Analysis of Potential Freight Ferry Alternatives to the Proposed Cross Harbor Freight Tunnel

Submitted to

North Jersey Transportation Planning Authority, Inc.

Prepared by

TransTech Marine Co.

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Contents

Introduction

In August 2004, NJTPA, Inc. retained TransTech Marine Company to prepare an *Analysis of Potential Freight Ferry Alternatives to the Proposed Cross Harbor Freight Tunnel.* The analysis is to assist NJTPA in formulating its response to the Cross Harbor Freight Movement Project DEIS issued by the New York City EDC in April 2004. Responses to the DEIS are due by 30 September 2004.

This report is organized according to seven deliverables listed below that were in the Draft Scope of Work provided by NJTPA to TransTech. Appendixes are included, where appropriate. Appendixes are keyed to deliverables and consequently, are not numbered sequentially.

1. Analyze the adequacy of the analysis of the Expanded Float Option considered in the Cross Harbor DEIS as an alternative to the proposed freight rail tunnel.

2. Identify differences between float alternatives in the DEIS and in the MIS.

3. Review and evaluate assumptions relating to capital and operating costs, operational feasibility and other relevant factors that were used in evaluating these alternatives.

4. Sketch alternative freight ferry systems using state-of-the-art marine technologies currently under design or in operation that could be implemented in the New Jersey New York freight movement corridor.

5. Identify existing freight ferry systems elsewhere in the country and world that demonstrate the feasibility of this technology and its successful use in freight ferries.

6. Provide summary estimates of capital and operating costs for modern freight ferry systems in the New York Harbor and contrast those costs to existing ferry operations and the proposed cross-harbor tunnel options.

7. Provide recommendations for policies and further research needed to realize the potential for freight ferry systems.

TransTech MarineCo. would like to acknowledge the assistance of Mr. Herbert Landow in the preparation of this analysis / review. Mr. Landow generously shared of his time and work done by his firm for the New York Sate Department of Transportation on the technical and economic viability of rail freight ferries in New York Harbor. The assistance of many others too numerous to mention is also recognized and appreciated. Any errors of omission or commission in this analysis / review are solely the responsibility of TransTech Marine Co.

Deliverable #1

Analyze the adequacy of the analysis of the Expanded Float Option considered in the Cross Harbor DEIS as an alternative to the proposed freight rail tunnel.

Various interests have studied the merits of building a freight rail tunnel under New York Harbor or under the Hudson River in the past. The Pennsylvania Railroad proposed it in 1893 and again in 1903, and it resurfaced in the 1920s and again in 1941. None of the proposed tunnels were built, though construction on one was started. One study in particular (actually, a series of studies) speaks to the question of "... adequacy of the analysis of the Expanded Float Option..." and is summarize below.

The Metropolitan New York Intermodal Study

In the late 1970s the New York State Department of Transportation sponsored a series of investigations to improve east-of Hudson River TOFC rail service into New York City. The studies are collectively known as the *Metropolitan New York Intermodal Study.*

The firm of Landow Consulting Associates, Inc. managed the *Metropolitan New York Intermodal Study* and all sub-contractors on behalf of NYS DOT. The study team included:

Reebie Associates	Market Analysis
Parsons, Brinkerhoff - Centec	Tunnel Engineering
Island Designed Products	Ferry engineering
Seatrain Shipbuilding Corp.	Ferry pricing

A total of ten technical approaches from an initial universe of fourteen possibilities were selected for detailed analysis to improve TOFC rail service to New York City via three geographic gateways. The gateways considered were: 1) improve access via the existing rail bridge at Selkirk, New York; 2) reopen the railroad bridge at Poughkeepsie, New York, and 3) cross directly into New York City proper from New Jersey via a tunnel or ferry.

The four technical approaches not considered after the initial investigation phase were as follows: (All page numbers below refer to the *Metropolitan New York Intermodal Study*, Summary Report).

1. Penn Station Tunnel: The study found that over 80% of trans-Hudson railroad traffic could not use the Penn Station route due to physical clearance problems. Track lowering, the only feasible solution, was rejected as too costly and as taking too many years to complete under traffic. (p. 19)

2. Greenville, NJ - Bay Ridge Freight Rail Tunnel: The initial study phase excluded this tunnel alignment on grounds that its cost was "far too high to be economic in terms of the operating savings contemplated". (p. 20)

3. Staten Island - Bay Ridge Freight Rail Tunnel. (IBID)

4. TOFC Operations via Car Float: Car floating is a method dating from the 19th century of transporting individual railroad cars or groups (cuts) of rail cars aboard barges fitted with tracks propelled by tugboats (Figure 1-1). Car float service was not considered sufficiently time sensitive to attract TOFC freight (p. 25), nor were the car floats large enough to efficiently handle full trainload operations (p.26), an objective of the study.

The remaining ten technical approaches divided into:

1. Seven different new freight rail tunnel alignments under the Hudson River.

2. Re-opening the Poughkeepsie Railroad Bridge and assessment of the amount of traffic likely to be attracted to this gateway.

3. Improvements to existing railroad infrastructure on the Hudson Division of (now) Metro North to enable movement of TOFC traffic.

4. Examination of the technical feasibility and economics of using modern, efficient, self-propelled train ferries (Figure 1-2) to transport entire trains across Upper New York Bay from Greenville, NJ to Bay Ridge, Brooklyn.

New York State adopted option three soon after completion of the Study, as it represented the best short-term (partial) remediation of the problem. However, concerning a longer-term solution, the Study concluded that a modern, efficient train ferry system operating between New Jersey and Brooklyn "... has sufficient positive economic merit to warrant further investigation." (p. 34).

The NYS DOT study speaks to the adequacy of the EDC DEIS analysis on three counts:

1. NYS DOT approached the subject of east-of-Hudson TOFC as a comprehensive intermodal study, whereas a stated goal of the EDC DEIS is "... to divert freight shipments in the future (2025) from truck to rail." (Cross Harbor Freight Movement Project, DEIS, Executive Summary, p. S -12).

Both studies share the goal of diverting truck traffic onto rails, but the wider lens through which NYS DOT viewed the challenge included naval architecture and ship building expertise on the study team. This enabled identification and validation of a more innovative and economically viable solution to tunnel construction. Notably, the train ferry advocated by the NYS DOT study varies only in scale and level of automation from many successful predecessor vessels of this type in America.

2. The NYS DOT studies were not designed for or intended for publication, and hence, all engineering and economic analyses were conducted in the absence of external political or regional economic influences. A "... strong public participation component ..." as cited in the EDC DEIS (IBID p. S - 5) can work two ways in the early planning stages of large, publicly funded projects. On one hand, a good project can be made better, but on the other, external pressures can be introduced that place parochial and political interests above broader societal interests.

3. The traffic volume estimates used to rank the technical approaches in the NYS DOT studies were based on actual freight traffic records provided by Conrail, totaling 6,818,777 individual rail shipments during ten months of 1977. Using the study's measure of merit of avoided cost from reduced circuity of travel, only identifiable trans-Hudson rail freight (449,933 shipments) that could be expected to use a given gateway based on costs saved was used as the volume on which to measure the economic benefits of that gateway. By contrast, the findings in the EDC DEIS are based on projected rail freight volumes in 2025. Implicitly, basing conclusion on real shipment records is more conservative than using estimates or projections.

Conclusion:

The DEIS is incomplete because the effectiveness of train ferries around the world and in America's past is not cited. Hence, accurate quantitative assessment of their potential contribution to today's challenges is unrecognized (Deliverable # 4).

The DEIS is inaccurate because it describes train ferry technology as "...new and experimental in nature." (DEIS Chapter 2, p. 2 - 37). As point in fact, no new technology is needed to build and operate a modern train ferry. All systems and components are proven "off the shelf" technologies (Deliverable # 5).

The DEIS is inconsistent with the EDC's MIS . The MIS determined the benefit - to - cost ratio (B / C) of car floating to be more than twice the B / C ratio of the best tunnel option (Deliverable # 2). Extending that finding to incorporate the far greater productivity of train ferries viz. a viz. car floats further increases the B / C disparity in favor of the maritime alternative to the tunnel. (Deliverable 6).

Therefore, the EDC DEIS analysis of the Expanded Float Option is inadequate.

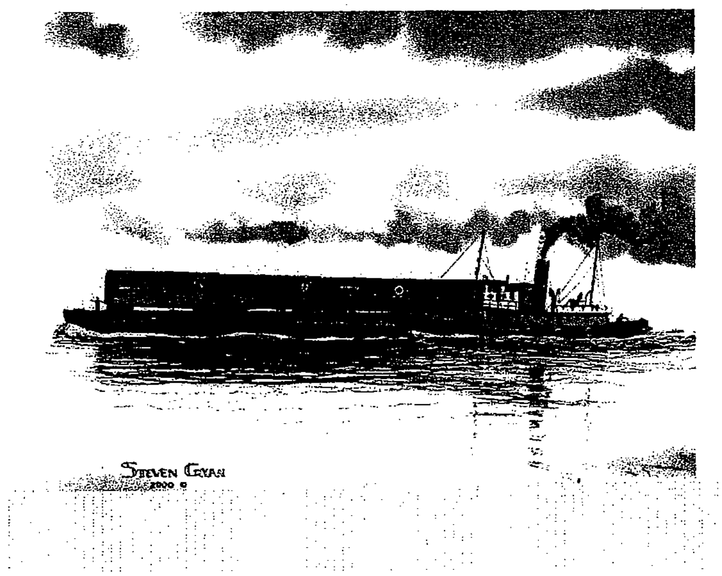


Figure 1-1

The last remaining car-float service in New York Harbor varies little from technology that was developed over a hundred years ago. Today, the tugs are diesel powered.

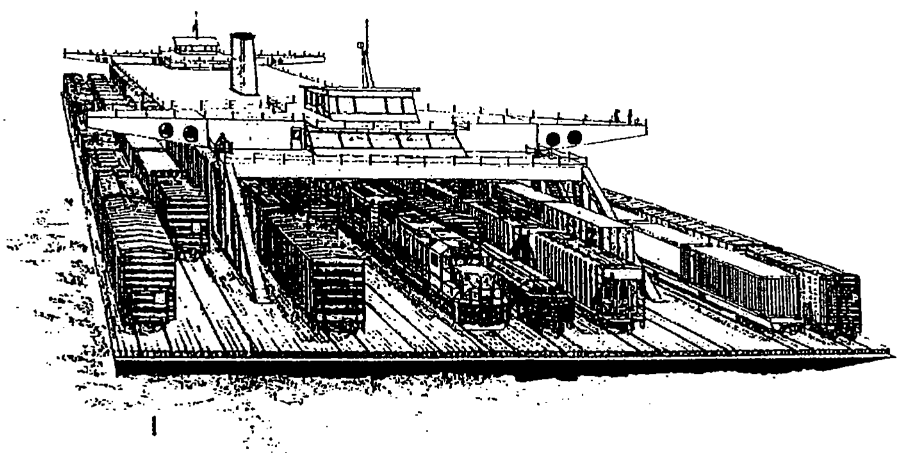


Figure 1-2

Large self-propelled ferries like this have been proposed to transport entire freight trains across Upper New York Bay from Greenville, NJ to Bay Ridge, Brooklyn.

Deliverable #2

Identify differences between float alternatives in the DEIS and in the MIS.

Findings in the MIS:

The Cross Harbor Freight Movement Major Investment Study (MIS) commissioned in 1998 by the NYC EDC examines alternatives to move freight more efficiently across New York Harbor and reduce truck congestion on New York City's roadways and bridges. Stated goals of the MIS are to decrease the region's excessive dependence on trucking, and subsequently improve air quality, lessen deterioration of local roadways and reduce the costs of goods for consumers in the New York City region.

In its findings released in May 2000 the EDC MIS recommends construction of a cross-harbor freight rail tunnel as the best means to achieve its stated objectives. Also significant, however, is the fact the MIS advocates upgrade of the car float system as an interim solution:

> "The expansion of cross-harbor "car float" operations is a significant opportunity for several reasons. First, float operations can be improved relatively quickly to address existing freight mobility problems and allow for near-term expansion of marine industrial activity along the New York waterfront. Second, float operations are far less capital-intensive than major infrastructure projects such as tunnels or interstate highway improvements. Third, float operations can "bridge the gap" while a tunnel is being planned, designed, approved and constructed, or can substitute permanently for a tunnel if that option is found infeasible."

Cross Harbor Freight Movement Major Investment Study (MIS), p. 5 - 40.

The investment cost to improve / expand float operations was put at $150 million with annual operating cost of $7.0 million. Diversion of truck freight to rail, the primary objective, was put at 2.2 million tons per year.

The investment cost of the least-cost rail tunnel option (single track alignment between Jersey City, NJ and Bay Ridge, Brooklyn) was put at $1.34 billion, with annual operating cost of $3.28 million. Diversion of truck freight to rail was put at 8.6 million tons per year.

Cross Harbor Freight Movement MIS, p.7 -3 & p. ES - 5.

Side-by-side comparison of the least-cost rail tunnel option in the MIS and improved / expanded railcar float operation appears on page ES - 5 of the MIS. This comparison is reproduced in Table 2 -1 below.

Summary of MIS Analytical Findings

	Improved Railcar Float System	NJ - Bay Ridge Single Track Tunnel
Diversion Truck Freight to Rail	2.2 Million TPY	8.6 Million TPY
Capital Cost	$150 million	$1.34 billion
Annual OPEX	$7.0 million	$ 3.28 million
Total Annualized Cost	$ 23.5 million	$ 111 million
Annual Benefits*	$197 million	$ 416 million
Benefit / Cost Ratio	8.38	3.75

(*) Monetized value of decreased air pollution emissions, reduced fuel consumption, fewer accidents, lower highway maintenance costs, decreased travel time for drivers.

Cross Harbor Freight Movement MIS, p. ES - 5, p. 7-3.

Table 2 - 1

The large disparity in Benefit / Cost Ratio between float operations and tunnel construction increases further for the other three tunnel options / alignments under investigation in the MIS.

Findings in the DEIS:

The DEIS differs radically from the MIS both quantitatively and qualitatively. Quantitative data in the DEIS is not presented as completely nor in the same format as in the MIS. Table 2 - 2 below is constructed from data extracted from numerous places in the DEIS Executive Summary to enable comparison to the data in Table 2 - 1. Notable ifferences between the DEIS and the MIS include:

- The DEIS decreases truck traffic diverted to the upgraded car float system by 80 percent, from 2.2 million TPY in the MIS to 459,000 TPY in the DEIS. The DEIS increases projected diverted truck traffic of the least cost tunnel system by 10 percent, from 8.6 million TPY to 9.5 TPY.

- The DEIS reduces investment in improved float operations by 47 percent, however, operating expenses of the scaled down float system are increased by 257 percent. The DEIS increases the investment cost of the least cost tunnel by 356 percent to almost $5 billion, and annual operating costs of the least cost tunnel are increased almost 1000 percent, from $3.28 million in the MIS to $30 million in the DEIS.

- The DEIS (Executive Summary) does not show Total Annualized Costs (Annualized CAPEX + OPEX) as does the MIS. Nor does the DEIS (Executive Summary) show the derivation of Annual Benefits in dollar terms as does the MIS. Absent these figures, the Benefit / Cost Ratios in the DEIS are impossible to interpret. The DEIS awards a B / C ratio to the least cost tunnel option that is more than six times the B / C ratio awarded to train floating (i.e., 1.9 : 0.29) The MIS awarded a B / C ratio to train floating more than twice the B - C ratio awarded to the least cost tunnel option (i.e. 8.38 : 3.75).

Comparison of Some Analytical Findings in DEIS and MIS

		Improved Railcar Float System	Pct. +/-	NJ - Bay Ridge Single Track Tunnel	Pct. +/-
Diversion Truck Freight to Rail		0.459 MTPY	-80%	9.5 MTPY	+10%
Capital Cost		$ 80 m	-47%	$ 4.77 b	+356%
Annual OPEX		$ 18 m	+257%	$ 30 m	+914%
Total Annualized Cost (1)		NA		NA	
Annual Benefits - regional (2)		$ 1.7 m	NC	$ 15.1 m	NC
	- national	$ 3.3 m		$ 69.8 m	
B / C Ratio	- regional (3)	0.29	NC	1.90	NC
	- national	0.27		0.70	

(1) Total Annualized Cost is not provided in DEIS Executive Summary.

(2) Computation of Annual Benefits in the MIS and DEIS are not directly comparable. The differences in Annual Benefits are so great between MIS and DEIS as to not be considered directly comparable. NC = not comparable.

(3) B / C ratios between the MIS and DEIS are not directly comparable since the DEIS does not derive Annual Benefits in the same manner as the MIS.

Cross Harbor Freight Movement Project DEIS, p. S - 8, S -10, S - 11, S - 18, S - 21.

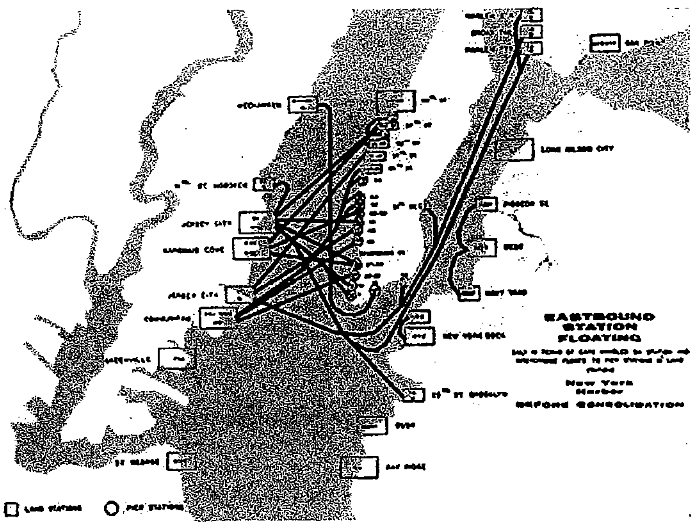
Table 2 - 2

The DEIS reverses findings in the MIS qualitatively as well as quantitatively regarding the rail car floating alternative. To justify reduction of the geographic scope of expanded float operations the DEIS says:

> " A float connection at Oak Point Yard was later dropped because it became apparent that float operations were only viable along a limited number of short, direct routes and that only a destination on the south Brooklyn waterfront could serve as a viable float destination."

DEIS, p. 2 - 37

This statement is inconsistent with the history of car floating in New York Harbor. Figure 2 - 1 shows part of the extensive route system over which more than 4,000 car floats of all types operated in the harbor and surrounding waterways.



Source: Columbia University archives

Figure 2 - 1

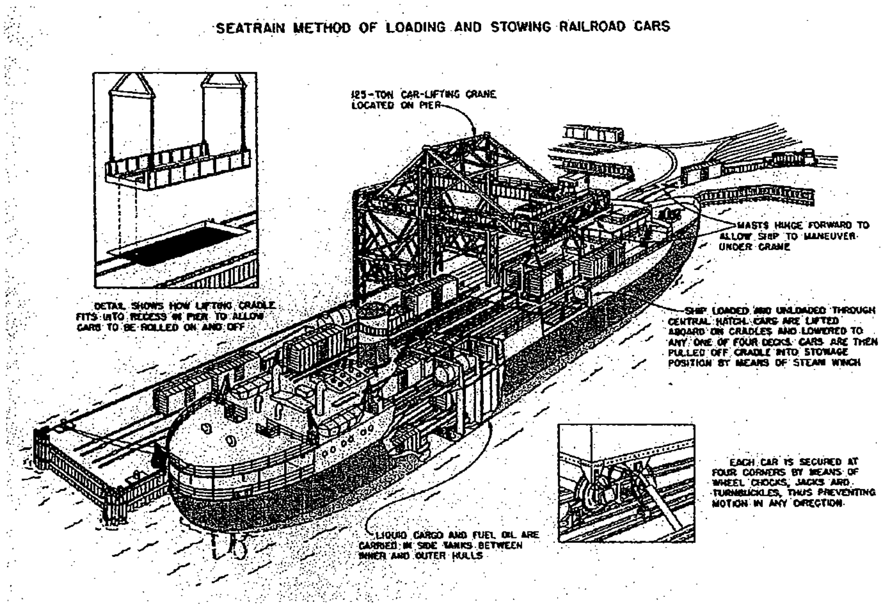
In justification of rejecting use of "a high-speed loading and unloading float bridge alternative ..." the DEIS says:

> "Specialized vessel design as well as advanced loading and unloading equipment would have to be designed at a scale that has not been successfully realized to date. The technology involved is new and experimental in nature."
>
> BID

This statement is inaccurate and misleading on several counts and directly contradicts findings in the MIS (Figure 2 - 4, below):

1. Virtually all freight ferries are built to dedicated routes over which they operate their entire economic lives. Hence, "specialized vessel design" in the form of optimization of vessel size, speed, cargo capacity, cargo handling equipment to accommodate the particular traffic mix, and berthing system are the norm in ferry design, not the exception.

2. The statement implies that all large train ferries are unique and complex, which is not the case (Deliverable 5 + Appendix 5). For instance, unlike the ships of Seatrain Lines that took entire railroad trains to sea distributed over four decks (Figure 2 - 2), the train ferry for Upper New York Bay that was advanced by the NYS DOT study loads all railcars onto the main deck. The only notable loading / unloading equipment of such a design is a ballasting / deballasting system to adjust vessel draft to compensate for vessel trim and heel and stage of tide during train loading / unloading operations.



Source: New York Harbor Railroads, V. 2, p. 25, T. Flagg, Morning Sun Books, Scotch Plains, NJ, 2002.

Figure 2 - 2

3. Nor is the statement correct that the technology involved is new and experimental. Figure 2 - 3 is a roll-on / roll-off ferry of very similar design to the train ferry recommended in the NYS DOT study. This particular vessel operates year-round in British Columbia, Canada and is able to break through ice three feet thick (Deliverable 4).

Source: KMM - Canada, used by permission.

Figure 2 - 3

Apparent inaccuracies in the DEIS regarding the viability of train ferries are surprising because they contradict findings on this subject that were reported in the MIS:

> "The high-speed vessels do not employ new technologies that are untested, however they do incorporate applications of technologies that have never been implemented. The vessel itself can be extremely large. One concept which has been reviewed is a vessel which is 800 feet in length with a width of 140 feet."
>
> Cross Harbor Freight Movement MIS, Task 6, Alternative 4

The 800' x 140' vessel referenced in the MIS is the train ferry that was developed in the NYS DOT study in 1979. That vessel size is used in this current review for reference, and is not necessarily the size ferry that would be recommended today, subject further market analysis. However, it should be noted the NYS DOT effort did advance from concept design to a detailed bid package that included complete drawings and technical information on the vessel and on the economics of modern-day train ferrying (Deliverable 4). Train ferries were rated acceptable on all seven of the criteria used in the MIS to rank cross-harbor freight transport alternatives (Figure 2 - 4).

Alternative 4 - High Speed Loading / Unloading Vessels For Freight Movement

1	Is the alternative feasible from an engineering or construction perspective?	Yes
2	Can it be constructed using technology that is raedily available or available in the foreseeable future?	Yes
3	Can the alternative overcome regulatory challenges?	Yes
4	Will the alternative have a positive impact upon the regional goods movement system?	Yes
5	Does the alternative resuly in a better balance between railroad and truck for the transport of freight east of the Hudson River?	Yes
6	Does the alternative have a reasonable likelihood of improving air quality?	Yes
7	Does the alternative promote regional economic benefits and development?	Yes

Source: MIS, Task 6, Table 2.2, Alternative 4.

