/or by the use of frictional restraints (usually wedges) on the tug's sides,
- (2) to restrict tug surge by the use of tensioned cables connecting tug to barge stern, and

(3) to restrict tug roll, yaw, and sway by closely fitting the tug's lines to the notch shape so that these movements are restrained by fenders or wedges.

Each design performs these functions in a different manner as discussed in the subsections below. These descriptions will be followed by a brief discussion of the commercial and military potential of loosely-linked OGTB systems.

Bludworth Loosely-Linked OGTB Design

The Bludworth linkage design was the first of the loosely-linked OGTB linkages to be put into operation. The first unit, the Ponciana, began operations in 1972. Details of the linkage are not available since the Bludworths are reluctant to divulge any information concerning its design. However, it is believed that the tug is held in the notch by tensioned cables and its movement is restrained by hydraulicly controlled wedges located at the after end of each side of the tug. Additionally, the tug is restrained from heaving by a frictional device on the tug's stem that clamps onto a vertical rail located at the tip of the barge notch. This device is articulated so that the tug may pitch at the bow.

There are currently five OGTBs operating with the Bludworth linkage. The last two to be delivered, the Velasco and the Plaquemine, are 22,000 DWT double-bottomed tank barges. Although built for Dow Chemical they have been under a temporary charter to Belcher Oil since August 1978. The operator claims that when the barge is pushed by its 7000 HP tug, it has averaged 10.8 knots. The tugs and barges have never had to separate even when experiencing twenty foot seas. The operator believes the system capable of withstanding 30 foot seas without difficulty.

Currently two container OGTBs are being built by Union Carbide with this linkage. The 11,000 DWT single deck barges will carry somewhere between 200 and 300 thirty foot containers from Puerto Rico to U.S. ports. These systems will operate with 5600 HP tugs in a 76 1/2 foot deep notch. Delivery is expected in late 1979.

Breit & Garcia Loosely-Linked OGTB Design

The Breit & Garcia linkage design is the second of the 3rd generation OGTB designs to be installed on new construction. The linkage of this system differs from the other designs since the tug's bow is not restricted against heave. Instead, the tug bow is fitted with rubber rollers mounted on a horizontal axis to fa-

Additionally, the tug is secured to the barge notch laterally by four hydraulicly operated laminated steel/plastic pads located on either side of the tug, fore and aft of amidships, which mate with matching units on the barge. Tensioning hawsers are led from the barge wings via rollers on each of the tug's quarters to hydraulic tensioning rams. These serve the dual purpose of holding the tug in position longitudinally and of providing the means for transmission of stern power. It should be mentioned that the tug is equipped with a towing winch and hawsers and is fully certified for operating in the towing mode if necessary.

4

Two tank OGTBs are being built with this linkage design for Belcher Oil Company. The profile of this system and some particulars are given in Figure 19. The total cost for both systems was approximately \$50,000,000 and they are expected to operate in the push mode 100% of the time on their coastwise trades.

CABLE-LOC Loose-Linked OGTB Design

Recently E. H. Fletcher has developed a loosely-linked OGTB design to be installed on new or existing OGTBs. The linkage design is shown in Figure 20. There it is seen that a horizontal, cylindrically-shaped, constant-tension, energy absorption device is mounted on the tug's bow. This rubber device, which is about seven feet long for a 1500 LT displacement tug, transmits the tug's thrust energy evenly into a corresponding horizontal concave cylindrical slot in the barge notch. slots can be fabricated at several drafts to allow for different ballast conditions. The tug and barge are held tightly together by tensioned chains and the tug's sides are fitted with hydraulic wedges to reduce vertical motions. The cost of the device to be retrofitted on a 23,000 DWT barge pushed by a 7000 HP tug is estimated to be less than \$250,000. Model basin tests have indicated that this system should be capable of operating in the push mode during any sea condition expected in its coastal trade.

Commercial Potential

The economic incentive for the development of these loosely-linked OGTBs is discussed in detail in the next chapter. It is their ability to provide 100% push-tow capability at little additional capital cost compared to pull-towed systems that have made them so popular. However, since most systems have not operated for a long period of time, it is not possible to really evaluate the commercial potential of one system over another at this time. Additionally, it is not known whether these systems

3rd

Loosely-Linked GTB System

OGTB

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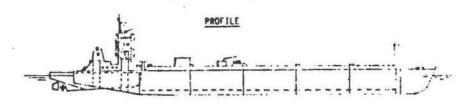
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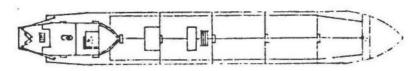
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PLAN



37,700 SOWT UNIT

PRINCIPAL DIMENSIONS:

TUG:	L.O.A. Beam Draft GRT	167 ' 53 ' 25 ' 290
BARGE:	L.O.A. Beam Depth GRT T.P.I.	585' 92' 41' 21300 106,
COMBINED UNIT:	L.O.A.	620'

Beam

Depth

37,700 SDWT UNIT

92'

41'

CARGO CAPACITY: (98%)

SOWT 37,700

35' S.W. Cubic Capacity 285,000 Bbls

SPEED/CONSUMPTION

12.0 knots/42 tons HVF plus 2.5 tons diesel fuel per day

CLASSIFICATION:

TUG: ABS Class Al Ocean-Towing Service

IMCO (Solas 1960) International Load Line

BARGE: U. S. C. G. Approved
ABS Class + Al Oil Barge

PROPULSION MACHINERY:

One B & W-type 7L67GF 7-cylinder, 2-cycle, maximum continuous rating 13,100 BHP at 119 RPM

AUXILIARY MACHINERY:

Two 550 Km. AC Generators driven by Caterpillar diesels. One emergency generator 135 Km. A.C. driven by Detroit Diesel.

Two 150 Kw. generators driven by Caterpillar diesels. Cargo pump engines Detroit Diesels. BARGE: Cargo

CARGO TANKS:

Tem, 5 Port, 5 Sthd.
Coating: Inorganic Zinc
Heating Coils: 25" Steel (1500 lin.ft.
tank) Hot Oil Heater: "Vapor" 8.4 million BTU's Up to 5 segregation available

55,000 SOWT UNIT

PRINCIPAL DIMERSIONS:

TUG:	L.O.A.	167'
	Beam	531
	Draft	25'
	GRT	290
BARGE:	L.O.A.	640'
	Beam	105'
	Depth	46'
	GRT	31000
	T.P.I	135
	8)	
COMBINED		
UNIT:	L.O.A.	675
	Beam	105
	Depth	46'

55,000 SDWT UNIT

CARGO CAPACITY: (981)

55,000

39' S.W. Cubic Capacity 417,000 Bbls

SPEED/CONSUMPTION

11.0 knots/42 tons HVF plus 2.5 tons diesel fuel per day

CLASSIFICATION:

TUG: ABS Class Al Ocean-Towing IMCO (Solas 1960) International Load Line

U. S. C. G. Approved ABS Class + Al Oil Barge

PROPULSION MACHINERY:

One B & W-type 7L67GF 7-cylinder, 2-cycle, maximum continuous rating 13,100 BHP at 119 RPM

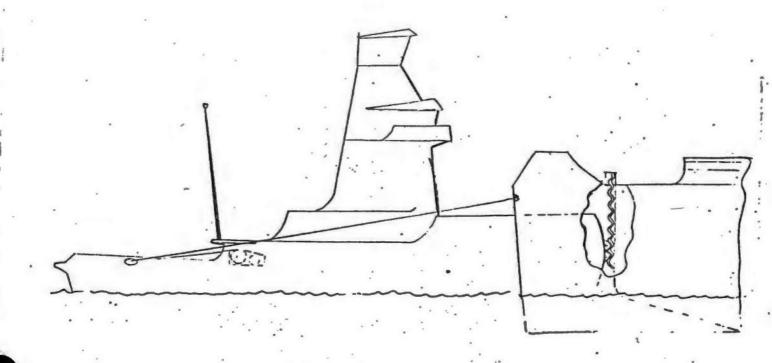
AUXILIARY MACHINERY:

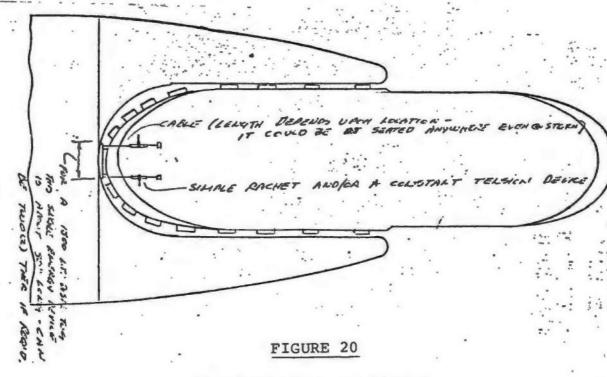
Two 550 Kw. AC Generators driven by Caterpillar diesels. One emergency generator 135 %. A.C. driven by Detroit Diesel.

Two 150 Kw. generators driven by Caterpillar diesels. Cargo pump engines Detroit Diesels.

CARGO TANKS:

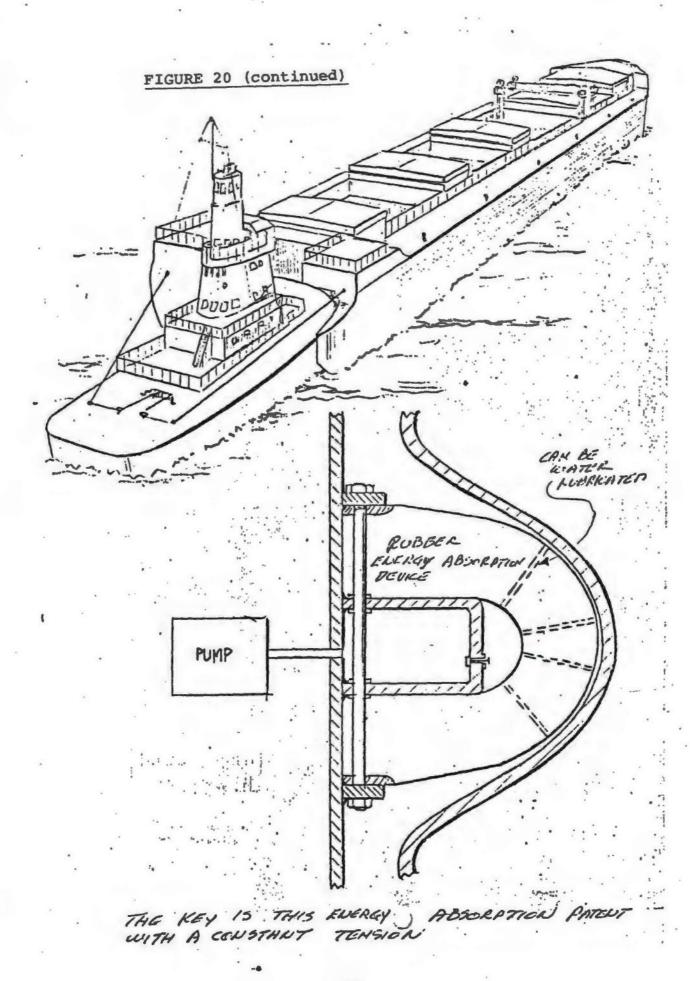
Ten. 5 Port, 5 Stbd.
Coating: Inorganic Zinc
Heating Codls: 2'3' sterl (2450 lin.
ft. tank) Not 011 Heater: "Vapor" 10.0 million BTU 's 5-grade segregation





CABLE-LOC Loosely-Linked
- 3rd Generation OGTB System.

Source: ANDUL Engineering, Inc.



are truly capable of push operation without damage in all sea conditions. Although they seem capable of withstanding between twenty and thirty foot seas, it is still questionable whether any or all of them could survive a major storm. This may not be of concern to most of the operators since their coastal trades allow their vessels to seek shelter when unfavorable sea conditions are expected. However, this may mean that none of them are trans-ocean capable or even suitable for some of the Northwest Pacific trades. On the other hand, if these systems are capable of operating in heavy seas, then it should be expected that they would penetrate these trades in the near future.

As for the cost of the linkage, it seems rather small, probably less than \$500,000. Additionally, all linkage systems should not interfere in the use of the tug for independent operation—for salvage, push-towing, or pull-towing. All of the linkage systems allow the barge to operate at different drafts without without major ballasting of the tug.

OGTB COMMERCIAL ECONOMICS

In this chapter the pros and cons of OGTBs will be discussed in comparison with ships. This will be followed by a brief discussion of the economics of the different modes of OGTB operation.

Economic Comparison of OGTBs with Ships

To compare ships and OGTBs with various linkages, the economic advantages and disadvantages of each system are compared. A summary of these comparisons is provided in Table 10.

Manning Size

The crews onboard ships at the end of 1985 averaged between 16-30 men. Although recently crew sizes have decreased, few ships of over 1,000 GRT are manned with less than 16 men. In fact the average manning of coastal vessels of 20-30,000 DWT in U.S., European, and Japanese trades is 23 men now.

Mechanically-linked OGTBs are manned with crews of approximately lw men. There are three reasons why these systems, although Coast Guard inspected and certificated, have substantially smaller crews than ships of equivalent deadweight.

The first reason is that their enginerooms are highly automated, typical of diesel tugs, so that they are classed for unattended engineroom service. This means that only a Chief Engineer, an Assistant Engineer, and another qualified member of the Engineroom Department are normally required for engineroom staff.

The second reason is that since the barges are classed as unmanned for the purpose of freeboard reduction, no crew is permitted on them for maintenance while underway. This allows the deck department to be reduced to the Master plus seven officers and men who are used primarily for underway watch standing.

The third reason why these mechanically-linked OGTBs have such small crews is because when they first came on the scene the crews were either non-union or company union members. Consequently, they did not pressure the owner to increase the manning level to match the national ship union manning scales. Additionally, they were permanently assigned to the same vessel which increased their familiarity with the ship, resulting in improved productivity and the need for fewer personnel. Later

TABLE 10

Economic Comparison of OGTBs and Ship by Cost/Operational Category

Cost/Operational Category	Ship	Mechanically- Linked OGTE	Loosely-Linked OGTB	Pull-Towed OGTB
Manning Size	Highest (20-30)	Intermediate (13-17)	Lowest (7-11)	Same as Loosely- Linked
Coast Guard Crew Licensing Requirements	Most Stringent	Same as Ship (unattended Engine Room)	Few Requirements	Same as Loosely- Linked
Union Control Over Manning	Strong	Weak	Almost None	
Crew Costs	Highest	Intermediate	Lowest	
Coast Guard Inspection Requirements	Most Stringent	Same as Ship	Apply to Barge Only	
Freeboard	Ship Rules	25% reduction for Unmanned Barge	Same as Mechanically- Linked OGTB	
Construction Costs	Higheat	Somewhat Less (70-90%) than Ship	Somewhat more Than Pull-Towed OGTBs	Lowest
Fuel Cost at a Given Speed	Least	Intermediate (~5% more than Ship)	Intermediate (10-15% more than Ship)	Greatest ("30% more than ship
Operational Safety	Most safe	About the same as Ship	Somewhat less safe than mechanically linked OGTB	Least Safe
Cargo Insurance Cost	Lowest	About the same as Ship	Probably somewhat more than mechni- cally-linked OGTB	Highest
Hull & Machinery Insurance Cost	Highest	Somewhat less than Ship	Somewhat more than Pull-Towed OGTB	Lowest
Protection & Indem- nity Insurance Cost	Highest	Intermediate	Intermediate	Lowest
Maintenance & Repair (Not performed by crew)	Lowest	Intermediate	Intermediate	Highest
Flexibility	Least	Little less Flexi- ble than Lossely- Linked OGTB	Little less Flexi- ble than Pull-Towed	Most

when other systems came into operation, the pattern of small crews had been established so that the national unions accepted them even when manned with their personnel. Besides, the large unions probably have come to the realization that if they attempt to inflate the crew sizes, the operators will tend to invest in the loosely-linked designs which require even fewer personnel.

Loosely-linked 3rd generation OGTBs and pull-towed OGTBs have even smaller crews. Since their tugboats are uninspected and usually under 200 GRT, there are practically no international or Coast Guard regulations pertaining to their manning. Thus, they can operate with two watches, usually of three men each, on voyages of less than six hundred miles and three watches on longer voyages. Consequently, crews range from 7 to 11 men.

To see how the different OGTBs and ships are currently manned, the reader may refer to Table 11. There the manning levels by rate are given for typical tank OGTBs and ships.

Coast Guard Licensing Requirements

Ships must have officers licensed in accordance with Coast Guard regulations. The deck officer knowledge and experience requirements differ somewhat as a function of the gross tonnage of the ship. Likewise, the engineering officer requirements differ somewhat as a function of the type and size of plant.

Mechanically-linked OGTBs must also have licensed deck and engineering officers. The Master and mate requirements are now based on the combined gross tonnage of the tug and barge, so that they are essentially the same as for equivalently sized ships. Engineering officer requirements are the same as those for diesel ship plants of the same horsepower.

Loosely-linked 3rd generation and pull-towed OGTBs (including 1st and 2nd generation push-towed systems) have relatively few requirements for the crews if the tug is less than 200 GRT. The deck watch officers must only be a certified Operator or Second-class Operator of Uninspected Towing Vessels. These Operators are required to fulfill substantially less stringent knowledge and experience requirements compared to the licensed officers onboard the mechanically-linked OGTBs. The Coast Guard does not even consider these certified men as officers. Engineers, if included, require no license at all. The only requirement on the crew overall is that 65% of the crew must be certificated as AB or above. It should be mentioned that many of the tug and barge operators, for the sake of safety,

TABLE 11
Typical Manning Scales for Tank OGTBs and Ships

Vessel Type Department	Typical Modern Tanker	Chevron Gas Turbine Tanker	Mechanically-Linked Tug-Barges	Loosely-Linked or Pull-Towed Tug-Barges (Voyages less than 600 mi.)	Loosely-Linked or Pull-Towed Tug-Barges (Voyages greater than 600 mi.)
Deck Licensed	Master Chief Mate 2nd Mate 3rd Mate	Master (3) Mates	Master (2-3) Mates	Uninspected Towboat Operator* 2nd Class Uninspected Towboat Operator*	Uninspected Towboat Operator* (2)2nd Class Uninspected Towboat Operator*
Deck Unlicensed	Boatswain (6) AB's	(6) AB's	(4) AB's or (6) AB's (2) Ordinaries	(3) AB's	(3) AB's
Engineering Licensed	Chief Engineer (2) 2nd/3rd Ass't Eng.	. Chief Engineer (3) Assistant . Engineers	Chief Engineer (2) Ass't Engineers or Ass't Engineer and QMED		
Engineering Unlicensed	Pumpman (3) QMED			Engineer(No license Required) Oiler	Chief Engineer (License suggested but not required) Ass't Engineer (2) Oiler/Utility
Steward Department	Cook (2) Stewards	(2) Cook/ Stewards	Cook/Steward	Cooking done by Crew .	Cook/Ordinary Seaman
Others	Radio Officer (2) General Utility (D/E)	Radio Officer	General Utility		
Total	<u>25</u>	17.	14-15	1	11

^{*}Requires Coast Guard Certificate rather than License

do hire licensed personnel and urge their crewmen to become licensed.

Overall Crewing Costs

Given the above information concerning manning levels and licensing requirements, it is apparent that ships cost more to man. Mechanically-linked OGTBs cost probably at least one half to man because they have crews that number almost half that onboard the equivalently-sized ships. And, loosely-linked OGTBs cost significantly less to man than their mechanically-linked counterparts since they can again reduce their crews almost by half. The crew that does remain onboard has practically no licensing requirements and so can be paid a lower average wage. One U.S. tug-barge operator has estimated that he saved at least \$600,000/year in crewing expenses by having a loose rather than mechanical linkage in his OGTB system. Such saving in crewing expenses certainly provides strong incentive for many shipping operators to invest in OGTBs, especially of the loosely-linked variety.

Construction Costs

The construction costs of large OGTBs (greater than 10,000 DWT) and ships of equivalent capacity and speed are compared in relative terms. That is, the features that make one system inherently different and more or less costly than another is discussed. In addition, one shipyard's estimate of the construction cost of the different systems is provided.

Certainly, the cheapest systems to construct are the hawser or pull-towed OGTBs. The tugs are the least expensive of the powering units to build since they are of standard designs that can be built at a great number of small vessel construction yards and without Coast Guard inspection. As these types of yards specialize in small boat construction, they do not require expensive building docks or ways. allows their overhead costs to be significantly less than those of multi-purpose shipyards. The barges, except for the very largest, can also be built in specialized barge construction These yards also have rather low overhead costs since barges, having little outfit material and machinery, can be built with lesser skilled workers. Additionally, since pulltowed barges can make only slow speeds, they can be designed with very simple hull lines with very little curvature. This means that most of the barge can be reduced to simple flat plate and frame construction which allows for inexpensive automated fabrication techniques. And finally the linkage between the tug and barge is the cheapest of all systems,

being only a towing winch and wire. For all of these factors, pull-towed OGTBs cost the least to construct.

Almost as inexpensive to build are the 1st and 2nd generation push-towed OGTBs. The tugs for these systems are still of standard designs. They require little additional hardware, possibly some extra bits and fairleads, for wires linking the tug and barge during push-tow operation. The deeper notch systems may also have some additional equipment to reduce heave or pitch in moderate seas. As for the barges, their notch will make them a little more expensive to build. But, the notch and other linkage costs should not add more than a couple of percent to the total cost of the system.

The loosely-linked third generation OGTBs will be somewhat more expensive to build than their 1st and 2nd generation counterparts. The tug, although of basically standard design, may require some special care in the fabrication of its hull form so that it mates closely with the barge notch. The tug may also require special modification to accommodate the machinery for the linkage devices. The barge cost should also be a little more expensive to build than its 1st and 2nd generation counterparts since its notch has to be built with closer tolerances to match the tug bow. Its notch also requires considerable reinforcement to accommodate the forces generated from operation at higher speeds or from severe sea conditions. Also, since these loosely-linked barges are normally operated at significantly greater speeds, their hull forms will require more shape and curvature to reduce hydrodynamic resistance, increasing their cost The linkage will also be substantially more more. expensive. For example, in most systems the tugs will have some capie/wire tensioning device to keep the tug snug in the notch. Additionally, some type of friction device that dampens the tug's motions in the notch is usually provided. The cost of these equipments can range from \$250,000 to \$500,000. This is in addition to a towing winch which is usually also installed on the tug for emergency pull-towing purposes or for increasing the operational flexibility of the tugboat. Thus, loosely-linked push-towed OGTBs are built with uninspected tugs, they are quite a bit more sophisticated and approximately 5% more expensive to build than systems designed mainly for pull-towing.

The mechanically-linked OGTBs are sustantially more expensive to construct than the other OGTBs. This is primarily because they come under all of the extensive construction requirements inherent to all vessels inspected by the Coast Guard. These requirements are designed to ensure that inspected vessels are as safe as possible—but safety costs money. For example, having redundancy in and/or a larger size of steering

gear is certainly a nice safety feature, but it makes an inspected tug more expensive compared to its uninspected counterpart. Also, since inspected tugs have much larger crews, they require more accommodation facilities, increasing their cost And, since these tugs are designed for 100% operation, the visibility requirements of the tug's pilothouse is based on the tug-barge combination. This may force the tug to have a very tall pilothouse which may have to be compensated by a costly ballast system to ensure adequate tug stability and Additionally, the tugs are often of very non-standard and sophisticated designs. The CATUG and Breit/Ingram designs are certainly good examples of such sophistication. This results in their cost being considerably higher than a standard design tug with equivalent horsepower. For all of the above reasons, it is apparent that the tugs of mechanically-linked OGTBs should be considerably more expensive to construct than the the tugs of other OGTBs.

The barges of semi-rigid mechanically-linked OGTBs should not be much more costly than their loosely-linked counterparts. They require only some additional expense for the engineering and fabrication of the notch to ensure it is built to the close tolerances required by the linkage. The barges of rigid mechanically-linked OGTBs should be somewhat more expensive to build than those of their semi-rigid counterparts because they must be built with heavier scantlings in accordance with ABS The linkage of any mechanically-linked system will certainly be a very expensive affair. The cost may range from \$1,000,000 for a semi-rigid linkage to more than twice that amount for the rigid linkages. In all cases, the systems require special hydraulics for establishing the linkage and some form of release mechanism to provide emergency separation. all of the above considerations make Certainly, mechanically-linked OGTB systems considerably more expensive to build than the other OGTB systems.

Ships, however, are the most expensive vessels to build. Probably the major reason why they cost so much more to construct than mechanically-linked OGTBs is because they are built in general purpose shipyards. The lack of specialization of these yards forces them to construct ships with higher overhead rates than those available from the more specialized tug and barge This increased overhead seems to outweigh the linkage costs incurred bу constructing the vessel as mechanically-linked tug and barge. Even in the case that a ship and a mechanically-linked OGTB with identical cargo handling equipment and carrying capacity are built in the same yard with the same overhead rates, there are some reasons why ships might cost more to construct even though they need no expensive linkage. First of all, since ship crews are almost double that

onboard mechanically-linked OGTBs, ship accommodations will be considerably more expensive. Secondly, ships cannot take advantage of the 25% freeboard reduction allowed by the 1966 International Convention on Loadlines for unmanned barges. This increases the depth and therefore the cost of weight limited ships by a few percent. Also, ships cannot take advantage of the less heavy scantlings allowed by ABS rules for the semi-rigid mechanically-linked OGTBs. This increases the ships' hull weight and cost by a few more percent.

