INTRODUCTION

of the

AIR CUSHION VEHICLE "LARUS"

to the

NORTH AMERICAN MARKET

by

EERO MAKINEN, WARTSILA ARCTIC INC.
and
JOHN WAINWRIGHT, ARCTIC TRANSPORTATION LTD.

Presented at

1985 JOINT INTERNATIONAL CONFERENCE
ON AIR CUSHION TECHNOLOGY

Crowne Plaza Hotel,
Rockville, Maryland

September, 1985

INTRODUCTION

of the

AIR CUSHION VEHICLE "LARUS"

to the

NORTH AMERICAN ARCTIC

"Abstract"

Arctic Transportation Ltd., in partnership with Wartsila Arctic Inc., will lease the air cushion vehicle "Larus" from the Government of Finland, refurbish the craft for the North American Arctic environment, and then transport the vehicle from Finland to Tuktoyaktuk, N.W.T. The project is well underway, and if the current schedule is maintained, the "Larus" will be available for charter in the Western Arctic in September, 1985.

This paper describes the air cushion vehicle "Larus", the refurbishing necessary to ensure her ability to withstand the harsh Western Arctic environment and the difficulties in transporting the vehicle to Tuktoyaktuk.

The "Larus" was constructed by Wartsila for the Government of Finland in 1981 and has since operated as a ferry in the northern portion of the Baltic Sea. The "Larus" is a generation beyond the air cushion vehicles which operated in the Arctic in the lates 1960's, early 1970's. She has a payload of 25 tonnes and 46 passengers and is propelled by four independent rotatable ducted propellers. The "Larus" has a maximum speed of about 20 knots over calm water or level ice. The paper will describe the air cushion vehicle "Larus" in greater detail.

The "Larus" currently operates in the Baltic Sea in temperatures as low as -30°C. Arctic Transportation Ltd. and Wartsila are refurbishing the vessel to ensure that she is able to operate reliably in ambient temperatures of -50°C. The refurbishing will also ensure that the vehicle meets all appropriate Canadian standards and requirements for air cushion vehicles.

The conversion work includes:

- a new Arctic grade rubber skirt complete with spare fingers
- added fire and thermal insulation for engine rooms, passenger compartments and piping
- additional heating for passenger compartments
- addition of washrooms in each passenger compartment
- additional diesel generator

- installation of a second radar system
- installation of high intensity lighting
- modification to the propeller pitch changing mechanism
- installation of fire extinguishing system
- installation of gyro compass, speed measuring device, and satellite navigation
- provision of lifesaving equipment to Canadian regulations

Perhaps the most interesting component of this project is the transport of the 90 tonne vehicle from Finland to Tuktoyaktuk. The current plan is to transport the "Larus" commencing in early August by heavy-lift ship from Europe to Resolute, N.W.T. The craft will then transit the final 2,000 kilometers from Resolute to Tuktoyaktuk under her own power, or on the aft deck of an ATL ice-strengthened supply vessel, arriving in Tuktoyaktuk in late August. This paper describes the development of a transportation plan particularly with regard to selecting a route for the "Larus" through the Western Arctic.

The Arctic Transportation Ltd. shoreside base in Tuktoyaktuk will serve as the operations centre for the "Larus". The "Larus" can be used for transporting material and people to offshore and onshore exploration sites and to communities. The vehicle can also be used for moving complete oil exploration camps including rig components. The greatest potential usage of the "Larus" is for heavy load transportation during the ice covered season when only helicopter transportation is available. The "Larus" does not directly compete with any of the present transportation modes in the area, but it merely compliments the present system. This paper describes, in further detail, the proposed operation of the air cushion vehicle "Larus".

INTRODUCTION

Arctic Transportation Ltd. and Wartsila Arctic Inc., in joint venture, are well underway with a project to:

- Lease an air cushion vehicle, designed and constructed for Arctic conditions.
- Refurbish this air cushion vehicle to insure efficient and reliable operation in the harsh North American Arctic environment.
- Transport the air cushion vehicle from Finland to Arctic Transportation Ltd.'s shoreside base at Tuktoyaktuk, N.W.T.
- Operate, maintain and market the air cushion vehicle during the life of this project.

The objective of the ATL/Wartsila joint venture is to test the commercial feasibility of a state-of-the-art air cushion vehicle in the North American Arctic. This paper describes this project, discussing in detail the plans to refurbish, transfer and operate the air cushion vehicle "Larus".