Figure 2 - 4

Conclusion:

In so far as train or car floating is concerned, enormous discrepancies exist between the MIS and DEIS. The MIS awarded car / train floating the highest benefit - to - cost ratio by a wide margin (8.38 for train floating, vs. 3.75 for least cost tunnel alternative). The MIS recommended improvement / expansion of the existing car floating system as attractive interim solution during construction of a cross-harbor tunnel, the recommended long-term solution.

The DEIS ranks car / train floating below tunneling on benefit - to - cost ratio (0.29 for train floating, vs. 1.90 for least cost tunnel alternative). The DEIS Executive Summary does not present the Annualized Cost figures for the technical alternatives, as does the MIS; nor does the DEIS Executive Summary present numeric derivation of the dollar Annual Benefits, as does the MIS. The latter figures are found deep within the body of the DEIS (Volume 2, p. 20 - 11) but not in a format that is directly comparable to the MIS. Absent consistency of these figures, reconciliation of B / C ratios between the MIS and DEIS is impossible.

The DEIS Executive Summary anticipates that the Final EIS "...will present a comparison of the following alternatives: No Action Alternative, the TSM (Transport System Management) Alternative, the New Jersey alignment of the Single Tunnel System, and the New Jersey alignment of the Double Tunnel System." (DEIS, p. S - 16).

By inference, the Expanded Float Operations Alternative is not presently contemplated by the EDC for inclusion in the Final EIS. Absent review / reinstatement of the train floating alternative at this time, this solution will be lost in subsequent planning stages of cross harbor rail freight transportation.

Deliverable #3

Review and evaluate assumptions relating to capital and operating costs, operational feasibility and other relevant factors that were used by the EDC team in evaluating these alternatives.

(Addressed elsewhere in this review)

Deliverable #4

Sketch alternative freight ferry systems using state - of - the - art marine technologies currently under design or in operation that could be implemented in the New Jersey / New York freight movement corridor.

In 1998 the train ferry design that had been developed for NYS DOT twenty years earlier was presented to the Transportation Research Forum of New York. Two aspects of the design warrant special emphasis:

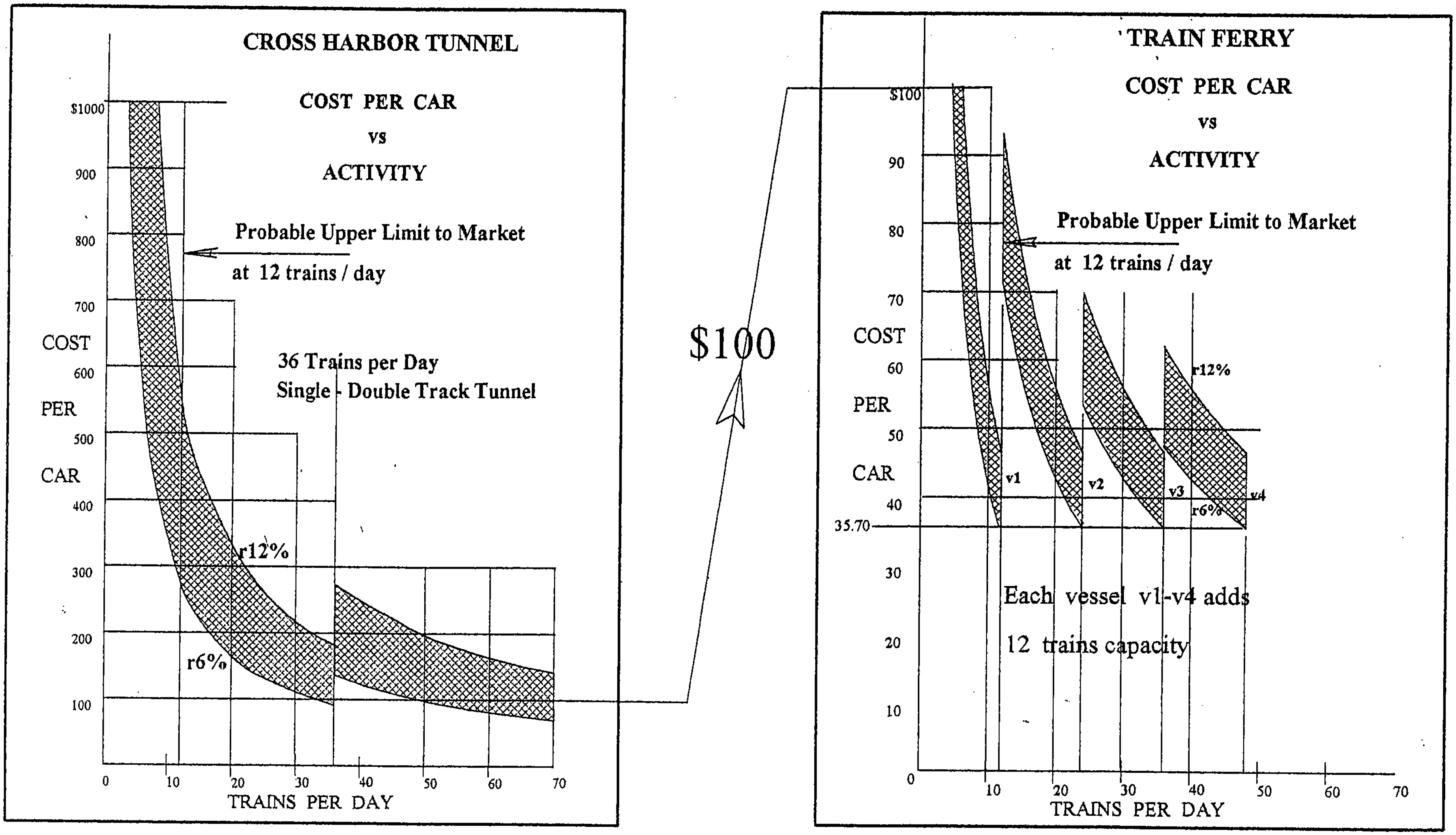
1. A train ferry is not simply a scaled up car floating operation. Similarly to conclusions reached recently by the EDC study teams in the MIS and DEIS, the NYS DOT team concluded car floats would not economically meet the time constraints and throughput requirements of large scale cross harbor train operations. The self-propelled train ferry design that evolved is intended to transport one full trainload (up to 140 cars) across Upper New York Bay in no more than 180 minutes cycle time. One cycle is the time needed perform a complete round trip. The result is a highly productive system able to handle up to 16 trains per day (eight in each direction) at cost per unit throughput far below those of a tunnel or less productive car floats.

   The dramatic difference in unit throughput cost, and in system cost structure, between the train ferry and tunnel is illustrated in Figure 4 - 1. This graph was created using the best cost information available at the time. While revision of some cost elements in both systems is warranted based on newer data (Deliverable 6), this does not radically change the relative difference in unit cost between the systems. This is best illustrated by two examples:

   i) Assume throughput of ten trains per day. At this volume the fully absorbed cost (all CAPEX divided by throughput + variable or out-of-pocket cost per unit) of moving a rail car through a single track tunnel is about $400 (assuming cost of capital is 9%, the mid-range in Figure 4 –1a). A single train ferry could move this same volume at roughly $45 per railcar. Were two train ferries mandated for the purpose of redundancy, the unit throughput cost would rise to about $80 per railcar.

   ii) Assume throughput of 36 trains per day. Even at this high volume, train ferries are still more economical than the tunnel. At 36 trains per day it costs between $150 and $200 per car to move via the tunnel, depending on whether the tunnel is single or double track. To move the same volume by a three - ferry fleet (to allow for redundancy) would again cost about $45 per rail car (Figure 4 – 1b).

Cost per Car Handled vs System Volume



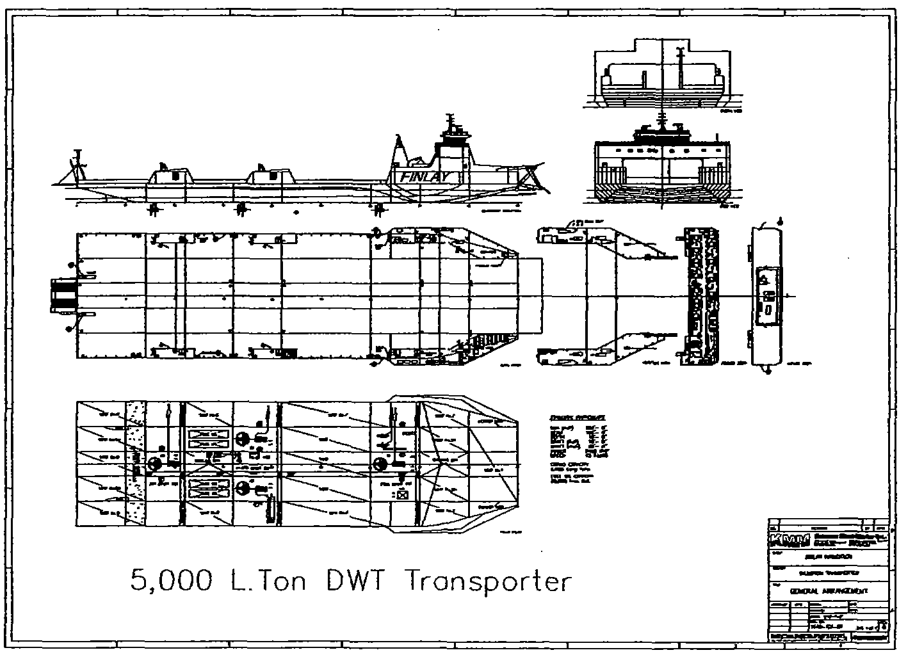
Tunnel
Figure 4-1a

Train Ferry
Figure 4-1b

Cost of Capital - Rate Range 6-12 %

The economics of the train ferry option are superior to those of the tunnel because of the difference in capital costs. In 1998 when Figure 4 - 1 was created the estimated cost of the train ferry was put at $70 million (plus $33 million for land - side improvements) compared to $2 billion for the tunnel. Today, lacking current shipyard price indications, the cost of each train ferry is put at $75 million, but the EDC consultants now put the cost of the least cost tunnel at $4.77 billion. These are the capital cost figures used in the pro forma cash flow statements that are developed for train ferry and least cost tunnel in Deliverable 6.

2. There is not presently and there never was anything experimental or revolutionary about the train ferry design developed for the NYS DOT study. All systems proposed in the design are in use in hundreds of vessels operating around the world today. The validity of the specific integration of systems in the NYS DOT design approach has been demonstrated by success of the roll-on / roll-off ferry *Williston Transporter* (Figure 4 - 2), which conceptually is very close to the NYS DOT design, differing only in size. Comparison of principal dimensions of the NYS DOT design and *Williston Transporter* are shown in Table 4 - 1. Profile drawing, plan view and midship section drawings of the ferry advanced by NYSDOT are shown in Appendix 4.



Source: KMM, Canada, used by permission.

Figure 4- 2

Comparison of NYS DOT Train Ferry to Williston Transporter

	NYS DOT Train Ferry		Williston Transporter
Length	800.0		360.0
Beam	140.0		100.0
Depth	25.5		15.0
Draft (full load)	13.3		10.0
Speed (knots)	9.5		13.0
Power (BHP)	9,600		7,400
Propellers (Steerprops)	4		4
Propulsion	Diesel-electric		Diesel-electric
Capacity (short tons)	9,000		5,600
Track / Truck lanes	10 @ 800' each		
53' Trailers with Tractor	110	all lanes	
50' RR Cars w/ Engine	140	all tracks	
FEU containers (max.)	280	double stack	

Table 4-1

From the foregoing, it can be surmised that a train ferry designed today to move railroad trains and large trucks across Upper New York Bay economically and expeditiously would probably not differ materially from the design developed by the NYS DOT study. Three significant design developments that have occurred over the twenty-five years since the original design was proposed are:

1. Improved Main Engines:

The main engines in the ferry designed today would be more efficient and less polluting than their predecessors. Hybrid diesel-electric propulsion would be investigated, since a ferry intended to reduce vehicular pollution should itself be as non-polluting as possible.

2. Better Electronics:

A train ferry built today would use GPS (Global Positioning Satellite) navigation technology that was unavailable in the 1970s. Dynamic positioning using GPS is how oil wells are drilled in 10,000 feet open-ocean water. Aboard a train ferry equipped with Steerprops®, (four in all) GPS would simplify and expedite vessel berthing, enabling very fast vessel turn-around, regardless of current and wind conditions.

Since the early 1990s, all vessels operating within New York Harbor are monitored 24 / 7 by the U.S. Coast Guard's Vessel Traffic System (VTS). VTS is a shore-based safety system that basically reduces the risk of collision between vessels. Excellent maneuverability, advanced navigation aids and VTS would enable large train ferries to operate safely in Upper New York Bay in all conditions.

3. Faster Train Loading / Unloading:

A train ferry built today would benefit from the operations research and computer algorithms developed over the past two decades that have enabled freight transportation companies around the world to vastly improve efficiency through greater equipment utilization. Computerized car classification and string (groups of cars) switching would speed turn-around time by direct train exchange - that is, each track aboard the ferry would mate with a dual set of tracks ashore connected by a switch. Exchange of entire strings of cars would thus be accomplished in minutes. This system of ferry loading / unloading is described more fully in "In Support of an Expanded Port Brooklyn", below.

In Support of an Expanded Port Brooklyn

In the EDC's MIS, the incremental contribution of benefits from an expanded Brooklyn port is put at $113 million. This is included in the report's "Forecast Monetary Benefits by Alternative" (EDC MIS, Figure 4.1, p. 4 - 7).

The proposed expanded Brooklyn port is a new containership terminal that has been advocated for a number of years. The need for this terminal is based on forecasts that show new containership handling capacity will be needed in the port within ten years. Advantages attached to constructing the terminal in Brooklyn include naturally deeper water (than Newark Bay) for large ships, proximity to the port's sea buoy, and the desire among policy makers in the bi-state region to "balance" the economic benefits of cargo handling operations on both sides of the harbor. Disadvantages attached to building the terminal in Brooklyn include the limited availability of upland space to store containers and the question of how west - of - Hudson cargo will gain access to / egress from Brooklyn, given already congested highways and currently limited rail service.

Figure 4 - 3 illustrates how a highly productive train ferry would help mitigate the two main obstacles to building a new containership terminal in Brooklyn. Direct, automated discharge of containers from ship to railcars to train ferry would expedite movement of cargo through the terminal, thus lessening upland space requirements. And, direct, frequent transfer of containers on flat car (COFC) by train ferry to / from New Jersey would be faster and more economical than backtracking by rail deep into Brooklyn to reach a tunnel portal. Further advantages of the train ferry are its ability to work containers from two vessels simultaneously and its ability to accommodate out-size cargo (such as yachts, electrical generators, etc.) that is often shipped as deck cargo aboard containerships.

Description of Train Ferry Working between Two Super Containerships

By using a 20 track yard adjacent to each super containership and a ferry berth between them, containers would be evacuated from Brooklyn by rail and ferry with no usage of trucking, except for local delivery.

Train Ferry Working Between Two Super Containerships

(5 Minute Ferry Loading Time)

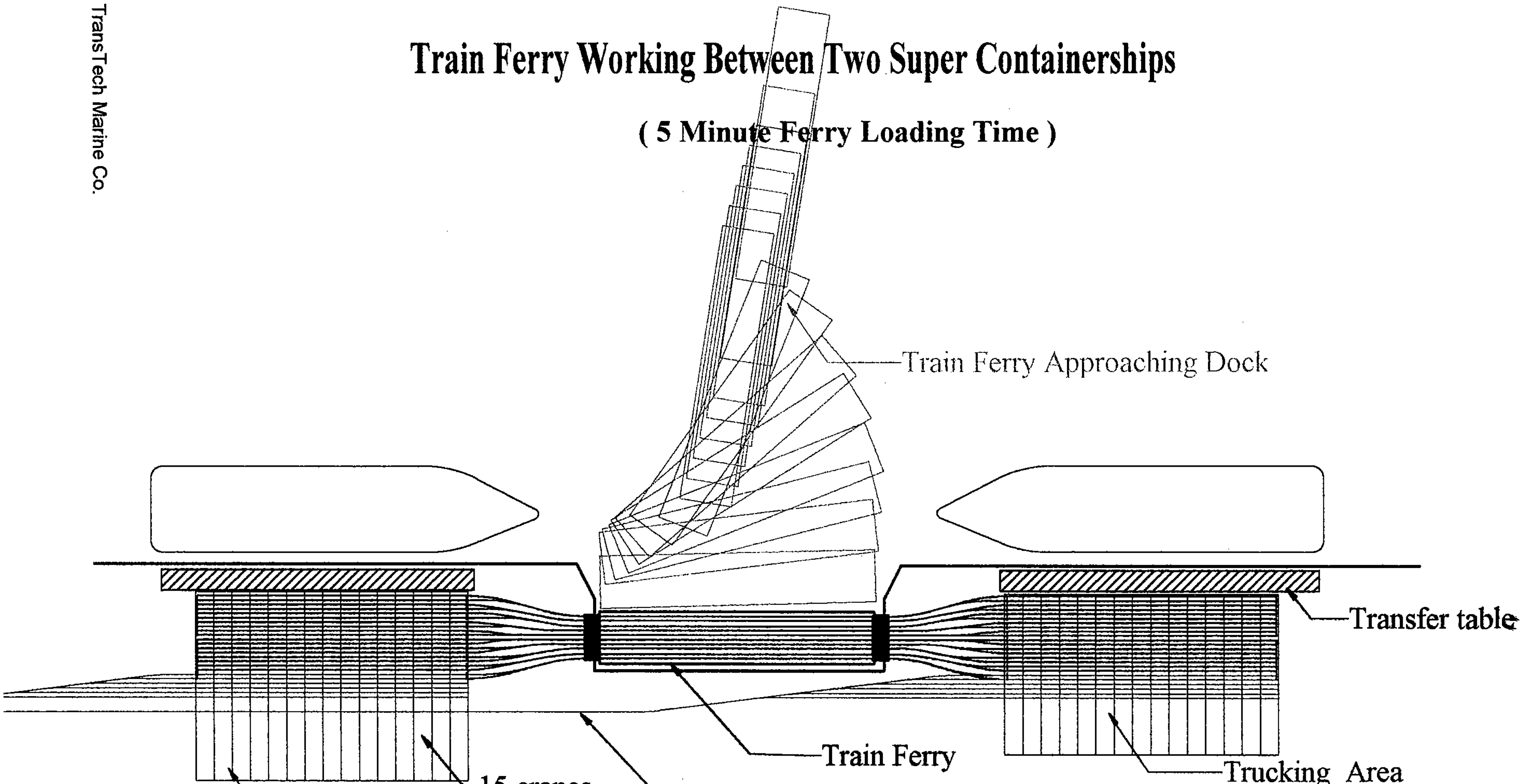


Figure 4-3

a. Track Layout

The train ferry has 10 parallel tracks that are not tapered at the end of the vessel. The Float Bridge has 10 tracks, also parallel, that mate with the tracks on the ferry.

Shoreward of the float bridges (one at each end of the ferry), a small rail yard is located with 20 tracks. Ten switches expand the 10 tracks from the float bridge to the 20-tracks in the yard.

b. Operation

Ten simultaneous train movements can be made between the yard and ferry. The ten moves do not interfere with each other. Odd and even numbered tracks in the yard are used for off-loading and on-loading strings of cars from / to the ferry.

Prior to arrival of the ferry, odd numbered tracks hold railcars to be loaded aboard the ferry, even numbered tracks are empty. On arrival of the ferry, the railcar sets are exchanged; arriving cars are unloaded onto the empty tracks, waiting cars are then transferred onto the ferry.

c. Productivity

The train ferry would have minimal dwell time to load / unload, enabling it to spend most of its day in harbor crossings producing useful output. Transport of 12 trains per day (24 one-way transfers) is well within the theoretical capability of one ferry and is close to the 14 trains per day in DEIS' current long-term volume forecast for 2025. Twelve COFC trains per day is equivalent to 6,720 FEUs or 13,440 TEUs. The productivity of the train ferry is thus equal to or better than the productivity of the most efficient container terminals working large containerships.

It is here noted that unit throughput costs for the train ferry alternative that are developed in Deliverable 6 do not use the ferry's theoretical productivity rates discussed above. To be conservative, ferry cycle time of three hours is assumed, instead of two hours. This equates to 8 train per day (16 one-way-transfers, equivalent to 4,480 COFC FEUs or 8,960 TEUs). The financial projections in Deliverable 6 are based on building and operating two ferries to accommodate the DEIS' projected volume of 14 trains per day. This provides excess ferry capacity and redundancy. The more likely scenario is to build one ferry initially which, via growth in productivity, could handle 14 trains per day by 2025, if indeed that level of traffic volume materializes.

Deliverable #5

Identify existing freight ferry systems elsewhere in the country and the world that demonstrate the feasibility of this technology and its successful use in freight ferries.

Train ferries are a specialized form of roll-on / roll-off cargo ship. Appendix 5 contains copy of an entire issue of *MacGregor News* that was devoted to these unique ships in 1985. MacGregor is the global leader in supplying ship cargo access equipment. The second inclusion in Appendix 5 is a more recent article about a new train ferry now operating between China and Hainan Island.

The literature reveals that most train ferries today are short sea vessels, rather than intra-harbor craft. However, the current paucity of intra-harbor train ferries should not be taken as prima fascia evidence of their non-utility or noncompetitiveness. Research by famed economists Nikolai Kondratieff, J. A. Schumpeter, and others demonstrated the existence of industrial and technological cycles of varying time lengths. As a consequence, some technologies thought to be obsolete do return, but never in the exact form of their predecessors due to technological progress. A technology that is currently out of favor may be heading for re-emergence. A good example of this phenomenon is the reincarnation of privately operated commuter ferries in New York Harbor and elsewhere in the U.S. and around the world. The new ferries provide the same service as did their predecessors, but most of them today are built of aluminum instead of steel, diesel engines have replaced steam, speeds are faster and outfit is usually more luxurious.

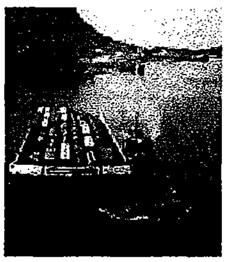


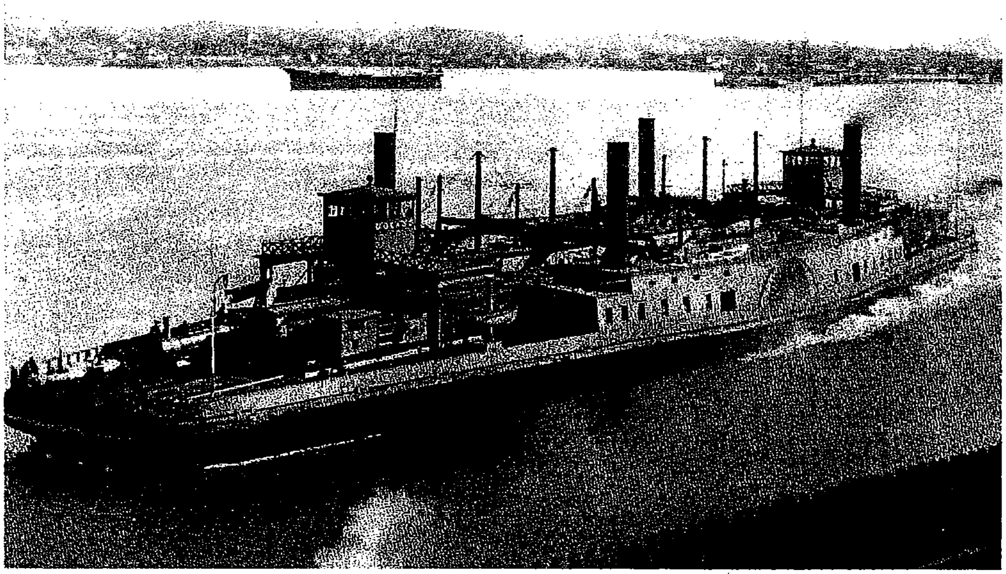
Figure 5 -1

The MIS and DEIS researched only current train floating operations, such as *Aquatrain* that operates seasonally from Canada to Alaska (Figure 5 -1). Research spanning a longer time period might have revealed huge, enormously productive train ferries like *Solano* (Figure 5 - 2) and *Detroit* (Figure 5 - 3) that might have altered some of the researcher's conclusions about the viability of shorter intra-harbor train ferry services.