And finally, another important consideration that makes ship construction more expensive is the time value of money. That is, tugs and barges can be built concurrently and delivered several months earlier than a ship built in a single yard. In this time of high inflation, such early delivery may result in several hundred thousand dollars reduction in capital interest expenses to both the shipyard and the vessel owner.

It should also be mentioned that shipowners usually specify considerably more sophisticated outfit equipment onboard ships than that commonly used on OGTBs. For example, tank barges usually have deep well pumps for their cargo handling equipment while ships normally have more expensive internal piping systems. Such "gold-plating" of ship outfit equipment increases a ship's cost substantially without adding any major real benefit - at least in the OGTB operator's point of view. In any case, all of these factors combine to make OGTB construction from 30% to 40% less expensive than ship construction for vessels of similar deadweight capacity and speed. The barge accounts usually for 40% of the OGTB cost. Therefore a OGTB system consisting of one pusher tug and three barges can often be built for 1.0-1.4 times the cost of a ship with equal DWT than a single barge (depending on size of vessels).

Fuel Expenses

The most fuel efficient way to move a given amount of cargo at a given speed at sea is by ship. This is because the ship's lines and propeller are designed to provide the designed speed with the minimum engine power. Care is taken to ensure that the hull form produces the least amount of hydrodynamic resistance and provides good flow to the propeller.

Rigidly-linked OGTBs are designed to have hull forms similar to those of ships. That is, when linked together the tug and barge lines are designed to join into smooth-like lines. Although the match is not perfect, the hydrodynamic

resistance of these OGTBs should be no more than 5% greater than for a ship of equivalent size driven at the same speed. Consequently, fuel expenses for these OGTBs should not be more than 5% greater than for ships.

Semi-rigid and loosely-linked OGTBs have tugs that resemble the more standard tug forms. Thus, when the tug and barge mated, the lines of the two vessels do not match well, particularly if there are significant draft differences between the units. This results in turbulence being generated at the linkage area and in disturbed flow to the tug's propeller. These effects might cause the resistance and power requirements of these OGTBs to be up to 15% greater than for ships of the same size and 15% figure is based on the model test results presented in Robinson (1976). Since these tests were conducted on rather crude forms, the increased resistance estimates may be high. In any case, linkage fairing flaps can be designed to reduce this added resistance by several percent. Unfortunately, practically no hydrodynamic model test results for currently operating semi-rigid and loosely-linked OGTBs have been published so the true amount of additional resistance caused by various linkage designs is not known.

1st and 2nd generation OGTBs probably have even more linkage drags than the deeper notched loosely-linked OGTBs when in the push-tow mode. Unfortunately, there is again no hydrodynamic resistance data available for these systems so the resistance and fuel consumption penalties incurred by them can only be guessed. Yet, at the slow speeds at which these OGTBs are usually operated, this fuel penalty is probably not significant.

Certainly, the least fuel efficient OGTB system is the pull-towed variety. Here, both tug and barge forms develop waves so that the total wave making resistance of the tug and barge exceeds that which would be developed if the tug pushed the barge. Additionally, barge skegs required for barge steerability and the hawser wire add frictional resistance drag. Thus, the pull-towed tug barge system will usually require at least 25% more power to pull than push the same barge form at the same speed. Although considerable work has been done on reducing the resistance of barge skegs, there has been little work on the resistance developed by the total pull-towed tug-barge system. Only crude resistance algorithms are available to provide the tug-barge operator an estimate of what horsepower is needed for moving a given barge tow at a given speed.

Given the above information about push and pull-towing fuel efficiency, it is apparent that the fuel costs of 1st and 2nd generation OGTBs depend on the percentage of time the tug is

pushing or pulling, fuel efficiency improving in proportion to the amount of pushing. And, it should be remembered that due to the control and handling difficulties involved, only barges of less than 20,000 DWT are usually towed for ocean voyages and at speeds lower than 10 knots. Higher speeds are impractical because of the severe frictional and drag resistances developed by the pull-towed system.

Operational Safety

There is no doubt that pull-towed OGTBs are inherently less safe than any other ocean transport system. The tug only has tenuous control over the barge. If the tow wire is severed, the barge may not be recovered before it is grounded or wrecked, particularly in bad weather. If the tug loses power, it may be run over by the barge. And, if the tug has insufficient reserve power, it may be dragged into trouble by the barge when seas or winds are severe. Certainly, the tug captain has much less maneuvering control over his barge when pull-towing rather than push-towing.

In principle, mechanically-linked push-tow operation should be as safe as ship operation. However, there are some differences between the two operating methods. Ships may be considered safer in some respects because they are usually manned with larger crews which can provide more emergency and firefighting manpower. Also, ships usually are provided with more extensive firefighting and ballasting/deballasting equipment than that onboard unmanned barges. On the other hand, tug-barge systems may be considered safer because their separability allows either unit to be used as the lifeboat of the other unit in the case it must be abandoned. As the damage or causes of damage on tankships usually occur in the cargo section of the ship, separability of the manned machinery section, the tug, may be assumed to provide an additional safety margin.

The other push-towed OGTB systems may be considered a little less safe than the mechanically-linked ones. This is because the crew is smaller, providing less firefighting or other emergency manpower. Also, since the tugs are uninspected they are not subject to many of the more stringent safety equipment standards pertaining to inspected vessels. Additionally, when ist and 2nd generation systems are in the pull-tow mode, they are subject to the same unsafe conditions as other pull-towed OGTBs.

Maintenance and Repair Costs

The maintenance and repair costs of any ocean going vessel will depend on the maintenance policy of the operator. The better maintained the vessel, the less the casualty repair costs. Maintenance can either be provided by the onboard crew or by shoreside personnel.

It has long been the philosophy of ship operators to have the personnel onboard do most of the ship's preventative and corrective maintenance. This makes quite a bit of sense if the ship is deployed on long voyages to ports far from the operator's home base. Shipside personnel can then take care of almost any casualty so that expensive repair delays away from home port can be reduced to the minimum.

Tug and barge operators, on the other hand, have opted to reduce their vessel crews to the minimum needed for operations. They have found it economical to leave most maintenance to less costly shoreside engineering personnel. This is a reasonable policy when the OGTB system makes short voyages to ports where shoreside personnel are readily available. If the maintenance cannot be accomplished without delaying the sailing, shoreside personnel are then sometimes embarked onboard the tug to accomplish tug maintenance. It should be remembered that since the barge is normally classed as an unmanned vessel, no routine maintenance and repair can be done on it while underway at its unmanned freeboard. This may not be a problem since practically no barge equipment is used while underway.

Given the above arguments, it would be expected that maintenance and repair costs of ships and OGTBs would be the least possible for their traditional trades. The question is raised what happens to these costs if OGTBs are sent on long voyages without additional maintenance crew or if ships are operated short coastal trades. It would seem plausible that OGTBs might be insufficiently maintained by their small crews if they continually remain on long distance trades. This would result in pensive casualties and/or frequent scheduled maintenance delays. Whether this is the fact may only be determined after systems like the Occidental CATUGs have operated for some time on transoceanic trades. On the other hand, coastal ships might be quite overmanned if adequate maintenance can be provided by less costly shoreside personnel as it is done for OGTBs. Whether this is the case may be determined from the maintenance and repair history of the large coastal OGTBs. But, since most coastal systems are only a few months old, it will be some time before it can be determined whether these OGTBs are adequately maintained to prevent expensive casualties or deterioration in the long term.

Insurance Costs

Marine insurance is made up of several different premiums: cargo, protection and indemnity (P&I), and hull and machinery (H&M). Insurance rates are determined by the underwriters, primarily from the operators previous operating record.* However, the different OGTB systems and ships have some inherent differences that affect insurance cost. These are discussed below.

First consider cargo insurance where premiums are ultimately based on the safety record of the vessel as well as the value of the cargo. Since pull-towed OGTBs are inherently less safe than other OGTB modes, cargo insurance premiums for these systems are usually significantly higher, sometimes twice that for ships. The push-towed OGTBs have, based on their good safety records, cargo insurance premiums about the same as for ships.

Protection and Indemnity insurance is marine liability insurance. It is predominately a function of the crew size since the larger the crew, the greater the risk of a crewman being injured. Since ships have the largest crews, they would have the largest P&I premiums. Conversely, the uninspected tugs of loosely-linked or pull-towed OGTBs have the smallest crews and thus the lowest P&I premiums. The premiums for mechanically-linked OGTBs would fall between those of ships and uninspected tugs since their crews are of intermediate size.

Hull and machinery insurance protects the operator against casualty or damage to his vessel's hull and machinery. Its premium is a function of the vessel's market value which is usually a function of the its capital cost. Since ships have higher capital costs and market values than OGTBs, they usually experience the highest premiums. It should be mentioned that H&M insurance is also a function of the repair and maintenance policy of the vessel. The better maintained vessels experience fewer casualties resulting in lower H&M claims and premiums. Thus, OGTBs with insufficient crews to maintain them could have such severe repair problems that they will have larger H&M premiums than other more costly and better maintained vessels.

It should also be added that pull-towed systems are also subject to a tower's legal liability insurance. This insurance protects the operator from any damage caused by the barge if the tugboat loses control of it during a voyage. Its premium depends on the safety record of the operator and the type of cargo.

^{*} Since cargo insurance is paid by the shipper to protect himself against loss or damage of his cargo, its premium is based on the shipper's rather than the operator's record. However, if the shipper predominately uses a particular OGTB system type, his cargo insurance premium will reflect the operating record of the operator.

Flexibility

Up to this point we have considered an OGTB as a system of one tug and one barge operating in a shiplike mode, that is, with the tug and barge remaining linked together at all times. However, OGTBs do have the advantage of being able to separate the propulsion component—tug from the cargo component—barge. This flexibility may be advantageous for several reasons. The primary advantage is that it allows tug and barge systems to operate in the same manner as truck tractors and trailers where the propulsion component drops and swaps the cargo components. The trades for which this type of operation is advantageous will be discussed in detail.

There are several other reasons why tug and barge separability provides useful system flexibility and cost savings. For example, if either a tug or a barge of a system requires repair, the other operating component can be utilized if there are other interchangeable operational components in the overall system available to be mated with it. Also, only the component that requires repair will need to be drydocked for hull repairs. This will result in significant savings if the small-sized tug needs such repairs more often than the large-sized barge.

Separability also provides flexibility in the long term investment policy of the operator. It allows him to trade, scrap or convert a barge if it becomes obsolete or unprofitable and replace it with one that can operate profitably with the same tug unit. Or, the tug component of many of the OGTB designs can be sold or operated as an independent ocean-going tug for pull-towing, salvage, or other purposes. Certainly, such flexibility allows the OGTB operator many more options than that are available to the ship operator. It even allows separate ownership of the tugs and barges.

It should be remembered that as the linkage design becomes more sophisticated, less flexibility is allowed by the system. For example, the most flexibility is provided by pull-towed Any tug of sufficient horsepower can pull any barge. OGTBs. Additionally, since the tugboat is in front, it will not experience any of the pilothouse visibility problems incurred by the push-tow operators when pushing barges with tall deck cargoes. 2nd generation and loosely-linked push-towed OGTBs are not so flexible. Although the tugs and barges are capable of pull-tow operation, the barges can usually only be pushed by tugs and barges designed for their notches. The tugs and barges of mechanically-linked OGTBs, except for the ARTUBAR system, are not designed for pull-towing. The the tugs are restricted to pushing their linkage system or to salvage designed for operations. But, even these systems have the advantage over ships of having either the tug or barge as the lifeboat for the other vessel in case of emergency.

Overall Economic Comparison of OGTBs and Ships

After reviewing the comparison of the various OGTB systems and ships by cost/operational categories shown in Table 10, some generalizations may be made concerning the trades for which a particular system might be most appropriate. Such generalizations are provided by vessel types in the paragraphs below.

Pull-Towed OGTBs: These types of OGTBs are the least expensive to construct and man but are also the least fuel efficient at sea. Thus, they are most appropriate for trades with short distance voyages where sea time is not a large proportion of the total voyage time or where speed is totally unimportant as in the transport of constructed facilities. In these trades the extra fuel costs are outweighed by capital and crewing savings. These systems are also the most flexible to operate since any ocean-going tug of sufficient horsepower can be matched with any barge. Thus, operators with large multipurpose tug and barge fleets tend to favor this towing mode. It allows them to use the same tug for towing cargo barges, for moving oversize construction equipment without visibility problems, and for salvage. If necessary, they can charter in or out their tugs and barges from or to other operators without worrying about the linkage match.

OGTBs with the additional capability of push-towing with any standard tug in calm waters. This ability to push in congested waters rather than taking the barge on a short wire makes these OGTBs much safer. If the hardware and/or shallow notch of these systems does not interfere with the barge's operational flexibility, it would seem reasonable that the greater safety provided by these systems over pull-towed systems would be well worth the investment. Thus, I would expect that most OGTBs predominately operating in the hawser tow mode to be built as 1st Generation OGTBs.

2nd Generation Push-Towed OGTBs: These systems are transitionally between 1st generation and 3rd generation loosely-linked OGTBs. That is, they allow more than 50% of the sea voyage to be in push-tow mode but in severe seas, say greater than eight to twelve feet, the tug and barge must resort to pull-tow operation. Although these systems are more fuel efficient than 1st generation OGTBs since they can push-tow for a larger percentage of the voyage, such fuel savings would not warrant the extra costs for a deeper barge notch and a sophisticated linkage in short distance trades. They also would not be useful in moderate distance trades when heavy seas might often force the tug out of the notch. This maneuver can be rather dangerous. So for these and longer distance trades, it would probably be worth

the moderate additional cost for installation of the new 3rd generation loosely-linked OGTB linkages, assuming that they allow push-towing in all sea-states expected during a voyage. As confirmation of this hypothesis, one 2nd generation OGTB operator has recently contracted for designs to convert his system into a 3rd generation loosely-linked system. It should also be realized that 2nd generation OGTB linkages reduce the operational flexibility of the barge since only tugs designed for the notch can be used for push-towing.

3rd Generation Loosely-Linked Push-Towed OGTBs: These OGTBs allow considerable fuel savings over the previous designs since 100% push-tow operation is achieved. However, continuous push-towing is obtained at the cost of a rather sophisticated and expensive linkage system. Whether this extra cost is warranted depends on how much can be realized in fuel savings. Since fuel savings would be greater the longer the system is at sea, these OGTBs are most suitable for long distance trades with rather short port times. As these systems do require tugs and barges specially designed to match each other and since there are no designs that predominate at this time, the operator has little opportunity to take advantage of the separability of his units except in drop-and-swap mode operation. However, the tugs are basically of standard designs and so could be used pull-towing if necessary. It should be mentioned that these designs (Bludsworth, Breit/Garcia, Fletcher) have not operated for very long so it has not been proven that they could be operated in the push-mode in very severe seas as would be experienced in transoceanic crossings. This is not of much importance to their owners since they are expected to be only used in coasttrades. However, it may reduce their ability to be speedily mobilized for foreign area operation.

3rd Generation Mechanically-Linked Push-Towed OGTBs: These OGTBs have little to offer over their loosely-linked counterparts. They are a little more fuel efficient since the tug and barge hull lines are designed for smoothness. They are also certain to be capable of push-towing in all ocean sea states, which has yet to be proved for the loosely-linked designs. And, they probably are somewhat safer since they have larger crews and the tugs built under Coast Guard inspection. However, these improvements are achieved with a large increase in the system's capital manning costs which result from the tug being built and manned under Coast Guard supervision. It would seem that these marginal improvements would only be warranted in very long trans-ocean or trans-coastal trades. For these trades the increased fuel efficiency and safety would be most important. The larger crews would also be useful for handling the preventative and casualty maintenance that would normally be done by shoreside personnel for the other OGTB systems.

Ships: Ships are certainly the most fuel efficient of all these systems. Their hull lines are designed for the greatest hydrodynamic efficiency. This would make them most suited for the same types of trades for which the mechanically-linked OGTBs are most economic. But, whether these fuel savings are worth the additional capital and manning costs incurred by ships over those incurred by mechanically-linked OGTBs of equivalent size and speed is subject to careful economic analysis.* Consideration must be given to the usefulness with respect to safety and for maintenance of the larger crews onboard ships. On the other hand, consideration must be given to the additional flexibility of operation available with OGTBs--particularly the ability to operate in a drop-and-swap mode. The economic ramifications of such flexibility is explained in the next section.

As of today, more and more mechanically-linked OGTBs are being constructed instead of ships for long distance trades. This indicates that at this time they are more economical to own and operate than ships of small unit capacity (<100,000 DWT) and moderate speed (<20 KTs). For the large unit capacity and faster trades, however, ships still have no competition.

Economic Comparison of CGTB Operation in the Drop-and-Swap Versus Integral Mode

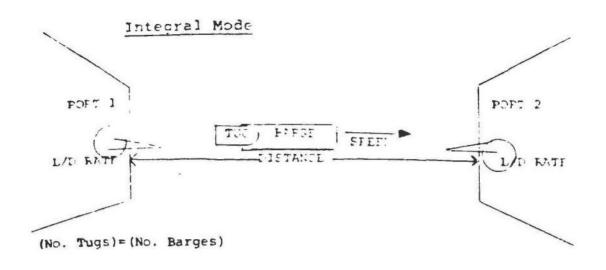
In the previous section an economic comparison of the different OGTB systems and ships was made, primarily based on tug-barge operation with the tug remaining with the barge at all This is because almost all OGTBs except for a few of the pull-towed and 1st generation OGTBs have been operated in However, this method of operation does not take advantage of the one inherent feature that all OGTBs have that is not available to ships. That is their ability to separate the propulsion unit from the cargo carrying unit. This flexibility can be used to increase system efficiency through increased utilization of expensive propulsion units and through the storage capability of the detached cargo units. It may be that many of the current 3rd generation loosely and mechanically-linked OGTB users, being previously experienced in only ship operations, have just overlooked the potential benefits of the separability of their assets, or it may be that it is not economically profitable utilize this capability in the trades in which they operate. However, since foreign operators such as Mitsui of Japan have operated fleets of tugs and barges in drop-and-swap operation for several years, it is certain that there are some trades for which this mode of operation is most economical.

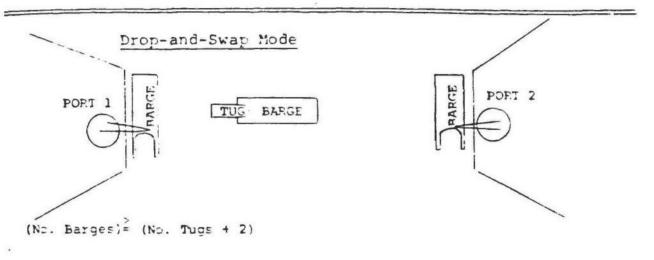
^{*} One mechanically-linked OGTB operator estimates that the operating expenses for a 35,000 DWT/11,000 HP system would be 40% less than the equivalent conventional ship operating at the same speed.

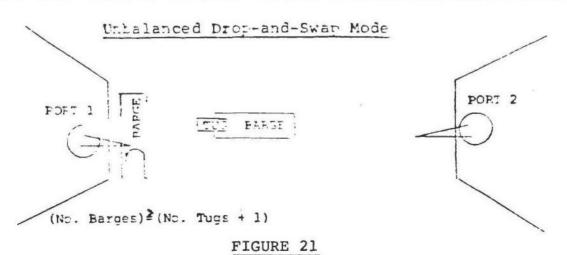
It is the purpose of the economic model to investigate ander just what conditions the separability feature of OGTBs should be utilized. When the model's output indicates that there are few existing or potential trades where this feature may be used, then it would be expected that the economics for OGTB integral mode operations discussed in the last section would solely apply. However, when the model's output indicates that there are many trades which could take economic advantage of this feature, then it might be expected that OGTBs, especially of the mechanically-linked design, would displace ships in these trades.

Detailed Description of the Different Modes of Operation

As it is the separability feature of OGTBs that make them more versatile than ships, more mention should be made on how this feature can be profitably used. The major benefit is the same as that enjoyed by tractor trailers over single unit trucks. That is, the propulsion unit (tractor or tug) can be detached from the cargo unit (trailer or barge) while the cargo unit is used for loading, discharging, or storage. It then can be used for transporting another cargo unit that is available for movement. This method of operation, the drop-and-swap mode, obviously increases the utilization of the costly propulsion unit as compared to the integral mode of operation in which the propulsion unit always remains with the cargo unit. However, as can be seen in the simple port pair system shown in Figure 21, the drop-and-swap mode will require at least two more barges than tugs in a balanced trade or at least one more barge than tugs in an unbalanced trade (where the tug remains with the barge in one port). Certainly, the drop-and-swap mode would be of most benefit in those trades in which loading/discharging times make up a significant part of the voyage time. then, is the most potential in increasing tug utilization, especially in multi-tug fleets which can often be scheduled so that a tug arrives with a barge for discharge just at the time when a barge in port has completed its cargo operations and is available for transport. In this case tug utilization can approach 100%. Also, in trades with long port times, the barges remaining in port in the drop-and-swap mode of operation are used essentially as floating warehouses, replacing shoreside assets. Since port time is a function of the barge cargo capacity and both terminals' loading and discharging rates, and since sea time is a function of port separation distance and OGTB speed, these four parameters are critical in determining whether the drop-and-swap mode should be used over the integral mode. Because the cost relationships that are functions of these parameters (e.g., fuel cost is a function of the tug-barge size and form, OGTB speed, and port







Port Pair Trades: Integral and Drop-and-Swap Modes

separation distance) are rather complicated, it is not intuitively obvious when one mode is superior to another. A systematic analysis, such as that performed by a computer, is required to determine where the tradeoff point is for the modes.

Typical Ocean Tug-Barge Costs

Item	Barge	(10kt)	Ship	(15kt)	
DWT	15000	t	15000	t	
One-way Trip Time	1.5	days	1.0	day	
Loading Time	1.0	day	1.0	day	
Unloading Tim	e 1.0	day	1.0	day	
Annual Tonnag	e 1,750,000	t	1,350,000	t	
Day/Year	350		350		
Capital Cost	Tug 1.5 Barges 3.4		Ship 7.2	m	
Capital Cost	Total \$4.9	m	\$7.2	m	
Fuel Cost/Yea	r \$1.7	m	\$1.8	m	
Crew Costs (U.S.)	\$0.5	m	\$1.1	m	
Insurance	\$0.3	m	\$0.3	m	
R&M	\$0.2	m	\$0.4	m	
Supplies	\$0.1	m	\$0.2	m	
Port Charges	\$0.3	m	\$0.4	m	
Administratio	n \$0.2	m	\$0.2	m	
Total Variabl Cost/Year	e \$3.3	m	\$4.3	m	
Total Finacia Cost/Year(10		m	\$0.7		Assume 20 year loan at 10%
Total Annual Cost	\$3.8	m	\$5.0	m	
Cost/ton del.	\$2.1	7/t	\$3.70	0/t	

In addition Tug - Barge supplies alongside storage at all times.

Loading/Unloading could be slowed - lower port invest and operating costs

APPENDIX A

Inland Water Barge Design

Inland water transportation barges are designed using Classification Society rules for the determination of the weight and the overall dimensions. Resistance is computed from the results of experimental and physical tests of hydrodynamic performance. A list of symbols used in barge design is given in Table A.1. The dimensional relationships of hull parameters used in determining barge displacement are shwon in Table A.2, while Table A.3 presents the freeboard calculations used in determining barge depth. Using test data, barge resistance was computed for various combinations of block coefficient and speed/length ratio, to obtain the resistance/displacement ratio as shown in Table A.4. Each is obviously determined for a specific length/beam ratio.

Barge resistance as shown is computed using Barge Resistance = $R = \Delta R_f \left(\frac{7}{L/B}\right)$

where R_f is expressed in terms of C_B , and speed/length ratio (V/\sqrt{L}) .

The plate parameters and resulting section modulus equations used in the structural design of the barges are presented in Table A.5.