THE JOINT VENTURE PARTICIPANTS

The air cushion vehicle project, as mentioned, is a joint undertaking by Arctic Transportation Ltd. (ATL) and Wartsila Arctic Inc. Arctic Transportation Ltd. is a Canadian company owned jointly by Fednav Limited of Montreal, Quebec and Crowley Maritime Corporation of San Francisco, California. ATL has now operated for twelve years in the Canadian Beaufort Sea providing marine support to the hydrocarbon exploration activities in the western Arctic by supply icebreakers, barges, and supply tugs to assist this endeavour. ATL also operates a tug and barge cargo transportation system along the Mackenzie River to support oil and natural gas development in Canada's north.

ATL now operates one of the largest marine fleets in the Beaufort Sea. The company operates eighteen (18) tugs, most of which are ice-strengthened, and twenty-seven (27) barges including a floating dry dock. The company owns and operates bases in the Northwest Territories at Tuktoyaktuk, Inuvik and Hay River to support these marine operations. The company's head office resides in Calgary, Alberta.

Wartsila Arctic Inc. is a Canadian firm, based in Vancouver, British Columbia, offering services in the field of Arctic marine technology to North American clients. Wartsila Arctic Inc. is a wholly owned subsidiary of Oy Wartsila AB,

one of Finland's largest industrial enterprises. The parent company was founded in 1834 and is engaged in such diverse industries as shipbuilding, diesel engine manufacturing, paper finishing systems, security systems, porcelain and glass fabrication.

Shipbuilding is Wartsila's major activity. The shipbuilding division specializes in the construction of cruise vessels, car/passenger ferries, icebreakers and other Arctic vessels as well as a variety of specialized ships such as sophisticated gas/chemical carriers. Wartsila is considered one of the foremost shipbuilders in the world in the area of passenger vessels and Arctic tonnage.

Wartsila is also a builder of air cushion vehicles. The first air cushion vehicle built by Wartsila was delivered by the company's Helsinki shipyard in 1981. This was the "Larus", designed and constructed for winter operation in the Finnish archipelago. Additionally, Wartsila has delivered fourteen air cushion vehicles for the operation in the eastern Soviet Arctic. These vehicles form the cargo handling equipment of multi-purpose dry cargo vessels built for Arctic operation. The design of the Wartsila air cushion vehicles is based on extensive inhouse research and development including model testing in the company's own laboratory and laboratories in Finland and the U.K. as well as full scale testing of a purpose-built prototype testing craft and the first commercial deliveries.

THE PROJECT ORIGINS

For a number of years, ATL has been interested in developing a project that would bring a state-of-the-art air cushion vehicle to the Canadian Beaufort Sea to demonstrate the technical and commercial viability of such a machine in supporting Arctic oil and natural gas exploration. ATL was convinced that the size and design of ACV's had progressed to the point where the vehicles could provide bona fide support to exploration activities in the Arctic and overcome the stigma, which continues to prevail, of less than successful experiences with Arctic hovercraft in the late 1960's/early 1970's.

Approximately eighteen months ago, ATL and Wartsila first discussed the possibility of leasing an air cushion vehicle owned by the Government of Finland and bringing this machine to the Beaufort Sea to test her commercial viability over a two or three year period. This concept had considerable merit for all parties to be involved. For ATL, it provided the opportunity to lease an air cushion vehicle and thereby assess technical and commercial viability without undertaking enormous capital investment. It also provided an opportunity to utilize a vehicle that had been technically proven during winter conditions in the Baltic Sea. For Wartsila, this project offered a potential introduction into the North American Arctic and the opportunity to enhance their knowledge of air cushion vehicle operations in Arctic conditions.

During this past winter, the project came together very quickly. In January, ATL and Wartsila agreed to form a company, owned 2/3 by ATL and 1/3 by Wartsila, which would lease the air cushion vehicle "Larus" from the Government of Finland. Shortly thereafter, the lease agreement with the Government of Finland was finalized. The joint ATL/Wartsila venture further agreed to refurbish the "Larus" and layed out a framework whereby this would be accomplished. The joint venture also developed a framework for the hiring and training of crew, the preparation of support infrastructure at Tuktoyaktuk, and the transport of the air cushion vehicle to the Beaufort Sea.

THE AIR CUSHION VEHICLE "LARUS"

The air cushion vehicle owned by the Government of Finland and to be leased by the ATL/Wartsila joint venture is the "Larus". The "Larus" was constructed in 1981 by Wartsila's Helsinki, Finland shipyard. She is 33 metres length overall, 14.7 metres breadth, a height of approximately 8.2 metres to the top of the propeller duct, a payload of approximately 25 tonnes and 46 passengers. The "Larus" is constructed of all-welded marine grade aluminum and equipped with a through deck with mechanically controlled ramps bow and stern to facilitate handling of cargoes. Longitudinal superstructures on each side contain engine rooms, passenger spaces and control rooms. The "Larus" is fitted with four integrated lift and propulsion systems each consisting of a 650 kW high speed diesel engine, a centrifugal fan for air cushion lift and a four bladed, pylon-mounted ducted propeller for thrust. The machinery is controlled and monitored remotely from a raised bridge located well forward on the starboard superstructure.