Ferries like *Solano* (Benecia - Porta Costa, CA) and *Detroit* (Detroit - Windsor) were called transfer steamers, since they transferred entire train sets across water. Describing the Southern Pacific Railroad's service across the Carquinez Strait, Pacific Maritime magazine noted in 2003,

> "In its heyday, the railroad's ferry, *Solano* and later her sister ship, the *Contra Costa*, shuttled an average of 30 transcontinental trains per day across the Carquinez Strait, two locomotives and 36 freight or 24 passenger cars."

Source: Pacific Maritime, November 2003, p. 30)



Railroad Transfer Steamer *Solano*

Figure 5 - 2

Railroad Transfer Steamer *Detroit*

Figure 5 - 3

Solano and *Detroit* offer some insight into the current challenge of efficiently transporting freight trains between New Jersey and Brooklyn:

- The transfer steamers were very large, larger in fact than most deep-sea freight ships of their day. Size was dictated by the need to transport entire train sets en bloc.

- Where rail car flows were concentrated, transfer steamers were preferred to car floats. Where rail car flows were fragmented, such as service from several rail / marine terminals in New Jersey into New York City in the early 20th century, car floating dominated.

- Excellent ferry maneuverability was essential to maintaining tight schedules. *Solano* had four rudders at each end that operated in tandem.

- Berths for transfer steamers were parallel to the shore to minimize the effect of currents when docking and when berthed.

Railroad bridges and tunnels replaced most transfer steamers in the U.S. by the end of the 1930s Great Depression. By then, the ships were aged, costly to maintain and required large crews. Tunnel and bridge projects financed by government put a lot of people back to work and could be built comparatively cheaply.

Three quarters of a century later, reversal of economic forces again favors train ferries in certain freight markets. U.S. shipyards are particularly efficient at building large roll-on / roll-off barges like the ones used by Trailer Bridge (Figure 5 - 4) and Crowley Maritime (Figure 5 -5) in their respective services to Puerto Rico. Competitive U.S. vessel price can be leveraged with low cost vessel financing available via the Title XI program of the Maritime Administration, U.S. Department of Transportation. Highly automated vessels would require only small crews. And it can all be put in place in a few years. This contrasts markedly to the enormous cost, complexity and time required today to build a new tunnel, which is documented explicitly in the EDC's MIS and DEIS.

Source: www.trailerbridge.com

Trailerbridge Roll-on / Roll-f Barge

Figure 5 - 4

Source: www.crowley.com

Crowley Roll-on / Roll-off Barge Entering San Juan Harbor

Figure 5 - 5

Deliverable #6

Provide summary estimates of capital and operating costs for modern freight ferry systems in the New York Harbor and contrast those costs to existing ferry operations and the proposed cross harbor tunnel options.

Cost of Capital

The cost of capital is critical to projects of this size, as is its amortization term. To give the tunnel every possible advantage its cost of capital is put at 4.5%. This is approximately equal to the U.S. 30 year T - bond rate. The finance term is put at 100 years. These are the absolutely most generous terms any publicly funded capital project might hope for, and, as a practical matter, these terms might be overly optimistic. Capital projects financed by bonds issued by the Port Authority of New York and New Jersey, for instance, carry coupons of around 6.5%.

Unlike the tunnel, the train ferry is assumed financed on commercial terms. Cost of capital, using the Title XI mortgage Guarantee program of the Maritime Administration, USDOT, is assumed at 7.5%, amortized over twenty-five years. Different costs of capital and amortization terms were used for the tunnel and ferry system to more accurately reflect the finance terms each solution might anticipate receiving.

Freight Throughput Volume

The unit cost of a transportation system is inversely proportional to the volume of freight put through it. To enable comparison of the tunnel and ferry systems, both analyses use the projected traffic volume in the DEIS of 14 trains per day (28 one-way trains per day) in 2025. This volume level requires two ferries. However, given that a train / truck ferry system can be put in place in about three years time, near-term traffic volume could initially be accommodated by a single ferry.

The Single Track Tunnel Alignment

The capital investment of $4.77 billion (DEIS *Executive Summary*, p. S -10) for a single-track tunnel, plus annual cost of $30 million to operate the tunnel, again from the DEIS (IBID), are used to derive a total annualized tunnel system cost Of $247,313,531 (Table 6 - 1). This is 100 year financing at 4.5% which equates to $677,000 per day. Were 6.5% bonds issued over 40 years, the annualized cost would be $367,209,073 or over $1 million per day. Annual OPEX of $30 million is optimistic in view of the costs to provide security for a tunnel costing $5 billion.

New Jersey Single Tunnel Alignment

Number of Tunnel Alignments		1	
Total One Way Trains per Day		28	
Operating Days per Year		365	
CAPEX:			
Investment Cost (DEIS, p. S-10)	$4,770,000,000		
Investment in Ancillary Facilities	$0		
Total System Investment Cost		$4,770,000,000	
Amortization of Capital - years	100		
Cost of Capital (Title XI Financing)	4.50%		
Annual CAPEX (Tunnel)	217,313,531		
Annual CAPEX (Ancillary Facilities)	0		
Annual System CAPEX		**$217,313,531**	
OPEX:			
Annual System OPEX (IBID)		**$30,000,000**	
TOTAL ANNUAL SYSTEM COST			**$247,313,531**

Table 6 - 1

Upper New York Bay Ferry

The annualized cost of operating a fleet of two self-propelled train ferries across Upper New York Bay would be $30.5 million (Table 6 - 2). This is equivalent to $84,000 per day. As noted previously, a single ferry could be put in service initially. Putting the near-term traffic volume at half of the 2025 figure (i.e. seven trains per day or fourteen one-way trains per day), the annualized cost of a one train ferry system would be $17.65 million. This is equivalent to $48,000 per day.

Comparison of Unit Throughput Costs

Per unit throughput costs were developed for the tunnel and train ferry systems using the DEIS volume of 14 trains per day. Train length is put at 140 cars, the maximum capacity of the ferry. FEU capacity of 280 is also defined by the ferry based on double stacking on COFC rail cars. Finally, since with relatively small modifications train ferries can also transport heavy trucks, 53' trailer capacity is also included and is also defined by the ferry capacity. Load factor in all cases is assumed at 100 percent to produce the lowest theoretical unit cost. As can be seen in Table 6 -3, the cost to move one rail freight car, or one 53' tractor trailer, or one FEU by train ferry between New Jersey and Brooklyn would be one eight the cost of moving the same freight through the least cost tunnel financed on charitable terms (100 years, 4.5% cost of capital). If the tunnel is financed on terms closer to other Port Authority of New York and New Jersey major capital investments (40 years, 6.5% cost of capital), then the unit throughput cost by train ferry is one twelfth of the cost of moving the same freight through the tunnel.

Single Track Tunnel Unit Throughput Costs

	Annual Max. Thruput	Assumed Load Factor	Tunnel Unit Cost
Railcars (140 per one-way train)	1,430,800.00	100%	$172.85
53' Trailers (110 per one-way train)	1,124,200.00	100%	$219.99
FEUs (280 per one-way train)	2,861,600.00	100%	$86.42

Upper New York Bay Train / Truck Ferry Unit Throughput Costs

	Annual Max. Thruput	Assumed Load Factor	Train Ferry Unit Cost
Railcars (140 per one-way trip)	1,430,800.00	100%	$21.33
53' Trailers (110 per one-way trip)	1,124,200.00	100%	$27.15
FEUs (280 per one-way trip)	2,861,600.00	100%	$10.67

Table 6 - 3

Upper New York Bay Train & Truck Ferry

	Number of Ferries in Fleet		**2**	
	Total Fleet Round Trips per Day		**14**	
	Operating Days per Year		**365**	
CAPEX:				
Investment Cost per Ferry		$75,000,000		
Investment in Ancillary Facilities		$40,000,000		
Total System Investment Cost			$190,000,000	
Amortization of Investment Cost - years		25		
Cost of Capital		7.50%		
Annual CAPEX (Ferries)			13,456,601	
Annual CAPEX (Ancillary Facilities)			3,588,427	
Annual CAPEX				**$17,045,028**
Fixed OPEX:				
Crew size per Ferry		6		
Crew Shifts per Day per Ferry		3		
Crew Wages (one shift year)		530,000		
Crew Benefits (IBID)		185,500		
Crew Victuals (IBID)		16,800		
Communications (IBID)		5,000		
Petties & Misc. (IBID)		10,000		
Annual Crew Cost (IBID)		747,300		
Annual Crew Cost per Ferry		2,241,900		
Annual Fleet Crew Cost			**$4,483,800**	
Insurance				
H & M Insurance per Ferry		1,125,000		
P & I Insurance per Ferry		300,000		
Other Coverages		50,000		
Annual Insurance Cost per Ferry		1,475,000		
Annual Fleet Insurance Cost			**$2,950,000**	
Maintenance & Repair				
M&R (Vendor Services per Ferry)		750,000		
Supplies & Misc. per Ferry		50,000		
Annual M&R per Ferry		800,000		
Annual Fleet M&R Cost			**$1,600,000**	
Annual GS&A Expense		1,000,000	**$1,000,000**	
Annual Fixed OPEX per Ferry			**10,033,800**	
Annual Fleet Fixed OPEX				**$10,033,800**
Variable OPEX:				
Fuel				
Prime Movers per Ferry		4		
Steaming FR / Prime Mover (gph)		125		
Berthed FR / Prime Mover (gph)		25		
Fuel Cost ($ / gal)		$1.50		
One-Way Distance per Trip (nm)		2.75		
Average Ferry Speed (knots)		9.00		
Steaming time per One-Way Trip (minutes		20.17		
In - Berth Time per One-Way Trip (minute		60.00		
Extra Time Margin per O.W. Trip (minutes		9.83		
Total Minutes per One-Way Trip		90.00		
Fuel Cost per One-way Trip		$317.21		
One-way Trips per Day per Ferry		14		
Fuel Cost per Day per Ferry		$4,441		
Annual Fuel Cost per Ferry		$1,620,920		
Total Annual Fleet Fuel Cost			$3,241,841	
Other Annual Variable OPEX (est.)		$200,000	$200,000	
Annual Fleet Variable OPEX				**$3,441,841**
TOTAL ANNUAL SYSTEM COST				**$30,520,668**

Table 6 - 2

Deliverable #7

Provide recommendations for policies and further research needed to realize the potential for freight ferry systems.

The following five policies / recommendations are offered as a result of this analysis and review:

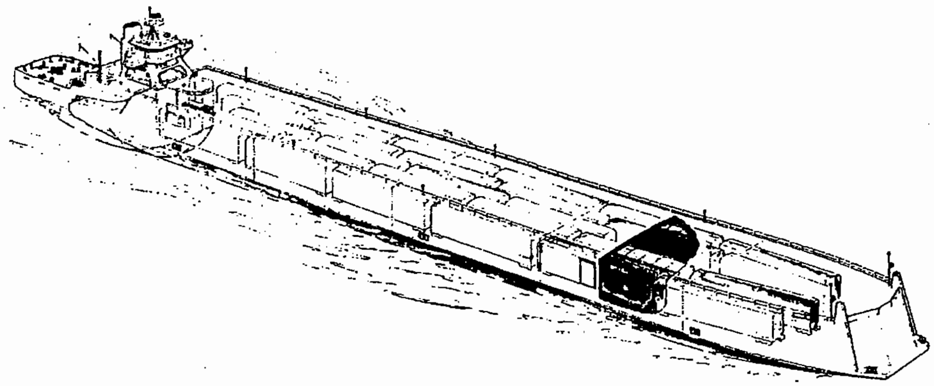
1. **NJTPA should file strenuous objection to the implied elimination of further consideration of the train floating option as reported in the EDC DEIS (Executive Summary, p. S - 16).**

   Findings in the DEIS relating to the train floating option (as distinct from car floating) are incomplete, inaccurate and inconsistent with the EDC's MIS and with other research on the subject. Unilaterally or in concert with a multi-agency organization such as CPIP, NJTPA should endeavor to ensure that the train floating option remains in consideration. Further, NJTPA should endeavor to ensure that qualified researchers and adequate resources are provided to revisit the train floating option in the context of information that is presented in this current analysis / review.

2. **NJTPA should request that MARAD (Maritime Administration, US DOT) be invited to join FHWA (Federal Highway Administration) and FRA (Federal Railroad Administration) as a joint lead agency for the preparation of the Final Environmental Impact Statement. The US Coast Guard should be invited to join the team as advisor.**

   The need to move more vehicular traffic onto other transport modes is a priority nationally. MARAD is actively attempting to move highway trucks onto water via its Short Sea Shipping initiative. Success of a cross harbor train ferry that is also equipped to accommodate heavy trucks in Upper New York Bay would be an important development towards establishing a vital Short Sea Shipping presence in the Port of New York and New Jersey. By familiarizing more shippers with the benefits of waterborne transport, an Upper New York Bay train ferry would also contribute to the PIDN (Port Inland Distribution Network) being developed by the Port Authority of New York and New Jersey. Participation of the US Coast Guard would ensure that any train ferry contemplated for this service is consistent with their regulations for operating within New York Harbor.

   The future that is brought closer if the cross-harbor rail freight maritime solution is developed can be appreciated in Figure 7 -1. This is a design for a U.S. flag coastal rail car / truck transport vessel based on articulated tug-barge technology. Successful cross-harbor rail / truck ferry service would form the base for expansion into longer coastal routes.



Source: TransTech Marine Co. files.

U.S. Coastal Rail Car / Truck Transport / Container Feeder Vessel

Figure 7 -1

3. **NJTPA should encourage efforts to preserve and rehabilitate the last remaining car float operator in New York Harbor.**

This analysis / review has emphasized, as have previous studies, that car floats are not the solution to transporting large volumes of rail cars expeditiously across water. Train ferries can do it. To the extent that a viable extant car float operator could grow into the larger business of operating train ferries, or attract a larger partner to enable doing so, government in the bi-state region should endeavor to preserve and sustain the last remaining car float operation in New York Harbor. In 1986 the *New York Times* described how the Koch Administration planned to spend $11 million on improved facilities for the New York Cross Harbor Railroad

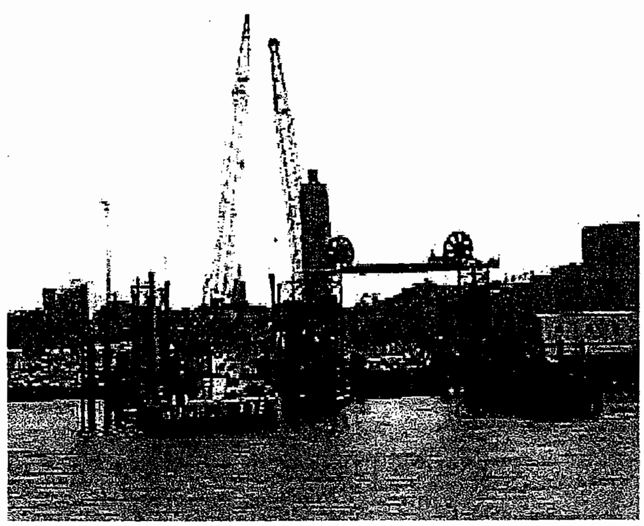


Figure 7 - 2

(Appendix 7, first article). Improvements were to include construction of two new float bridges at 65th Street Brooklyn. These were completed during the Giuliani Administration (Figure 7 - 2). However, two years into the Bloomberg Administration the *New York Times* reported that the new float bridges had yet to be used (Appendix 7, second article). NJTPA should bring to the attention of counterpart agencies around the port that the investment in new car floats has already been made. To not make use of them when they are indeed needed (Appendix 7 Inspection Report: Cross Harbor Railroad Pontoon at 43rd St., Brooklyn) is inconsistent with the stated goals of the EDC's MIS and DEIS. Any increase in cross-harbor freight transport by water represents immediate reduction of highway truck traffic and its concomitant pollution. NJTPA should support efforts by the New York Cross Harbor Railroad to gain access to the new, unused float bridges at 65th Street in Brooklyn.

4. NJTPA should advocate and co-sponsor in partnership with other appropriate agencies / authorities continued research and development of the train floating option.

Building upon this analysis / review and previous research, the following are recommended to advance the train floating option:

Train Ferry Technical Development

- Update train ferry design to incorporate new market size information and modern vessel technologies.
- Define optional vessel features to extend market range, such as to enable simultaneous transport of rail cars and heavy trucks.
- Revise vessel specification and preliminary drawings. Prepare new bid package.
- Solicit price indications and delivery from potential vessel builders.
- Develop detailed capital and operating costs for ferry service.

Terminals and Operations

- Develop the plan for "short train" operations aboard the ferry. Consult with New York and Atlantic Railroad / others.
- Establish dialogue with labor interests / others to implement "short train" strategy at New Jersey ferry terminal.
- Identify best locations for ferry terminals; establish suitability to accommodate projected freight volumes.
- Identify vendors of train ferry / terminal transfer bridge systems.
- Obtain price indications from vendors, services providers.

5. **NJTPA should advocate a public / private partnership as the preferred alternative to build and operate a cross-harbor train ferry service in New York Harbor.**

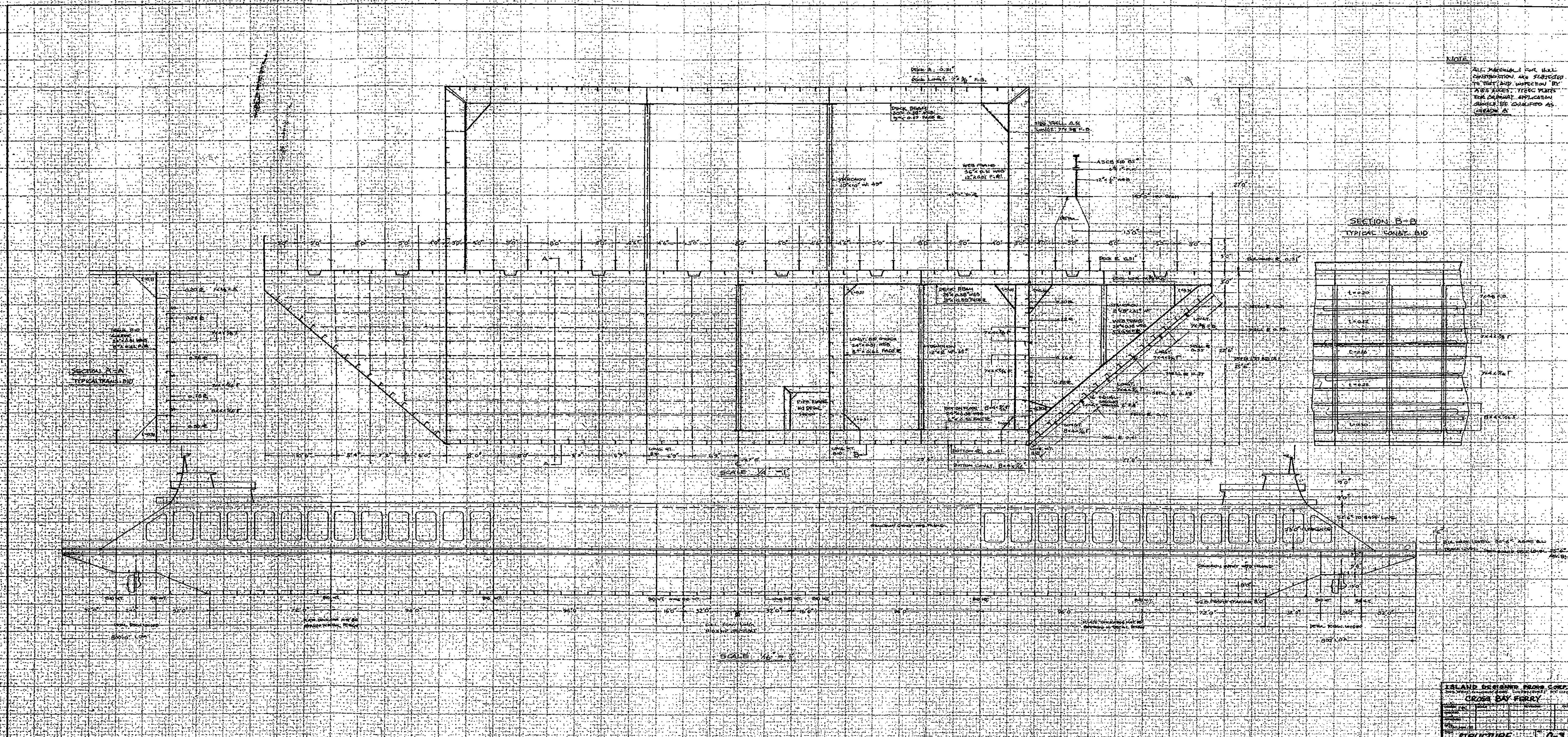
Successful precedent exists in the RFP put out by the Port Authority of New York and New Jersey in 1985 to elicit interest from the private sector in building and operating commuter ferries to run between Hoboken, New Jersey and the World Financial Center in lower Manhattan. Response to the RFP by reputable vessel builders and operators was high. Success of that initiative is largely credited as a major catalyst of the resurgence of private commuter ferry services in New York Harbor that has occurred over the past twenty years.