To determine barge hull (steel) weight and costs, an analysis of typical steel weights and manhour requirements was performed by reviewing average shippard manhour requirements which are applied to the barge steel weight, defined by the different weight categories such as longitudinal stiffener, web frame, and panel weights. These, in turn, were determined separately for the fore, mid body, and aft end of each barge design. Total steel weight for inland water barges can be expressed as:

Steel Weight = .00179L B[12(t₁+t₃)+
$$\frac{A_1}{S_1}$$
+ $\frac{A_3}{S_3}$ + $\frac{A_3}{S_3}$ + $\frac{A_4+A_6}{8}$] + D [36t₂+ $\frac{3A_2}{S_2}$ + $\frac{7A_5}{16}$] + BD [$\frac{3t_2}{8}$ + $\frac{A_1}{32S}$] tons

TABLE A.1

Symbols used in Barge Design

· ‡, ·	= bottom plate thickness
-	
t ₂	= side and BHD plate thickness
ta	= deck plate thickness
S	= bottom frame spacing
S	= side and BHD frame spacing
S	= deck frame spacing
SM ₁	<pre>= required section modulus for bottom longitudinals</pre>
SM ₂	= required section modulus for side and BHD longitudinals
SM ₃	<pre>= required section modulus for deck longitudinals</pre>
1,	= free span of bottom transverses
1,	= free span of side web frames
1,	= free span of deck transverses
SM	= required section modulus for bottom transverses
SM ₅	= required section modulus for side and BHD web frames
SM 6	= required section modulus for deck transverses
D	= depth
L .	= length
. В	= beam
н	= draft
T	= distance inboard of the shell and above the baseling of the flat bilge chines
A	= beam cross section for beam for SM;
i	

TABLE A.1 (continued)

rake of the bow RB Rs rake of the stern width of headwall width of the transom Ws V_B volume of the bow v_s volume of the stern volume of the mid-section total volume LD length of the forward hull, forward of the parallel mid body $^{\mathtt{L}}_{\mathtt{S}}$ length of the aft hull, aft of the parallel mid body CB block coefficient displacement in fresh water Δ A_S displacement in salt water ratio of draft to the rake of the bow PB ratio of draft to the rake of the stern

PS

TABLE A.2

DISPLACEMENT

\$700 Killing

Given L, B, D, H, T Define $L_{B} = 0.10 L$ $L_{S} = 0.08 L$ $L_{M} = 0.82 L$ $W_{B} = 0.35 B$ $W_S = 0.70 B$ $R_{B} = D - 1$ $R_S = D - 2$ $\rho_{\rm B} = H/R_{\rm B}$ $\rho_S = H/R_S$ $V_{B} = \frac{4 (HB-T^{2}) + 2 T\rho_{B} [W_{B} + (B-W_{B})\rho_{B}] - T^{2}\rho^{2}_{B}}{L_{B\rho B}}$ $V_{M} = (HB-T^{2})L_{M}$ $V_S = \frac{4(HB-T^2) + 2T\rho_S [W_S + (B-W_S)\rho_S] - \frac{2\rho^2}{S} L_{S\rho S}}{V_S + (B-W_S)\rho_S}$ [FT²] $v = v_B + v_M + v_S$ $C_B = V/LBH$ [Dimension|ess] [Short Tons, (FW)] $\Delta = V/32.14$ [Short Time) (SW)] $\Delta_{S} = V/31.25$

 $\frac{\delta V}{\delta H} = \frac{B}{2} (L_B \rho_B + L_S \rho_S + 2L_M)$

TABLE A.3
FREEBOARD CALCULATIONS
(feet)

Freeboard = (z + .5D + .05L + 5)/12

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where Z =	for L =	for $D = 10$	Freeboard =
6.3	60		1.6
6.9	80		1.7
8.5	100		2.0
10.5	120		2.2
. 12.7	. 140		2.5
15.0	160	•	2.7
17.7	180		3.1
20.5	200	v	3.4
23.6	220		3.7
26.9	240		4.1
30.5	260		4.5
34.3	280		4.9
38.3	300		5.3

TABLE A.4 RESISTANCE INPUTS

 $RT/D = (RT/D)_1 \times (\frac{7}{L/B})^{0.5}$

Vk/ /L	C _B	(RT/D) ₁	Vk/ √L	C _B	(RT/D) ₁
0.3	0.8470.85	1.0	0.3	0.88-0.90	2.0
0.4		1.8	0.4	(- 01 p = -	2.9
0.5		3.0	0.5	/ IA	4.3
0.6		4.8	0.6		6.4
0.7		7.2	0.7		9.3
0.8		10.5	0.8		13.4
0.9		14.4	0.9		19.0
1.0		19.0	1.0		25.6
1.1		23.9	1.1		33.1
1.2		29.5	1.2		41.9
0.3	0.86-0.87	1.5	0.3	0.91-0.93	2.6
0.4	\	2.4	0.4		3.8
0.5		3.9	0.5		5.5
0.6		5.9	0.6		7.9
0.7		8.5	0.7		11.2
0.8		12.0	0.8		15.8
0.9		16.1	0.9		21.8
1.0		20.8	1.0		29.5
1.1		26.0	1.1		38.5
1.2	1	31.9	1.2		47.5

TABLE A.5 PLATE PARAMETERS

SECTION AND MODULUS EQUATIONS

TABLE A.5 (continued)

$$1_{2} = \frac{D - T - 1.5}{M_{2}}$$

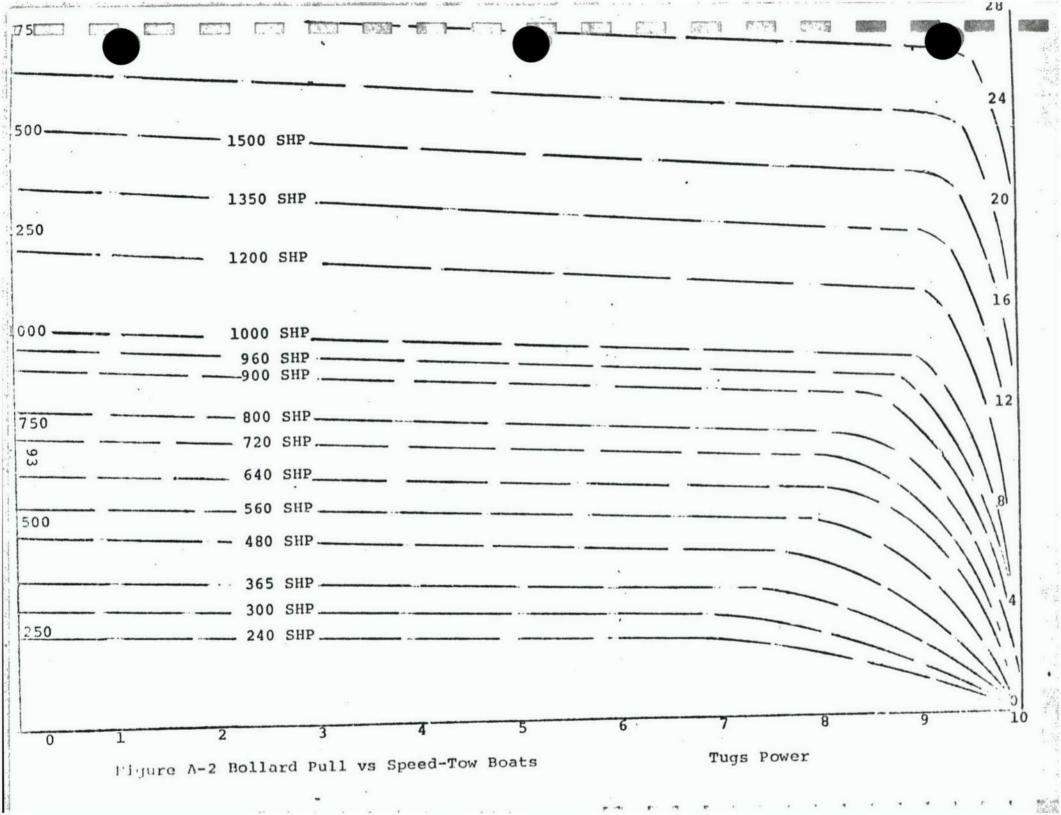
$$1 = \frac{B - 3}{M_{1}}$$

$$SM = 0.36 (l_{1})^{2} (D + 4)$$

$$SM_{5} = .058 (l_{2})^{2} \frac{(l_{2} + 8)}{2}$$

$$SM_{6} = .142 (l_{3})^{2}$$

Steel material costs vary from \$360-520/ton and barge construction labor manhours vary from 30-80 manhours/ton of steel weight dependent on size of barge and productivity of the shipyard. The cost of a 3500 DWT barge built in the U.S. for example with a steel weight of 414 tons, labor productivity of 40 manhours per ton, and labor cost (fully burdened) of \$22/mh, and steel cost of \$400/ton (average) then barge costs = $[400 \times 414 + 40 \times 22 \times 414] = 529,920$ or \$1851/ton of DWT capacity (1986). Obviously labor costs in developing countries should be significantly lower than \$22/mh and therefore barge construction costs correspondingly lower.



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TABLE A.6

Bollard Pull in Tons at Full Tug Power

Speed in Knots

Installed BHP	4.5	5.0	5.5	6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
240	3.41	3.36	3.33	3.30	3.25	3.2	2.88	2.56	2	1.44	.8	.16
300	4.4	4.32	4.24	4.16	4.08	4.0	3.76	3.36	2.72	2	1.12	.32
365	5.39	5.28	5.25	5.23	5.22	5.2	5.12	4.64	3.84	2.88	1.6	.48
480	6.99	6.96	6.88	6.85	6.78	6.72	6.56	6.24	5.44	4.16	2.32	.64
560	8.32	8.24	8.16	8.08	8	7.92	7.84	7.68	7.12	5.6	3.44	.80
640	9.6	9.44	9.41	9.33	9.26	9.2	9.12	9.12	8.56	7.36	4.96	.96
720	10.99	10.8	10.75	10.69	10.62	10.56	10.4	10.4	9.92	8.48	5.6	1.02
800	12	11.84	11.76	11.68	11.6	11.52	11.39	11.28	10.88	9.92	7.26	1.36
900	13.6	13.44	13.39	13.3	13.2	13.12	12.96	12.89	12.8	11.36	8.56	1.6
960	14.4	14.24	14.19	14	13.97	13.92	13.76	13.6	13.52	12.56	9.28	2.0
1000	15.2	-14.99	14.96	14.86	14.75	14.64	14.56	14.4	14.32	14	11.2	2.4
1200	18	17.92	17.76	17.61	17.49	17.36	17.2	17.12	16.96	16.8	14	4.0
1350	20.4	20.32	20.16	20	19.84	19.68	19.6	19.52	19.36	19.2	16.8	8.4
1500	22.59	22.56	22.4	22.24	22.11	22	21.92	21.76	21.6	21.44	20	12.4

APPENDIX B

Preliminary Outline Specifications for Oceangoing Tug-Barge Systems GENERAL CONDITIONS & INTENT:

It is the intent and spirit of this specification that the Builder shall construct, equip, and furnish the vessel complete in every respect and ready for service in accordance with the Contract Plans accompanying these Specifications and subsequent drawings made by the Builder and approved by the Owner, which carry out the general idea and intent of the original plan, and to meet the requirements of the American Bureau of Shipping, of United States Coast Guard, and of all other regulations of governmental authority.

Wherever the terms "or equal", "as selected", "as directed", "as approved", are used it is understood that the decision rests with the Owner.

The Builder shall furnish all items required for the completed barge. Any error in the description or the omission of any item in the Specifications or Contract Plans which is essential to complete the vessel ready for service, in accordance with the intent of these Specifications and usual practice, shall not release the Contractor from furnishing such item at his own expense.

The barge shall be unmanned and suitable for carrying Grade B and lower petroleum products generally referred to as light distillates including gasoline.

DIMENSIONS: (Molded)	30,000 DWT	40,000 DWT	50,000 DWT
Length on deck	531.0'	584.0	629.0'
Beam	90.4	99.4'	106.9'
Depth at side amidships	36.0'	39.6'	42.6'
Scantling Draft	28.21	31.2'	33.5'

GENERAL DESCRIPTION:

The barge is basically divided into the following sections:

Forward and After Peak Compartments arranged for ballast, storage, windlass motor room, and cargo tanks.

INSPECTION:

The authorized agents and inspectors of the Owner shall have access to the vessel and any item of material or equipment intended for same, at all reasonable times. Every facility will be afforded inspectors for the performance of their work. All materials necessary for the purpose of inspection and testing will be furnished and handled at the expense of the Builder.

MATERIALS:

Unless otherwise specified, all materials required for construction and equipping the vessel shall be furnished new and of the best commercial marine quality in accordance with the latest requirements of the applicable regulatory agencies. All structural calculations shall be based on the requirements of A.B.S., U.S. Coast Guard and accepted marine practice.

All materials, fittings, and equiptment supplied by the Builder shall be of recognized manufacture and/or proven design and quality for the intended service.

For thicknesses recommended by the steel manufacturers, cold flinging material shall be used.

The approval of the Owner is to be obtained in all cases where the Builder intends to employ subcontractors.

All steel shall be in accordance with A.B.S. requirements. Certification of physical and chemical properties and necessary test pieces shall be furnished to the Bureau as required. Consideration will be given to procurement problems and certain non-structural items by the Owner, but in all cases the substitutions must be acceptable to other regulatory bodies.

Steel castings for deck fittings may be ASTH A-27 Grade 60-30 to chemistry only cast true to pattern, free from defects, and ground smooth to prevent wear and tear on ropes, as acceptable to regulatory bodies.

GUARANTEL:

The Builder's guarantee obligations are defined in Article IX of the Contract.

PATENT RIGHTS:

If any article, tools, arrangements, or equipment used in or about the vessel are covered by patents, all royalties shall be paid by the Builder, who assumes full responsibility for infringements

and guarantees the Owner against any costs for damage growing out of same.

TUG/BARGE ELECTRONIC PACKAGE

It should be noted that the entire radio control tug/barge electronic package will be considered the barge's equipment and that portion of the gear required on board the tug will be supplied and purchased by the Builder. Except for tug transmission equipment, functional responsibilities of same will be included by the Builder.

TESTING:

Builder is to furnish Owner with two (2) copies of all material test certificates. The Owner shall have the right to reject any material exhibiting defects or poor working qualities.

Upon completion of the work, all parts of the vessel including structures, machinery, equipment, fittings, piping, electrical and other systems and all operable items shall be tested to demonstrate proper installation and working order. The demonstration of all requirements of the Specifications and accompanying plans, with authorized changes are to be complete. Shop tests of machinery and equipment shall be conducted in accordance with the best marine practice. All remote control gear is to be operated. Testing work shall be performed to the satisfaction of the Owner, A.B.S., U.S.C.G., and all other regulatory bodies that may be applicable.

The Builder shall prepare a test agenda and submit same to the Owner in advance of testing for approval. The Contractor is responsible for taking readings and compiling operating test data in report form with copies to the Owner.

Testing shall be conducted at the expense of the Builder. Fuel and lube oil remaining in tanks after testing will be paid for by the Owner.

Particular attention should be given to the following:

- (a) <u>Hull Structure</u>: Except for inorganic zinc coatings, paint is not to be applied prior to air testing. Where air tests are substituted, the pressure is not to exceed 1 1/2 PSI while soaping and inspecting seams.
- (b) Piping: Testing per regulatory bodies except in no case is the hydrostatic test pressure to be less than 1 1/2 times the normal working pressure. It should be also noted that all systems must be tested whether under specific jurisdiction of regulatory bodies or not. No testing is to be undertaken until all supports, hangers, brackets, etc. are all completely installed.

In addition to hydrostatic test on cargo piping and ballast piping, systems shall be given an operational test at operating discharge pressure and capacity. (Minimum 4 hours per succeeding paragraph.) All other systems will also be given at least operational/endurance tests.

(c) <u>Electrical</u>: To be completely meggered out and all lights, circuits, motors, etc. to be tested and proven satisfactory.

Generators to be tested in accordance with AIEEE 45 recommendations.

Substitutions shall be made to close radio actuating circuit and any electrically controlled valves, and any regulated operation shall be followed through, if applicable.

Automatic anchor drop shall be checked through for several drops in a similar manner. Sufficient drops made to insure cut-in of DC charging (Hyde) motor.

Manually operated skegs shall be moved through their complete range.

- (d) Radio Circuits: Near the time of acceptance, the tug will be on hand at the shipyard to test the complete radio controlled transmission gear between tug wheel house and barge. It will be the Builder's responsibility to have the suppliers of the complete radio receiving transmission package have a representative on hand for adjustments, explanations to crews, etc. Circuitry shall be actuated to duplicate actual sea operation complete including the cut on/off of equipment and actuation of alarm failures.
- (e) Machinery: All major machinery and equipment are to be subject to a four (4) hour endurance test under full load conditions, except Where inapplicable due to absence of actual cargo. In this case, reasonable substitions will be made subject to final testing approval on completion of the "Trials, Loading & Unloading" section described herewith.
- (f) Outfitting: All cargo hatches, ullage, and butterworth covers, and entrance hatches are to be chalk tested immediately before delivery.

Prior to launching, all hull tanks including voids, ballast spaces, forepeak, after peak, and fuel oil tanks shall be tested with air. Decks, shell, storage spaces, and similar areas outside of tanks spaces shall be hose tested. Hydrostatic testing of tanks will be accomplished after launching and will meet ABS and USCG procedures.

Any deficiencies which may have developed or become apparent during the testing shall be corrected by the Builder at his expense, to the satisfaction of the Owner and the various regulatory bodies. The Builder shall open machinery and equipment for inspection and corrective measures where advisable to show cleanliness, prevent operating damage or inspect for first-class condition. Should reasonable questions occur as to the desired performance of equipment purchased by the Builder, it shall be incumbent on the Builder to arrange for the supplier's representative

to attend the testing. In making corrections on initial workmanship, putty, gunning, or other substitutes of poor workmanship will not be permitted to attain tightness.

TRIALS, LOADING & UNLOADING:

When the barge has been delivered to the Owners/Clients refinery to take on the first cargo, the Builder shall have specific personnel on board the tug/barge (access between from notch) to make necessary connections and demonstrate effective working of all machinery, controls, fittings required for mooring, loading and/or unloading the barge.

ELECTRICAL

GENERAL:

For purposes of clarity, the basic operation and intent is briefly described as follows with details following:

Generating Equipment: There will be two (2) 15 KW. generators.

During sea operation in the winter time, one 15 KW generator shall be on at all times to furnish the warmers in the various electrical motors.

Generally the two (2) 15 KW sets will be on the line in parallel in port for ship's lighting and machinery load. In event of extended lay-over or breakdown, one 15 KW will run for emergency lights and/or miscellaneous loads, or shore power if connections are available.

In the event of the operating 15 KW generator failing when vessel is at sea, the other 15 KW generator would automatically start and take up load.

To carry the sea load for the transistorized radio/receiver equipment for anchor windlass remote control two (2) banks of batteries are to be provided and arranged so the load will automatically be transferred to the second bank in case of a failure in the first bank.

The batteries will also carry the navigation lights and emergency lighting system for the machinery spaces. The emergency lights to be controlled by switches outside each space adjacent to the access. A light shall be provided outside each space to serve as an indicator when the emergency lights are on inside the space.

The navigation lights to be dual lamp type controlled from a fully automatic panel to transfer to standby lamp in the event of a primary lamp failure. The control panel shall be provided with momentary test switches but shall not have indicator lights which are continually on.

All electrical equipment shall be located so as to be readily accessible for maintenance and repair, or removal and shall be of a type proven satisfactory for marine use.

All necessary light fixtures shall be supplied by the Builder of neat and substantial design, approved U.S.C.G. type, suitable for the purpose intended. Oceanic, or equal, cast bronze, style, number and arrangement in accordance with layout approved by the Owner. Vapor-proof cages shall be used as required. Three (3) heavy duty portable lights with 40' cords shall be provided.

Cables passing through water-tight bulkheads and deck shall be

made water-tight by means of stuffing tubes and terminal tubes and packed with an approved packing. Galvanized elbows in lieu of brass angle tubes, which will not be acceptable, shall be used.

Cables shall be sized in accordance with the regulatory body rules and voltage drops shall not exceed 5% from switchboard to load.

All water-tight equipment shall incorporate a drain plug at its lowest point.

Outside light fixtures to be Oceanic, or equal, through bulkhead mounted, water-tight fixtures, cast bronze, Wiring to be principally located below decks except for longitudinal runs to fore and aft spaces and deck.

Snap switches shall be installed at accesses to spaces for all lighting circuits within spaces. All appliances shall be submitted to the Owner for approval before they are ordered.

Care shall be taken to provide slack cable at hinged flood light masts.

Complete electrical connections shall be provided for all motor-driven units, including pumps, blowers, ventillation fans, etc.

Cables to run on deck, protected from mechanical damage by steel cover plates or pipes. Wiring to be arranged to permit painting of all surrounding structures and guards. Armored cable to have metallic sheath grounded at each end.

All lighting circuits to be stepped down by transformers to 110 volts.

BATTERIES & CHARGERS:

Builder shall supply and install two banks (14 batteries in each bank) "Exide" ironclad batteries, having a rating of 245 ampere hours full charge gravity 1.215-1.225 finish charge rate 18 amps fitted in 2 rows of fourteen trays of the latest marine type complete with terminal lugs and separators all neatly packed in leadlined boxes secured in place, installed in vented battery compartment fwd. Stowage shall be provided for syringe hydrometer, two large distilled water bottles, all supplied by Builder. Batteries to be designed for low discharge rate, and shall be used for emergrncy lighting, navigation lights, and anchor drop system.

Charger shall be Exide, Gould, or equal, providing a high rate charge after discharge with automatic reduction to trickle charge. The charger for the 120 volt battery system shall be designed and

arranged for supply to all DC load with battery loads after discharge of the 120 volt batteries. Charger to be rated at a minimum of 16 amps.

Two starting batteries shall be supplied to provide 24 volt capacity for battery starting diesel generator.

MOTORS:

Louis Allis, or "top line quality" GE or Westinghouse motors, or equal, may be selected. All motors shall have heaters incorporated to prevent condensation. All motors shall be provided with a common size grease pressure relief fitting of CRS or Honel.

DISTRIBUTION:

Distribution shall be in general accordance with electrical one line diagram.

Generator control cabinets shall be furnished and nounted on each diesel generator set. They shall be complete with all necessary and required motoring and controls including paralleling equipment, for the two 15 KW sets.

One main distribution panel will be located in the port side generator space including distribution breakers, etc. as follows:

Panel to be dead front bulkhead mounted type suitable to withstand shipboard vibration. Suitable circuit breakers for all circuits to be provided.

Rectifiers, converters, and transformers to be supplied as needed for circuits where requirements exist.

Panel shall provide necessary switches to take care of power circuits as designated.

All circuits to use breakers, no fuses permitted (except for panel instruments).

Generator pilot lights shall be of such type as to give illumination for the front panel. All other necessary instruments such as pilot lights, switches, fuses, etc., are to be approved type, all in accordance with AIEE #45 Rules.

The main generator circuit breakers are to be ITE Type "ETM" non-automatic marine breakers, rated in accordance with AIEE #45 Regulations. Other circuit breakers to be in general ITE, Type. All remaining small breakers to be acceptable make and style suitable for loads carried. ITE circuit breaker or equal will be acceptable.

The main distribution panel will include one set of instruments as shown on the line diagram.

Instruments to be protected by necessary shunts and fuses and arranged with a transfer switch to read on either independent circuit.

SHORE POWER:

Shore power receptacle to be rated at 450 VAC 3 phase 100 ampere capacity. In addition, a 120 VAC single phase 30 ampere shore power to be installed for maintaining storage batteries on charge during layover. Two 120 V outlets to be provided, one forward and one aft. Transfer switches to be installed in main distribution panel to select either ship's power or above shore power for battery charging.

DC DISTRIBUTION:

The panel to be located forward.

MOTOR CONTROLLERS:

Motor controllers to be across the line type, push button starters, complete with overload protection, running indicator lights, marine type, Cutler Hammer, or equal. Motors to be 440 volt, 3 phase, 60 Hz. Care must be taken before ordering to check height clearance.

TAGS & IDENTIFICATION:

Basic electrical diagrams to be appropriately mounted in frames in (Control House). All control cabinets, switches, breakers, etc., to be marked with engraved tags per standard marine practice.

CABLE SUPPORTS:

All cable to be run in a neat and orderly manner using hangers or expended metal trays.

DECK LIGHTING:

(a) Above deck hinged flood light masts to be provided near alternate transverse bulkhead, total of four with shock mounting

cast brass or bronze sockets, flood lights, Pyle-National, water tight sealed beam 300 watts, each, diffusing lens, each incandescent, two units on each mast, one facing fwd. and the other aft.

Outdoor fixtures at after rake access port and starboard, windlass room accesses, and battery room access.

Provide (8) 115 volt receptacles on deck mounted near pump engines and in shelters.

(b) Below Decks.

Generator Space, Storage Aft, Windlass Fwd., and Battery Fwd., including log desk on 110 volt AC and reserve DC as previously noted. Also include receptacles in these spaces for power tools.

- (8) Machinery Space Starboard
- (8) Machinery Space Port
- (2) Windlass
- (1) Outside Battery Room

HEATERS: (Electric)

To be located in the windlass room and the machinery spaces and battery rooms. Each space mentioned shall contain sufficient "Chromalox" or equal electric heaters, with fan to raise interior temperature to 60-65° with 0° temperature outside. Complete with individual thermostatic controllers. The heater in the battery room to be explosion proof convector type.

STRIP HEATERS: (Each Electric)

All motors and generators on vessel be provided with Chromalox tubular heaters, type TRS .315 diameter, hair pin bent. Maximum rate 3W/Sq. In. heater ratings, 400° sheet tempeature.

Deck mounted pump drive engines to be provided with "Chromalox" NWH Jr. engine warmers for cooling water to maintain a 40°-50° temperature. Each deck diesel engine and generator diesel to be fitted with oil immersion heater 5000-6000 W "Chromalox" for winter use.

AUTOMATIC AND REMOTE SHUTDOWNS:

Individual remote shutdowns by push buttons on the weather deck at the entrance to the respective spaces for diesel engines and vent fans. Automatic shutdown shall be provided by discharge of ${\rm CO}_2$ or dry chemical into respective space.

Specifications For

REMOTE DROP ANCHOR WINDLASS

The anchor Windlass shall be a Vertical Single Wildcat type. The windlass shall be designed for handling a 12,000 lb. stockless anchor and 120 fathoms of 2 5/16 high strength stud link chain.

The windlass shall have a capacity to hoist the 12,000# anchor and 30 fathoms of chain from 30 fathoms of water at approximately 30 feet per mimute and shall be capable of hoisting 120 fathoms at no specified speed.

The 24" Gypsy head shall be mounted on the wildcat shaft above the wildcat. The Gypsy head shall rotate at all times when the windlass is power driven. The wildcat shall be declutchable and held by a band type brake when the Gypsy head is used alone. The wildcat brake shall be spring set and hydraulic release. The release of the brake shall be controlled remotely from the tug by means of a radio signal. Retrieving of the anchor shall be accomplished by a man boarding the barge and engaging the clutch mechanism so the anchor can be hoisted by power. The maximum speed of free drop shall be automatically controlled for a speed range of 200 to 275 feet per minute.

Particular care shall be taken during location of the windlass, chain leads, hawsepipe design, etc. to obtain satisfactory free fall of the anchor. A model shall be constructed to prove the system and eliminate as much frictional drag as reasonably possible.

The windlass shall drop without requirements of generator on line at sea by tug radio signal. Barge receiver shall energize electric solenoid to open hydraulic brake release. A charging unit driven by a 1/2 H.P., 115 volt, DC electric motor shall automatically recharge the system. The entire drop release mechanism shall operate off the 110 volt battery bank. The electric motor shall be a 75 H.P., two speed, AC, 440 volt, 3 phase, 60 cycle, Design D, vertical type. The motor shall be full and quarter horsepower and full and quarter speed. An electric controller shall be furnished to control the motor during hoisting and lowering. A spring set solenoid released brake shall be installed on the electric motor to hold the anchor when electric power is interrupted.

A torque controlled coupling shall be installed between the electric motor and pinion shaft to protect the equipment when the anchor is housed under power operation.

The windlass manufacturer shall furnish a complete radio system for the tug and barge, The equipment shall use an encoder decoder system to preclude inadvertent actuation of the drop system by some unauthorized outside party. The equipment shall consist of a transmitter on the tug and a transistorized receiver on the barge. Provision shall be included for voice communication between the tug and barge during testing and adjusting. The radio equipment shall operate from a 12 volt DC supply or a 115 volt AC supply. The windlass manufacturer shall assume complete system responsibility and furnish all components for a complete system.

The following amperage is required for the system Radio Receiver at 13.6 volts DC:

1. Radio ON, door closed, no signal 0.05 Amps
2. Radio ON, door closed, receiving signal 1.50 Amps
3. Radio ON, door open, no signal 2.10 Amps
4. Radio ON, transmitting 14.00 Amps

Notes on above conditions:

- 1. Is the normal standby condition on the run for an estimated 95% of the time.
- Applies when a function is being dialed from the tug, such as anchor drop or ballast valve control. It requires about 6 seconds to dial one function.
- 3, Is the normal drain when the equipment is being serviced.
- 4. Applies when a failure alarm is being sent to the tug, or when the equipment is being used as an intercom to the tug. The failure alarm signal requires 5 seconds to transmit.

Solenoid Valve, 110 volts, DC:

Inrush current and holding current .33 amps. Solenoid is energized for approximately one minute per ten fathom drop.

Accumulator recharging pump motor, 1/2 H.P., 1,725 RPM, 110 volt, DC.

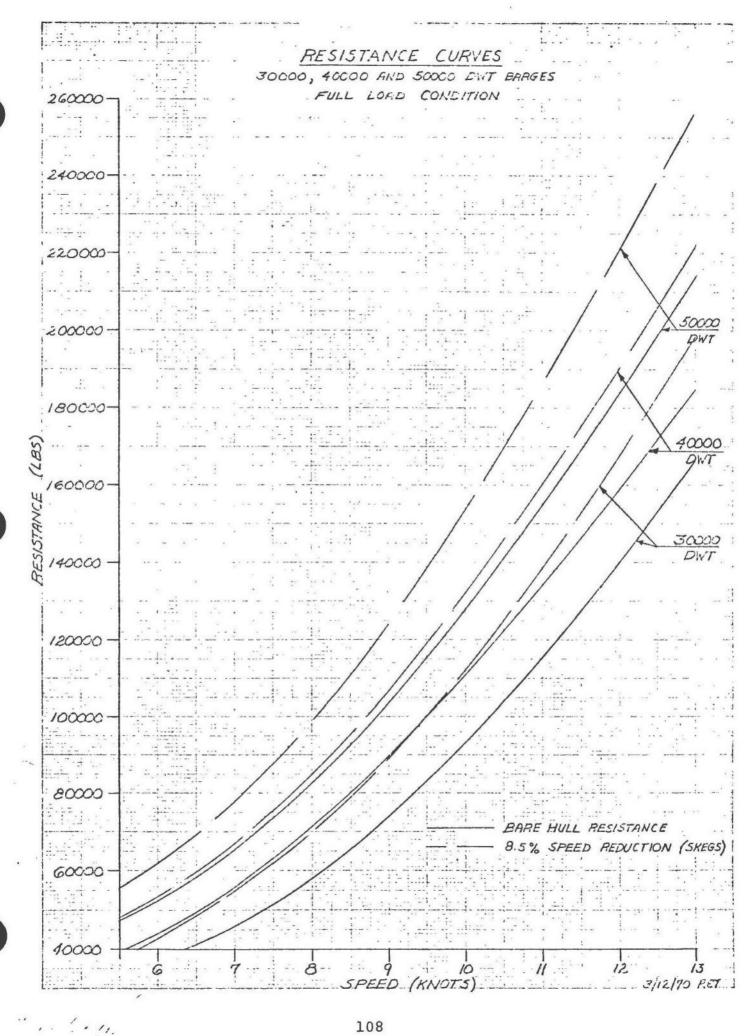
Full load starting Full load running:

42. Amps 5 Amps

Estimated starts per day would be 3. Running time per start is approximately 10 minutes.

Resistance Curves for OGTBs

Resistance curves were calculated for both the 30,000 dwt and 50,000 dwt barges. The basis of these curves was S.N.A.M.E. Technical and Research Bulletin No. 1-29, "Design Considerations and the Resistance of Large Towed Seagoing Barges". A correlation allowance of .0004 was used and the frictional resistance was obtained from the A.T.T.C. line.



APPENDIX C

Bibliography of Inland and Ocean Tugs and Barges

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APPENDIX D

SUMMARY OF MAJOR BARGE AND TUG BUILDERS

Hudson Shipbuilders, Pascagoula, Mississippi, U.S.A. Alabama Dry Dock & Shipbuilding, Mobile, Alabama, U.S.A. American Shipbuilding Co., Lorain, Ohio, U.S.A. Asia-Pacific Shipyard Pte. Ltd., Singapore Avondale Shipyards, Inc., New Orleans, Louisiana, U.S.A. Barbour Boat Works Inc., New Bern, North Carolina, U.S.A. Bay Shipbuilding Corp., Sturgeon Bay, Wisconsin, U.S.A. Bethlehem Singapore Private Ltd., Singapore Bethlehem Steel Corp., Shipbuilding, Bethlehem, Pennsylvania, U.S.A. Bodewes' Shipyards Ltd., Hoogezand, Netherlands Boele's Scheepswerven En Machinefab, B.V., Bolnes, Netherlands Brooke Marine Ltd., Lowestoft, England Canadian Vickers Ltd., Montreal, Canada Central Inland Water Transport Corp. Ltd., Calcutta, India China Shipbuilding Corp., Taipei, Taiwan Cochin Shipyard Ltd., Kerala, India Cockerill Yards Hoboken, N.V., Hoboken, Belgium Dae Sun Shipbuilding & Engineering Co. Ltd., Pusan, Korea Davie Shipbuilding Ltd., Quebec, Canada Dravo Shipyard, Pittsburgh, Pennsylvania, U.S.A. Eriksbergs Mekaniska Verkstads A/B, Gothenburg, Sweden Espanoles, Astilleros S.A., Madrid, Spain FMC Corporation, Portland, Oregon, U.S.A. Far East-Levingston Shipbuilding Ltd., Jurong Town, Singapore Flender Werft AG, Lubeck-Siems, Germany Flensburger Schiffsbau-Gesellschaft, Flensburg, Germany

Fredriksstad Mek. Verksted A/S, Fredrikstad, Norway Garden Reach Workshops Ltd., Calcutta, India Govan Shipbuilders Ltd., Glasgow, Scotland Gutehoffnungshutte Sterkrade A.G. Rheinwerft Walsum, Werftstr, Germany

Hakodate Dock Co. Ltd., Tokyo, Japan
Halter Marine Services, Inc., New Orleans, Louisiana, U.S.A.
Harbor Marine Industries, Terminal Island, California, U.S.A.
Harker (Shipyards) Ltd., John, West Yorks., England
Higaki Shipbuilding Co. Ltd., Imabari City, Japan
Hitachi Shipbuilding & Engineering Co. Ltd., Osaka, Japan
Howaldtswerke-Deutsche Werft Aktiengelsellschaft Hamburg Und
Kiel, Hamburg, Germany

Hyundai Shipbuilding and Heavy Industries Co. Ltd., Ulsan, Korea

IHC Holland, Rotterdam, Netherlands
Imabari Shipbuildiug Co. Ltd., Imabari City, Japan
Italcantieri, Trieste, Italy
Jeffboat Inc., Jeffersonville, Indiana, U.S.A.
Jurong Shipyard Ltd., Jurong Town, Singapore
Karachi Shipyard & Engineering Works Ltd., Karachi,

Kawasaki Heavy Industries Ltd., Kobe, Japan
Kelso Shipbuilding, Galveston, Texas, U.S.A.
Keppel Shipyard Ltd., Singapore
Korea Shipbuilding & Engineering Corp. Seoul, Korea
Kristiansands Mek. Verksted A.S., Kristiansand S., Norway
Nishi Shipbuilding Co. Ltd., Imabari City, Japan
Norfolk Shipbuilding & Drydock Corp., Norfolk, Virginia, U.S.A.
Northwest Marine Iron Works, North Sydney, Nova Scotia, Canada
Odense Staalskibsvaerft A/S, Odense, Denmark

Orens Mek. Verksted, Trondheim, Norway

Pakistan

Pacific Shipyard, Anacortes, Washington, U.S.A.

Pan Asia Shipyard & Engineering Co. Pte. Ltd., Jurong, Singapore

Rickmers Werft, Bremerhaven, Germany

Saint John Shipbuilding & Dry Dock Co. Ltd., Saint John, New Brunswick, Canada

San Diego Marine Construction Corp., San Diego, California, U.S.A.

Santander S.A. (Astander), Astilleros De, Santander, Spain Sasebo Heavy Industries Co. Ltd., Tokyo, Japan Scott Lithgow Ltd., Greenock, Renfrewshire, Scotland Sembawang Shipyard Ltd., Singapore Setenave-Estaleiros Navais de Setubal S.A.R.L., Almada, Portugal Shalimar Works Ltd., West Bengal, India Singapore Shipbuilding & Engineering Ltd., Jurong Town, Singapore Stord Verft, A/S, Stord, Norway Sumitomo Heavy Industries Ltd., Tokyo, Japan Swiftships Inc., Morgan City, Louisiana, U.S.A. Tacoma Boatbuilding Co. Inc., Tacoma, Washington, U.S.A. Taiwan Shipbuilding Corp., Keelung, Taiwan Tanjung Priok, P.N. Dok, Jakarta, Indonesia Todd Shipyards Corp., New York, New York, U.S.A. Valmet Oy, Helsinki, Finland Wataname Shipbuilding Co., Ltd., Ehime Pref., Japan Whyalla Shipbuilding & Engineering Works, Whyalla, Australia Wiley Manufacturing, Hanover, New Hampshire, U.S.A.

Note: Complete mailing addresses, corporate officers, telephone/telex numbers available in the Directory of Ship Owners, Shipbuilders, & Marine Engineers published by Marine Week.

INLAND WATER TRANSPORTATION

Review of An Underutilized Mode of Transport with Major Potential for Developing Countries

Ernst G. Frankel Massachusetts Institute of Technology

Prepared for the International Bank for Reconstruction and Development

November 12, 1986

Copy of Viewgraphs Used in Presentation

INLAND WATER TRANSPORT

CHARACTERISTICS

LEAST EXPENSIVE TRANSPORTATION MODE FOR BULK COMMODITIES IN TERMS OF COSTS/TON MILE

- -INEXPENSIVE INTERFACE/TERMINAL OPERATIONS
- -FLEXIBLE OPERATIONS
- -LOW INVESTMENT COSTS AND LOW MAINTENANCE AND OPERATING SKILL REQUIREMENTS.

USE

-IN THE U.S.A. AND WESTERN EUROPE INLAND WATER TRANSPORT USE GREW
BY 7.8% AND 6.6% COMPOUNDED ANNUALLY IN TON-MILES MORE THAN DOUBLE
THE GROWTH RATE OF ROAD TRANSPORT OR THREE TIMES THAT OF RAIL.
-BEFORE INDEPENENCE 39% OF TON MILES OF MATERIAL GOODS TRANSPORT IN
AFRICA WAS BY INLAND WATER (1955) -TODAY LESS THEN 6%.

TECHNOLOGICAL DEVELOPMENT

OPERATIONAL

-TOWING TECHNIQUES

HAWSER FLEETING TOW

LINE TOW

PUSH TOW FLEETING TOW

INTEGRATED TOW

ALONGSIDE TOW

-CONFIGURATION AFFECTS RESISTANCE AND MANEOUVRABILITY OF TOW

DIRECTIONAL STABILITY

TURNABILITY

-EFFECTS OF CURRENTS AND TIDES

Role of Inland and Coastal Water Transportation

- * Low Cost Transport
- * Low Cost Right of Way
- * Low Cost Terminal and Transfer
- * Flexibility
- * Low M & R Simple
- * Safe, cheap storage,
 - Old, Traditional and low prestige Method of Transport
- * 85% of population of Africa lives within 50 km of navigable waterways, coast or inland lakes.
- * 82% of population of China lives within 100 km of navigable waterways or coast.
- * 80% of South Asian population lives within 100 km of navigable waterway or coast.

* Low Investment Cost

Vehicle	Capacity	Cost
Truck	10 ton	\$ 36,000
Barge	600 ton	\$ 80,000 - 120,000
Tug	500 hp	\$500,000

-PROPULSION

TUGS - PUSHER TUGS

- TOWING TUGS

BARGE DRIVE - HARBORMASTER, ETC.

JET PROPULSION

BARGE TYPES

FLAT TOP

TANK BARGE

HOPPERS BARGE

OPEN HOLD BARGE

Inland Barge Investment Analysis

Barge 3500 DWT \$300,000

30 Barges \$9.0 m

Tow Boat 11000 BHF \$3.5 m

Total Investment \$12.5 =

Depreciating 25 year \$0.5 = 'year straightline

\$1.8 m/year (12%) Capital Repayment and Interest

1000 ton miles/\$ Barge Typical Capital Productivity

Typical Labor Productivity = 48000 ton miles/MH

Truck Typical Capital Productivity = 262 ton miles/\$

Typical Labor Productivity = 617 ton miles/MH

Milage of Navigable Waterways

U.S. 27826

France 4887

West Germany 2675

China 14824

Inland Water Transport Terminals

Type

- * Fixed Piled Sheet Bulkhead Wall
- * Guided Ramp Floating Pontoon Fixed
- * Floating
 Pontoon
 Catamaran Semisub. Catamaran
- * Barge Slip
- * Barge Dumper
- * Fleeting
- * Lock Dock Terminal
- * Barge Lift
- * Barge Foundation

Equipment

- *Cranes Fork lift/Front loader Ramp
- * Conveyors Chutes Sliders
- * Scissor Lift
- * Float On Cargo Transfer (Submersible Barges)
- * Artifical Bouyancy (Stability Draft Reduction, etc)

. .

Handling Rates (Typical)

COMMODITY	TOUS/I	n
	Loading	Unloading
Coal	700-900	300-400
Liquid Bulk	400-900	400-500
Iron/Steel	100-150	50-100
Dry Bulk	200-600	100-300
General Cargo	100-120	40- 80

Ocean Tug - Barge Costs

Item	Barge	(10kt)	Ship	(15kt))
DWI	15000	t	15000	t	
One-way Trip Time	1.5	days	1.0	day	
Loading Time	1.0	day	1.0	day	
Unloading Time	1.0	day	1.0	day	
Annual Tonnage 1,7	50,000	t	1,350,000	t	
Day/Year	350		350		
Capital Cost Tug Barge	1.5 s 3.4		Ship 7.2	m	
Capital Cost Total	\$4.9	m	\$7.2	m	
Fuel Cost/Year	\$1.7	m	\$1.8	m	
Crew Costs (U.S.)	\$0.5	m	\$1.1	m	
Insurance	\$0.3	m	\$0.3	m	
R&M	\$0.2	m	\$0.4	m	
Supplies	\$0.1	m	\$0.2	m	
Port Charges	\$0.3	m	\$0.4	m	
Administration	\$0.2	m	\$0.2	m	
Total Variable Cost/Year	\$3.3	m	\$4.3	m	
Total Finacial Cost/Year(10%)	\$0.5	m	\$0.7	m	Assume 20 year loan at 10%
Total Annual Cost	\$3.8	п	\$5.0	m	
Cost/ton del.	\$2.1	7/t	\$3.7	0/t	

In addition Tug - Barge supplies alongside storage at all times.

Loading/Unloading could be slowed - lower port invest and operating costs

• Current Transport Cost Comparisons

- Cargo densities on water 1.3 times rail and 3.2 times truck
- Truck costs include pickup, delivery and consolidation
- Useful life: truck 4-8 years, water and rail 20 years
- · Inflation therefore affects truck costs more
- As value of 5 decreases, ton-mile productivity per unit investment will decline without a true change in capital productivity.

Table 1. Aggregate labor productivity for water, rail, and truck: 1955-1979.

	Employe	ds of Ton N e Year			
Year	Water	Rai!h	Truck	Water, Rail (7)	Water/Truck
1955	2010	524	222	26	11
1950	2817	654	147	23	5.2
1965	5040	965	173	19	3.4
1970	9097	1230	162	13	1.8
1775	8627	[41]	144	16	1.7
1.50	9557	1515	155	16	16
	9718	1632	184	17	1.9
1-14	8280	1622	140	19	1.7
1979	7805	1658	180	21	2.3

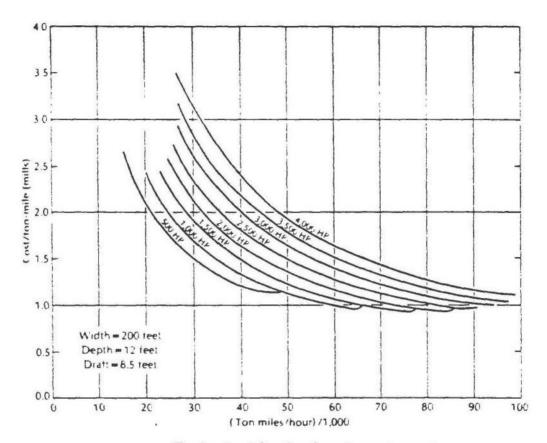
Note: Average enausi growth is 12 percent for water, 9 percent for rail, and -0.1 percent for truck.

Table 2. Aggregate capital productivity for water, rail, and truck: 1955-1979.

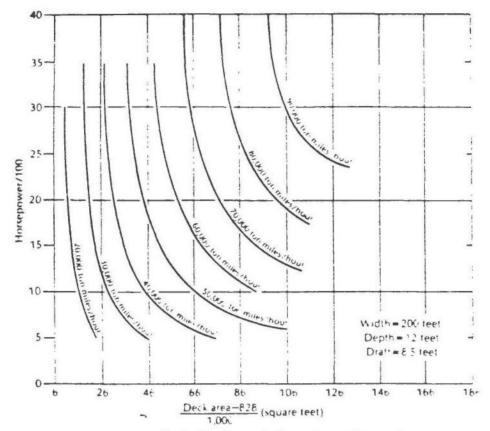
	Property	and I qui	pasent			Total Assets							
		ALL DES			Water Truck		s per 18er		Water-Kail	Water Trus			
Year	Witer	Ka !	Iruck	Water Kiril Flat	·%'	Water	£.,	Truck	25	FER			
1415	N) D	55.1	416	nr. 4	15.5	Ne. 1	21 2	48.4	24.5	51. 1			
14.0	730	41 %	25 8	0.04	35 4	797	101	27.6	24.1	34 5			
14.5	KU 5	48.8	23.3	40 A	2 4 4	81.6	210	23.1	28 2	28.3			
1970	130 2	46. 2	171	36.5	13.1	144 4	210	15.5	15.7	10.7			
1975	911	41 h	21.1	45.4	21.2	87.5	20.1	10 3	210	118			
1476	41.1	417	21.8	45.1	22.0	RH I	22 :	105	25.2	11.9			
19:7	K5 4	415	21.7	50.7	25.1	76.2	21 7	104	28 5	13.6			
1975	85.7	44 :	20.7	51.6	23.8	74 0	22.1	444	204	13.3			
1979	Sec. 4.	44.0	176	50 4	20.4	1.5 4	27.0	8.78	114	12.3			

Sold Sources of too mile data same as in Table 1:
All for most data taken from ICC Transport Statistics in the United States. Part 5 - Carriers by Water, Part 5. Radissude, and Part 2: Motor Carriers, for response terms.

^BExcluding reserves for Jepticiation



Family of cost functions for waterway transport.



Production isoquants for waterway transport

TOW BOAT	CPERATING	COSTS 1051
Horsepower	Cost per day	(8 12 c/ barrel)
500	\$ 750	
1,000	900	
1.500	1.050	
2.000	1.200	
2.500	1,330	
3,000	1.480	
3,500	1,625	
4,000	1.775	
4,500	1.920	

Barge Tow Performance

FACTORS:

- 1. Resistance of barge (or flotilla) as a function of speed, length, beam, draft...
- 2. Push (tow) generated by towboat as function of size, BHP, speed...
- 3. Environmental effects on above factors such as waterway depth, width, current, and wind.

AT CONSTANT SPEED:

 $R = 0.07289 e^{\left(\frac{1.46}{D-H}\right)} S^{2}H^{0.5} + \left(\frac{50}{W-B}\right)_{L}^{0.38} B^{1.19}$

Where D = Waterway Depth in ft.

H = Barge (Flotilla) draft in ft.

S = Still water speed in mph

W = Width of Waterway in ft.

B = Beam of Barge (Flotilla) in ft.

L = Length of Barge (Flotilla) in ft.

 $EP = 31.82 \text{ HP} - 0.0039 \text{ HP}^2 + 0.38 \text{HP} \times D - 172 \text{S}^2 - 1.14 \text{S} - \text{HP}$

Where HP = Brake Horse Power (Operating)

A = Total Desk Area of Barge (Flotilla)

- * In addition to resistance tow must overcome or is assisted by slope drag. Force $R_{\rm d}$ (incline force)
- * Actual speed must also be corrected for water flow velocity Sw and EP for Rd

$$EP = R(s^*...) + (-1) + (-1)$$

ô ≠ 1 upstream

5 = 0 downstream

Over ground Tow Speed ST

$$S_T = S^* + (-1) \in S_W$$

Joint Effects of Channel Width and Depth on Line-Haul Coets per Ton-Mile

	Width feet														
Deptha (lect-	180	200	2 50	3 00	3 50	400	450	60	85%						
12	23 71	1.21	1 0-	1.03	1.00	0 65	0.94	(9-	0.62						
18	19 64	1 02	(0	0.87	0.8	0 54	0.83	(K	(1 K.						
24	18.11	0 84	0.83	0 80	0.78	0 77	0 77	0 78	0.76						
30	17.05	0.84	0.78	0 75	0 73	0.72	0 72	0 71	0.71						
36	16.22	0 83	0 74	0.71	0 69	0.68	0.68	0 67	0 67						
42	15.52	0.79	0.70	0.67	0.66	0.65	0.65	0 64	06						
45	14.91	0.76	0.67	0.64	0.63	0.62	0.62	0.61	0.63						

B = 8.5, B = 144.8; A = 116, 825; HP = 4,500

Effects of Channel width and draft are great as B only slightly larger than H and W only slightly larger than B.

But:

- Channel deepening decreasing returns to scale (no RTS after D > 4H)
- Channel width no RTS beyond W > 2B

Channel width and dept costs must be included in economic analysis of transport costs and benefits.