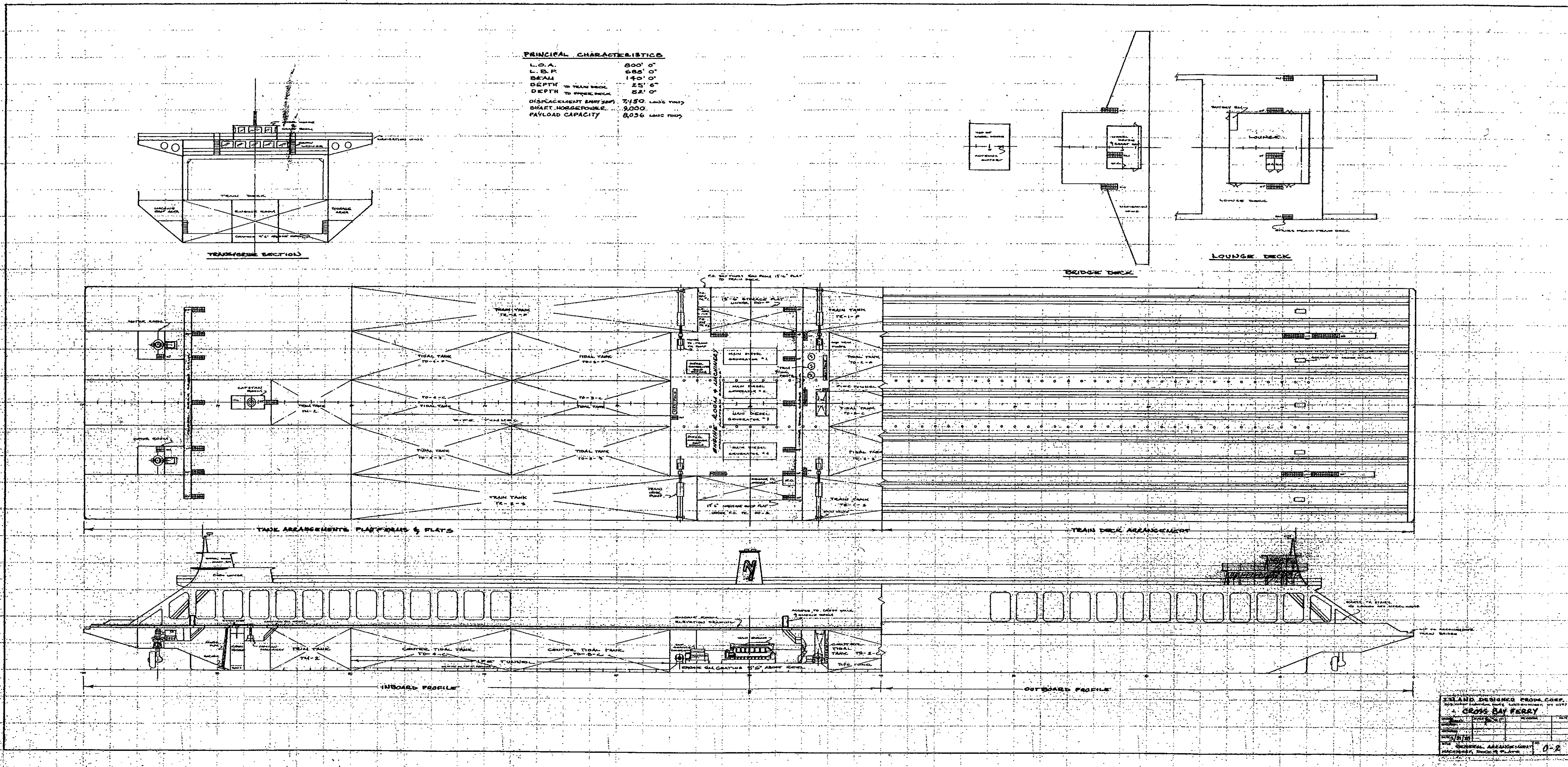
Subject findings of Recommendation 4 in this analysis / review, NJTPA should advocate that a public / private partnership build and operate a cross-harbor train ferry service (with the possibility of also transporting heavy trucks). The Port Authority of New York and New Jersey's successful commuter ferry RFP in 1985 should be the model for this partnership. Public / private partnership offers the potential to produce an efficient cross-harbor freight transport system, at small fraction of the time and cost of building a tunnel, with immediate benefits and virtually no adverse social and environmental impact, and with greater flexibility and potential expandability and less vulnerability than a tunnel. This requires comparatively small investment and offering proper incentives. By doing so, government would preserve scarce resources to fund essential infrastructure projects that are unable to attract private sector participation.

Appendix to Deliverable 4

NYS DOT Proposed Train Ferry:

Outboard Profile
Inboard Profile
Plan View
Midship Section (reverse side)


SECTION A-A
TYPICAL TRANS. B'HD
SECTION B-B
TYPICAL LONGT. B'HD
NOTE
ALL MATERIALS FOR HULL CONSTRUCTION ARE SUBJECTED TO TEST AND INSPECTION BY ABS RULES. STEEL PLATES FOR ORDINARY APPLICATION SHOULD BE QUALIFIED AS GRADE A
ISLAND DESIGNER PROFS CORP.
CROSS BAY FERRY
STRUCTURE
0-3

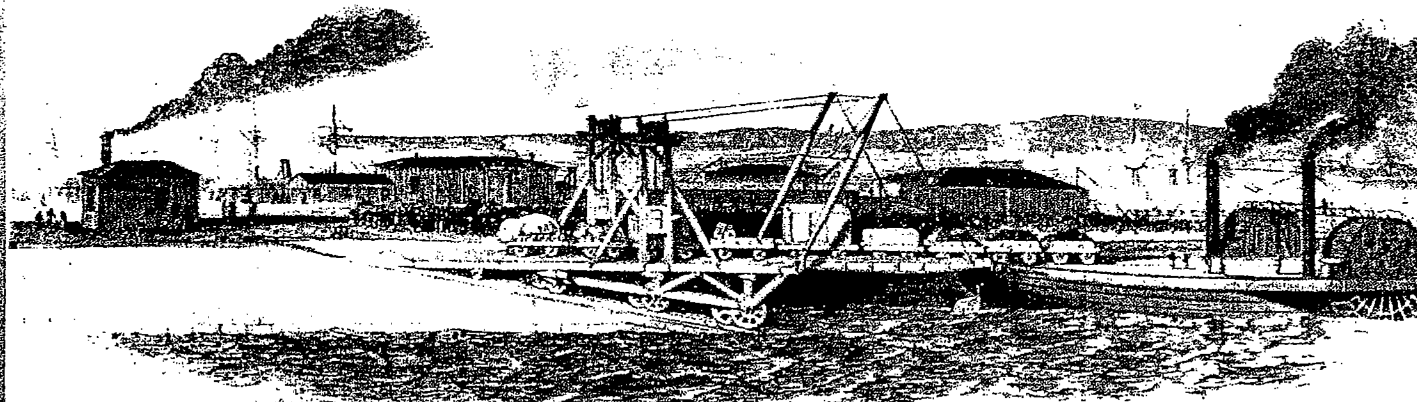

PRINCIPAL CHARACTERISTICS
L.O.A. 800' 0"
L.B.P. 688' 0"
BEAM 140' 0"
DEPTH TO TRAIN DECK 25' 6"
DEPTH TO UPPER DECK 52' 0"
DISPLACEMENT (LIGHT SHIP) 7,150 LONG TONS
SHAFT HORSEPOWER 9,000
PAYLOAD CAPACITY 8,036 LONG TONS
TRANSVERSE SECTION
TRAIN DECK
BRIDGE DECK
LOUNGE DECK
LOUNGE
TANK ARRANGEMENTS PLATFORMS & FLATS
TRAIN DECK ARRANGEMENT
CAPSTAN ROOM
TIDAL TANK
TRAIN TANK
PIPE TUNNEL
MAIN DIESEL GENERATOR
INBOARD PROFILE
OUTBOARD PROFILE
CENTER TIDAL TANK
ISLAND DESIGNED PROD. CORP.
CROSS BAY FERRY
GENERAL ARRANGEMENT
MACHINERY, DECKS & FLATS
0-2

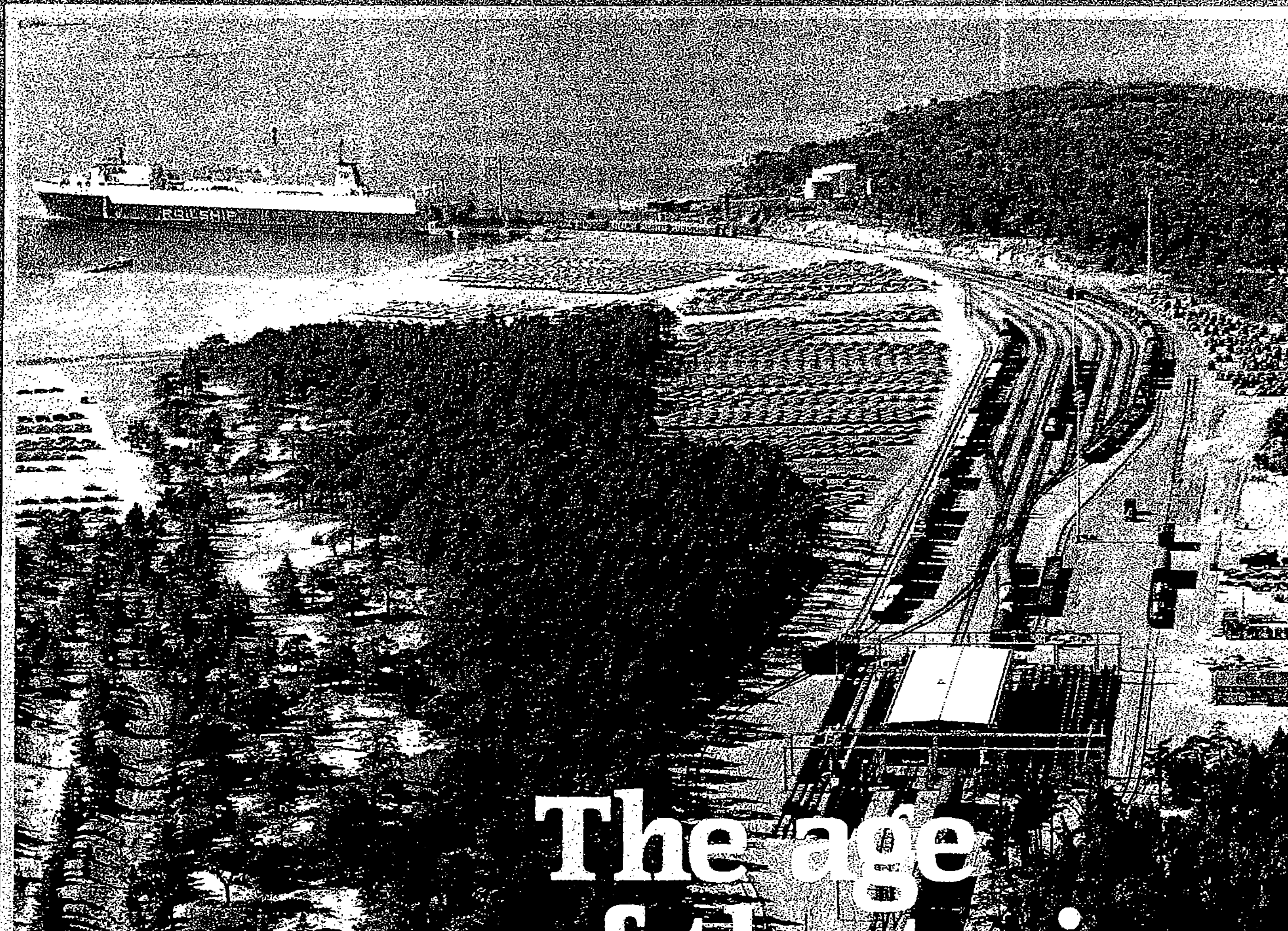
Appendix to Deliverable 5

A Survey of Current Train Ferry and Float Bridge Technology

MacGREGOR NAVIRE NEWS

Number 105 March 1985





MacGREGOR NAVIRE

CONTENTS

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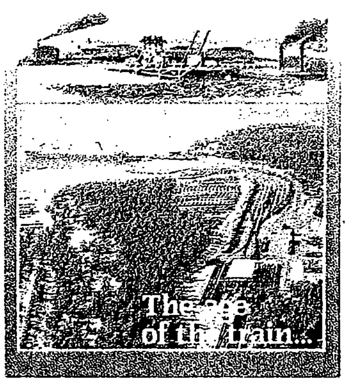
Our cover:
First and latest railway linkspans
In 1850, the first linkspan (top) came into operation at Granton, near Edinburgh in Scotland, as part of the Forth train ferry service, linking the railway to Burntisland on the north side of the Firth of Forth.

The terminal at Hanko in Finland (lower picture) shows the *Railship I* train ferry which traverses the Baltic to Travemunde in Germany. In the foreground is the building where the wagon bogies are changed from the Finnish 1520mm gauge to the German 1435mm

MacGREGOR NAVIRE NEWS



A German-built rail ferry

a renaissance on two fronts

The economic success of the German Federal Republic continues to be admired and indeed envied by the rest of Western Europe. With this year's economic growth forecast to be 3 percent and last year's inflation, at 2.4 percent, the lowest in 15 years, Germany's export order books are filling up fast and there is massive investment in new technology.

This economic miracle, as it is being termed in some quarters, considering the general sluggishness of the economy in most other European countries, is being reflected in the performance of West Germany's shipbuilding industry. This year marks the 100th anniversary of Verband der Deutschen Schiffbauindustrie (the Association of the German Shipbuilding Industry) and its president, Dr. Michael Budczies, says that following the large scale restructuring which has taken place within the industry, it is now in a very healthy state. The structure now consists of a few large shipyards and many medium and small size establishments.

West German yards now have a 6 percent share of the world market, having recovered last year to what is considered their normal share from the drop to 3.7 percent experienced in 1983. In 1984, orders for 145 ocean-going ships were taken, with about two thirds of them for domestic owners.

One of the factors contributing to the success of the West German yards must surely be their continuing interest in specialised ships and this is reflected in the ratio of 465,000grt/658,000 compensated tons contained in the 1984 order book. The cargo access factor in high compensated tonnage is usually equally high, unless of course the ships are non dry cargo, such as LNG or LPG carriers.

In our last issue, No.104 published in December 1984, we featured some of the interesting small and medium size vessels built by J. J. Sietas of Hamburg, the designs of which have resulted in the yard becoming a by-word for clever and innovatory design. In this issue, we continue the German success story with ships from Seebeckwerft, HDW, Busumerwerft and Krogerwerft.

MacGregor-Navire prides itself in the lead it gives the marine industries in access technology and in meeting the needs of that industry wherever it might be. In order to provide the best cargo access capability, both in newbuilding and servicing, there is now only one company in Germany, Navire Cargo Gear (Deutschland) GmbH, able to offer the full range of MacGregor-Navire technology. The two technologies of the previous separate MacGregor and Navire organisations are from now onwards available under one roof. And this combined 'know-how' has never been available before in Germany. What are also now available in Germany for the first time are all the international facilities of the MacGregor-Navire group – unmatched by any other German-based supplier.

One of the most outstanding of the latest ships delivered from a German yard is the train ferry 'Railship II' which, as a result of her MacGregor-Navire access capability, is able to discharge and load rail wagons on three decks during a turnround time of only six hours on one of the world's longest train ferry routes across the Baltic to Finland.

It is no coincidence that MacGregor-Navire has been involved in this latest rail ferry technology. From what was seen in the 1970s as a declining form of transport, we feature in this issue deliveries of rail ferries for Italy, New Zealand and the USSR, as well as rail link spans at each of the Russian and Bulgarian terminals used by the Russian ships on the Black Sea service. In other parts of the world too, there is a resurgence of interest in rail ferries and in the article on page 3, Richard Hope, the internationally respected editor of *Railway Gazette*, gives his views on why this is happening.

Renaissance? Perhaps "Wiedergeburt" reflects more of the German quality in the undoubted success story of the country's shipbuilding industry. But whatever the language employed, the message is still the same – success and determination to survive in the highly competitive shipbuilding market of the mid 1980s.

Commercial prospects for train ferries

By Richard Hope, Editor of Railway Gazette International

Before writing about railways, Richard Hope, C.Eng, M I E E, M I Mech E, used his qualifications to practical effect in the railway industry serving with companies in the UK and abroad, as well as with British Rail and Britain's Central Electricity Generating Board. He has been with 'Railway Gazette' for 21 years and its editor for the last 15

Whereas the RoRo ferry has evolved over the last 30 years, train ferries have a long history stretching back to the nineteenth century.

A venerable wood-burning steamer built on the Clyde still ferries goods wagons and passenger coaches across the mighty Parana River separating Paraguay from Argentina. At the other extreme, tugs regularly tow barges carrying freight cars on open decks from Seattle to the Alaska Railroad's southern terminus at Whittier, a long and hazardous voyage despite the shelter of islands along the coast of British Colombia.

Classic train ferry operations have been tuned to the finest pitch in the Baltic, where passenger trains run on and off ships in seconds rather than minutes and vessels are continuously on the move carrying wagons between Sweden and Denmark.

The trouble is, the economics of many of these ferries are questionable. Railway costing is notoriously complex, and so long as rail carriage dominated inland freight movement, nobody bothered overmuch about the high costs of the ferry link. Wagons had to be moved from Sweden across Denmark to Germany, and that was that.

With railways losing out to road hauliers all over Europe because they were too slow in adapting obsolete rate structures and dealing with overmanning, it looked in the mid-1970s as though the train ferry was doomed to decline. Then, in 1975, a private sector consortium surprised everybody by putting *Railship I* into service on the 870km run between Travemunde in West Germany and Hanko in Finland.

Railship I broke fresh ground in several respects. For a start, it did not represent the shortest route between isolated rail networks. Rather, it by-passed a continuous but slow railway journey through Poland and Russia – or more likely perhaps, a long haul through Denmark and Sweden to Finland's land frontier at Tornio in the far north.

Then there was the capacity of the new ship: 60 four-axle wagons on three decks – many more than any train ferry previously built could handle. Nor were the promoters deterred by the fact that Finland uses the 1,520mm broad gauge whereas most of Europe is 1,435mm standard gauge. Wagons were simply lifted on to different bogies at Hanko, or unloaded on the quay into lorries.

Three years later, a similar service appeared in the Black Sea, also connecting 1,520 and 1,435mm gauge networks in Russia and Bulgaria respectively. This time it was Roumania that was by-passed, possibly to avoid frontier delays. This also may have been the thinking behind two other proposed rail ferry routes neither of which has yet materialised. One, raised during the late 1970s, visualised a service linking Volos in Greece with Latakia in Syria; the other, first projected in 1982, would open yet another rail ferry route in the Baltic – this time linking the USSR and East Germany.

That the Railship enterprise has been a success is proven by the fact that a second ferry – *Railship II* – is now in service on the route along with the pioneering *Railship I*. It is a success which demonstrates quite conclusively that long distance train ferries can be made to pay – provided they are large enough, and are designed and equipped for rapid loading.

Despite strikes and other problems, we are seeing well managed railways freed from government interference recapture traffic from the roads in several parts of the world, notably North America. This undoubtedly opens up opportunities for train ferries operated by entrepreneurs.

Perhaps the outstanding example is between Britain and mainland Europe. The present ships are far too small, and as a result the service is uneconomic. In tonnage terms, less than 5 per cent of cross-channel freight travels in rail wagons, yet the potential trade is larger by an order of magnitude than the 350,000 tonnes/year moved by *Railship I*. Now that British Rail no longer owns the existing ships and port facilities, there must surely be scope for a competitive route, say from Cuxhaven to Immingham.

Other interesting possibilities exist, such as France to Morocco by-passing broad gauge Spain.

The container was supposed to have made the idea of carrying rail wagons on ships obsolete – but somehow it doesn't seem to be working out like that. Maybe somebody should look at the North Atlantic!; at least Europe and North America share a common track gauge.

New chief-executive for MacGregor-Navire

Mr. Lars G. Larsson, presently managing director of Consafe AB, Gothenburg, has been appointed chief executive of MacGregor-Navire International and will take up his position on June 15th, 1985.

Born in 1940 and married with two children, Mr. Larsson will bring to the MacGregor-Navire organisation a lifetime's experience in the marine industries, both ashore and afloat.

Beginning his seagoing career in 1960 with the Brostrum Group, he took his master's certificate in 1966 and thereafter served as chief officer on various vessels, including the passenger liner "Kungsholm". From 1969 to 1972 he held a shore-based appointment with Brostrum's which involved cargo traffic, and at the same time studied cargo handling subjects at Chalmers University in Gothenburg.

In 1973, Mr. Larsson took an appointment with Transatlantic AB, which among other things included organising Transatlantic's West African liner traffic.

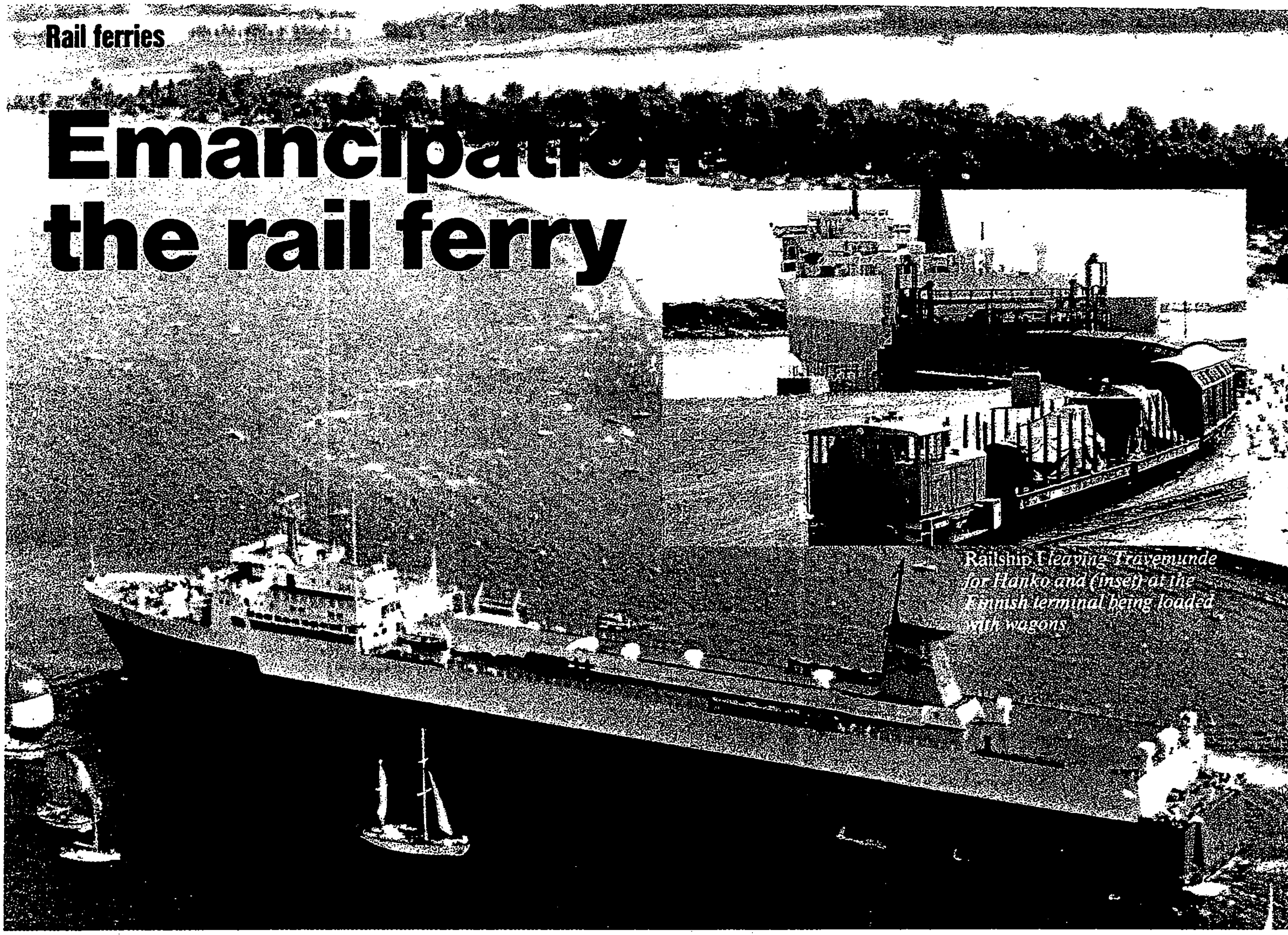
In 1977, he joined Leif Hoegh, Oslo, as operations manager of Hoegh Lines.

Two years later, in 1979, Mr. Larsson was appointed director of Consafe (Offshore), a subsidiary of Consafe AB, Gothenburg, becoming in 1983, managing director of the parent company. During the period which Mr. Larsson has been associated with Consafe, the group's turnover has increased 15 fold, with the figure for 1984 reaching SEK 1.4 billion.

In announcing this important appointment, MacGregor-Navire's chairman, Mr. Johan Horelli, commented that he was extremely pleased that Mr. Larsson would be joining the group, bringing as he does, his tremendous experience in the shipping and offshore industries. It would also add further strength to MacGregor-Navire's existing management team.

While Johan Horelli relinquishes his appointment as chief executive of MacGregor-Navire on June 15th, he will continue as chairman.

Emancipation of the rail ferry



Railship I leaving Travemunde for Hanko and (inset) at the Finnish terminal being loaded with wagons

The present renewed international interest in the train ferry started in 1975 when 'Railship I' inaugurated the new Travemunde, West Germany to Hanko, Finland service that set records both for distance between the terminals of the two networks linked – 535 miles – and for capacity – at 60 x 20m wagons, by far the largest train ferry up to that time.