An Illustrative Marginal Productivity Schedule for the Barge Input

Flotilia deck area (eq. feet)	Ton miles/hono	ΔTon miles/hour	
6.825	13,030	-	
16,825	27,149	14.119	
26.825	3 8. 65 3	11.504	
36,825	48,579	9.92€	
46,825	57,356	8,777	
56,825	65,201	7,845	
66,825	72,223	7,022	
76,825	78.499	6,276	
86,825	84.011	5.512	
96,825	88.807	4,796	
106,825	92.832	4,025	
116,825	95,911	3,079	
126,825	97.989	2.078	
136,825	95,817	828	
146,825	96,126	- 691	
156,825	95,412	-2,714	
166,825	90,153	-5,259	

[•] W = 200: D = 12.0: H = 8.5; HP = 4,000; L B = 5.5714

An Illustrative Marginal Productivity Schedule for the Towboat (Horsepower) Inputs

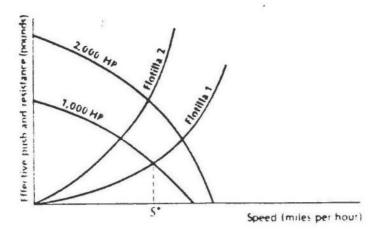
Horsepower	Ton miles hour	△Ton miles hour	
500	46.683	_	
1,000	63.024	16,341	
1,500	73.756	10.732	
2,000	81.299	7.543	
2.500	- 86.594	5,295	
3,000	90.118	3,524	
3,500	92.144	2,026	
4,000	92.832	688	
4.500	92.276	- 556	
5,000	90.520	-1.756	

[•] W = 200: D = 12.0: H = 8.5: B = 138.5: A = 100: 825.

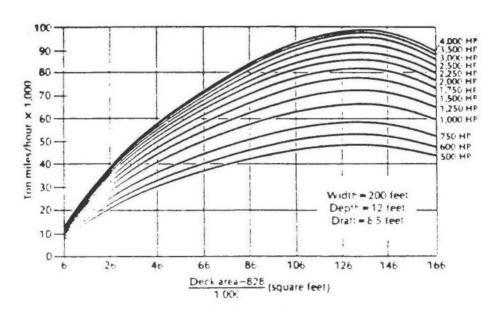
An Illustrative Marginal Productivity Schedule for the Towboat Input with a Larger Flotille

Horsepower	Ton miles hour	ΔTor. miles hou-	
500	43.517	_	-
1,000	59.169	15,652	
1,500	69.659	10.490	
2,000	77.209	7,550	
2,500	82.682	5.473	
3.000	86.515	3.833	
3,500	88.957	2.442	
4,000	90.153	1.196	
4,500	90.186	33	
5,000	89,092	-1.094	

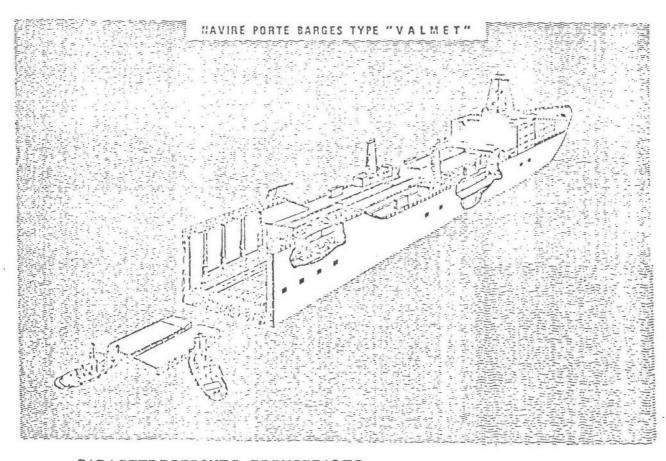
^{*} W = 200, D = 12.0; H = 8.5; B = 173.0; A = 166, 825.



Determination of equilibrium speed.



Total product curves.



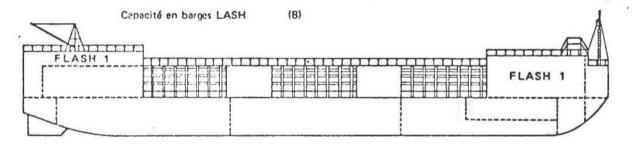
CARACTERISTIQUES PRINCIPALES

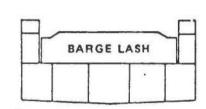
-	~~~~~	_	_	-		-	_		-		-	_	-	-																
Longueur																								26	6	m				
Largeur																		•						3						
Creux																			•					2	2	,94	m		63	
Tirant d'																								1						
Jauge bru	ıte																							35	. 8	878	t.	.p	.1	•
Port en 1	Lourd																							37	. 8	£50	t.	.p	.1	
Capacités	S :																													
Cont	teneu	r	S		20	0	O	i	e	25				7	20	0	E	n		D	0	n	t	ée						
							-							8	32	2	e	n		C	a	1	е							
Barg	ges :			•	•	٠.		•	•		•	•		t																
Puissance	e dév	е	2	0	PI	2 6	ée													•				36		000	ch	1		

FLASH Caracteristiques Generales

FLASH I, II et III Caracteristiques Principales

Longueur HT	268'2"	81.76m.
Largeur	80'1"	24.42m.
Creux	17'6"	5.33m.
Tirant d'eau en route	11'3"	3,42m.
Tirant d'eau en opération	27'6"	8.38m.





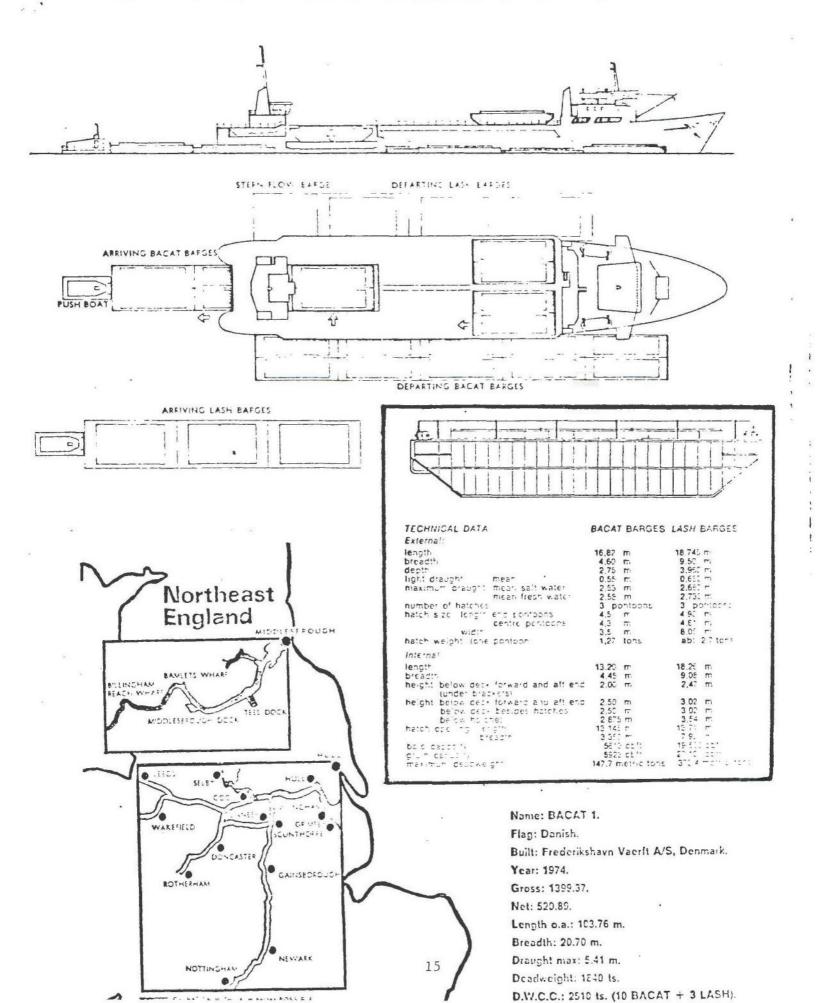
FLASH IV Caracteristiques Principales

Longueur HT	337'10"	103m.
Largeur	112'4"	34.23m.
Creux	21'4"	6.49m.
Tirant d'eau en route	11'9"	3.59m.
Tirant d'eau en opération	31'	9.45m.

	Largeur	112'4"	34.23m.			
Figure 9	Creux	21'4"	6.49m.			
	Tirant d'eau en route	11'9"	3.59m.			
	Tirant d'eau en opération	31'	9.45m.			
$A \sim$	Capacifé en barges LASH	(15)		4		
H \				14.		A
						-41
FLASH IV					FLASH IV	
	<u> </u>	-1111111		H		
	1					1/

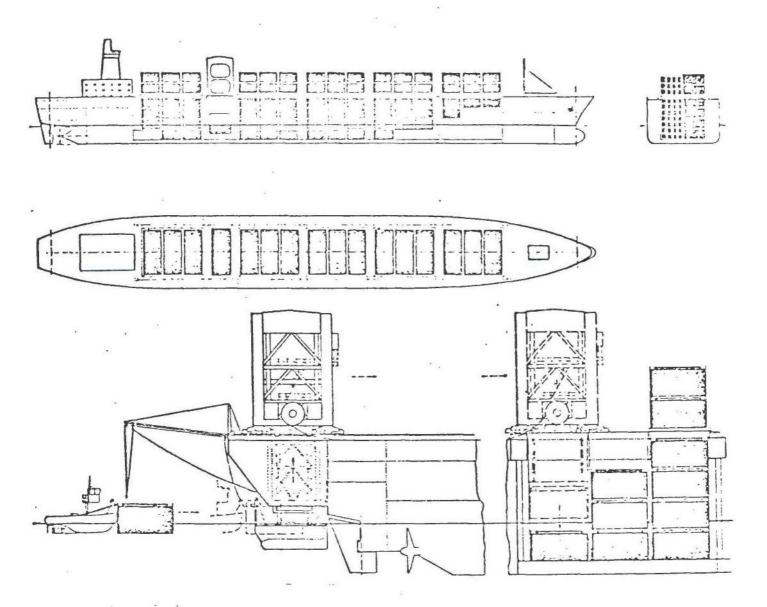
X	BARGE	BARGE LASH	BARGE LASH	

SYSTEME PORTE - BARGES "BACAT 1"



SYSTEME PORTE-BARGES EUROPEEN

(PROJET BLOHM & VOSS)



CARACTERISTIQUES :

-du navire porte-barges:

longueur HI:

ngueur HI: 237m

largeur: 32,4m

creux: 19,8m

tirant d'eau: 8,1m

puissance développée: 18.000 CV.

capacités:

conteneurs 20 pieds:1.050

conteneurs 40 pieds: 520

bargettes: type Blohm & Voss

-des bargettes:

longueur:

tirant d'eau: 3,5m

largeur:

20, Em.

8,25

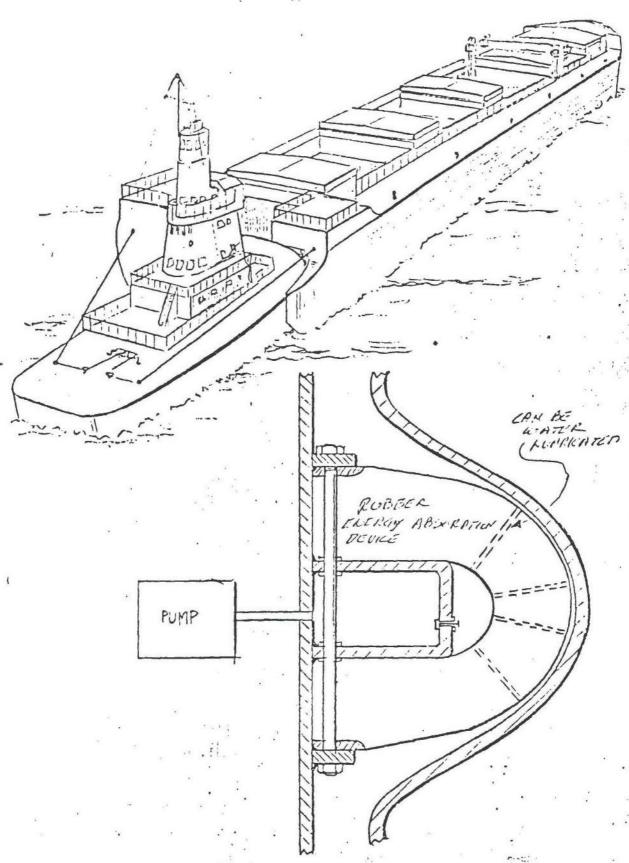
Table 2.2
Typical Manning Scales for Tank OGTBs and Ships

Vessel Type Department	Typical Modern Tanker	Chevron Tanker	Mechanically-Linked Tug-Harges	Loosely-Linked or Pull-Towed Tug-Barges (Voyages less than 600 mi.)	Loosely-Linked or Pull-Towed Tug-Barges (Voyages greater than 600 mi.)
Deck Licensed	Master Chief Mate 2nd Mate 3rd Mate	Master (3) Mates	Master (2-3) Mates	Uninspected Towboat Operator* 2nd Class Uninspected Towboat Operator*	Uninspected Towboat Operator* (2)2nd Class Uninspected Towboat Operator*
Deck Unlicensed	Boatswain (6) AB's	(6) AB's	(4) AB's or (6) AB's (2) Ordinaries	(3) AB's	(3) AB's
Engineering Licensed	Chief Engineer (2) 2nd/3rd Ass't Eng.	Chief Engineer (3) Assistant Engineers	Chief Engineer (2) Ass't Engineers or Ass't Engineer and QMED		
Engineering Unlicensed	Pumpman (3) QMED			Engineer(No license Required) Oiler	Chief Engineer (License suggested but not re- quired) Ass't Engineer (2) Oiler/Utility
Steward Department	Cook (2) Stewards	(2) Cook/ Stewards	Cook/Steward	Cooking done by Crew	Cook/Ordinary Seaman
Others	Radio Officer (2) General Utility (D/E)	Radio Officer	General Utility		
Total	<u>25</u>	17	14	7.	11

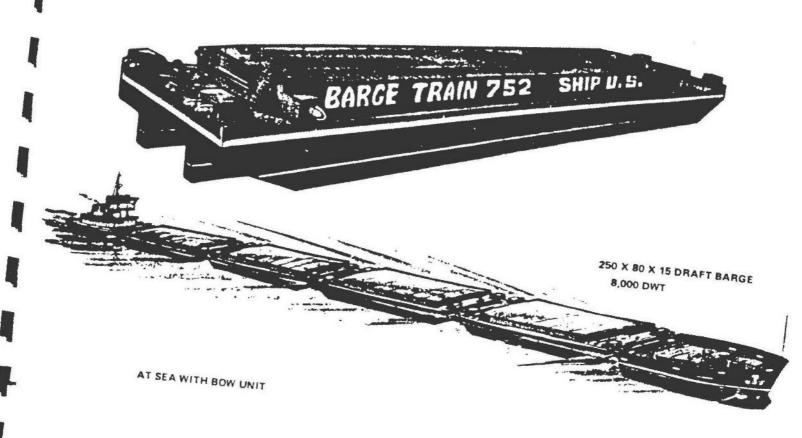
^{*}Requires Coast Guard Certificate rather than License

Table 2.1
Economic Comparison of OSTBs and Ship
by Cost/Operational Category

Cost/Operational Category	Ship	Mechanically- Linked OGTE	Loosely-Linked OGTB	Pull-Towed OGTB
Manning Size	Highest (20-30)	Interpediate (13-17)	Lowest (7-11)	Same as Loosely- Linked
Coast Guard Crew Licensing Requirements	Most Stringent	Same as Ship (unattended Engine Room)	Few Requirements	Same as Loosely- Linked
Union Control Over Manning	Strong	Weak	Almost None	
Crew Costs	Highest	Intermediate	Lowest	27 N
Coast Guard Inspection Requirements	Most Stringent	Same as Ship	Apply to Barge Only	
Freeboard	Ship Rules	25% reduction for Unmanned Barge	Same as Mechanically- Linked OCTS	н н
Construction Costs	Highest	Somewhat Less (70-90%) than Ship	Somewhat more Than Pull-Towed OGTBs	Lowest
Fuel Cost at a Given Speed	Least	Intermediate (*5% more than Ship)	Intermediate (10-15% more than Ship)	Greatest (~30% more than ship
Operational Safety	Most safe	About the same as Ship	Somewhat less safe than mechanically linked OGTB	Least Safe
Cargo Insuranco Cost	Lowest	About the same as Ship	Probably somewhat more than mechni- cally-linked OGTB	Hichest
Hull & Machinery Insurance Cost	Highest	Somewhat less than Ship	Somewhat more than Pull-Towed OGTE	Lowest
Protection & Indem- nity Insurance Cost	Highest	Intermediate	Intermediate	Lowest
Maintenance & Repair (Not performed by crew	Lowest	Intermediate	Intermediate	Highest
Flexibility	Least	Little less Flexi- ble than Lossely- Linked OGTR	Little less Flexi- ble than Pull-Towed OGTES	Most



THE KEY IS THIS EVERGY ABSORPTION PATENT WITH A CONSTHUT TENSION



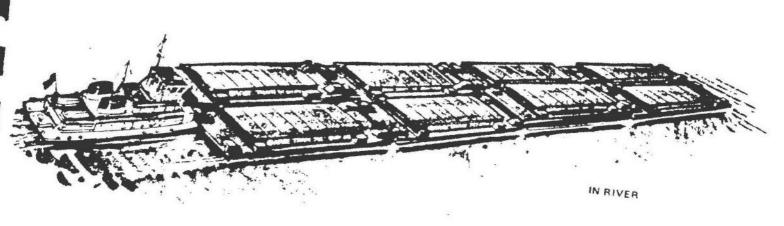
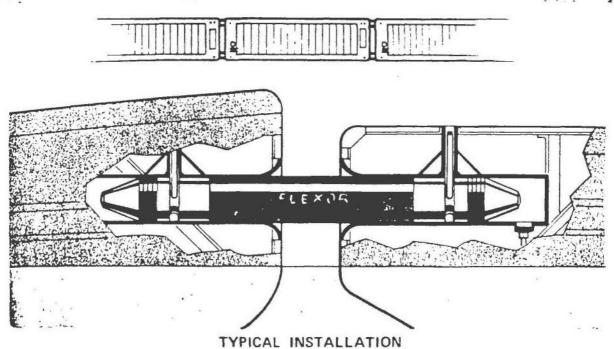


Figure 1.15

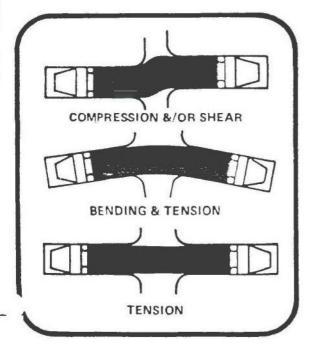
Artist Drawing of FLEXORS in Commercial Flexibly-Linked OGTB Systems

Source: Barge Train (1974)

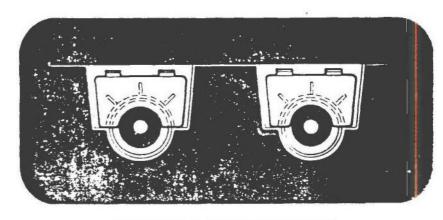




BARGE TRAIN, INC. FURNISHES FLEXORS AND FLARED CONNECTOR
PIPES COMPLETE WITH LATCH MECHANISM.



Source: Barge Train (1971)



SECTION THRU LATCH MECHANISM

Figure 1.14

FLEXOR Linkage

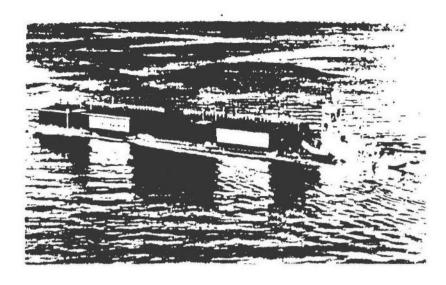


Fig. 1 - 1450 horsepower tug SAN MIGUEL HOPSTER pushing two barges in tandem.

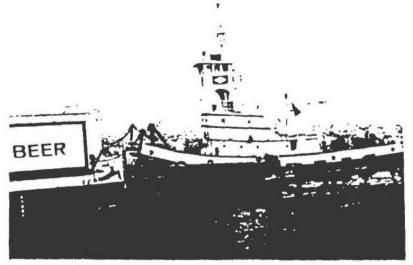


Fig. 2 - Sea-Link installation on SAN MIGUEL HOPSTER.

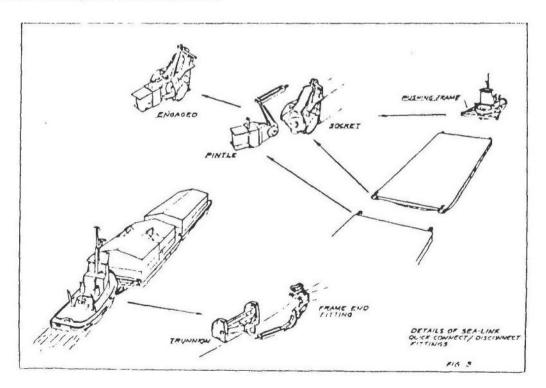
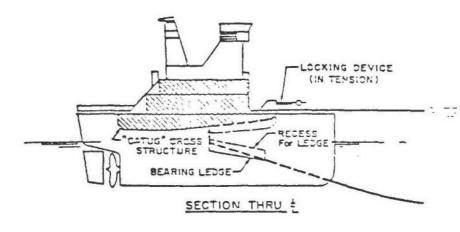
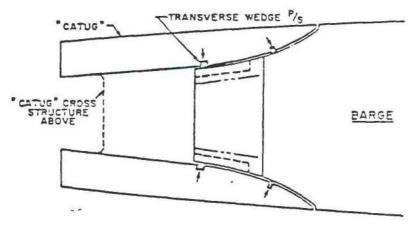


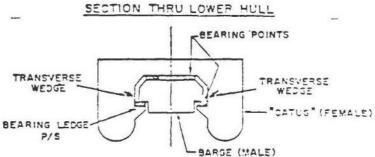
Figure 1.13

Sea-Link Semi-Rigid 3rd Generation OGTB System

Source: Glosten (1975)



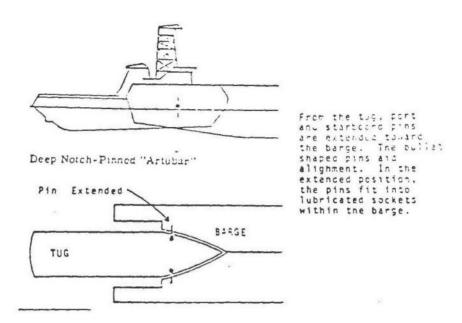




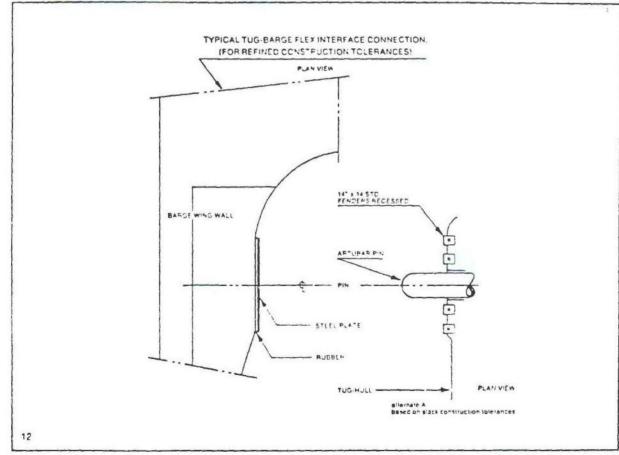
SECTION THRU "CATUG" B BARGE

SOURCE: Wallor (1972)

Figure 1.10
CATUS OGTB LINKAGE DESIGN



Source: Waller (1977)



Source: Fletcher (1974)

Figure 1.11

ARTUBAR Semi-Rigić
OGTB Linkage

Table 1.5

U.S. Flag Third Generation OGTBs

Linkage Design	Barge Type/ Service	Name: Tur Barge	Dimensiona (LxBxD): Tug Barge	Tug-Barge: Draft Length	Tug-Barge: HP/Design Speed DWT	When Built: Tuq Barge	Where Built: Tug Barge	Omner/ Operator
Breit/Ingram	Faconite Dry Bulk/ Great Lakes	Presque Isle Presque Isle	140.33'x54.0'x31.25' 974.5'x104.58'x46.50	29' 1000'	14,849/16mph 52,000	12/73	Halter Marine Erie Marine	Crocker National Pan∀ U.S. Steel
Breit/Ingram	Clean Products Tank/Ocean	Martha R. Ingram 10S 3301	145.84'x46.0'x30.25' 584.5'x87.0'x46.33'	37'5" 620'	11,12R/14.1 Kts 36,500	7/71 3/71	Southern Shipbuilding Alabama Drydock	Ingram Corp.
Breit/Ingram	Clean Products	Carole G. Ingram	145.84'x46.0'x30.25' 584.50'x87.0'x46.33'	37'5" 620'	11,128/14.0 rts 37,500	3/72	Southern Shipbuilding Levingston Chipbuilding	Indraw Corp
Breit/Ingram	Rice Phosphate Dry-Bulk/Ccean	Valerie F Valerie F	150.67'x54.0'x34.0' 620.0'x85.0'x45.0'	30'8" 656'	16,000/15.5 tts 25,000	12/76	Southern Shipbullding Maryland Shipbuilding	
Breit/Ingram	Fertilizer Dry-Bulk/Ocean	Jamie A. Baxter CF-1	125.0'x45.0'x27.75' 500.0'x75.25'x46.5'	32' 600'	7200 /12.5 Kts 22,500	6/76 12/77	Peterson Builders Avonsdale Shipyard	C.F. Industries
CATUG	Oil Tank/ Ocean	Seabulk Challenger SSC-3901	116.08'x90.44'x38.42' 581.0'x95.0'x46.0'	37' 629'	14,000/15.5 Kts 35,000	1/75	Galveston Shiphuilding (Kelso Marine)	Hvide Shipping/ Shell Oil
CATUG	Chemical Tank/Ocean	Seabulk Magnachem SSC-3002	116.08'x90.44'x38.42' 582.17'x95.0'x52.0'	40'1" 615'	14,000/15.5 rts 40,000	2/77	Galveston Shipbuilding (Kelso Marine)	Hvide Shipping/ Diamond Shamrock
CATUG	Superphosphoric Acid/Ocean	Two or Three Systems to be Named	126'5"xn0'4"x39' 626'6"x99 x50'	36' 677'10"	18,200 /15.5 Kts 41,250	80+	Avondale Shipyard	Occidental Oil
CATUG	Oil Tank/ Ocean	Two Systems to be Named	127'7"x90'4"x39' 645'x95.0'x61.6"	40'6" 699'4"	18,200/15.5 Ktq 47,075	80-81	Halter Marino Bethlehem Steel	Amerada Hess
ARTUBAR (2-units)	Ro-Ro/ Ocean	JJ Oberdorf GR Moir Barge Names Unknown	140'x40'x 568'x85'x41'6*	19' 605'6"	7,500/-16 Kts 6450(165 40' containers	79-80	Marinette Marine Seatrain Shipbuilding	Coordinated Caribbean Transport

58 cars)

	CONFIGURATION	Direction of Travel	
COHE: 1,C	PULL TOWNS	PUSH TOW NO	SIDE TON NO
FLEXIBLE	. — Б	7	- (70)-
SEMI- FLEXIBLE HINGE	· - B		B
SEMI- FLEXIBLE LINK	B	- B -)	B
4. SEMI- RIGID	- (-B-==================================	- T- B-	- (b) v).
5. RIGID	. B] 7	· B	B

Table 3. Tons of cargo carried and cargo density for rail and inland waterway. 1978

	Raii				In and Waterway			
Commodity Group	Tons Carried ^a (DOG DOOK)	Percentage of Total	Cargo Density ^h (th ft ²)	Density Weightings	Lanv Carried ^d (000-000s)	Pri entage of Total	Cary + Density + OF It 5)	Denuty Weighting
Farm products	1247	4 111	40	3.86	50 101	10 11	40	405
Fresh fish and other marine products	.*	.*	.*	.*	h 442	1 -0	245	17 54
Meta",, ores	112.5	474	100	N 45	6 717	1 15	1 (21)	1 15
Coal and lignite	3811	28 Tr.	-0	20-13	114 + 114	23 117	-10	10 15
(r. f. g. mr. a.m.	.*	•		•	47.426	455	40	4 77
No man appearance	114 -	41.1.	100	10-11	71 717	14 44	2.4%	14 44
For the discrete two	45.4	- 100	30	2.15	10 5 %	2.13	244	11 7 4
fur berand wood products	451	7 14	20	14:	4 ***	1) 75	211	41 714
Pulp paper and allied products	414	3 11	32	0 44	2 720	0.55	3.2	0.15
Chemicals and alterd products	106.7	5 01	4.3	3 44	34 295	11 40	43	2 97
Petroleum and coal products	44 4	3.33	49	1.63	123 563	24 88	20	1219
Stone class glass, and concrete products	599	4 50	80	3 60	5.245	1 Ot:	80	0.85
Prin ary metal products	601	4.51	155	6 99	- 86.9	1.58	155	2.45
Transportation equipment	32 2	2.42	6	0 15	.*	.*	.*	
Waste and scrap materials	37 8	2.84	100	2.84	10.853	2.18	100	2.18
Total	1332.0	100 00		65.77	496.682	100 00		02.90

Brum Americation of Railroads (1°) Brom American Trucking Associations, Inc. (18) Column 2's column 3.

Equipment Use (U.S.)

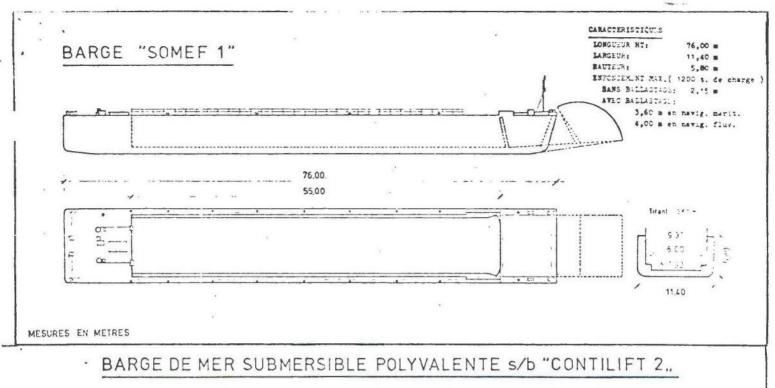
(based on loaded/unloaded vehicle mileage)

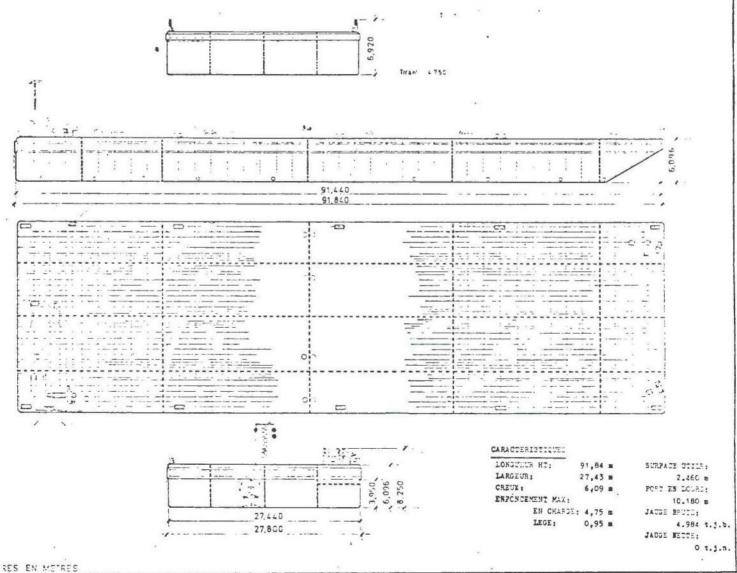
Barge	64.5%	of	miles	loaded	
Rail	56.8%	of	miles	1oaded	
Truck	58.1%	of	miles	loaded	(intercity)

Mode		ata	4515	pital on-mile	s/\$)		or n-mile -hour)	8/
Waterway	-	ine-has	11 10	91		48	703	
nacer-aj		CC	**************************************	86.4		4	460	
Truck		ine-ha	ul 2	62			617	
11001	225	cc	*.e.	17.6			103	
-	E.	Btu pr	-	cluc (1	V. feg	tile	s per !	Gallor
Case		Barge	Irust	Pail	Barge		Truck	Rail
Best		103	3230	396	1347		38	350
Average		270	7486	696	514		24	202

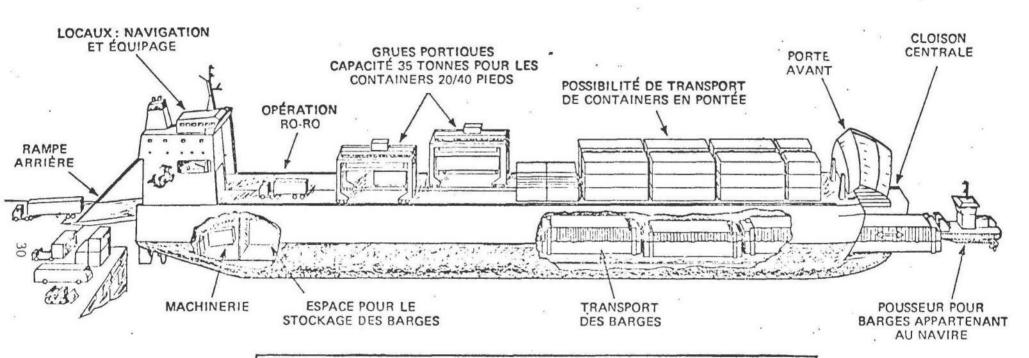
[#] Prom U.S. Aims s. a.ps of Engineers, Waterborne Commerce of the United States. Part S. National Summaries, Table 10, page 31.

"Quantity is negligible.

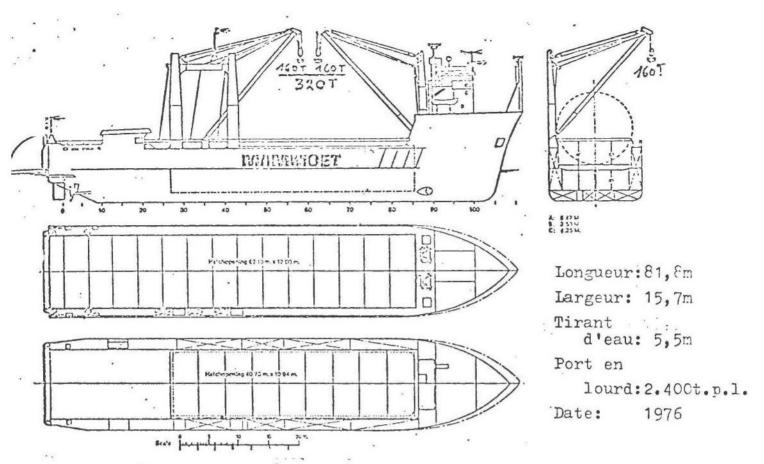




"CAPRICORN CARRIER" - BARGE/CONTAINER/RO-RO

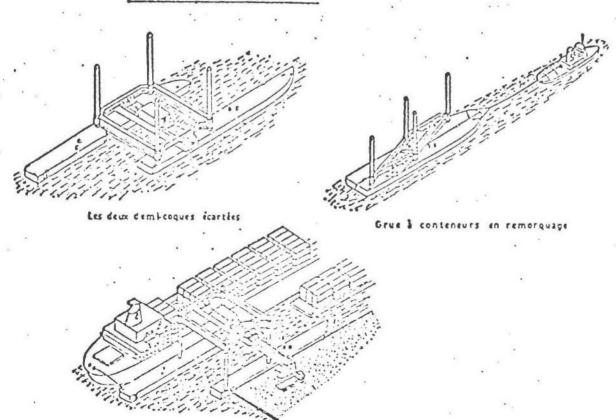


O.	CARACTERISTIQUES I		MINOLATES		
	African-Trader	China-Clipper	Capricorn-400	Lasher-12	
	-		900	-	
Langueur hurs tout	259 m	292 m	177 m	158 m	
Largeur	32,3 m	32.3 m	32 m	29.8 m	
Creux	24 m	24 m	19.7 m	15,8 m	
Tirent deau	10,7 m	10,7 m	6.7 m	6,0 m	
Jauge brute	24 700 ti	28 000 ti	19 500 tj	13 500 tj	
Port en lourd	35 000 1	43 700 t	15 500 t	10 150 1	
Canadités :					
Conteneurs 20 pieds	. 798	1 C24	432	288	
routage (mêtres finéaire)	1 323	1 701	921	720	
barges: type	Capricora-100	Mississipi	Capricain-100	Lash	
nembre	21	14	8	12	
Equipage	35	40	33	25	
Annound propulse	lersh	diesel	diesel	diesel	
Parssam e d'Andoppée	30 Ollu ch	50 000 ch	10 000 ch	6 000 ch	
Vitesse en service	20	70	14	13	
Consummation points liter	175 t	165 t	351	211	



Source: Mammut Transport B. .. (Dusseldorf)

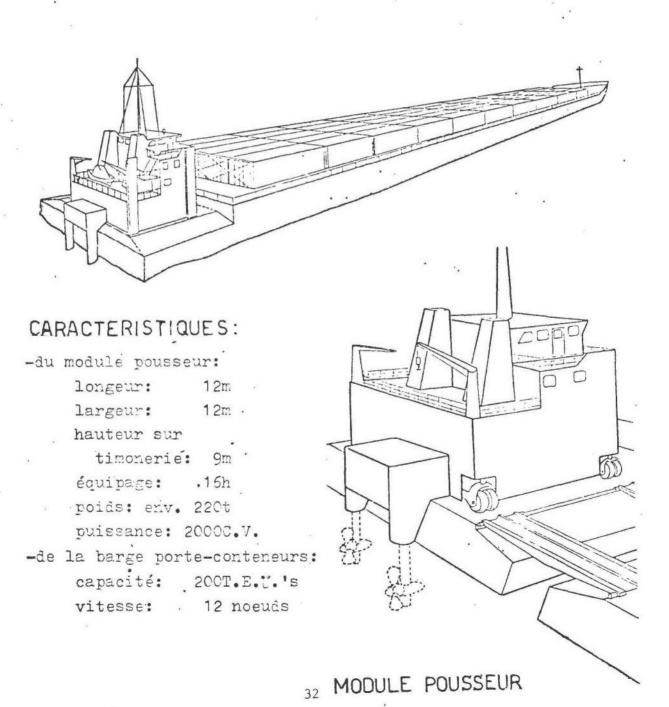
Chaland - grue "Eness"



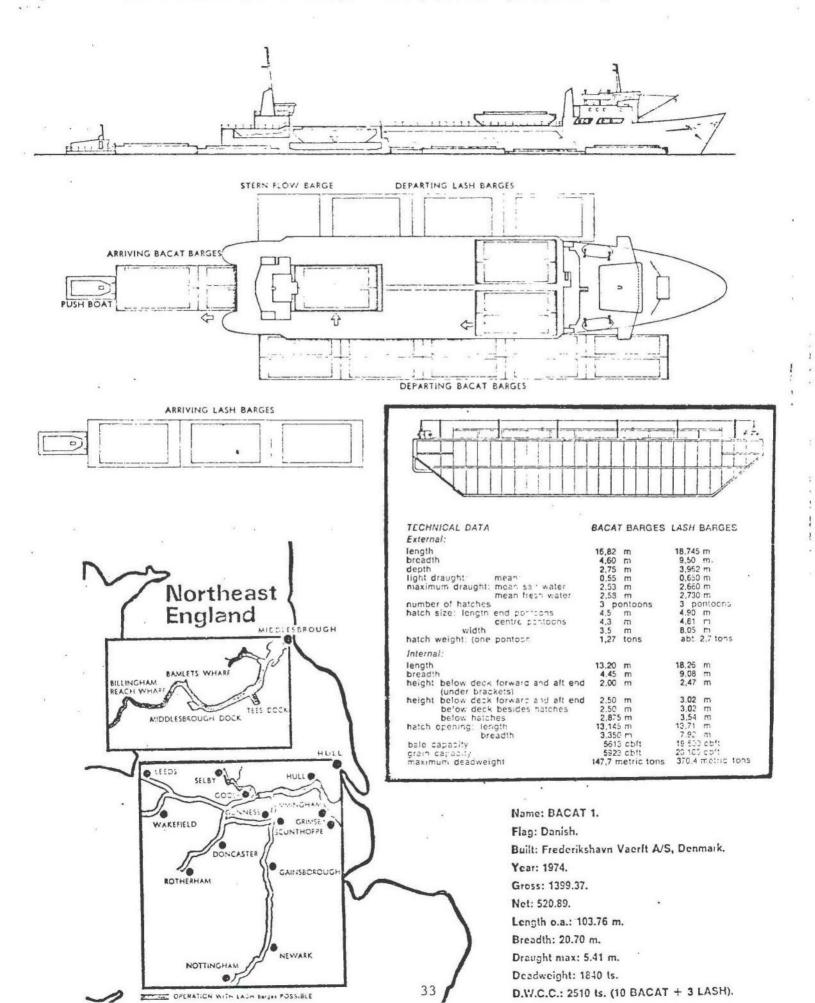
Grue 2 conteneurs precedant à la manutention des conteneurs a bord d'un navire

(Source: "Navires, Ports et Chantiers" page 694 , 1973)

SYSTEME DE POUSSAGE "TUGTAINER"

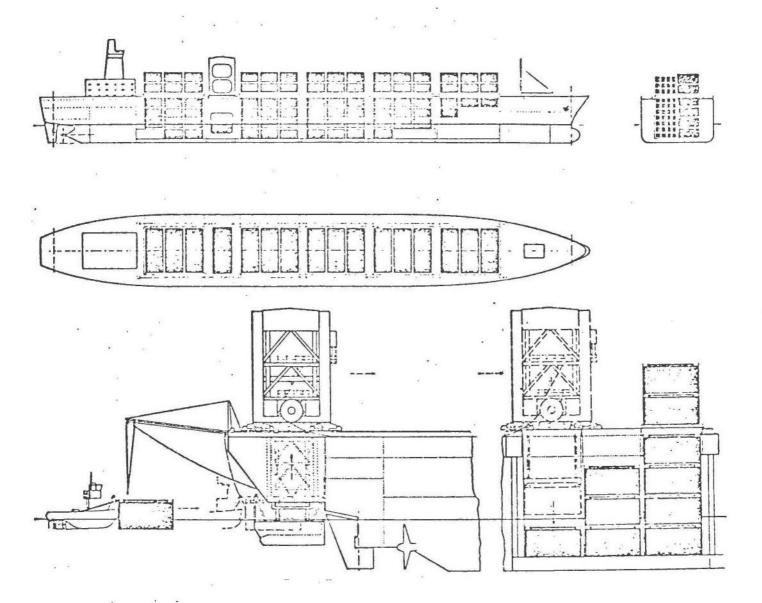


SYSTEME PORTE - BARGES "BACAT 1"



SYSTEME PORTE-BARGES EUROPEEN

(PROJET BLOHM & VOSS)



CARACTERISTIQUES :

-du navire porte-barges:

longueur HT:

237m

largeur:

32,4m

creux:

19,8m

tirant d'eau:

8,1m

puissance développée:18.000 CV.

capacités:

conteneurs 20 pieds:1.050

conteneurs 40 pieds: 520

bargettes: type Blohm & Voss

nombre:

-des bargettes:

longueur:

20,5m

largeur:

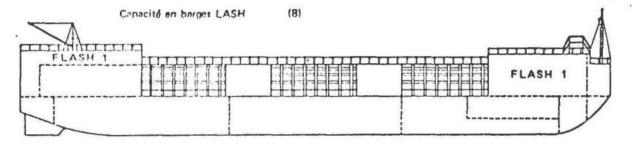
8,2m

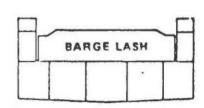
tirant d'eau: 3,9m

FLASH Caracteristiques Generales

FLASH I, II et III Caracteristiques Principales

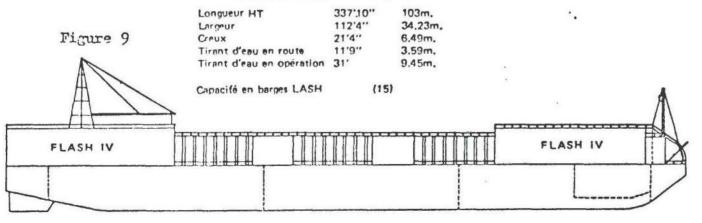
Longueur HT	268'2"	81,76m.
Largeur	80'1"	24,42m.
Creux	17'6"	5.33m.
Tirant d'eau en route	11'3"	3,42m.
Tirant d'eau en opération	27'6"	8.38m.





FLASH IV

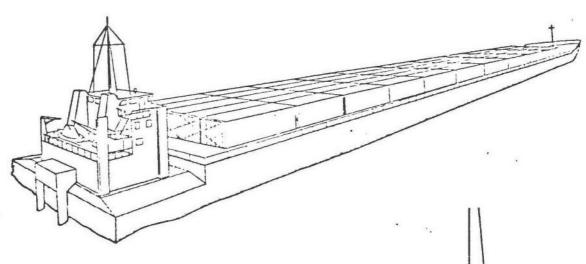
Caracteristiques Principales



XI	BARGE	BARGE LASH	BARGE LASH	
1				A.,

SYSTEME DE POUSSAGE

"TUGTAINER"



CARACTERISTIQUES:

-du module pousseur:

longeur:

12m.

largeur: 12m -

hauteur sur

timonerie:

équirage: .16h

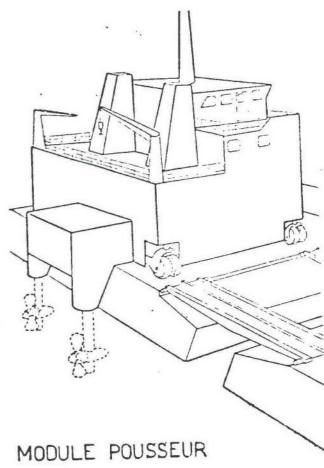
roids: erv. 220t

puissance: 20000.V.

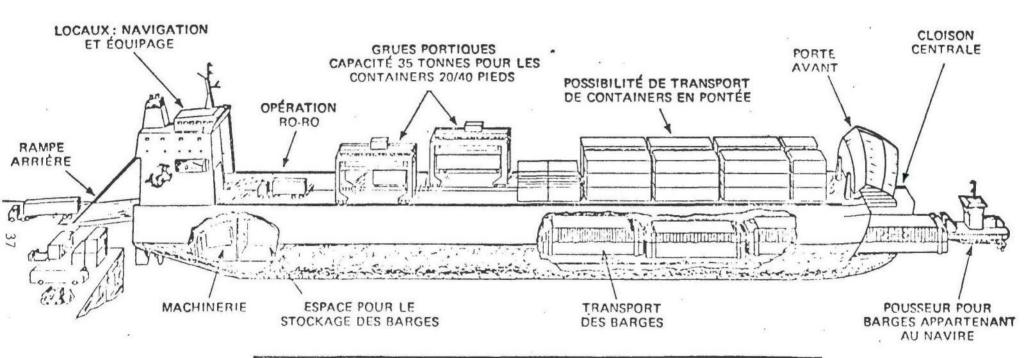
-de la barge porte-conteneurs:

capacité: 2007.E.T.'s

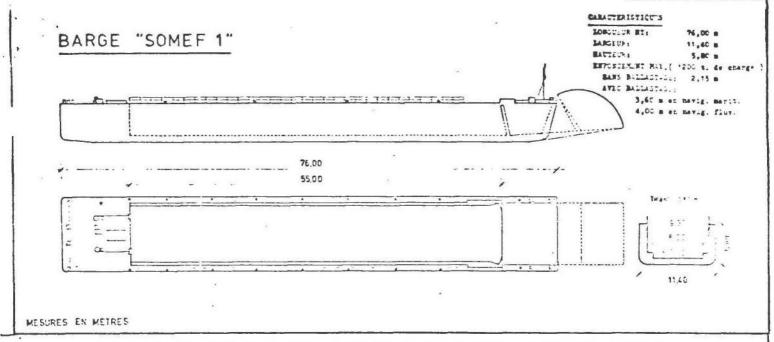
vitesse: . 12 noeuds



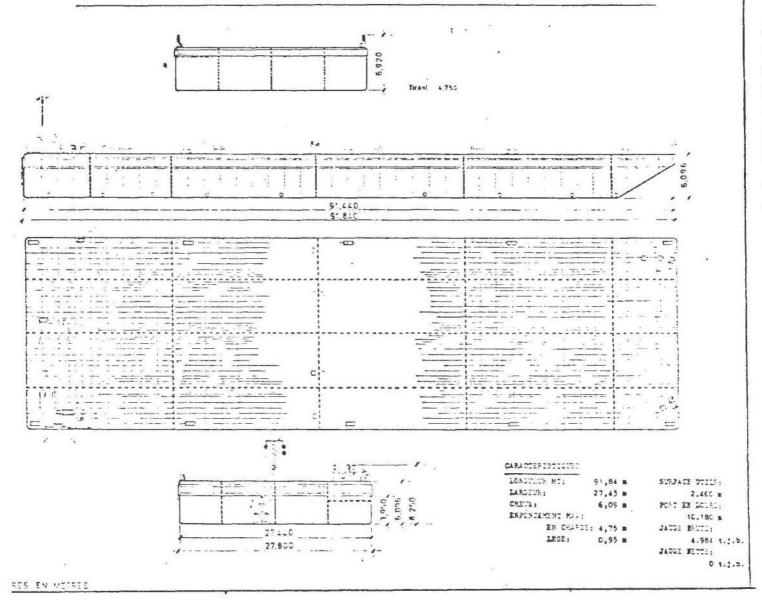
"CAPRICORN CARRIER" - BARGE/CONTAINER/RO-RO

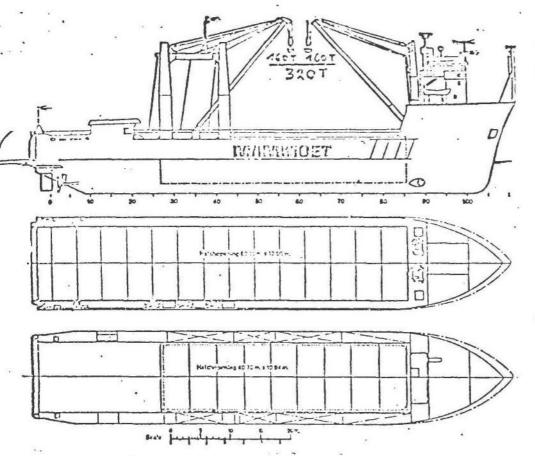


	PARACIERIS	HUULS	PRINCIPALE	-5
	African-Trader	China-Clipper	Capricorn-400	Leeher-12
	-		-	
Langueur hors tout	259 m	292 mi	177 m	158 m
larg-ut	32.3 m	32 3 nt	32 m	29 8 m
Creum	24 m	24 m	19,7 m	15,8 m
Tirent Ceau	10.7 m	10.7 m	6.7 m	6.0 m
Jange brute	24 700 tj	28 000 1	19 530 tj	13 500 tj
Port en 'nurd	35 0701	43 7001	15 500 t	10 1501
Capitalia :				
Conteneurs 20 pieds	758	1 024	432	288
ro singe funtires indered .	1 323	1 701	921	720
barges type	Canticorn 100	Missesipi	Capricain 100	Lash
ncinhre	21	14	8	12
Europage	35	40	33	25
Annount pages/set	diesel	direl	dieset	diesel
Parsyane is distributed by the second	30 Dillich	50 ppp ch	10 edneh	8 Can ch
Citesan en terzine	20	20	14	1.3
Consumury or or on white	1251	1651	351	211



BARGE DE MER SUBMERSIBLE POLYVALENTE S/b "CONTILIFT 2...





Longueur: 81, 8m

Largeur: 15,7m

Tirant d'eau: 5,5m

Port en

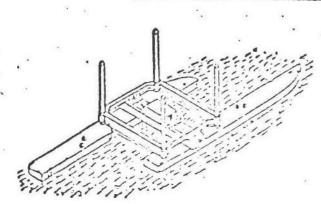
lourd: 2.40Ct.p.l.

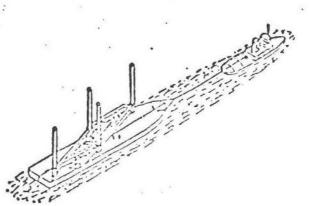
Date:

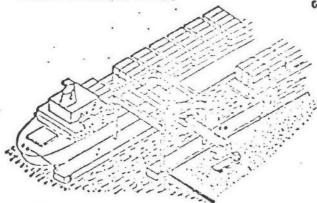
1976

Source: Mammul Transport ex, (Dusseldorf)

Chaland - grue "Eness"







Grue & conteneurs precedant à la manutention des conteneurs a bord dwn navire

(Source: "Navires, Ports et Chantiers" page 694 , 1973)

Table 3. Tons of eargo serried and cargo density for rail and inland waterway. 1978

	Ra				In and Warenway			