The boldness of the concept astounded experienced observers and caused much scepticism for, traditionally, the train ferry – well over a century old – had been of limited capacity and employed only on routes where the networks to be linked were in fairly close proximity. In the context of the total rail transport chain the ferry had, hitherto, been seen as playing a subsidiary role.

That type of thinking changed with the advent of *Railship I*. Now, with a ship large enough to realise the economy of scale and with an efficient on-board system distributing and stowing wagons on three decks, route distances could be envisaged that, by-passing frontier delays and avoiding difficult overland geographical features, could become the principal link and be quicker and even cheaper than all-rail routes.

In the 10 years of her life *Railship I* has confounded the sceptics and justified the faith of her backers who, at the time, were investing in a type of rail ferry operation hitherto unproven. Subsequent events have proved the route's commercial viability such that 'stretching' to increase the vessel's capacity was insufficient to cope with the volume of traffic generated – a problem eventually dealt with by commissioning into the service a second ferry – see report on *Railship II* elsewhere in this issue.

But, if the pioneer *Railship I* transformed the economics of rail ferry operation she also vindicated the designs of the ship and of her wagon handling equipment – opening up new vistas for operators and inspiring moves in other countries which aimed to emulate her success.

At the present time just over 100 train ferries are in operation worldwide – about 70 of which service routes in Europe and Scandinavia with the remainder operating in Canada, USA, Japan, Australasia and the Russian Far East.

The great majority of ferries carry their wagon cargo on a single deck having between 250m and 500m of track – sufficient to accommodate around 15-25 wagons. This compares with *Railship I*, first of the new breed, which, utilising the latest advances made in ship design and in the art of access and on-board transfer, loads wagons on three decks having track length and capacity raised by around a factor of three in each case, i.e to 1,710m and 75 wagons.

Since the first of the two *Railships* was commissioned, six three-deck ferries (including *Railship II*) have been built and others are building or projected. Those built include four on the Black Sea, Varna (Bulgaria) to Iliychevsk (USSR) route and one in the Mediterranean operating between Civitavecchia on the Italian mainland and Golfo Aranci on the island of Sardinia. Undoubtedly, in the case of these triple-decked ferries with their capacious appetite, the key to successful operation is their efficient method of interdeck transfer plus a switching system which enables the wagons to be stowed on the four or five adjacent tracks per deck.

It is this great increase in capacity with its marked effect on the operating economy that has been mainly responsible for the rail ferry's dramatic comeback – and as designer/supplier of the equipment that has made it possible, Navire has been deeply involved right from the start. For, all seven of the vessels mentioned above as discussed and pictured in the articles which follow – are equipped with access and transfer equipment bearing the Navire (now MacGregor-Navire) logo.

Navire's involvement also includes the landward side of the rail ferry interface – namely, the link span, which compensates for tidal heights. The installations at both ends of the Black Sea service and that at one terminal on the Baltic Railship service, are of Navire design.

With the advances made over the last decade the train ferry can truly be said to have attained emancipation. Now, ferry operators can seriously examine the possibility of connections of several hundred miles or more, employing ships of 180 wagon capacity. No longer need it be regarded as subsidiary, connecting two rail systems by the shortest possible sea crossing – but as a major element in the rail transport chain.

[redacted]

Classic rail ferry for Baltic Sea

One of the largest and most technically advanced train ferries yet built was delivered to its Lubeck (W.Germany)-based owner Railship GmbH, on November 22nd last year. Constructed at the Seebeck Werft yard in Bremerhaven, the 9,700dwt 'Railship II', a vessel equipped by MacGregor-Navire for rapid loading, entered service on one of the world's longest train ferry routes, namely the trans-Baltic Travemunde, W. Germany to Hanko, Finland crossing – a run of 870 km (535 miles). She joins an existing smaller ship on the service, 'Railship I', a ferry of slightly earlier vintage.

Railship I broke new ground technically and, as a result commercially, when in 1975 she inaugurated the 30 hour Travemunde-Hanko crossing. Rapid strides in ship design and in the on-board handling and transfer equipment designed and supplied by Navire, enabled the building of a ship that at 60 wagons capacity – later increased by lengthening to 75 – was larger than any built hitherto and so advantage could be taken of the economy of scale. Thus, the vessel proved the viability of and revived interest in, a transport mode regarded in the mid '70s as in decline.

Now *Railship II,* larger at a capacity of 85 wagons and with even more advanced MacGregor-Navire (MGN)-designed access and transfer equipment, is confidently expected to build on and consolidate her predecessor's achievement, satisfying a demand for the much needed additional capacity that has been generated and is now needed on the route.

Railship II's large capacity derives mainly from her ability to load wagons on three decks and the key to this ability is the double-deck lift, the upper and lower platforms of which are joined by a lattice work construction. This lift forms the centrepiece of the vessel's loading and distribution system and is the principal item in an extensive shipset of cargo access equipment supplied by MGN which enables a highly efficient movement of wagons on to and off the ship. A capacity load can be embarked/disembarked in normally six hours though turnround in five hours is possible.

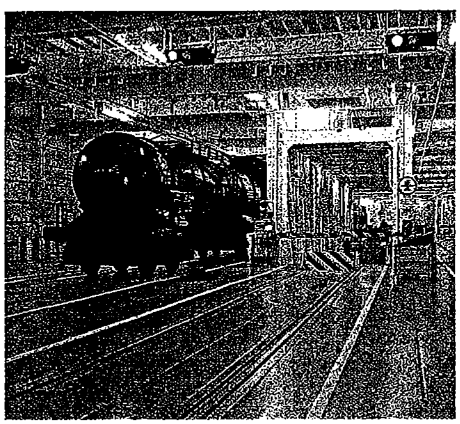
The fully tally of MGN-designed equipment on *Railship II* is as follows:

(a) one – watertight stern door
(b) one set – stern mooring equipment
(c) one – two-deck wagon elevator
(d) two – slewing rail sector switches
(e) two – car davits
(f) two – shell doors
(g) four sets – electro-hydraulic power units

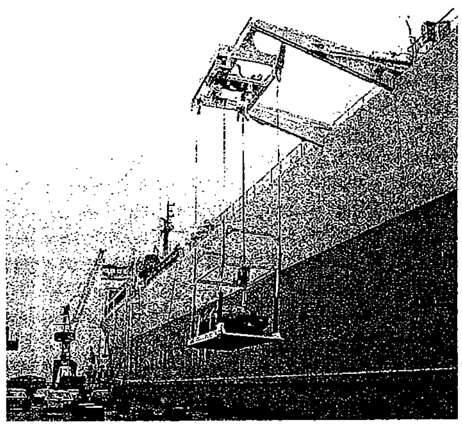
Additionally, MGN has designed and made provision for the installation at a later date of an extra stern ramp that would be used to permit car access. Of fundamental importance to *Railship II's* on-board wagon distribution system is the use of dual-mode (i.e road/rail) diesel powered shunting vehicles, widely known as 'Uniloks', one or more being permanently stationed on each cargo loading deck.

The MGN-supplied equipment is involved in the loading sequence in the following manner:

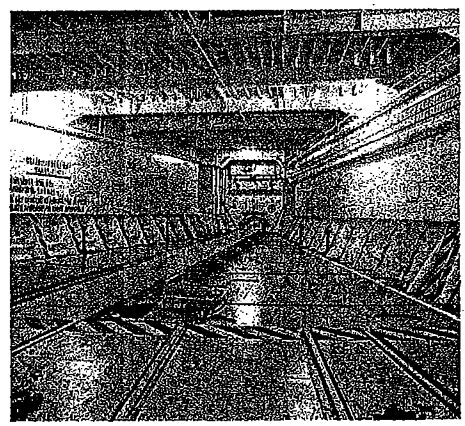
● Following height adjustment of the link span (at Hanko or Travemunde) the upward pivoting stern door is raised to permit wagon access. Actuation is by two direct acting hydraulic cylinders unsealing an opening 12.6m wide x 5.15m high. The door is battened and locked hydraulically, the locking ▷



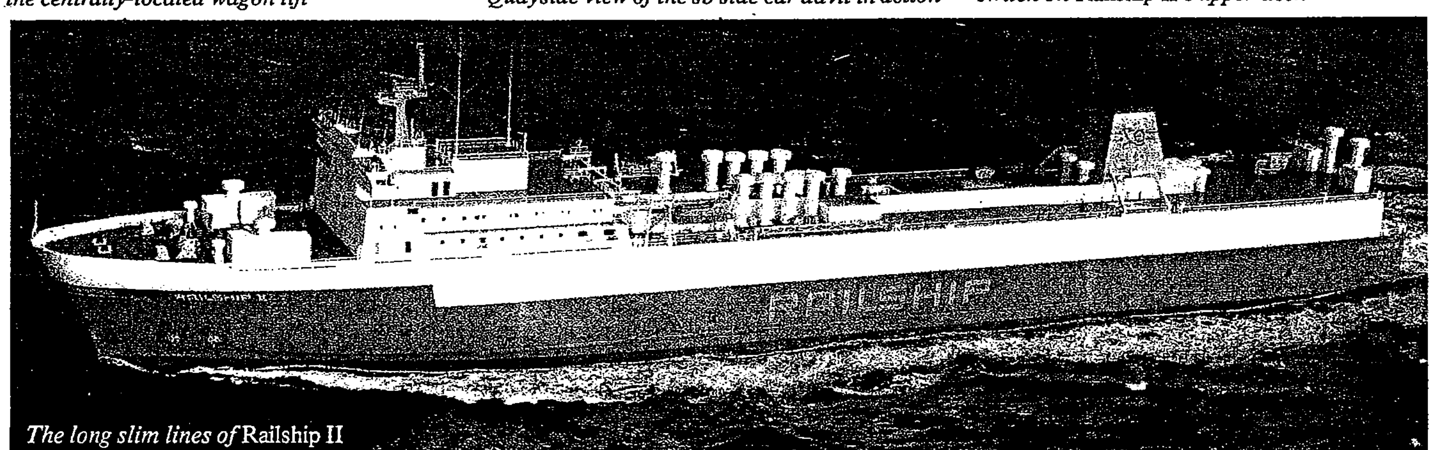
View on the main deck of Railship II *showing the centrally-located wagon lift*



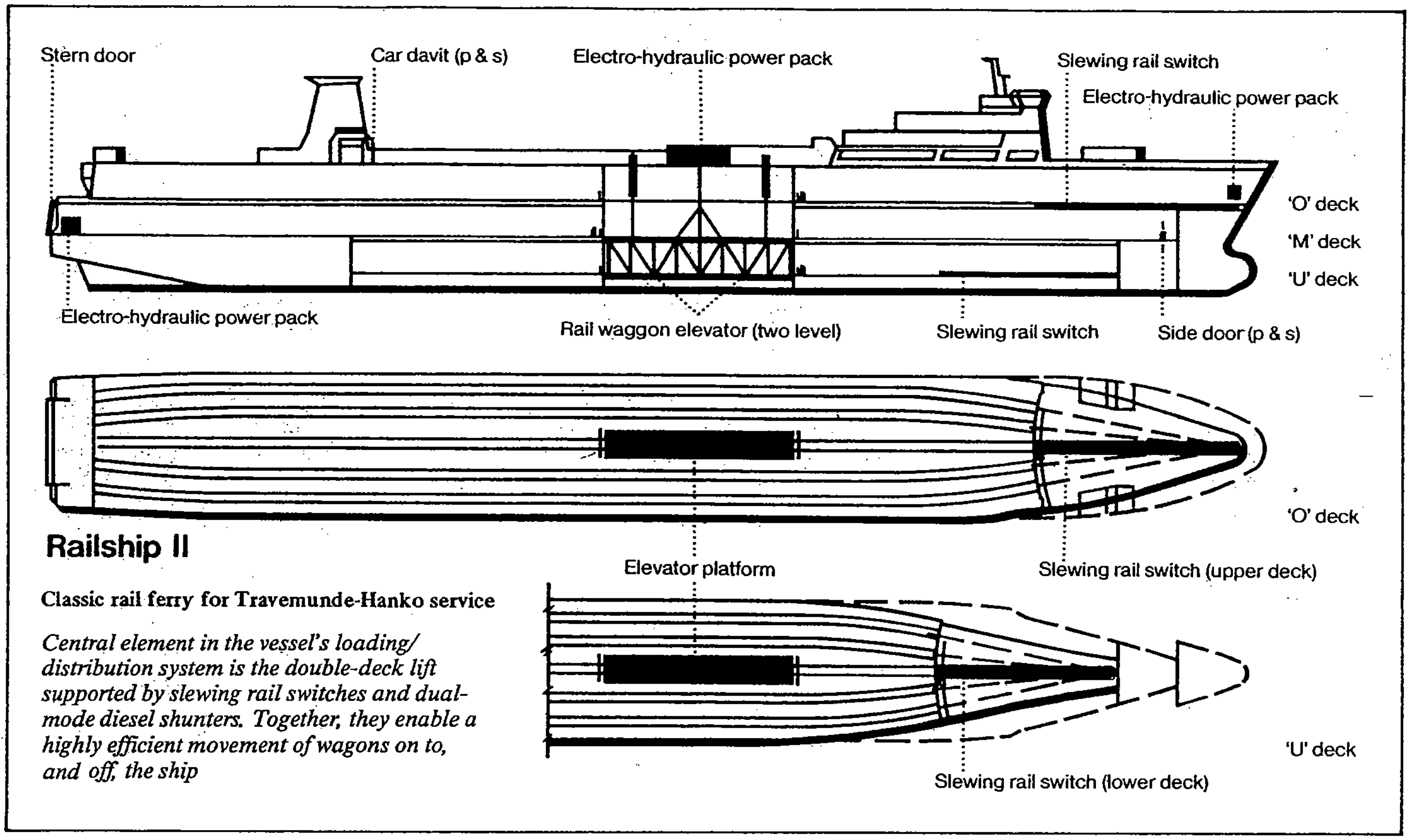
Quayside view of the sb side car davit in action



View from the central track of the sector rail switch on Railship II's *upper deck*



The long slim lines of Railship II



Railship II

Classic rail ferry for Travemunde-Hanko service

Central element in the vessel's loading/ distribution system is the double-deck lift supported by slewing rail switches and dual-mode diesel shunters. Together, they enable a highly efficient movement of wagons on to, and off, the ship

"Railship II .... is confidently expected to build on and consolidate her predecessor's (Railship I) achievement"

▷cylinders also functioning as ice breakout rams. Total weight is 20 tonnes.

● When mooring for loading/ unloading, the rails on ship and link span are aligned by means of aft-located, hydraulically actuated stern mooring equipment. Incorporating cylinders mounted one at each side, which each exert a 15 tonne force, they are controlled by sensitive valves which act to keep the stern tight against the fenders.

● A wagon entering the vessel on the main deck can be switched onto any one of five tracks. However, if it is to be stowed on the upper (or lower) deck, it is shunted along the centre track which leads on to the top platform of the midships-located elevator. Once on, uncoupling is remotely controlled by the driver of the Unilok.

After the lift has ascended to the upper deck for wagon No. 1 to be collected and positioned, a second wagon is moved on to the lift's lower platform – now level with the main deck; the lift now descends for wagon No. 2 to be collected and positioned on the lower deck (tank top); meanwhile a third wagon is shunted on to the lift's top platform – which now again ascends to the upper deck for wagon removal and positioning. This process – in which the lift never moves in the empty state – is continuously repeated until loading is completed.

Both platforms of the lift measure 28.2m long x approximately 3.35m wide with the free height, i.e. between platforms and decks, being 5.0m. Operated by four direct acting hydraulic cylinders the lift is designed to lift 92 tonnes (i.e 88 + 4 tonnes = wagon(s) + shunters). The cycle time, hoisting or lowering fully loaded (i.e lift barrier closed to lift barrier opened) is 60 secs.

● Sector rail switches – one each on the upper and lower deck – are used to distribute wagons from the central track on each deck on to the adjacent tracks at each side; there are five tracks per deck.

The switch – actually a length of rail, which, pivoted at the bow end can be regarded as the segment of a turntable – is respectively 31m and 27m long on the upper and lower decks. It is hydraulically actuated, moving through an arc on wheels set in a deck recess. The switch is equipped with hydraulic locking and braking and controlled from either the operation console of the lift or by radio from the diesel shunting vehicle.

Each sector switch is designed to sustain the following: axle loading 22 tonnes; stationary load 100 tonnes; carrying load 92 tonnes, i.e. 88 + 4 tonnes which includes shunting vehicle. Operating time, i.e. from central position to either of the outer tracks, is approximately 30 secs.

● Provision is made on *Railship II* for carriage on the aft part of the elongated fo'castle deck of about 80 standard length automobiles. These are embarked LoLo fashion and for this purpose MGN has supplied two specially designed car davits. Mounted aft, one port, one starboard, each davit consists of a luffing frame supporting, via cable from a hydraulic winch, a car cradle. The car platform measures 5.0m x 2.0m x 2.5m free height, the capacity is two tonnes and luffing is effected by direct acting hydraulic cylinders. The lifting/luffing cycle is an automatic one, performed in 60 secs. quay to deck, under the control of a hand operated valve.

● Two shell doors situated right forward (one p, one sb) are brought into use during berthing/mooring. With frames 1.6m high x 1.2m wide they each close watertight an opening 0.95m high x 0.75m. Operated by direct acting cylinders, the doors are locked hydraulically – with the lockings also being utilised in an ice breakout function.

● The final items of MGN supply are the units for delivering the considerable amount of hydraulic power needed to operate the access equipment described above. Four separate electro-hydraulic power packs are installed on *Railship II*, one each to serve the following equipment: **(a)** the elevator, **(b)** the track brakes, **(c)** the stern door and mooring equipment and **(d)** the sector switches on upper/lower decks. The units supplied are designed with fail-safe and standby pump provision and all are complete with the necessary indicators and controls.

Railships I and II are operated by the consortium Railship GmbH, the partners in which are H.M. Gehrkens of Hamburg, Schenkers the Swiss-German forwarding agents and the Finnish and German Railways.

PRINCIPAL PARTICULARS
'Railship II'

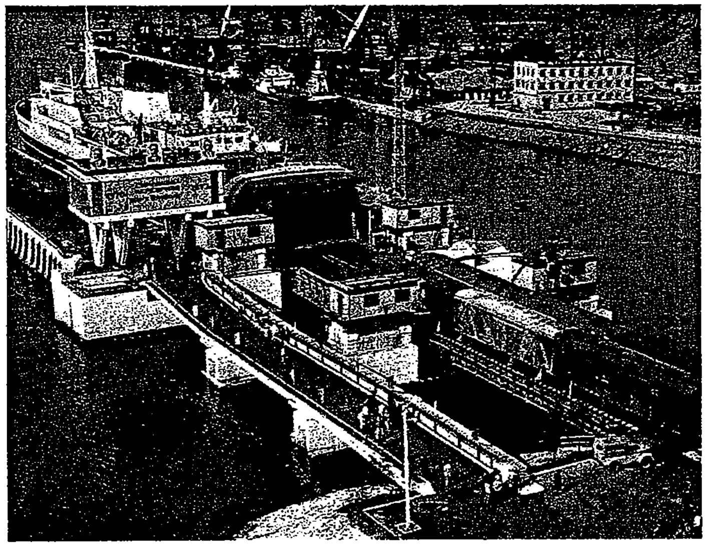
Length (o.a.)	186.50m
Length (b.p.)	174.40m
Breadth	21.60m
Depth	18.95m
Draught	6.50m
Deadweight	9,700 tonnes
Track length	1,885m
Capacity, wagons 20m	85
Propulsion	2 x MaK, each 8,000kW
Speed	18.5 knots
Accommodation	36 crew, 12 passengers

USSR involvement in train ferries

In the last 20 years great advances in marine transport have been made by the USSR – and not least in the planning and institution of new train ferries, of which as a nation, the USSR is one of the principal exponents. In the case of both domestic internal connections and also jointly with nations around her coasts, the USSR has initiated a number of rail ferry projects.

An article on the Baku-Krasnovodsk internal route in the Caspian Sea is included on p8 of this issue; another Russian domestic train ferry service is in the Soviet Far East where comparatively small ferries of the 2,300dwt 'Sakhalin' type ply the 160m route between the ports of Vanino on the mainland and Kholmsk on Sakhalon, the large island just north of Japan.

In the international sphere a new Baltic route due to be inaugurated in 1986 – of which the USSR is the instigator – is that between Klaipeda in Lithuania and the new port of Mukran in the German Democratic Republic, a run of about 320 nautical miles that will by-pass the Polish overland route. For this project, six ferries, each of 11,700dwt and 100 wagon capacity are presently under construction at Mathias Thesen Werft in the GDR.



Sakhalin I *unloading at the port of Vanino, Soviet Far East*

The Iliychevsk-Varna service

One of the world's most economically successful international freight train ferry services is the one opened in November 1978 that was almost certainly inspired and encouraged by the success of the Travemunde-Hanko Railship service inaugurated in 1975. This is the one operated jointly by the Soviet Union and Bulgaria which runs between Iliychevsk and Varna – ports situate on the western coast of the Black Sea. The route by-passes Roumanian territory.

Three years in the planning, the service is operated by four large ferries (owned two each by the participating countries) that in external appearance bear a striking resemblance to *Railship I* and indeed, except for the greater breadth of the Black Sea vessels – which no doubt is due to the broader Russian rail gauge – are very similar in overall dimensions.

Carrying the similarity further, these four vessels, like *Railship I*, use a system of wagon access and transfer that depends on Navire-designed equipment for its success – the central element being the double-deck lift for distributing wagons between the three cargo decks, plus sector rail switches.

The economics associated with this route are interesting. According to the English language magazine 'Soviet Shipping' the principal justification for the establishment of the service was the fact that existing railway and shipping services could no longer cope with the growing cargo flow between the two countries.

Total savings made by the rail ferry service in terms of both time and cost, says the magazine, have been impressive. Transportation time compared with the alternatives has been cut by a factor of three to four, due not only to the unhindered mode of carriage but to the very considerable savings made by the elimination of cargo transhipment as is involved with traditional sea shipping. Greater cargo safety is also a plus factor and in terms of straight cost savings, those made in perishables alone amount annually to millions of roubles.

The vessels operating on the route – known as the 'Geroite Na Odessa' class – were completed in 1978/9 by yards in Yugoslavia and Norway – the two for Russian account at Uljanik and those for Bulgaria at Fredriksstad MV and Framnaes MV. Each of 12,900dwt, they have capacity for 108 standard wagons – the word "standard" here meaning 14.73m long x 70 tonne railcars as used on USSR tracks – though heavier stock, 20.24m x 125 tonne, can also be loaded on to the 1,650m of rail contained by each of the three-decker vessels.

The voyage time on the approximately 560 mile round trip (280 nautical miles each way) is 60 hours including a turnround time at either Varna or Iliychevsk, of 11 hours.

In 1983, on the fifth anniversary of the commencement of the venture, the four ferries had between them made in excess of 3,000 trips between the two countries transporting over 250,000 wagons in both directions. The volume of traffic, which has grown each year, had at that time reached a rate of 3¼ million tonnes annually – equivalent to 10 percent of the two-way total freight passing each year between the two countries.

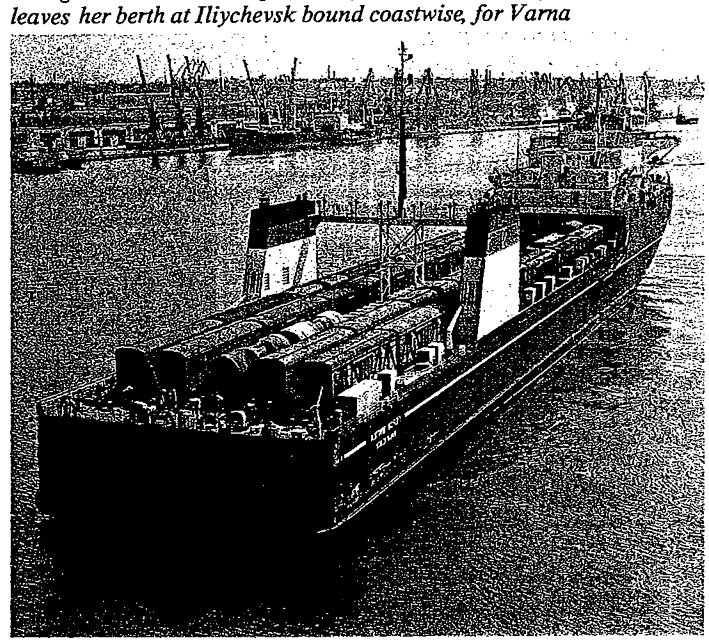
Rounding off an impressive set of statistics 'Soviet Shipping' calculates that to carry this volume of cargo in ships' holds would require dozens of conventional vessels, 12 quays and about 4,000 sea-going and shore-based personnel – the latter figure to be compared with the 300 people currently employed on the rail freight ferry route.

Interdeck transfer/ rail switching

As stated earlier the four vessels on the service were built in Yugoslavia and Norway with the designs being near identical. They carry 49 wagons on the tank top, 16 on the main deck and 43 on the upper deck. The number of tracks per deck is three on the tank top and five each on the other two decks.

Interestingly, although the carriage of rail wagons is their primary function, because all rails are sunken flush with deck surface, the ships can also very easily load road vehicles i.e 193 roll trailers or ▷

A wagon-laden Geroi Shipki, *one of four ferries serving the route, leaves her berth at Iliychevsk bound coastwise, for Varna*



"Interestingly . . . the ship can also load road vehicles"

▷101 refrigerated trailers or motor cars.

The set of equipment on each vessel comprises the following:

- One watertight stern door 18.0m long x 5.50m high operated by hydraulic cylinders.

- One watertight cover closing the lift aperture in the upper deck. Size 31.75m long x 4.33m wide and operated by hydraulic cylinders.

- One double-platformed elevator, each platform 31.60m long x 4.15m wide with 6.6m of free height. Powered by four direct acting hydraulic cylinders (with another two in reserve) the lift is rated for a dynamic deadweight of 170 tonnes and a static load of 340 tonnes.

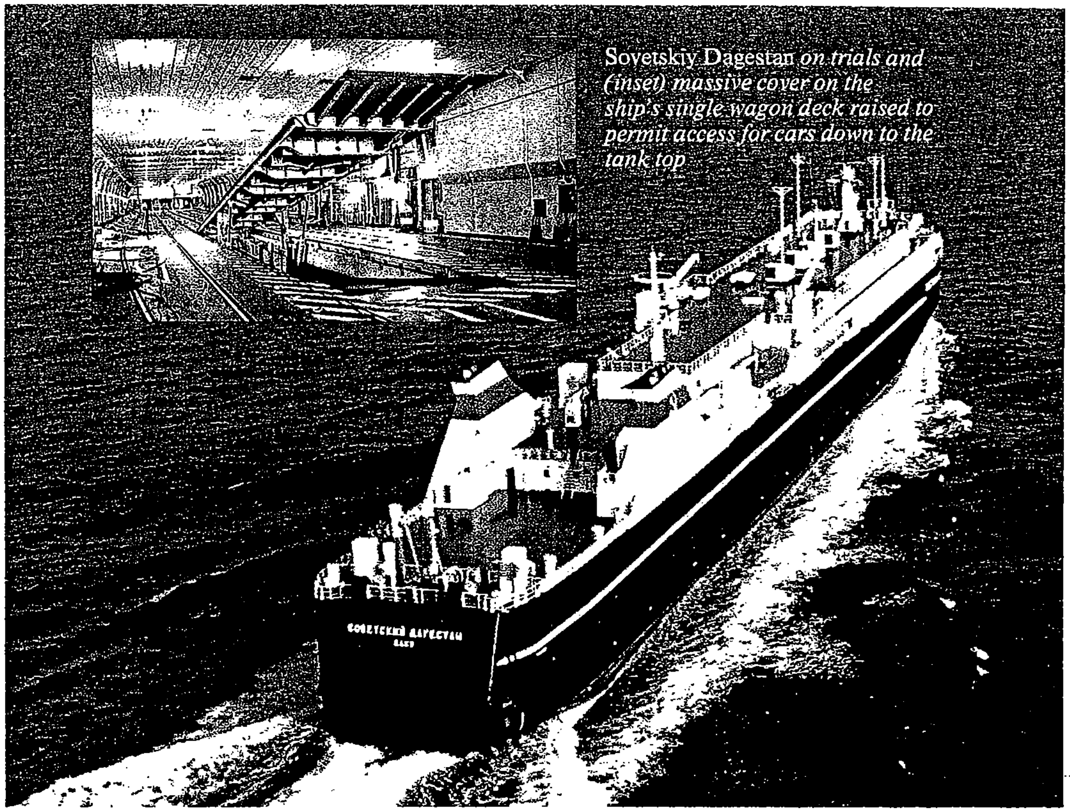
- Two sector rail switches, one on the upper and one on the lower deck, each located and pivoted right forward in the bow of the vessel. That on the upper deck is 34.00m long and, powered by hydraulic motors, has a dynamic deadweight capacity of 175 tonnes and a static loading of 340 tonnes. The switch on tank top is 20m long with capacities of 90 tonnes and 175 tonnes.

As in the case of *Railship I* built three years earlier, the wagon lift is the central element in the vessel's distribution system, its twin platforms and always-loaded movement enabling the quick charging/discharging of the ferry that is so important for economic viability. The lift is located amidships and on the ship centreline.

The vessels built at Uljanik for Russian account are named *Geroi Shipki* and *Geroi Plevny* while the two Norwegian-built ferries for the Bulgarian partner in the enterprise are named *Geroite Na Odessa* and *Geroite Na Sevastopol.*

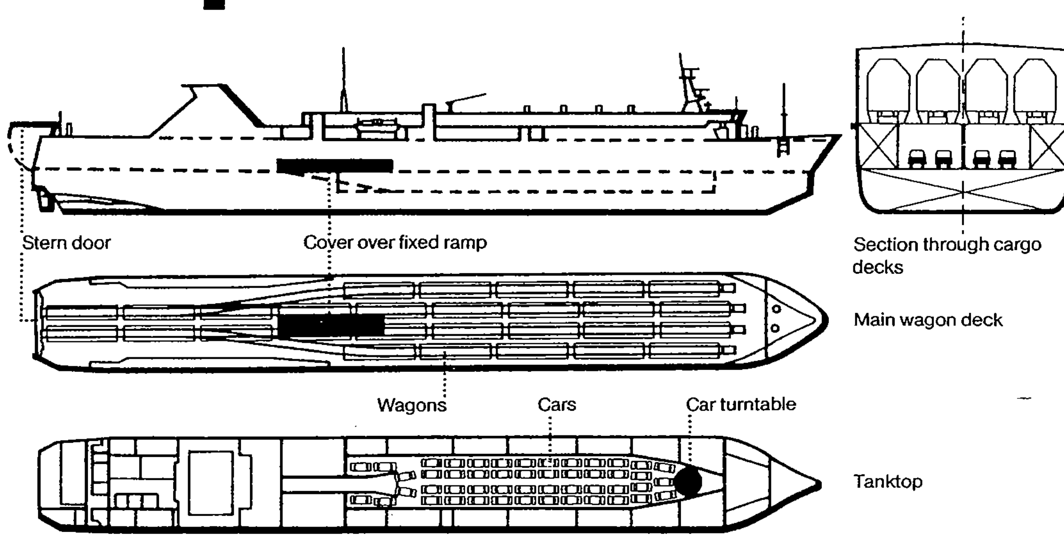
PRINCIPAL PARTICULARS
Iliychevsk-Varna rail ferries

Length (o.a.)	184.25m
Length (b.p.)	170.00m
Breadth (max)	26.76m
Depth main deck	9.00m
upper deck	15.20m
Draught (max)	7.40m
Deadweight	12,900 tonnes
Track length	1,650m
Capacity, wagons 14.7m	108
Propulsion	2 x Uljanik/B&W, each 6470kW



Sovetskiy Dagestan *on trials and (inset) massive cover on the ship's single wagon deck raised to permit access for cars down to the tank top*

Eight rail/car ferries for Soviet Caspian Sea service



The Russian provinces of Azerbaydzhan and Turkmenskaya located on opposite coasts of the Caspian Sea, have for many years been linked by a rail ferry service. Running between the principal ports of Baku and Krasnovodsk on the Caspian's western and eastern coasts respectively – a distance of 175 miles (290km) – the route cuts many hundreds of miles from the shortest rail overland trip and, in the process, avoids crossing the Iranian border.

The Soviet State Railways have embarked on a modernisation programme that, by the end of 1986, will see a series of eight new sister ferries of 2,970dwt and 28 wagon capacity, commissioned into the service. All are stemmed for building at the Yugoslav Uljanik Shipyard and the first two of the series, *Sovetskiy Dagestan* and *Sovetskiy Tadzikistan,* were delivered in the two closing months of 1984. Each of the eight vessels is to be fitted with an identical set of MGN-designed access equipment.

Being completely land-locked (and as much as 28m below sea level) the Caspian is fed by rivers and canals. One route into its waters and the one to be taken by these Yugoslav-built vessels in transit to their operating area – is via Leningrad, a fact which, having regard to navigation problems caused by manoeuvring along rivers and through canal locks, placed certain limitations in the dimensions. Another factor occasioning headaches for the Uljanik planning engineers was the requirement that the train deck be without transverse bulkheads – a stipulation for which damage stability requirements were met by specially designed double bottom tanks situate beneath the tank deck.

There is a limitation on draught in the Caspian of 4.25m – which means that train ferries navigating her waters could not be of the three-wagon deck type described elsewhere in this feature. Thus *Sovetskiy Dagestan* and her sisters are designed to carry rail wagons on one deck only with the much lighter car cargo being consigned, via a fixed ramp, down to stowage on her lower deck. There is parking space for 50 cars and accommodation on the 14 hour crossing for 202 car drivers/passengers.

MacGregor-Navire's contribution to the vessel is associated with both wagon and car decks. It comprises **(a)** the massive watertight stern door giving access onto the wagon deck **(b)** a watertight ramp cover closing off the aperture over the fixed car ramp leading to the lower deck and **(c)** the rotating car platform (turntable) located at the bow end of the lower deck.

The stern door, hinged at the top and opening upwards, is a one-piece structure, closing an opening 11.53m wide x 7.0m high. It is actuated by hydraulic cylinders and is also battened and locked hydraulically.

The cover, 19.7m long x 3.4m wide, is orientated fore to aft and closes an aperture located on the ship's centre line. It is raised and lowered by hydraulic cylinders and is designed to sustain the weight of loaded wagons. Rails are built into its top plate.

The rotating car turntable is essential in view of the restricted width available for automobiles to turn/park at the forward end of the ship's car deck. Located at this point on the vessel, the turntable, which is 5.0m diameter, is turned by hydraulic power.

The next three ships in the series will be delivered at intervals during 1985 and the remaining three in 1986.

PRINCIPAL PARTICULARS
'Sovetskiy Dagestan' and seven sisters

Length (o.a.)	154.47m
Length (b.p.)	147.00m
Breadth (max)	18.30m
Depth (upper deck)	13.30m
Draught	4.25m
Deadweight	2,970 tonnes
Propulsion	Uljanik-B&W 2 x 4,350 kW
Speed	17.15 knots
Capacities	Wagons – 28 Cars – 50 Passengers – 202

Tight operating schedule for 'Garibaldi'

A rail ferry of the generation brought forth by 'Railship I' (see p4 of this issue) went into service with Italian State Railways early in 1983 on the 120 mile shuttle route between Civitavecchia on the Italian mainland and Golfo Aranci, Sardinia. The vessel is named 'Garibaldi' after the Italian patriot.

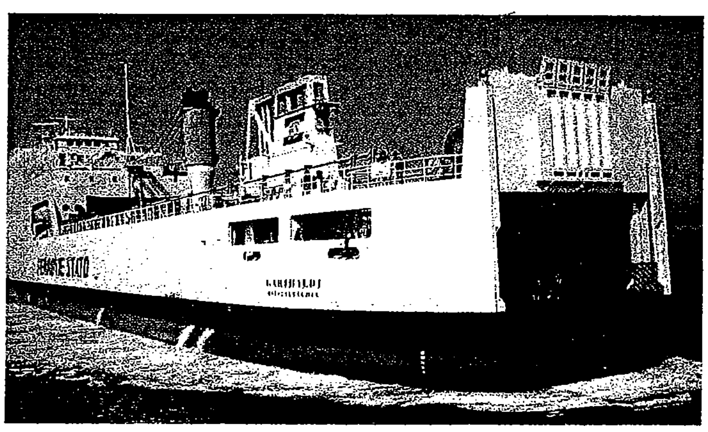
Though *Garibaldi* is slightly smaller than the vessel now regarded as the forerunner of modern railstock transportation and considerably smaller than the recently delivered *Railship II* – being only roughly half the latter's deadweight, track length and wagon capacity – she can fairly be compared with those forebears since, like them, her cargo handling system, serving a freight only vessel having three wagon decks, employs a mode of access and internal transfer that uses a Navire-designed shipset of equipment, including two double-platform wagon lifts.

Built by the Palermo yard of Cantieri Navali Riuniti, the 4,311dwt *Garibaldi* can accommodate 80 wagons of 10.58m length on her three decks which between them incorporate 940m of track; this is distributed on four adjacent tracks on the lower deck, four on the main and two on the upper deck.

The design of this sophisticated and technically advanced vessel emerged from studies which had to take account of stringent constraints and a tight operating schedule; the service is a daily one, the crossing being of seven hours' duration each way which, in a 24 hour schedule, leaves only 10 hours to perform two complete loading/unloading cycles i.e five hours each.

Under such operating conditions the Navire access and handling equipment would be subject to very intensive use. But, with at least seven years of experience emanating from reports of the equipment fitted to *Railship I* and also that on the Navire-equipped Black Sea ferries, it was possible to draw on the accumulated experience and former designs and incorporate it into the equipment to be supplied for *Garibaldi*. With appropriate modifications, that stored up knowledge was in fact, used to good effect.

Below: View from the main deck of one of Garibaldi's *two wagon lifts; the just-ascended wagon is about to leave for stowage while another wagon moves to the lower platform for descent to the tank top*
Bottom: Garibaldi *moving astern to be aligned for loading. Note the guillotine door with the unusual incorporated ramp*



The complete package of access and transfer equipment on *Garibaldi* comprises:

1) A guillotine type watertight stern door 9m wide x 6m high. Incorporated in the door as a separate panel is a watertight ramp which, hinged at the base of the door, lets down to permit access for road vehicles with axle loads not exceeding 13 tonnes. Both door and ramp are hydraulically actuated.

2) Wagons crossing the main deck threshold which are for stowage on the upper or lower decks, are shunted along either one of the two inboard tracks onto one of the 80 tonne capacity dual-platform lifts. These are located side by side with their forward ends near to amidships. The platforms on either lift are 22m long x 45m wide, each long enough to accept two 40 tonne wagons. Operation of each elevator is by four hydraulic cylinders which operate at two speeds, such that the time taken to move one deck height is 30 secs on fast and 45 secs on slow speed. Cycle time is optimised because loading follows an alternate upper-deck/tank top cycle ensuring the lift is always loaded. Interlocked safety devices such as rail brakes, wheel stoppers and personnel control booms are fitted as well as automatic lift level controls.

3) Two-watertight covers on the weatherdeck, one each closing the lift apertures. They are hydraulically operated, electrically controlled and operationally interlocked. The covers, 22.3m long x 4.8m wide, are flush mounted and embody rails for transiting wagons of 20 tonnes load per axle.

4) Two traversers. These transversely moveable platforms situated on the lower deck and located one ▷

"Garibaldi can accommodate 80 wagons on three decks"

each in way of the lift well, function as a rail switch, moving wagons from the inner to the outer tracks. Each 11m long x 4.5m wide traverser is driven across the ship by a hydraulically actuated rack and pinion motor, travelling 4 metres in 16 seconds. When a traverser is stowed and cleated for voyage in the outboard position, a pivoted cover incorporating rails takes its place on the inner track.

5) A watertight bulkhead located forward of the traversers is equipped with two sliding doors which line up with the inboard tracks. The clear opening of each is 5m x 4m. When open, flaps and track connectors enable wagons to gain access into the two-track forward compartment.

6) 10-Mini-Locomotives (or 'Mules'). Developed by Navire for marshalling/shunting the wagon cargo onto and off the lifts and onto their designated tracks, these permanent items of ship equipment are distributed four each on the lower and main decks and two on the upper deck – one for each track to which it is permanently attached. Moved by pinions electro-hydraulically driven which engage with a rack running between the rails, these locos are remotely controlled and powered by cable through self-winding drums. Each 4 tonne unit is 3.2m long x 2.0m wide and has a power rating of 45kW, a maximum push/pull of six tonnes and a maximum speed of five km/hour.

7) The hydraulic power demand for operation of this extensive shipset of equipment is very considerable and to perform the task a single power pack rated at 800kW and capable of driving all the equipment simultaneously, was supplied.

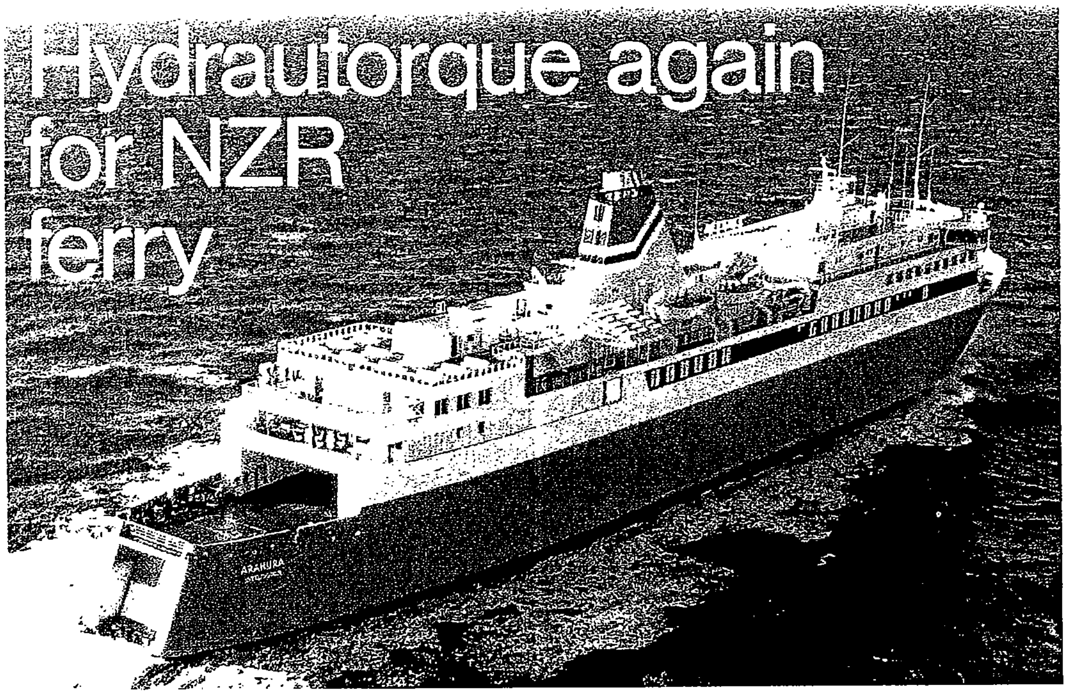
Garibaldi can also load up to 24TEU containers on her weatherdeck – for which purpose she is equipped with a 25 tonne crane mounted aft on the ship centreline.

Loading/unloading of the wagons in the correct sequence is critical and to control and monitor these operations a sequence computer having pre-programmed cassettes is used and the whole operation is observed on several TV screens centrally located.

PRINCIPAL PARTICULARS
'Garibaldi'

Length (o.a.)	146.00m
Length (b.p.)	137.80m
Breadth	18.80m
Depth (main deck)	7.20m
Draught (max)	5.70m
Deadweight	4,311 tonnes
Track length	940m
Capacity, wagons 10.58m	80
Propulsion	2 x GMT, each 7,500 bhp (max)
Speed	20.30 knots

Hydrautorque again for NZR ferry



When early last year, New Zealand Railways accepted into service from the Danish builder, Aalborg Vaerft, its new flagship – the 60 wagon capacity rail/vehicle ferry 'Arahura', the vessel joined an existing fleet of train ferries that maintains a service across one of the most turbulent stretches of water met with on any regular ferry route in the world.

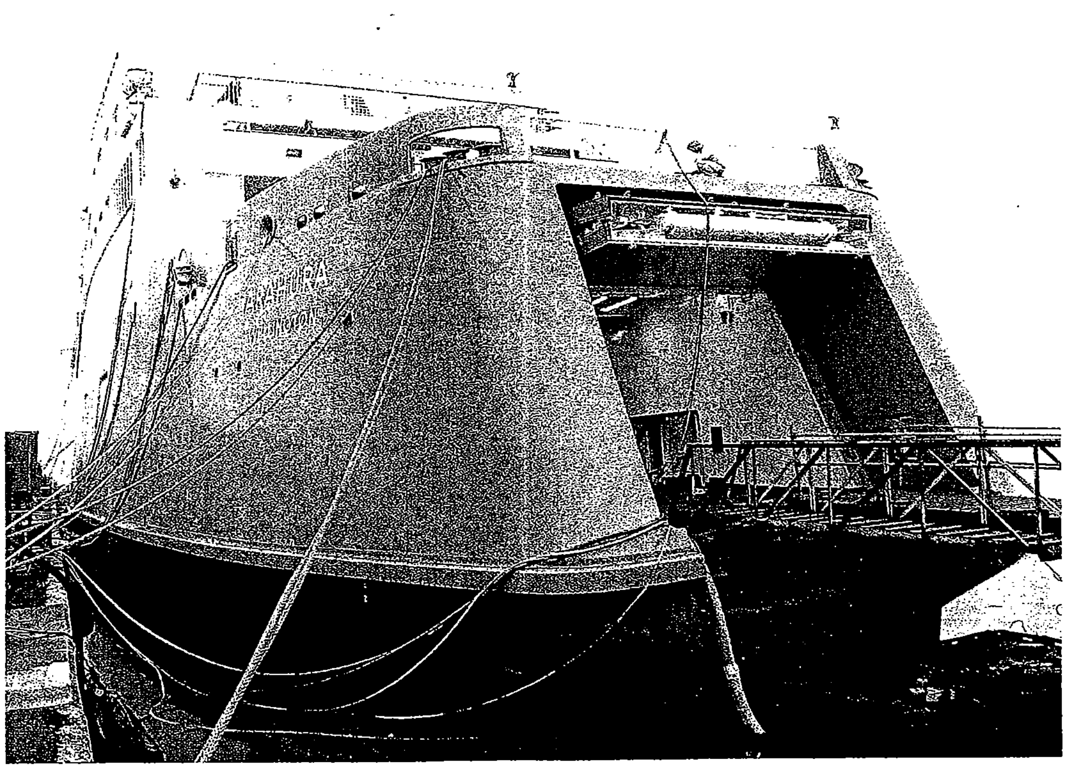
Winds in the Cook Strait – which divides New Zealand's two main islands – of Beaufort 4 but frequently above force 7, are the norm which, together with strong tides and powerful swells from the Pacific, make the maintenance of regular timetables on the 3½ hour, 54 mile Wellington to Picton run, a regularly performed achievement.