formed ty Group	Tons Carried* (000 000k)	Processage of Total	Cargo Dersola Ob tr ³)	Electricity Weightings	Tork Carried [®] (ORK) (NRA)	Processian of Total	face Description	Denuts Weighting
karm products	128.7	9 1.1.	40	3 Ar.	40 101	10:13	41:	404
Fresh fish and other marine products	•	•			A * -:	1	1.1	11 54
Metal , intex	112.5	4.45	100	A 45	16 77 7	1 44	110	116
Ena and ligh te	3911	24.76	-re,	26 13	. 40.00	231	-1	10 15
t trees to	•	•	•	•	4" 471		41	4
No. of the same	114	1	144	11 .	-, -,-	.4 2.	8	. 4 4 4
Fig. factors to the	4.7		3.6	: 15	11 5 .			1: + 4
for the and would profession	44.1	* .4	20	14:	4		w .	t x
Pulp paper and allied products	41 4	3.11	3:	04.	2 720	6	1.2	0.15
Chenicals and alord products	10e 7	A 01	43	3.44	14 704	+, 40	4.1	: 4-
Petroleum and coal products	44.4	3.33	49	103	123 563	24 85	40	12 14
Scone clay, glass, and concrete products	59 9	4.50	80	3 4.0	5 245	1 Or	AL.	O 85
Primary metal products	60 1	4.51	155	6.99	- 81.9	1 58	155	2.45
Transportation equipment	32 2	2.42	6	0 15	.*		.*	
Waste and scrap materials	37 8	2 44 2	100	2.84	10.853	2.15	100	2.18
Total	13320	100 00		65 77	440 CH2	TOO ON		62 46

B From Association of Railcook (1")
b From American Trucking Associations, Inc. (18)
c Column 2 x column 3.

Equipment Use (U.S.)

(based on loaded/unloaded vehicle mileage)

Barge 64.5% of miles loaded Rail 56.8% of miles loaded

Truck 58.1% of miles loaded (intercity)

(ton-miles/ Capital (ton-miles's) man-hour) Mode Data Line-haul 1091 48 703 Waterway 4 460 86.4 100 617 Line-haul 262 Truck 103 17.6 100 Exery Freductivita Bru pr Tor-Mile Barge Trun Fail 103 32ac 396 .Ton-Miles per Gallor 3g 350 C380 Barge 1347 best Average 2 7 200 270 7786 686 514

[#] Prom U.S. Arms C. optiof Engineers. Waterbothe Commerce of the United States. Pa. S. Ingional Summaries, Table 10, page 19.

* Quantitis in negligible.

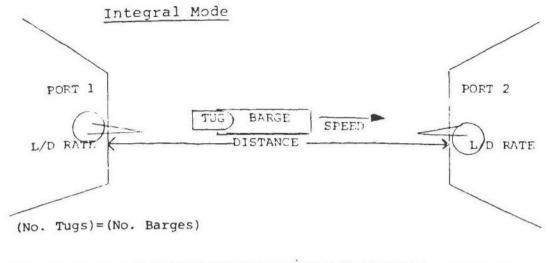
	CONFIGURATION	Direction of Travel	
COUR NO	PULL TOWARS	PUSH TON NO	SIDE TOWNS
FLEXIBLE	-Б-	7 - 0 - 5	-(70)-
SEMI- FLEXIBLE HINGE	- B	B - B B - B	B
SEMI- FLEXIBLE LINK	B	- B-)	- B
SEMI- RIGID	- (-B-)	- (T-)-	- B - + 11 - 11 - + 11 - 11 - + 11 -
5. RIGID	B 7		B

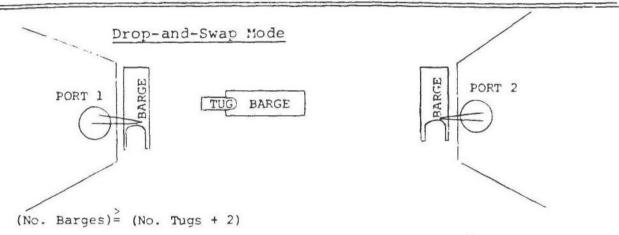
Table 1.5

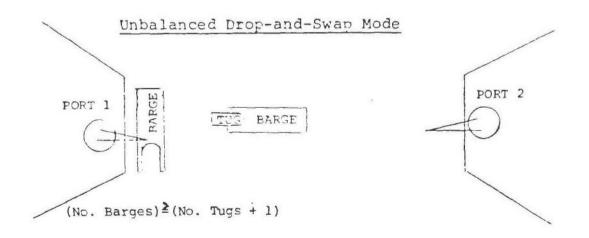
U.S. Flag Third Generation OGTBs

Linkage Design	Barge Type/ Service	Name: Turi Barge	Dimensions (LxBxD): Tuq Barge	Tug-Barge: Draft Length	Tug-Barge: HP/Design Speed	When Built: Tug Barge	Where Built: Tug Barge	Owner/ Operator
Breit/Ingram	Taconite Dry Bulk/ Great Lakes	Presque Isle Presque Isle	140.33'x54.0'x31.25' 974.5'x104.58'x46.50	29' 1000'	14,840/16mph 52,000	12/73	Halter Marine Erie Marine	Crocker National Bank U.S. Steel
Breit/Ingram	Clean Products Tank/Ocean	Martha R. Ingram 105 1001	145.84'x46.0'x30.25' 584.5'x87.0'x46.33'	37'5" 620'	11,128/14.1 Kts 36,500	7/71 3/71	Southern Shiphuilding Alabama Drydock	Ingram Corp.
Breit/Ingram	Clean Products Tank/Ocean	Carole G. Ingram 109 1302	145.84'x46.0'x30,25' 584.50'x87.0'x46.33'	37'5" 620'	11,128/14.0 Kts 37,500	3/72	Southern Shipbuilding Levingston Chipbuilding	Ingram Corp.
Breit/Ingram	Rice Phosphate Dry-Bulk/Ocean	Valerie F Valerie F	150.67'x54.0'x34.0' 620.0'x85.0'x45.0'	30'8" 656'	16,000/15.5 Kts 25,000	12/76	Southern Shipbullding Maryland Shipbuilding	to the second second second
Breit/Ingram	Fertilizer Dry-Bulk/Ocean	Jamie A. Baxter CF-1	125.0'x45.0'x27.75' 500.0'x75.25'x46.5'	32' 600'	7200 /12.5 Kts 22,500	6/76 12/77	Peterson Builders Avonsdale Shipyard	C.F. Industries
CATUG	Oil Tank/ Ocean	Seabulk Challenger SSC-3901	116.08'x90.44'x38.42' 581.0'x95.0'x46.0'	37' 629'	14,000/15.5 Kts 35,000	1/75	Galveston Shipbuilding (Kelso Marine)	Hvide Shipping/ Shell Oil
CATUG	Chemical Tank/Ocean	Scabulk Magnachem SSC = 1702	116.08'x90.44'x38.42' 582.17'x95.0'x52.0'	40'1" 615'	14,000/15.5 Fts 40,000	2/77	Galveston Shiphuilding (Kelso Marine)	Hvide Shipping/ Diamond Shamrock
CATUG	Superphosphoric Acid/Ocean	Two or Three Systems to be Named	126'5"x90'4"x39' 626'6"x99 x50'	36° 677'10"	18,200 /15.5 Kts 41,250	80+	Avondale Shipyard	Occidental Oil
CATUG	Oil Tank/ Ocean	Two Systems to be Named	127' 7"x90'4"x39' 645'x95.0'x61.6"	40'6" 699'4"	18,200/15.5 Kts 47,075	80-81	Halter Marine Bethlehem Steel	Amerada Hess
ARTUBAR (2-units)	Ro-Ro/ Ocean	JJ Ober forf GR Mott Barge Names Unknown	140'x40'x 568'x85'x41'6"	19' 605'6"	7,500/-16 Kts 6450(165 40' containers	79-80	Marinetta Marine Seatrain Shipbuilding	Coordinated Caribbean Transport

58 cars)







Port Pair Trades: Integral and Drop-and-Swap Modes

Foss 163 Works thip haryes

Miscelleneous general cargo berges

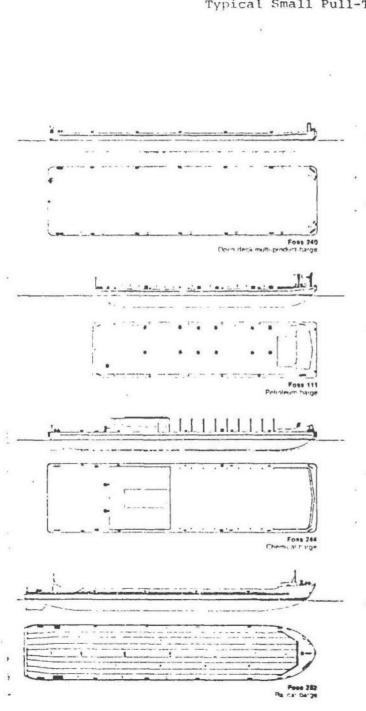
Fost Lainth & Two Geneany Le la se multi-product carges tre si in acual to a commo late general traditions of the second of the seco engin with cardo capacities up to 4000 ST.

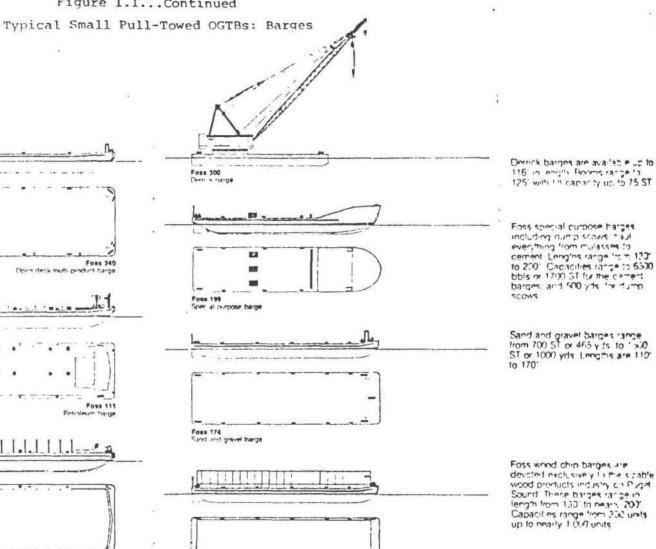
Foss comprarations of petroleum carrier range in length from 1651 to 250. Ferro eum bilige rangemes are from 6500 obis to GUTTUS.

45

Chamical barges are available with the atties up to 20 000 bbts Fr 4160 AR Lengths range from 150 to 3171.

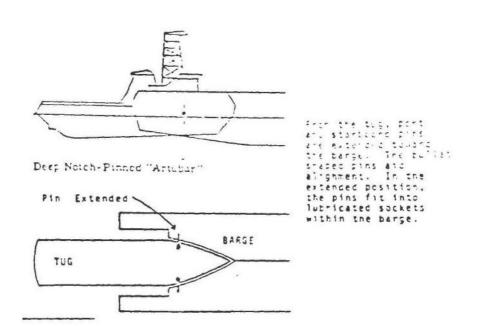
Fres Launch & Tug Company ry har harvas can apcommodate train 18 to 24 railbars. Lengths tarice 'to 5 260' to 320'



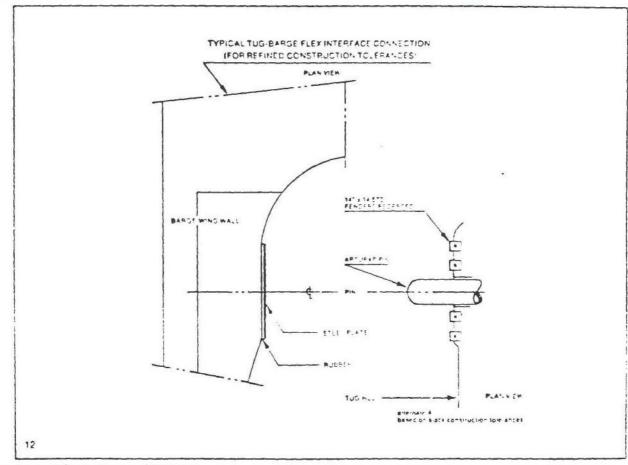


Foss wood chip barges are devoted exclusively to the stable wood products industry on Plant Sound Those barges range in length from 130" to nears 200" Capacities range from 300 units up to nearly 1 000 units

Foss maintains a substant at number of misco facers, a sed general cargo Larges to meet almost every need. These barges range in length from 32, to 235 Capacities start at 100 ST and range up to 7000 ST.



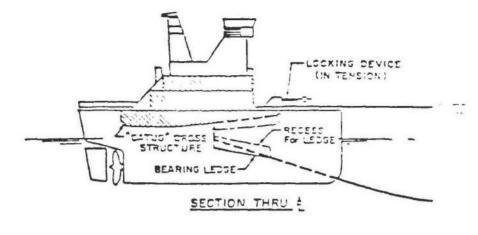
Source: Waller (1977)

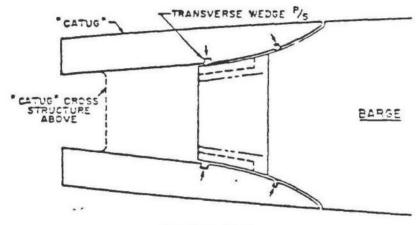


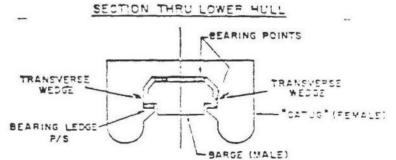
Source: Fletcher (1974)

Figure 1.11

ARTUBAR Semi-Ricić OGTB Linkage







SECTION THRU
"CATUG" B BARGE

SCURCE: Waller (1972)

Figure 1.10 CATUS OCTE LINKAGE DESIGN



Fig. 1 - 1450 horsepower tug SAN MIGUEL HOPSTER pushing two barges in tandem.



Fig. 2 - See-Link installation on CAN HIGHEL HOPSTFM.

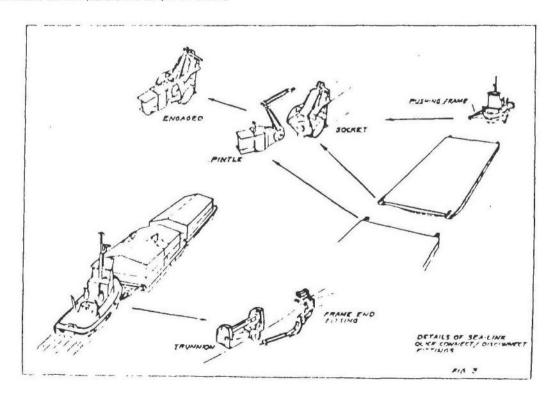
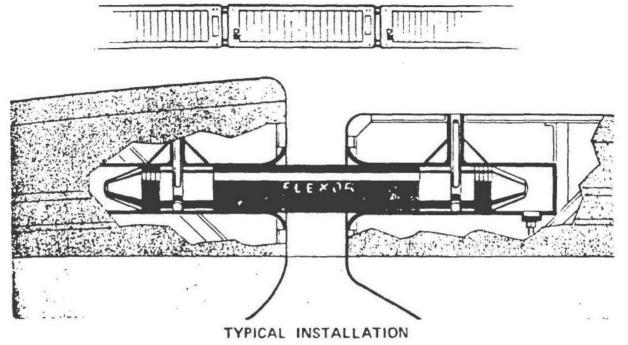
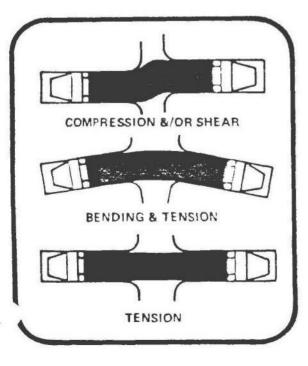


Figure 1.13

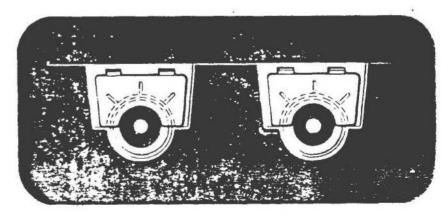




BARGE TRAIN, INC. FURNISHES FLEXORS AND FLARED CONNECTOR PIPES COMPLETE WITH LATCH MECHANISM.



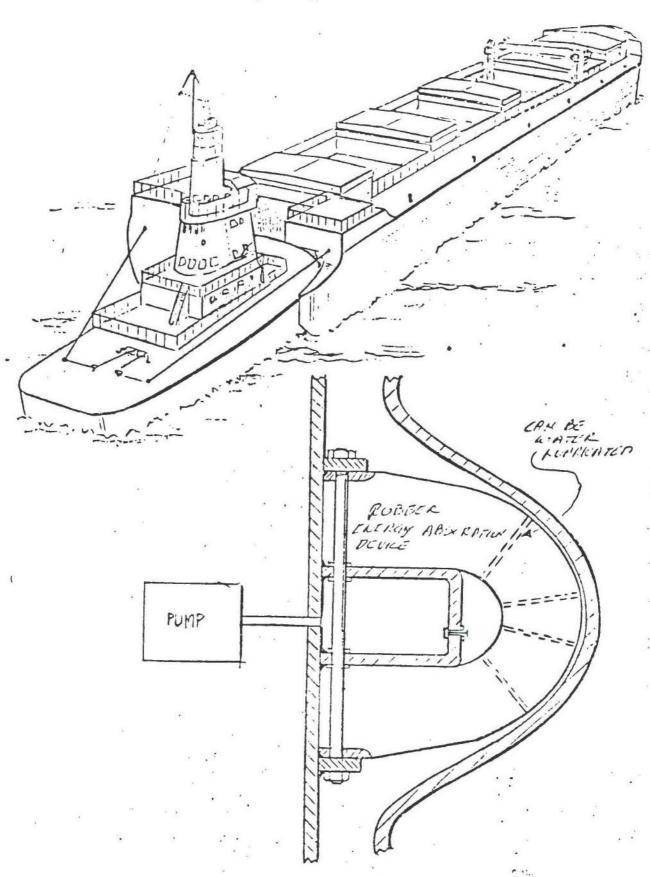
Source: Barge Train (1971)



SECTION THRU LATCH MECHANISM

Figure 1.14

FLEXOR Linkage



THE KEY IS THIS ENERGY ABSORPTION PATENT WITH A CONSTANT TENSION

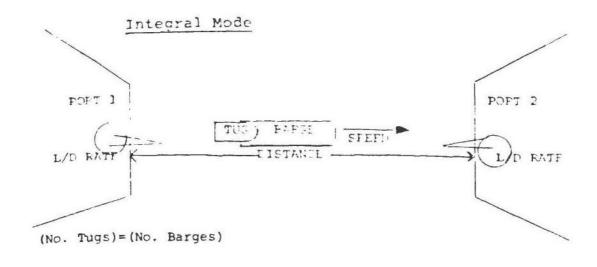
Table 2.1

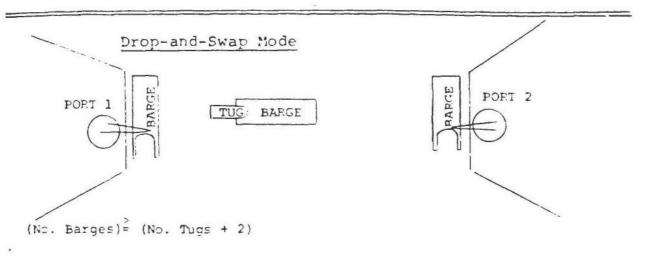
Economic Comparison of OCTBs and Ship
by Cost/Operational Category

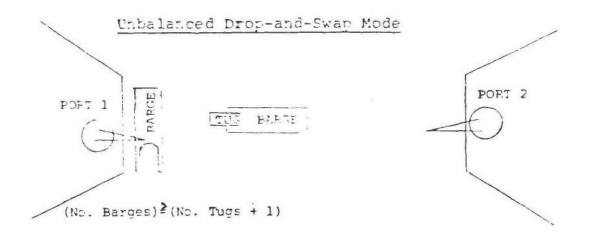
Cost/Operational Category	Sh.ir	Mechanically- Linked OGTE	Loosely-Linked OGTF	Pull-Towed OGTB
Manning Size	Highest (20-30)	Intermediate (13-17)	Lowest (7-11)	Same as Loosely- Linked
Coast Guard Cres Licensing Requirements	Most Stringsrt	Sarv es Stip (unattended Engine Room)	Few Requirements	Same as Loosely- Linked
Union Control Over Manning	Strong	Weak	Almost None	
Crew Costs	Highest	Intermediate	Lowest	
Coast Guard Inspection Requirements	Most Stringent	Same as Ship	Apply to Barge Only	
Freeboard	Ship Rules	25% reduction for Unmanned Barge	Same as Mechanically- Linked OGTE	
Construction Costs	Highest	Somewhat Less (70-90%) than Shir	Somewhat more Than Pull-Towed OGTBs	Lowest
Fuel Cost at a Given Speed	Least	Intermediate (75% more than Ship)	Intermediate (10-15% more than Ship)	Greatest ("30% more than ship
Operational Safety	Most safe	About the same as Ship	Somewhat less safe than mechanically linked OCTE	Least Safe
Cargo Insuranto Cost	Lowest	About the same as Shir	Frobably somewhat more than mechni- cally-linked OGTF	Highest
Hull & Machinery Insurance Cost	Highest	Somewhat less than Ship	Somewhat more than Pull-Towed OGTE	Lowest
Protection & Indem- nity Insurance Cost	Highest	Intermediate	Intermediate	Lowest
Maintenance & Fepair (Not performed by crew	Lowest	Intermediate	Internadiate	Righest
Flexibility	Least	Little less Flexi- ble than Lossely- Linked OGTE	Little less Flexi- ble than Pull-Towed DSTR:	Most

Vessel Type Department	Typical Modern Tanker	Chevron • Tanker	Mechanically-Linked Tug-Harges	Loosely-Linked or Pull-Towed Tug-Barges (Voyages less than 600 ml.)	Loosely-Linked or Pull-Towed Tug-Parges (Voyages greater than 600 ml.)
Deck Licensed	Master Chief Mate 2nd Mate 3rd Mate	Master (3) Mates	Master (2-3) Mates	Uninspected Towboat Operator* 2nd Class Uninspected Towboat Operator*	Uninspected Towboat Operator® (2)2nd Class Uninspected Towboat Operator®
Deck Unlicensed	Roatswain (G) AB's	(6) AR'q	(4) AR's or (6) AR's (2) Ordinaries	(3) AB's	(3) AB's
Engineering Licensed	Chief Engineer (2) 2nd/trd Assit Eng.	Chief Engineer (3) Assistant Engineers	Chief Engineer (2) Ass't Engineers or Ass't Engineer and OMED		
Engineering Unlicensed	Pumpman (3) (MED			Engineer(No license Required) Oiler	Chief Engineer (License suggested but not re- quired) Ass't Engineer (2) Oiler/Utility
Steward Department	Cook (2) Stewards	(7) Cook/ Stowards	Cook/Steward	Cooking done by Crew	Cook/Ordinary Seaman
Others	Radio Officer (2) General Utility (D/E)	Radio Officer	General Utility		
Total	2.5.	17.	14.	٢.	<u>ri</u>

^{*}Requires Coast Guard Certificate rather than License







Port Pair Trades: Integral and Drop-and-Swap Modes

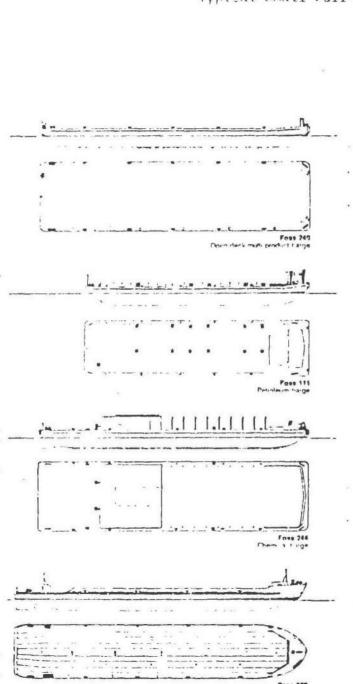
Foss Barges

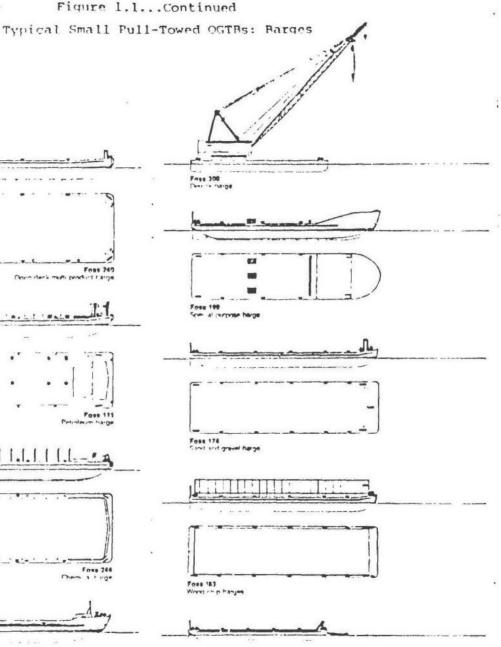
Fest 1 ares 3 Day Company The man beautiful arises and a second arise are a second arise and a second arise are a second arise and a second arise arise are a second arise a from the grin ranch up to 240 in moth with certs capitalities up to 4000 \$5

Figs complete the of potroloum grande est palin length from 1651

Contras traiges are available with the name of the 2000 bhis at 60 AR Lengths range from 340 in 317".

Forst a nich & Tug Company ru tinn in rama commodate the first Miralisars Langths 15 garden 5,260 to 5201





general nargo herges

Dornick harges are and 'stie up to 115 a north flores is te to 175 with the capt ty in to 75 ST

Fore special purpose barges וענ" מינה מינה מינה מינה וחולים even, thing from mulasses to cement. Lengths range trum 120' to 200'. Calcapties range to 5500 hole or thin ST by the camer parges and sho /te ta dump SCOMS

Sand and gravel barges range from 700 ST or 465 y is to 1 x 20 ST or 1000 yels Langths are 110" to 170

Fore word thin harges are don'this nech cive y to the coatle word products inches e in an Sound There barges range in Incom Imm 137 to make 707 Capacil or range from 3'a' ipots up to nearly 1 IXA units

Foss maintains a substant at number of misce farmus and general raign barges in meet almost every nearly these barges tange in length from 32, 19,7 % Capitalies start at 100 ST and range up to fring St.

* Current Transport Cost Comparison

•

- Cargo densities on water 1.3 times rail and 3.2 times truck.
- Truck costs include pickup, delivery and consolidation.
- Useful life: truck 4-8 years, water and rail 20 years.
- · Inflation therefore affects truck costs more.
- As value of \$ decreases, ton-mile productivity per unit investment will decline without a true change in capital productivity.

Table 1. Aggregate labor productivity for water, rail, and truck: 1955-1979

Year	Thousand Employe	ti of Ton M t Year	************	022 - 7 - 722 - 72	
	Water#	Raith	Truck	Water, Rait (♥)	Water Truck
1955	2010	524	222	26	11
1960	2817	654	147	23	5.2
1965	5040	905	173	19	3.4
1970	9047	1230	102	13	1.8
1275	8627	1411	144	16	1.7
10-1	9557	1515	155	16	1.6
1"	9718	1632	184	17	1.9
1575	8280	1622	140	19	1.7
1979	7805	1658	160	21	2 3

Minte: Average annual growth is 12 percent for water, 9 percent for rail, and +0.1 percent for truck.

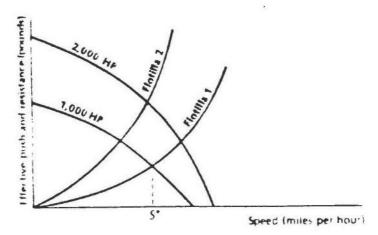
Table 2. Aggregate capital productivity for water, risk, and truck. 1955-1979.

	Propert.	Property and Equipment						Total Assets			
	Ton Macoper IN Park			N Y	Ton Miles per fixillar						
Year	Witte	Kal	Truck	Water his	Water Iru.k	Water	Rait	tru •	Water Kai	Water Trust	
1455	#1 D	55.1	44.0	66.4	44.4	pre. 3	21.2	4 × 4	24.5	56.1	
IUno	710	41 x	25 A	60.0	35 €	747	191	27 6	24.1	14 5	
146.5	80 5	45 K	211	n6 h	2* 4	81.6	210	23 1	25.2	28.3	
1970	140 :	41. 2	171	34 5	13.1	144 4	210	155	14.7	10.7	
1475	91 (41 8	21.1	45.0	21.2	87.5	20.1	10.1	2:0	11.8	
1470	9-11	44 7	21.8	451	220	8× 1	22.2	105	25.2	114	
1477	854	435	21.7	50.7	25.1	20. 2	21-2	104	28.5	136	
1978	K 5 7	44.2	20.7	51 6	23.8	24 6	22.1		2019	111	
1474	86.4	44 (1	176	50 4	20.4	1.5 4	22.0	A 78	114	1 . 3	

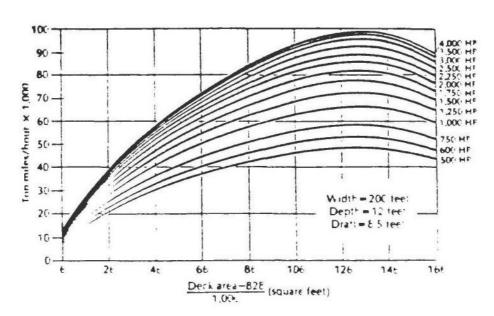
Post: Nources of time and rate same as in TaNs. 2.

At finincial data taken from to C. Eransport Statistics in the Enrich States. Part 5 - Carriers by Water, Part 5 - Kalifolds, and Fart 2 - Motor Carriers, for respective seas.

^{*}Excluding reserves for depressation



Determination of equilibrium speed.



Total product curves.

At Illustrative Marginal Productivity Schedule for the Barge Input*

Flotilla deck area (aq. fact	Ton miles how	ΔTon miles how	
6.82	13,03	-	
16,82	27,149	14,119	
20,82	38.65	11,504	
36,825	48.579	9.92	
46,825	57,356	8.777	
56,825	65,201	7,845	
66,825	72,223	7,022	
76,825	78,499	6,276	
86,825	84.011	5.512	
96,825	88,807	4,796	
106,825	92.832	4,025	
116,825	95,911	3,079	
126,825	97.989	2,078	
136,825	96,817	828	
146,825	96,126	691	
156,825	95,412	-2.714	
166,825	90,153	-5.259	

 $[\]bullet W = 200$, D = 12.0, H = 8.5; HP = 4.000; L/B = 5.5714

an Illustrative Marginal Productivity Schedule for the Towboat (Horse-power) Input*

Horsepower	Tor. miles hour	DTon miles how	
500	46.683	-	
1,000	63,024	16,341	
1,500	73.75€	10.732	
2.000	81.299	7,543	
2.500	86.594	5, 2 95	
3,000	90.118	3,524	
3.500	92.144	2,026	
4,000	92,832	685	
4.500	92,276	- 550	
5,000	90.520	-1.75€	

[•] W = 200, D = 12.0, H = 8.5, B = 138.5, A = 100, 825.

An Illustrative Marginal Productivity Schedule for the Towboat Input with a Larger Flotilia

Horsepower	Tor. miles hour	ΔTor. miller hour	
50C	43.517	-	
1.000	59.169	15,652	
1,500	69.659	10.490	
2,000	77.209	7,550	
2,500	82.682	5.473	
3,000	8€,515	3.833	
3,500	88.957	2.442	
4.000	90.153	1.195	
4.500	90.186	3 3	
5,000	89.092	-1.094	

[•] W = 200 D = 120, H = 8.5, B = 173.0, A = 160, 825

35. 30-25 Horsepower/100 20 15. 10. Width = 200 feet 5 -Draff = 8.5 feet 26 45 8t 106 126 145 166 18+ 66 Deck area—828 (square feet)

Production isoquants for waterway transport

TOW BOAT	CPERATING	cosis Lust
Horsepower	Cost per day	(8 120/ barrel)
500	\$ 750	,
1,000	900	
1.500	1.050	
2.000	1.200	
2.500	1.330	
3,000	1.480	
3,500	1,625	
4,000	1.775	
4.500	1.920	