Under such conditions the soundness of a ship will be put to the test – with special attention having to be paid to such items as the strength of cargo lashings and the seakeeping qualities of doors. It is as supplier of the latter item that MacGregor-Navire (MGN) is involved with *Arahura*.

That involvement is not large compared with the quantity of cargo access equipment per ship more usually supplied by MGN – but from the viewpoint of safety it is vital. A total of three doors on *Arahura* carry the MGN logo, namely, the principal one at the stern giving wagon access to the train deck plus a door for people both port and starboard, on the passenger deck.

The stern door is of particular interest in that it is a repeat of the special jack-knife type door fitted to all four existing train ferries on the Cook Strait service. Nevertheless, the method of actuation is relatively unusual in this particular application for the door is opened and closed watertight by the patented MGN powered hinge known as the 'Hydrautorque' 180 – a combined rotary actuator and hinge.

The door consists of two panels – one being hinged to the hull at its top edge – which fold to open upwards due to the action of the powered hinge, and to stow underneath the deck above.



carrying domestic New Zealand traffic, both rail and road. Her design was massively influenced by the turbulent seas in the Cook Strait

The door closes a clear opening in the stern 4.27m high x 5.48m wide. Of open web construction it is sealed by rubber packings/compression bar in the hull coaming, is hydraulically cleated and automatically locked in the open position. Operating time from closed to open is about 60 secs. The door weighs approximately 9.2 tonnes.

Each of the MGN passenger doors is of the 'strong arm' design, the arm being hinged to door frame and hull. It seals a clear opening, size 2.0m high x 2.0m wide and is operated hydraulically.

Arahua has replaced the first train ferry on the busy Wellington-Picton service, namely the pioneering *Aranoana* of 1962 vintage. The ships remaining are *Aranui* (1966), *Arahanga* (1973) and *Aratika* (1974). The consulting naval architects for all the vessels has been the well known U.K firm, Burness Corlett.

Why was Hydrautorque actuation again chosen for *Arahura's* stern door? According to the consultant it was "because the system has been so very satisfactory in operation on all her predecessors. Why change a system that has proved so totally reliable?"

PRINCIPAL PARTICULARS
'Arahura'

Length (o.a.)	148.30m
Length (b.p.)	137.00m
Breadth	20.25m
Draught	5.47m
Deadweight	2,500 tonnes
Gross	7,583 tonnes
Depth (bulkhead deck)	6.9m
Propulsion	Wartsila Vasa 4 x 5,560 bhp)
Speed (service)	19 knots
Capacities	Passengers 1,085
	Rail deck 60 wagons
	Vehicle deck 276 lorries/100 cars

Left: The jack-knife actuation of Arahura's *stern door is effected by a Hydrautorque actuator, plainly visible as the hinge in this picture*

Harbour ramp at Baltic and Black Sea terminals

The ability to compensate for tidal heights and ship lists is just as essential at the interface between a rail ferry and the quay, as it is between a vessel designed to load road vehicles. However, the structures built to enable the loading of the two kinds of rolling cargo, though performing basically the same function, usually differ considerably in their appearance.

The need for an exact alignment of the rails as between those on board and those on the ramp plus the necessity for greater rigidity at the interface does, of course, profoundly influence the design of the rail unit as compared with its road vehicle-bearing companion. Hence the former's portal-like structure at the ship end of the ramp – the frame of which is embedded in concrete columns with their bases secured to the sea bed.

The essentially rigid nature of the railway harbour ramp is often in marked contrast to the majority of road vehicle link spans built today, most of which, being pontoon based, are buoyant and therefore, are portable.

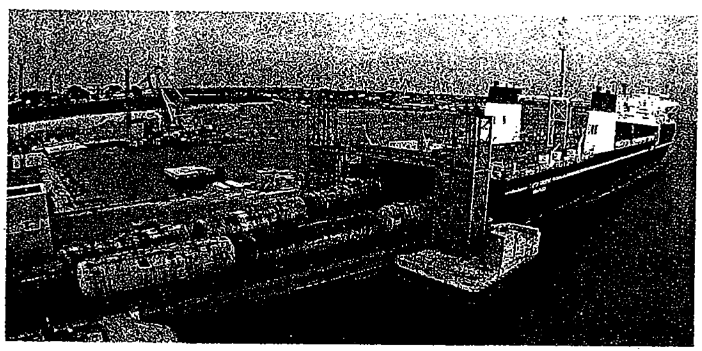
The design on both types of interface is within the expertise of MacGregor-Navire. Indeed of 34 MGN units installed worldwide, five were designed specifically for rolling stock, the remainder for road vehicles.

Date installed and location of Navire-designed railway harbour ramps currently in operation are as follows:

1) 1975. Hanko. installed concurrently with the commissioning of *Railship I* as the ship/shore link at the Finnish end of the Travemunde-Hanko train ferry service across the Baltic. It is 42.0m long x 7.5/14.0m broad. It will sustain a maximum total load of 480 tonnes.

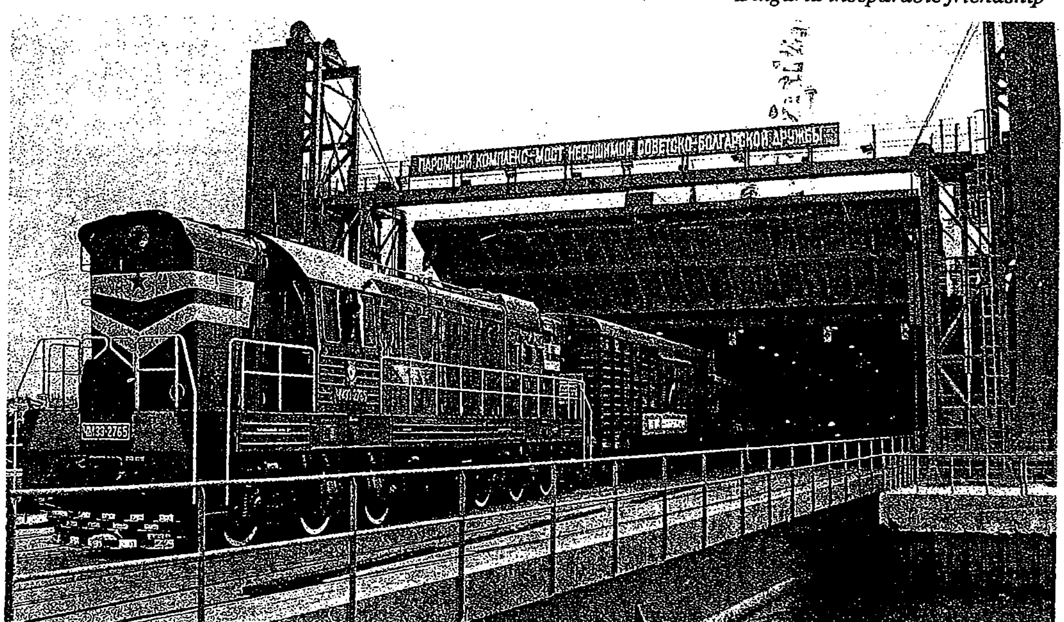
2) 1978. Iliychevsk (near Odessa), USSR and Varna, Bulgaria. Both units installed preparatory to the commencement of the coastal train ferry service on the Black Sea. Each is 40.0m long x 9.0/18.5m broad, capable of sustaining a total weight of 420 tonnes.

3) 1982. Iliychevsk and Varna. Two further units identical to those delivered in 1978 were made necessary by the growth in traffic on the route i.e from 2M tonnes carried by the four ferries in 1979 to 3M tonnes in 1982.



Left: The railway harbour ramp at Iliychevsk, USSR, conveying tank wagons on to the train ferry bound for Varna, Bulgaria

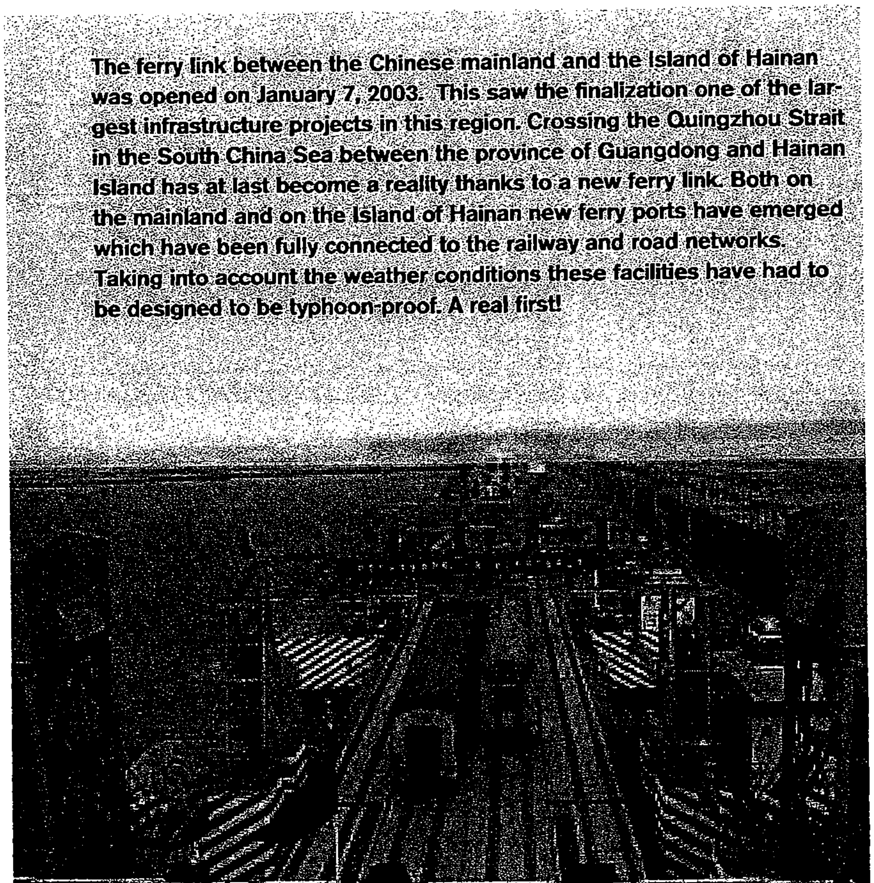
Below: Gala 1978 opening for the Iliychevsk-Varna rail ferry. Words in Russian across the Navire harbour ramp read "Ferry system – the bridge of Soviet-Bulgaria inseparable friendship"



A First in the Year of the Horse:

Large-scale Train Ferry Project in the South China Sea

The ferry link between the Chinese mainland and the Island of Hainan was opened on January 7, 2003. This saw the finalization one of the largest infrastructure projects in this region. Crossing the Quingzhou Strait in the South China Sea between the province of Guangdong and Hainan Island has at last become a reality thanks to a new ferry link. Both on the mainland and on the Island of Hainan new ferry ports have emerged which have been fully connected to the railway and road networks. Taking into account the weather conditions these facilities have had to be designed to be typhoon-proof. A real first!



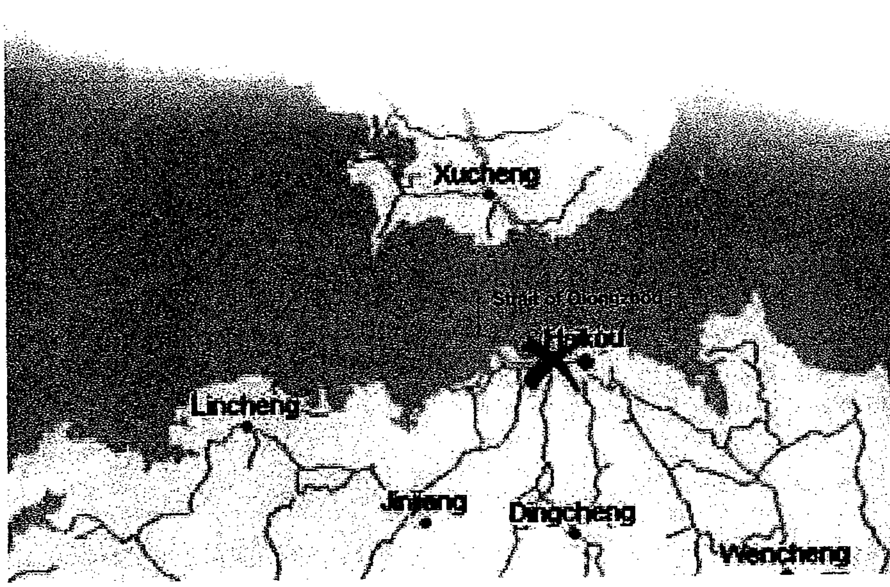
North Port (on mainland): View from the ferry towards the mainland

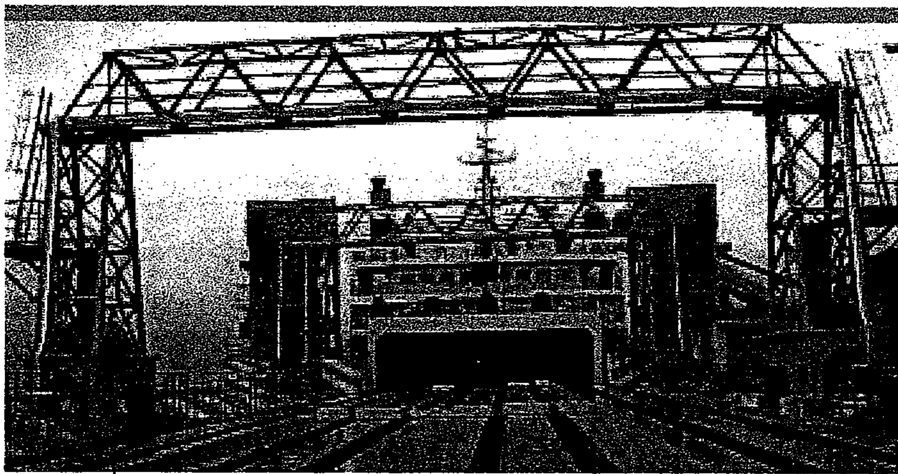
Each ferry port is equipped with three ferry bridges for loading and unloading ferries, both for passengers and motor vehicles and for trains. The bridges for passengers and motor vehicles consist of single-section ramps, each operated by means of two hydraulic cylinders. The 90 meter-long bridges, for trains of all kinds, consist of three individual ramps hinged together. Movement is effected via three pairs of cylinders in a gimbal bearing arrangement and these are electronically controlled and run in synchronization. The cylinders are large cylinders coated with CERAMAX (ceramic) and fitted with the CIMS (Ceramax Integrated Measuring System).

A Convincing Concept

Together with the Corporate Center of Competence for Hydraulic Steelwork and the Pre-Development Business Unit, and using up-to-the-minute computer simulation techniques, Bosch Rexroth (China) Ltd. has succeeded in rolling out a highly convincing ferry bridge concept for loading and unloading. Interproject stood guarantor for a successful implementation of this ambitious project as far as the customer, China Railway Import and Export Co. was concerned. Interproject is the Rexroth strategy for world-wide, inter-disciplinary collaboration for purposes of sales development and the implementation of major international projects.

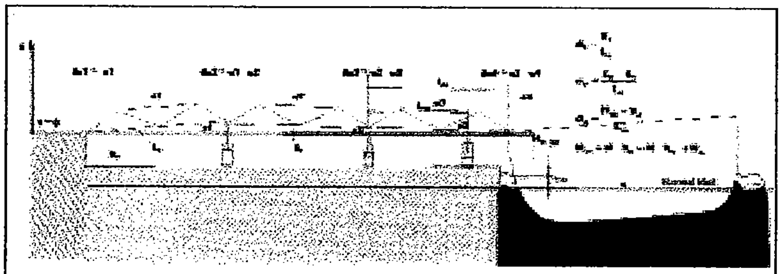
This concept made provision for the development of a calculation process which could be applied to the 22 loading and unloading processes required to determine the optimum cylinder positions of the individual axes depending on the water level, the ship's trimming and the loading process. At the same time the narrow limits in relation to the gradients of the ramps, the differences in inclinations between the individual ramps and the kinematic interrelationships had to be maintained.





4-track ferry ramps for trains: the hydraulic cylinders for ramps I and II are green

The aim was to find the right calculation process (algorithm) and to implement it appropriately in the PLC (Programmable Logic Control). The starting point and the route to finding the solution are set out as follows in a highly condensed form. The actual final report to the customer comprised around 160 pages.



Diagrammatic view of ramps

One of the largest infrastructure projects in this region is now complete.

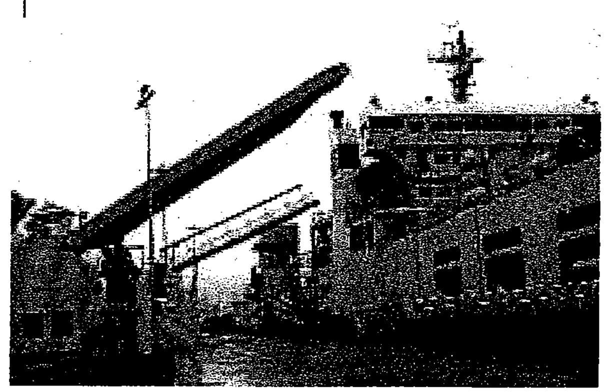
The diagrammatic view shows the arrangement of the ramps, the definition of some of the variables and the system of co-ordinates for the cylinder positions. The following are specified: characteristic lengths for the bridge LII, LI, LG and LG0, maximum and minimum water levels as well as the height of the dock pedestal in relation to standard zero. The customer specified 22 load processes, 17 of which are defined by four cycles and five by two. For each cycle the ship height H, the trimming angle a4 and the actual water level are defined. In the course of a cycle only the final ramp (LG) moves together with the ferry, the remaining ramps (LII, LI) are fixed. In order – within the permitted range – to be able to realize changes to draught at the stern loading area of up to 1,200 mm it is very frequently necessary prior to a load cycle to set up neighbouring ramps with opposing gradients.

A load sequence together with the relevant cycles is set out in the table by way of an example.

Loading process	H(m)	α_4(‰)	Cycle
All PZ are on the ferry, 18 WA distributed across 4 tracks	4.062	0.87	
2 PZ at 5 WA are leaving the ferry: 6 WA are on the ferry, 2 on the last ramp, 2 have left the ferry	3.628	8.30	1
2 PZ at 5 WA have left the bridge	4.218	2.72	
2 FZ a 5 WA are driving onto the ferry: 5 WA are on the ferry, 1 on the last ramp, 4 are on land	3.239	12.21	2
2 FZ at 5 WA are in the end position on the ferry	3.741	1.26	
2 PZ at 4 WA are leaving the ferry: 6 WA are on the ferry, 2 on the last ramp	3.209	9.53	3
All PZ have left the ship	3.733	4.57	
2 FZ at 4 WA are driving onto the ferry: 5 WA are on the ferry, 2 on the last ramp, the last is on land	2.849	13.12	4
Alle FZ in their end position on the ferry, 18 WA distributed across 4 tracks	3.337	2.4	

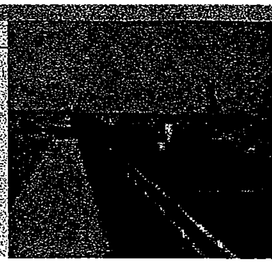
PZ = Passenger trains, FZ = Freight trais, WA = Waggons

Front: Ferry loading ramp for motor vehicles. Rear: Pedestrian gangway. Left: Engine room with control center. The hydraulic cylinders are green

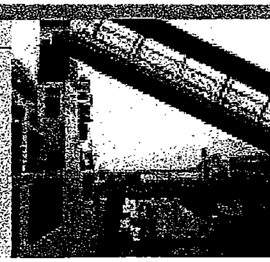


Hainan Island, the ferry port of Haikou, at start of project, January 2002.

Acceptance test incorporating loading of train



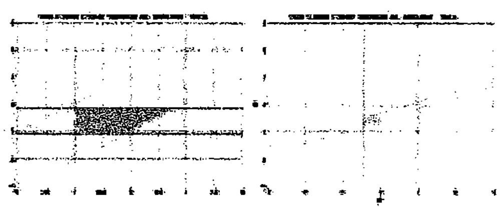
Hainan Island, the ferry port of Haikou, eleven months later.
Front: Pedestrian gangway. Rear: Docked ferry loading ramp for cars and lorries.



The computer simulation exercise carried out beforehand formed the basis for the contract and its successful implementation.

Up-to-the-minute Computer Simulation

The graphic chart "Conditions for Gradients" illustrates the conditions for the stated water level. The hatched area represents the cylinder positioning area which meets all the conditions. Since not only inclinations but also differences of inclination must lie within the specified limits, the solution lies at the intersection area of the left and right hand diagrams.



Conditions for the gradients (left) and inclination differentials (right)

In a further step the maximum/minimum permitted water levels were determined. These result from where the areas from the left hand and right hand diagrams are reduced to a point of intersection. A precise cylinder position is allocated to each of these critical water levels. The cylinder positions for any water level are interpolated between these extreme cylinder position values.

The aim was a general solution,

- where the pre-defined 22 loading processes are reduced to differentiating between types of train,
- necessitating as few adjustment processes as possible and
- permitting loading and unloading whatever the existing water level.

The permissible maximum and minimum water levels as calculated are clearly less than those which need to be achieved in practice. In order to minimize/eliminate this restriction, the effect of an additional trimming of the ferry by means of a modified distribution of the liquid ballast over the on-board ballast was investigated. This measure enables the ferries to be loaded and unloaded whatever the actual water level. Here too the same solution concept was used for calculating the maximum and minimum water levels possible and corresponding cylinder positions. However, under these circumstances interpolation between the extreme values is not possible, but it is important for the calculation to differentiate also between high and low water levels.

The actual load processes are defined by means of different train weights. Generally speaking, the critical load factors are empty trains for high water levels and fully loaded trains for low water levels. The maximum and minimum ship and ramp movements at maximum/minimum laden weight are known factors. With the help of this information we can calculate the cylinder positions for each cycle using the solution concept presented as well as by means of the maximum and minimum ship heights and trimming angles. A precondition for this is, however, that, after each cycle, the height of the ship and the trimming angle are re-specified. This is done with the help of the CIMS sensory mechanism in the cylinders, the level measurement in relation to standard zero and the inclinometer on the ferry.

The prior computer simulation exercise carried out formed the basis for the contract and for successful practical implementation. It proved possible to meet all the customer's expectations in relation to loading and unloading. The plant runs right round the clock. Bosch Rexroth (China) Ltd. is the contact partner and provides the required service on site. This project clearly demonstrates one of the aims of the Drive & Control Company Bosch Rexroth and the opportunities at its disposal: the project management of complex, intelligent systems and drives using best-in-class components.

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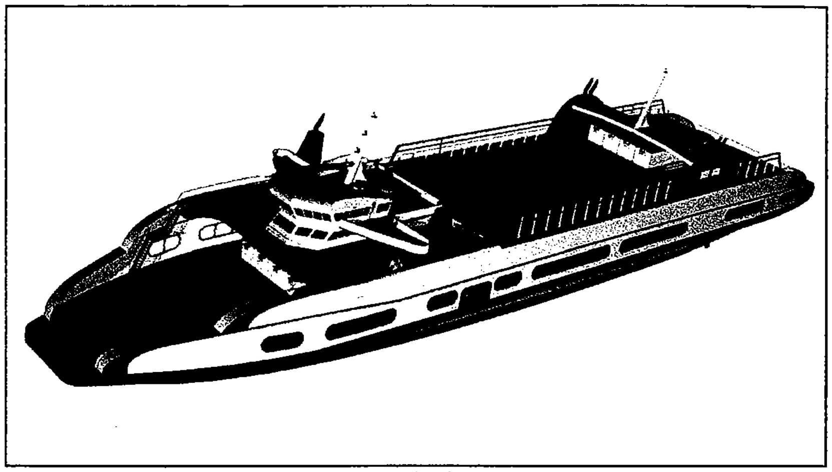
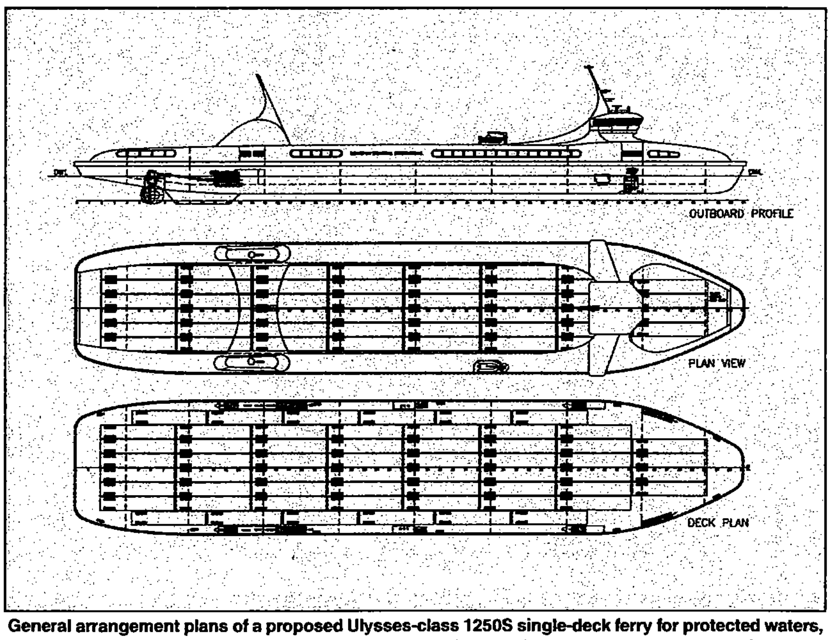
New trailer ferry proposal to relieve US road congestion



An impression of a typical Ulysses-class ro-ro trailer ferry for protected waters, designed by Robert Allan to help relieve road congestion in the USA. This version has two trailer levels but a single-deck variant has also been conceived; for more exposed routes, the bow access would be enclosed and cargo only loaded over the stern.



General arrangement plans of a proposed Ulysses-class 1250S single-deck ferry for protected waters, with bow-door access for 58 x 50ft unaccompanied trailers. Drive-through versions for trailers with their tractors are also possible. Although a Z-drive propulsion configuration is shown, Robert Allan can provide a conventional geared diesel-mechanical or diesel-electric plant if required.

ELSEWHERE in this issue, we report on the RoRo 2004 conference, where delegates were updated on moves in Europe to try and switch freight off motorways onto 'sea highways'. Some people may have been surprised to learn that similar problems of congestion also exist in the USA, and Mr Robert Kunkel, chairman of the new Short Sea Shipping Cooperative Program, outlined plans (in his interesting paper 'The North American short-sea initiative') for a new class of open-water ferry to assist solve these difficulties.

The design for a new family of such ferries - which particularly aims at accommodating domestic 53ft trailers - has been drawn up by the Vancouver (Canada) naval architectural consultancy Robert Allan Ltd, well-known for its advanced tug and other designs. These Ulysses-class concepts come in various formats, depending on individual operators' requirements, with one or two trailer decks. Most are for sheltered waters but Mr Kunkel also requested a more robust version with stern-only access to sail on exposed East Coast routes. The designer additionally says that the ships are appropriate for certain European operations.

All are based on successful prototypes developed in the 1960s by Robert Allan for ferry companies in the British Columbia area running services to Vancouver Island. Today, many of these are due for replacement, and this was one of the catalysts for the new generation of Ulysses ships.

The essential character of the hull form has been well proven on other comparable vessels, such as the Kootenay Lake ferry design Osprey 2000, and performance characteristics were confirmed recently through a comprehensive model test program. A fully developable double-chine hull should ensure easy and low-cost construction, with resistance as good as most typical round-bilge forms. A 1.80m-deep double bottom extends throughout the hull length to provide easy access for maintenance, and this extends outwards to cover the chines - areas vulnerable to impact damage. Subdivision is to a two-compartment flooding standard. All fuel tanks are located inboard and above the double bottom.

Ballast tanks are located at the extreme hull ends and at the extreme sides to provide maximum trim and heel correction moments with the minimum amount of ballast transfer. This should reduce the cost of coated tanks and time for trimming. Additional ballast space could be provided in the double bottom if required for light load conditions.

A main deck layout has been carefully planned to maximise the ease and speed of trailer handling, with eight lanes running almost the full hull length, minimal use of casings and on-deck structures, and designated parking areas at the bow for tractor units. The entire level is enclosed by a 3.8m high so-called stanchion 'fence'.

All crew facilities are above the main deck and all stores spaces are either below decks or in the superstructure, to avoid wide casings. Various passenger and crew layouts can be provided, depending on an owner's request.

Although the accompanying illustrations and general arrangement plan show a Z-drive propulsion layout, a Ulysses-class ship can be powered by a conventional geared diesel arrangement, or an electric propulsion layout; Robert Allan will evaluate a system to suit an individual project.

A typical example of a Ulysses ferry is the 1250T twin-deck version for 88 unaccompanied trailers. This has a length oa of 127m, a breadth over the fenders of 25.80m, a depth of 6.1m, and a draught of 3.2m. Two diesel engines (such as Caterpillar 3608 types, 2 x 6600bhp or 2 x 4800kW) would drive two azimuthing Z-drives (such as Rolls-Royce US305 designs fitted in Nautican high-speed nozzles).

A retractable 1600bhp Z-drive or tunnel bow thruster could be fitted. With this arrangement, the service speed would be around 18knots. Bow and stern access would normally be provided for all models, except on the open-water version, which would feature stern-only access.

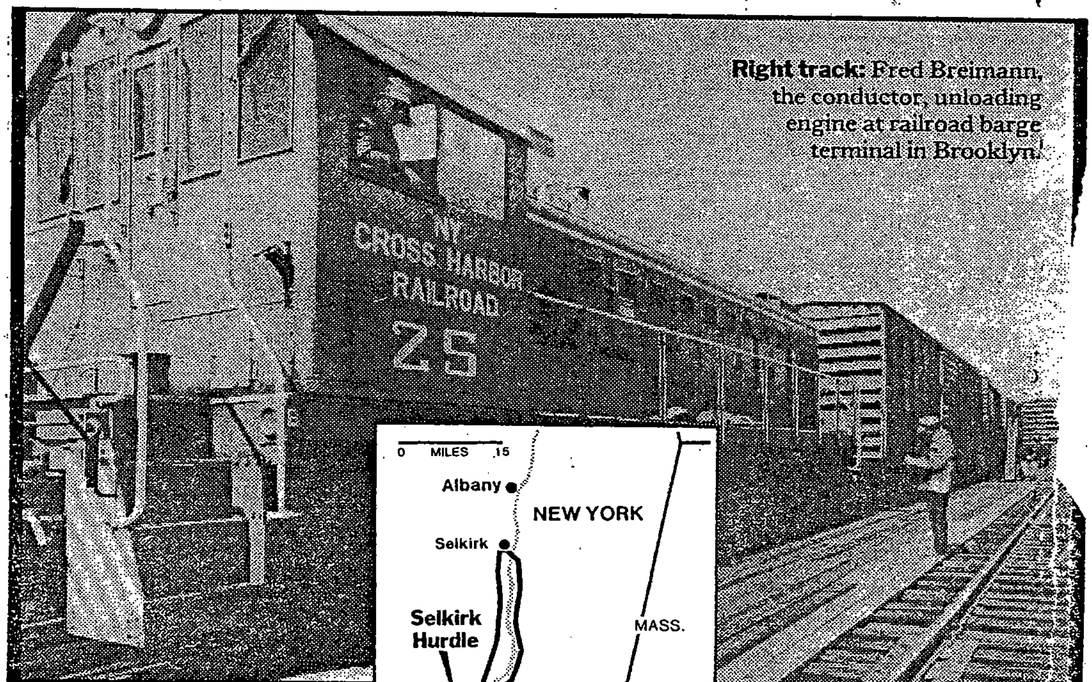
Appendix to Deliverable 7

"Using Barges to Revive a Rail Route", NY Times, May 4, 1986.

"Riding the Bounding Rails", NY Times, March 2, 2003.

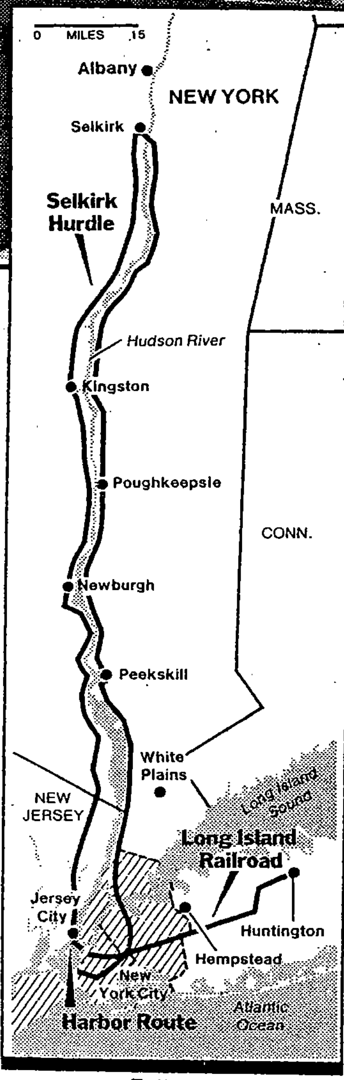
"Inspection Report: Cross Harbor Railroad Pontoon at 43rd Street, Brooklyn", TransTech Marine Co., Nov. 10, 2003.

Using Barges to Revive a Rail Route



Right track: Fred Breimann, the conductor, unloading engine at railroad barge terminal in Brooklyn.

The New York Times/Debbie Hodgson



The New York Times/May 4, 1986

Little more than three miles separates Brooklyn from New Jersey across Upper New York Bay. By freight train, however, the trip between the two can cover 280 miles and take more than 24 hours.

That is because in recent years virtually all rail traffic between Brooklyn, Queens and Long Island, at one end, and points south, at the other, has traveled over the "Selkirk Hurdle," a 280-mile loop that extends up the east shore of the Hudson River to a bridge at Selkirk, N.Y., near Albany, then down the west side of the river.

"The Selkirk route is ridiculous," said Anthony M. Riccio Jr., director of Mayor Koch's Office of Rail Freight Development. "Basically, we hope to see its demise."

City officials and local shippers say there is a way to get southbound rail freight across the harbor faster and more cheaply: by floating it on barges.

Improved Barge Facilities

To that end, the city has allocated $11 million to build and refurbish rail and barge facilities on the Brooklyn waterfront. The plan is designed to attract freight business and help the New York Cross Harbor Railroad, a company that operates the only remaining barge service connecting Brooklyn rail yards and Conrail's regional network in New Jersey, on the other side of the harbor.

"We have been advocating this route for many, many years," said George Pezold, general counsel for the Freight Users Association of New York. "It makes sense from an economic standpoint, an energy standpoint and an environmental standpoint. It's a much more efficient way of moving traffic."

The cross-harbor route was heavily traveled for the first half of the century, but withered amid a wave of railroad bankruptcies, among other factors, in the 1960's and 1970's.

When Conrail was created in 1976 to take over most of the freight operations of the bankrupt railroads, it began sending the bulk of its traffic through Selkirk because of high costs associated with the cross-harbor route.

But the deregulation of the railroad industry in 1980 allowed Conrail to adjust its prices and deliver more Long Island-bound freight to Cross Harbor's float service. Now, the route may be poised for a comeback.

The city has sought to revive the route to enhance rail service in all boroughs, and already has spent about $5 million of the planned $11 million on construction of a 33-acre rail yard at 65th Street, next to the Brooklyn Army Terminal.

Among the immediate benefits of increasing rail use, Mr. Riccio said, is reducing the amount of local freight carried by tractor-trailers, thus relieving congestion on the city's roadways, especially bridges and tunnels.

Cross Harbor, which took over from the bankrupt New York Dock Railroad in August 1983, floats boxcars between the Greenville float yard in Jersey City and the First Avenue rail yard at 51st Street in Brooklyn.

At Jersey City it connects with Conrail and in Brooklyn it distributes freight on its own line to customers with rail sidings. It also connects with the Long Island Rail Road for destinations in Brooklyn, Queens and Long Island.

The link with the L.I.R.R., established last year, has been a boon to a number of Long Island companies, including the Stone Container Corporation, a maker of paper grocery bags in Huntington.

Using the cross-harbor route, Stone Container has reduced its freight charges by $25 a car, according to Tom Cimaglia, the company's director of traffic and warehousing.

The L.I.R.R.'s general manager for freight, Dan Cleary, said increased traffic on the route was one reason the L.I.R.R.'s freight business improved for the first time in 20 years in 1984.

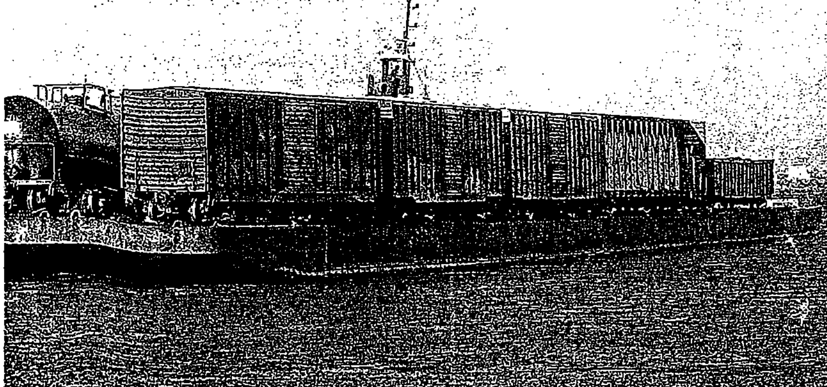
Cross Harbor has steadily increased its business — from handling about 2,800 carloads in 1984 to a projected 7,000 this year — but it is still losing money.

Frank Dayton, Cross Harbor's president, said 1986 "could be the turnaround year," and that 15,000 carloads a year would be a "realistic goal" as rates change and shippers become more aware of the service.

That number is a far cry from the early 1960's, when the harbor served as a vast switching yard for rail freight, with half a dozen companies floating more than 100,000 cars a year between New Jersey and points around the city.

The New York Times
The City
Sunday, March 2, 2003

Riding the Bounding Rails



immy Lada, right, keeping an eye on the track of the New York Cross Harbor Railroad, the city's smallest line. Above, railcars aboard a barge bound for Jersey City and the rest of America.

By WENDELL JAMIESON

HERE'S this little railroad on the Brooklyn waterfront with 1.5 miles of track, one locomotive and a three-man crew — the engineer, the conductor and the brakeman. Trains like
eed, but this one never goes faster than five miles an
ur, on rails that run through Sunset Park, beneath the
ched footbridges of the Brooklyn Army Terminal,
d alongside and through old warehouses.
The engineer is Charlie McClellend, 60, who has been
ing this for 31 years. It shows: he can move a mam-
oth battleship-gray diesel-electric locomotive by the
h, backward and forward, gently easing his brake
d throttle levers, as if he were manipulating a child's
onel. The conductor is Jimmy Lada, 35. The brake-
an is José Torres, 30, who grew up with Mr. Lada on
th Street and Seventh Avenue in Park Slope, which is
w he got the job.
The three represent the Brooklyn crew of the New
rk Cross Ha... Railroad, which provides direct rail
rvice from the borough to the mainland of the United
ates, in this case, a particularly hellish stretch of the
rsey City waterfront. After the three men nudge their
rs onto a float — a barge with tracks on it — it is
lled by tugboat for three miles, to a dusty plot of
oreline next to rusting mountains of scrap metal.
ere, another locomotive and crew take over, hitching
cars to trains that shoot across North America.
The railroad brings train cars carrying rice and lead
es to customers in Sunset Park, and it floats cars
ed with wood and cocoa — which comes to Brooklyn
m the Ivory Coast of Africa — to Jersey City. The co-
goes to Hershey, Pa., and comes back to Brooklyn
Hershey's Kisses.
This is one of only two active shortline railroads in
w York City; the other, the New York & Atlantic, has
arly 300 miles of track and mostly serves Long Is-
d. The Cross Harbor is also one of the country's
allest. It is the only railroad that runs on New York's

Continued on Page 10

End of the Line?

Perhaps the single biggest factor w
against Cross Harbor is its trouble
tionship with New York City. As a r
the company is regulated by the fede
ernment. But the city wants to e
company from Bush Terminal; unde
ous management in the mid-1990's,
contends in a civil suit, the compan
ly buried pesticides, petroleum w
old railroad ties there. The cit
$750,000 to clean it up, and is suing
pany to get the money back.
At the same time, the city's Econ
velopment Corporation wants Cros
to succeed, because more freight
ice to Brooklyn would help local b
strengthen the port and cut dow
traffic in Manhattan. As the agen
the viability of a multibillion-doll
nel connecting New Jersey and
floating more rail cars appear
short-term solution. Cross Har
only company that does it.
"We recognize that they are t
prove rail freight; we are not
ond-guess them," said Seth Kay
opment corporation's executive
dent. "It just makes it difficult f
them as a tenant at that site,
this point, the failure of New Y
Harbor to take responsibility f
tion."
Just a few blocks away from
nal, at 65th Street, is a $20 mil
loading dock that the city f
years ago. A rail car has yet to
it. The men who run Cross H
the unused facility, with its s
tracks, raked gravel track be
setlike gantries, and imagine
ier their lives could be. No
down First Avenue to get New
tic rolling stock. No more
cars.
They believe that the city
dock hostage until the law
They argue that the accusati
tenure of a previous com
and note that nothing has y
Mr. Eastman points to his
— 32 years in the business,
Conrail — as proof that p
now in charge.
The city denies that the
65th Street situation are lin
ly want to come to an agre
whereby they could use th
at 65th Street," Mr. Kaye
It's all very complica
things in railroads in the
cially those involving Bro
the ground underneath a
tween. But as the teleph
and forth, and as the
McClellend, Mr. Lada a
be out there, hitching th
ing rice, putting blocks
and waiting for the day
road is not quite so silly

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10 November 2003

Inspection Report

Cross Harbor Railroad Pontoon at 43rd St., Brooklyn

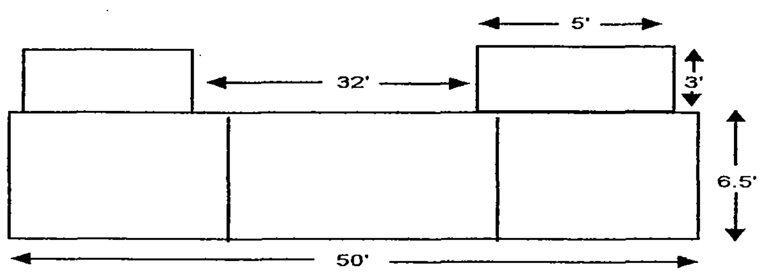
Introduction:

At the request of the East-of-Hudson Task Force, TransTech informally inspected the pontoon at the 43rd Street Brooklyn terminus of the Cross Harbor Railroad. This inspection was requested because the pontoon leaks and has recently been subject to sinking, necessitating suspension of car floating operations until it is refloated. The Task Force requested TransTech to comment on condition of the pontoon and on the proposed solution by the Cross Harbor Railroad to increase the pontoon's buoyancy to effectively render it unsinkable. The inspection was conducted on Sunday, 9 November in the company of Mr. Howie Samelson, vice president of Cross Harbor Railroad. The inspection was performed pro bono on behalf of the East-of-Hudson Task Force. The following remarks are informed opinions only and are not formal technical recommendations, which can only be made after more detailed analysis of the structural integrity of the pontoon and the various, numerous loads placed upon it.

The Pontoon:

The pontoon supports the seaward side of an approximately 90' rail car transfer bridge. The floating pontoon enables Cross Harbor's car floats (flat deck barges fitted with rails to transport railroad cars) to mate with the transfer bridge over the range of tides in New York harbor.

Cross Harbor Railroad 43rd Street Pontoon
(Dimensions are Approximate and Note to Scale)



Cross Section

Figure 1

Approximate dimensions of the pontoon in cross-section are shown in Figure 1. The pontoon's length (not shown) is approximately 26'. The pontoon consists of three separate floatation chambers permanently joined together. The main chamber is approximately 50' in beam, 26' in length, 6.5' in depth. Because of the use of welded construction, the main pontoon is believed to have been built after WW II. Some time later, additional floatation "boxes" were welded port and starboard to the main deck of the original pontoon. A wooden trestle system is installed in the 32' wide channel formed by the wing float boxes on which two sets of tracks ride. A switch built into one of the tracks enables the two track trestle to load a three track car float without shifting the car float.

Pontoon Condition:

Internal examination of the main pontoon revealed leakage, structural deterioration from age / elements and damage from wear and tear. The internal space is divided into six compartments, all accessible, created by one transverse and two longitudinal bulkheads. The inner bottom and underside of the main deck of the pontoon are strengthened by longitudinal angles 4" x 6" on approximately 27" centers. The sides of the pontoon are flat plate steel of unknown thickness with no additional structure.

Access was not available to the inside of the float boxes added at a later date.

Without drydocking, it is impossible to render complete opinion on condition of the pontoon. On one hand it clearly shows its estimated half century of use; on the other, its scantlings indicate it was overbuilt in anticipation of rugged use.

Proposed Solution:

Removal of the pontoon to drydock it would be extremely costly because the transfer bridge that it supports would have to be lifted to free the pontoon. This would necessitate suspension of car floating operations until the pontoon is returned to service.

Less complex and costly solution proposed by Cross Harbor is to fill the pontoon with blocks of styrofoam. The permeability (percentage of available volume that can be occupied by water) of the pontoon's compartments is currently almost 100 percent. Seawater weighs 64 lbs./ cu. ft. whereas styrofoam weighs about 1 lb. / ft. and is chemically stable (does not dissolve) in seawater. By occupying sufficient internal volume of the pontoon with styrofoam, it will therefore be possible to render it effectively unsinkable.

TransTech's view is that this proposed solution is a technically feasible interim solution until the pontoon can be rebuilt or replaced.

Recommendations:

The following recommendations are offered, subject to further validation:

> Styrofoam is so buoyant, Cross Harbor need concentrate only on filling the main pontoon, not the wing boxes which were added later.

Only the lowest layer of styrofoam need be put down horizontally to fit between the longitudinals that run along the inside of the bottom plating. Above this layer, styrofoam cut in columns wedged beneath the main deck longitudinals will create a tighter fit and reduce the number of individual pieces of foam to be fitted.

Preliminary calculations suggest it will not be necessary to completely fill each compartment with foam to achieve the desired added buoyancy. Hence, the judicious placement of foam would not impede future access to areas of the pontoon that may warrant repair in the future.

When the pontoon is removed to a drydock for more extensive repairs, TransTech recommends that jacking up the transfer bride should be investigated, rather than lifting it with a crane. This would put less stress on the bridge, would cost less and would be easier, especially if the jacking coincided with a spring tide.

TransTech Marine Company believes car floating is and should remain an essential component of New York Harbor's freight distribution system. We hope these comments are helpful to the East of Hudson Task Force and to the Cross Harbor Railroad.

Respectfully submitted.

Geoffrey F. Uttmark
MM, MSc, BSc