3 5 3 C 2.5 (ost/100-mile (mills) 1.0 Width = 200 feet Depth = 12 feet Draff = 8.5 feet (Ton miles 'hour) /1,000

Family of cost functions for waterway transport.

ATTENDING:		
NAME	DEPT. / DIVN.	PHONE
JF MAQUET	WAPTZ	75371
RJN Leonard	PPDPC	78923
MAURICE LE BLANC	AEPTR	61227
E-JAMES	AEVTA	61226
E. VASUR	EMPTR	32572
G Bain	INDDZ	74797
ABIL	LOPTR	+6561
G. Panagakos	TRP	61718
LILY V. UY	AEPTR	61236
R SCHEINER	COMS. WAFT ?	75372
A. LITVAK.	EAPTR	75875
P. Parker	EMPTRV	32565
H. PETERS	TRP	61678
G. THARAKAN	TRP	61734
H. HANSEN	WAPT2	74814
E. VERNIGORA	ASPTR	32866
P. HILL	LCPTR	76576

1

ATTENDING				
NAME	DEPT. / DIV"	PHONE		
Peter Parker	EMPTRV	32565		
Richard Leonard	PPPPC	76923		
LILY V. UY	AEPTR	61236		
George Panagakos	TRP	61718		
Geo Bain	INDDZ	74797		
E. VASUR	EMPTR	32472		
H. HANSEN	WAPTZ	74814		
D. S. HILL	LCPTR	76576		
MAURICE LE BLANC	AEPTRV	61227		
E- JAMES	ASITH	6,226		
Graham Smith	TRP	61709		
Adhemar BYL	LCPTR,	76561		
R. SCHEINER	WAPT 2 / Cons	75372		
Adhemar BYL R. Schener	LCPTR,	76561		

Inland Water Transport: Wednesday and Thursday, November 12 and 13, 2:30 to 5 p.m., Rm. N-955. Professor Ernst G. Frankel, Department of Ocean Engineering, Massachusetts Institute of Technology, will be the speaker. Session 1: Inland water transport and port technology—push and pull tows, barge and tug design and operations; inland water ports and cargo transfer technology. Session 2: Inland water transport operations—fleeting, barge swapping, and barge scheduling; routing of operations; up and down river operations control; and inland water transport economics. Written material will be available prior to and at the seminar. For further information, call Helen Frost, Ext. 61667. Sponsor: TRP.

Hard-currency Debt and the Growth of the Eastern European Economies: Thursday, November 13, 2:30 p.m., Rm. S-10-001. Iliana Zloch, consultant to the External Debt Division, will analyze post-1970 developments in the hard-currency debts of Eastern European countries and assess the contribution of these debts to their economic growth. For a copy of the paper, call Ext. 3-3724. Sponsor: EPDED.

"Stabilizing Inflation with Incomes Policy Support"--Monthly Seminar in the Frontiers of Economics Series: Thursday, November 13, 2:30 p.m., Rm. C-1006. Professor Rudiger Dornbusch, Massachusetts Institute of Technology, will discuss his research on the interaction of stabilization and incomes policies. Special attention will be focused on experiences in Argentina and Israel. Background papers are available from Jennifer Abner, Ext. 69738. Sponsors: CPD and WAN.

Housing Finance: Freddie Mac--Past and Future Roles: Friday, November 14, 10:30 a.m., Rm. C-1006. Michael Lea, Chief Economist of Freddie Mac (Federal Home Mortgage Corporation), will give an overview of what has been Freddie Mac's role in the U.S. secondary mortgage market. He will also discuss recent proposals to remove the Federal Government ties to the mortgage credit agencies and their implications. Sponsor: WUD.

The Use of Geotextiles in Road Construction: Friday, November 14, 10:30 a.m. to 12:30 p.m., Rm. N-955. M. Dewsbury and H. Tan of DUPONT, Reemay and Typar Division, will give a presentation on the use of geotextiles in civil works, particularly for road construction. For more information, call Peter Ludwig, Ext. 3-2686.

Finnish Mining Technology Seminar: Tuesday, November 18, 9:30 a.m. to 5 p.m., Rm. I-4-270, and Wednesday, November 19, 10 a.m. to 5 p.m., Rm. N-550. The seminar will be given by the Embassy of Finland and the Finnminers Association. For more information and reservations, call T. Beltran, Ext. 72725. Sponsor: IND.

Occupational Roundtable--Economists in the Bank and IFC: Thursday, November 20, 3 to 4:30 p.m., Rm. H-2-300. Panelists Basil Kavalsky, Nissim Ezekiel, Guy Pfeffermann, Salem Gafsi, Carlo Castelli, Mansour Farsad, and Michael Sharpston, will open a discussion on careers of Economists in the Bank/IFC. The discussion will include views and issues about opportunities, trade-offs, responsibilities and trends. A question-and-answer session will follow. To reserve a space, call Jim Carey, Ext. 75725. Sponsor: CIC.

Preshipment Inspection Services--SGS Experiences in Preventing Illegal Capital Flight: Tuesday, November 25, 2:30 p.m., Rm. N-550. Oscar J. Kneubuehler, Executive Vice President, and Fred J. Herrin, Vice President of Societe Generale de Surveillance, will speak and answer questions about SGS experiences in 24 countries and the implications for World Bank SALs and project procurement. For more information, call Gene Tidrick, Ext. 61078. Sponsor: CPDDR.

INFORMATION RESOURCE TECHNOLOGY

LOTUS Users Group Meeting: Tuesday, November 11, 12 noon to 1 p.m. There will be two concurrent sessions: (1) Introductory Graphics Workshop: K building (1825 K St., N.W.), 10th floor, for LOTUS users who have had no prior experience using LOTUS graphics. Find out how to get started and what types of graphs can be generated. Create and print at least one type of graph. The workshop will help users decide whether to pursue LOTUS graphics training further. (2) Installation of latest LOTUS Release 2.01: ITF Studio, Rm. H-3-230. The demonstration will include both hard and floppy disc systems, along with a discussion of related issues. For more information on either workshop, call Ext. 75393.

FOCUS Modify Internals/Advanced Update Techniques: Wednesday, November 12, 9:30 a.m. to 5 p.m, Rm. H-B2-050. Intended for experienced FOCUS programmers. The internal processing performed by FOCUS during MODIFY; techniques for multiple segment processing, HOLD buffers, and the REPEAT loop, and a number of new features available in version 5.0.3 will be covered in the course. Simple solutions to some of the problems faced in FOCUS updates will also be discussed. For more information, call Maureen Miller, Ext. 3-2134. To register, call Jennifer Meade, Ext. 48048. Sponsors: ITF and PMD.

Personal Computer Users Group--Public Domain Software Library: Thursday,
November 13, 12 noon, Rm. HB-050. Kyle Cummings, ITF, will describe the
software available to all staff through the World Bank User Group electronic
bulletin board, and will advise staff how to get copies of the programs. He
will also demonstrate the ProCom public domain communications package for the
IBM PC. Staff interested in PC Telephone Bulletin Board Systems, public domain
software, and PC communications are invited. Sponsor: Personal Computer Users
Group.

FOCUS Reporting Internals and Efficiency: Tuesday, November 18, 9:30 a.m. to 5 p.m., Rm. H-7-144. Intended for experienced FOCUS programmers. It describes the internal operations of FOCUS during report retrieval. Methods for coding more efficient FOCUS report programs will also be discussed. For more information, call Maureen Miller, Ext. 3-2134. To register, call Jennifer Meade, Ext. 48048. Sponsors: ITF and PMD.

Personal Computer Users Group Meeting: Wednesday, November 19, 12 noon, Eugene Black auditorium (C-1114). Morton Sinkoff, IBM Corporation, will present IBM's intelligent workstation products and network architecture, and its strategy for the future. Sponsor: ITF and Personal Computer Users Group.

Seminar by the Petroleum Economics Ltd., London: Monday, November 10, 10 a.m. to 5:15 p.m., Rm. C-610. Topics will include outlook for petroleum products demand and refinery capacity developments; structure and evolution of world oil inventories and contractual relationship with the Bank. For more information, call Ext. 72293. Sponsor: EGYPA.

Regenerative Agriculture: Monday, November 10, 2 to 3:30 p.m., Rm. C-1006. A presentation by staff of the Rodale Institute. The workshop will include introduction of regenerative agriculture concepts, research results at the Rodale Research Center, discussion of low-cost resource efficient technologies and regenerative farming practices, and possible applications in developing countries. For more information, call Mario Kamenetzky, Ext. 76826. Sponsors: PPDES/CGIAR/AGRPT.

Strategies for Environmental and Tribal Protection in the Amazon—The Case of the Carajas Project in Brazil: Tuesday, November 11, 12:30 to 1:30 p.m., Rm. E-855. A presentation by Dr. Lourdes Davies de Freitas, head of the Environmental Unit of Companhia Vale Do Rio Doce. Dr. de Freitas is responsible for the environmental and tribal components of the Carajas Project, and for issues related to urban site planning. Dr. Stephen Bunker, Johns Hopkins University, who is presently engaged in socioeconomic research related to the Carajas Project, will also participate. Bring a brown bag lunch. Sponsor: LCPAB.

Consulting Services from Germany: Tuesday through Thursday, November 11, 12, 13. VUBI, the Association of Germany's international consulting firms, will make a series of presentations on newly-developed consulting services in the fields of economics, rural development and regional planning, energy, transportation, mining, and telecommunications. Place, time, and detailed topics are available from the German Executive Director's office, Ext. 72723. Additional information will follow in the November 10 Weekly Bulletin. Sponsor: EDS.

Inland Water Transport: Wednesday and Thursday, November 12 and 13, 2:30 to 5 p.m., Rm. N-955. Professor Ernst G. Frankel, Department of Ocean Engineering, Massachusetts Institute of Technology, will be the speaker. Session 1: Inland water transport and port technology—push and pull tows, barge and tug design and operations; inland water ports and cargo transfer technology. Session 2: Inland water transport operations—fleeting, barge swapping, and barge scheduling; routing of operations; up and down river operations control; and inland water transport economics. Written material will be available prior to and at the seminar. For further information, call Helen Frost, Ext. 61667. Sponsor: TRP.

Hard-currency Debt and the Growth of the Eastern European Economies: Thursday, November 13, 2:30 p.m., Rm. S-10-001. Iliana Zloch, consultant to the External Debt Division, will analyze post-1970 developments in the hard-currency debts of Eastern European countries and assess the contribution of these debts to their economic growth. For a copy of the paper, call Ext. 3-3724. Sponsor: EPDED.

"Stabilizing Inflation with Incomes Policy Support"--Monthly Seminar in the Frontiers of Economics Series: Thursday, November 13, 2:30 p.m., Rm. C-1006. Professor Rudiger Dornbusch, Massachusetts Institute of Technology, will

Wednesday, November 5, 2 p.m. Friday, November 7, 11 a.m.

Wednesday, November 12, 2 p.m. Friday, November 14, 11 a.m.

Managing People: Managers Need to Provide an Opportunity for people to share their aspirations, seek views on how realistic those aspirations are and jointly explore ways they can develop skills and acquire experience. The CIC designs and conducts programs tailored to a unit to assist managers and supervisors in this process. To schedule a discussion of the topic, call Charles Kramer, Manager, CIC, Ext. 75724 (participation is limited to Division Chiefs and Unit Managers).

Development Business

Issue	Deadline for Receipt of Material	Publication Date
212	November 20	December 16

When close to deadline, hand carry procurement notices to Rm. E-1055. Include your extension and room number with the material.

1987 schedules are now available from the Development Forum Unit.

SEMINARS AND TRAINING

Seminar on Design Issues in Policy Seminars: daily through Friday, November 7, 9:15 a.m. to 12:30 p.m., and 2 to 5 p.m., Rm. G-1070. Executive Directors, staff from the Bank, Fund, and Inter-American Development Bank are welcome. If you wish to attend any of the sessions, call Seminar Co-Director Surinder Deol, or Seminar Secretary Vasantha Israel, Ext. 72762.

AGRES Brown-Bag lunch on "Increased Variability in Cereal Production since the 1960s--Causes, Concerns, and Remedies": Thursday, November 6, 12 noon to 2 p.m., Rm. N-1121. Peter Hazell, AGRES, will review the evidence on increasing variability at the global and country levels. For a copy of the paper, call Ext. 60103. Sponsor: AGRES.

"Cost Comparisons of Technical/Vocational Education in China--Preliminary
Results from Shanghai," Thursday, November 6, 12:30 p.m., Rm. N-955 (Education
and Training brown-bag lunch). Professor Teh Wei Hu, Department of Economics,
Pennsylvania State University, will conduct the seminar. Professor Hu was a
consultant to the Bank-sponsored research effort undertaken by Fudan University
in Shanghai. Open to all staff. Sponsor: EDTRS.

Presentation on Mistblower Equipment: Friday, November 7, 11 a.m. to 12:30

p.m., Rm. A-530. CMS Turbine, an Italian company, will make a presentation on its mistblower product for tree and other crops. All interested staff are invited. For more information, contact Christopher Walton, Ext. 74497.

Sponsor: WAP.

1818 H Street, N.W. U.S.A.

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September 17, 1986

Professor E.G. Frankel Department of Ocean Engineering Massachusetts Institute of Technology Building 5-222 77 Massachusetts Avenue Cambridge, Mass. 02139

Dear Ernst:

Presentation of Wednesday Afternoon Seminars for Bank Staff

Thank you for your letter of August 28, 1986 on the above-mentioned subject and we are pleased that you will be able to offer a series of seminars for this unit.

Following our conversation, I now confirm that we would like you to present the following seminars:

i) Liner Shipping in Transition

Effect of the Code of Conduct for Liner Conferences and the U.S. Shipping Act of 1984, on liner shipping and its organization. Load centering and impact of round-the-world services and large integrated container operations on liner services in developing countries.

Dates: October 15 and 22.

Two days of presentation plus three days of preparation at US\$587 per day (handouts to be provided). Two return air fares economy plus local taxis, etc.

ii) Inland Water Transport

Session 1 - Inland Water Transport and Port Technology Push and pull tows, barge and tug design and operations, inland water ports and cargo transfer technology.

Session 2 - Inland Water Transport Operations

Fleeting, barge swapping, and barge scheduling. Routing of operations. Up and downriver operations control. Inland water transport economics. Costs: Two days of presentation plus three days of preparation (handouts to be provided) at US\$587 per day.

One return economy airfare plus one overnight stay and local expenses.

We will now proceed with the advertisement of the seminars in the Bank's Weekly Bulletin.

Looking forward to seeing you again.

Yours sincerely,

John Lethbridge Acting Ports and Aviation Adviser Transportation Department

cc: Mr. Carnemark (TRP)

JLethbridge:hf