The "Larus" is equipped with steerable propeller ducts rotatable 240° and controllable pitch propellers which provide excellent manoeuvring characteristics even under severe weather conditions.

The steering control system is electro-hydraulic. The propellers are remote controlled from the wheelhouse or manually operated from the engine rooms. Each of the propeller pylons rotates 240°, 90° inwards and 150° outwards.

The directional control of the propeller pylons is controlled by a steering wheel and pedals.

The vehicle skirt is the loop and finger type comprised of rubber-coated nylon fabric. The material and method of installation are appropriate for Arctic conditions.

It must be emphasized that the "Larus" was designed and constructed to be much more robust and less sophisticated than the typical hovercrafts currently operating in climate more temperate than the Arctic. This is obvious in the following areas:

- rather than gas turbines, diesel engines were selected as the propulsion units, for reasons of simplicity and proven cold-weather operation
- the maximum speed of the craft is only about 30 knots, which results in a relatively simple skirt design
- controls have been selected for simplicity and proven cold-weather operation
- the hull is of an all-welded construction

These differences, among many others, are of utmost importance in the operation and maintenance of an air cushion vehicle in an Arctic environment.

Following delivery to the Government of Finland in 1981, the "Larus" has been operated as a ferry between mainland Finland and offshore islands in the Baltic Sea. The "Larus" has been used to transport trucks, cars and passengers between the islands in the archipelago in the southwest Finland and also between islands and the mainland in the northern part of the Gulf of Bothnia. In addition to the transportation service, the craft has performed river icebreaking duties preventing ice dam formations during the winter melt-off period in the spring.

In early March of this year, the "Larus" completed her winter service in the northern portion of the Baltic Sea. She was immediately flown to Wartsila's Kotka shipyard where she underwent refurbishment prior to being transported to the Beaufort Sea.

REFURBISHMENT OF THE "LARUS"

The technical reliability of the "Larus" has been demonstrated during the four years since her construction. The "Larus" has operated successfully and reliably during four Finnish winters in the Baltic Sea. However, the success of the vehicle in the Beaufort Sea is very much dependent upon her being available for operation when required and to perform efficiently and reliably in the environment of the North American Arctic. ATL and Wartsila elected to refurbish, and in certain cases upgrade, the "Larus" to ensure this reliability. As the "Larus" is to be registered in Canada, there were also certain modifications necessary to conform to Canadian Coast Guard standards. The conversion work commenced about mid-March and was completed in late July.

The conversion work was completed at Wartsila's Kotka shipyard and included:

- a new Arctic grade rubber skirt complete with spare fingers

- added fire and thermal insulation for engine rooms, passenger compartments and piping
- additional heating for passenger compartments
- addition of washrooms in each passenger compartment
- addition of a second diesel generator
- installation of additional navaids and high intensity lighting
- modification to the propeller pitch changing mechanism
- installation of fire extinguishing system
- provision of lifesaving equipment to Canadian regulations

The majority of these modifications are to ensure reliability of the "Larus" in temperatures of -50°C and to conform to Canadian Coast Guard standards.

Following completion of the conversion work in late July, performance tests were conducted and crew training was also completed. In early August, the "Larus" was ready for shipment to the Beaufort Sea.

TRANSPORTATION OF THE "LARUS" TO THE BEAUFORT SEA

One of the more interesting aspects of this project is the transportation of the "Larus" from Finland to Tuktoyaktuk in the Canadian Beaufort Sea. It is both difficult and expensive to transport large and cumbersome cargoes from Europe to the Beaufort Sea. Very early in the project planning, the option of bringing the "Larus" into the Beaufort Sea from the west via the Panama Canal was discarded as too expensive. As well, the alternative of shipping the "Larus" by bulk carrier or heavy-lift ship from Europe to a southern Canadian port such as Montreal or Halifax and then by rail to Hay River, N.W.T. was also discarded. The journey by rail required the "Larus" to be transported in sections or pieces, which also rendered this option as too expensive when all costs were considered. As a result, the project concentrated efforts upon three principle options for transporting the "Larus" from Europe to the Beaufort Sea, via the Northwest Passage. These options were:

- load the "Larus" upon the main deck of a bulk carrier or heavy-lift ship for transport to Resolute, N.W.T., then fly the ACV under her own power to Tuktoyaktuk
- transport the "Larus" from Europe to Resolute aboard a bulk carrier or heavy-lift ship, and then transport her the remaining 2,000 km on the aft deck of an icebreaking or ice-strengthened supply vessel

- transport the "Larus" from Europe directly to Tuktoyaktuk using ice-strengthened tug and barge

After reviewing the various alternatives, the project elected to transport the "Larus" from Helsinki, Finland to Resolute N.W.T. aboard heavy-lift ship. On August 8, the "Larus", along with a few containers of spare parts, was loaded aboard the vessel M.V. "Fairlift". The "Fairlift" encountered limited ice conditions on her journey to Resolute and arrived the morning of August 21.

The project seriously considered flying the "Larus" under her own power from Resolute to Tuktoyaktuk. However, the project eventually decided that the logistics and risks associated with such an arduous maiden Canadian voyage could not be justified. As a result, the "Larus" was to be transported the final 2,000 km on the aft deck of ATL's ice strengthened supply vessel "Arctic Mallik". On August 17, the "Mallik" was dispatched from Tuktoyaktuk. She encountered severe ice conditions along a portion of the route, particularly in James Ross Strait and Peel Sound. The "Mallik" arrived at Resolute on August 23 and the transfer of the "Larus" from the heavy-lift ship was performed very quickly.

The "Arctic Mallik", with the "Larus" aboard, is now proceeding to Tuktoyaktuk where she should arrive about September 7. At Tuktoyaktuk, the "Larus" will be off-loaded by heavy-lift crane.

Upon arrival at Tuktoyaktuk, the "Larus" will again undergo performance tests and crew training will be completed.

CREW

In Finland, the "Larus" was operated with a crew of two; a pilot and a navigator/loadmaster. As well, the Government of Finland employed a shorebased engineer to support the operation.

ATL and Wartsila will operate the "Larus" with a crew of three; a pilot-in-command, a navigator and a loadmaster. The pilot-in-command, who will have significant knowledge and experience with air cushion vehicles and Arctic ice conditions, will operate the "Larus" and be Master of the machine. The navigator also is to have knowledge and experience with air cushion vehicles and in particular, the Arctic environment. The navigator will support the pilot providing navigational assistance and recommending route particulars. The loadmaster will have knowledge of stability of the ACV and will be responsible for the loading of cargo and safety of passengers. The loadmaster will also be capable of performing minor maintenance of the craft should this be necessary during operations.

The "Larus" operations will also be supported by a shorebased engineer. This person will be knowledgeable of all mechanical aspects of the "Larus".

The four-man team; (pilot-in-command, navigator, loadmaster and engineer) as currently proposed will likely work a rotation of two weeks out with every two weeks in. At present, it is envisaged that the "Larus" will operate from eight to twelve hours per day so that one crew only is necessary in the Arctic at any particular time.

All crew members for the project have now been hired. For all positions, the project was very fortunate in receiving applications from a substantial number of Canadians having the abilities and experience being sought.

UTILIZATION OF THE "LARUS"

ATL and Wartsila envisage the greatest utilization of the "Larus" occurring in the Beaufort Sea with the transportation of passengers and cargo between shoreside bases and offshore islands and structures. In this capacity, the project believes that the "Larus" will not necessarily supplant existing transportation systems, but rather supplement these, by allowing movement of heavier cargoes through severe weather conditions. In this capacity, the "Larus" has advantage of:

- carrying larger and heavier cargoes
- greater overall range
- ability to operate in virtually all Arctic weather conditions
- transporting cargoes for substantially lower cost on a per pound mile basis
- enable complete drilling rig crew changes to be completed in a single run

than conventional, alternative transportation methods.

In discussing the "Larus" with potential clients, a number of alternative and interesting uses for the vehicle have been brought to the attention of the project. These include:

- transportation of cargo along shallow water tributaries of the Mackenzie River when tug/barge access is not available
- utilization as a safety/standby vessel able to respond to emergency situations in virtually any weather conditions and also able to carry on deck appropriate safety equipment

- utilization as a safety/standby vessel able to respond to emergency situations in virtually any weather conditions and also able to carry on deck appropriate safety equipment

- utilization as an oil spill dispersant spray vehicle; the advantage here being able to respond quickly through use of roll-on/roll-off of equipment and in particular, gaining through the air cushion aspect, a more thorough mixing of surface oil and spray dispersant than is otherwise available

- shallow water, and Arctic tundra seismic where the "Larus" offers the advantage of transporting large and heavy cargo at a reasonably high speed

- construction of ice islands and protective rubble fields

- research vehicle for accumulation of ice data

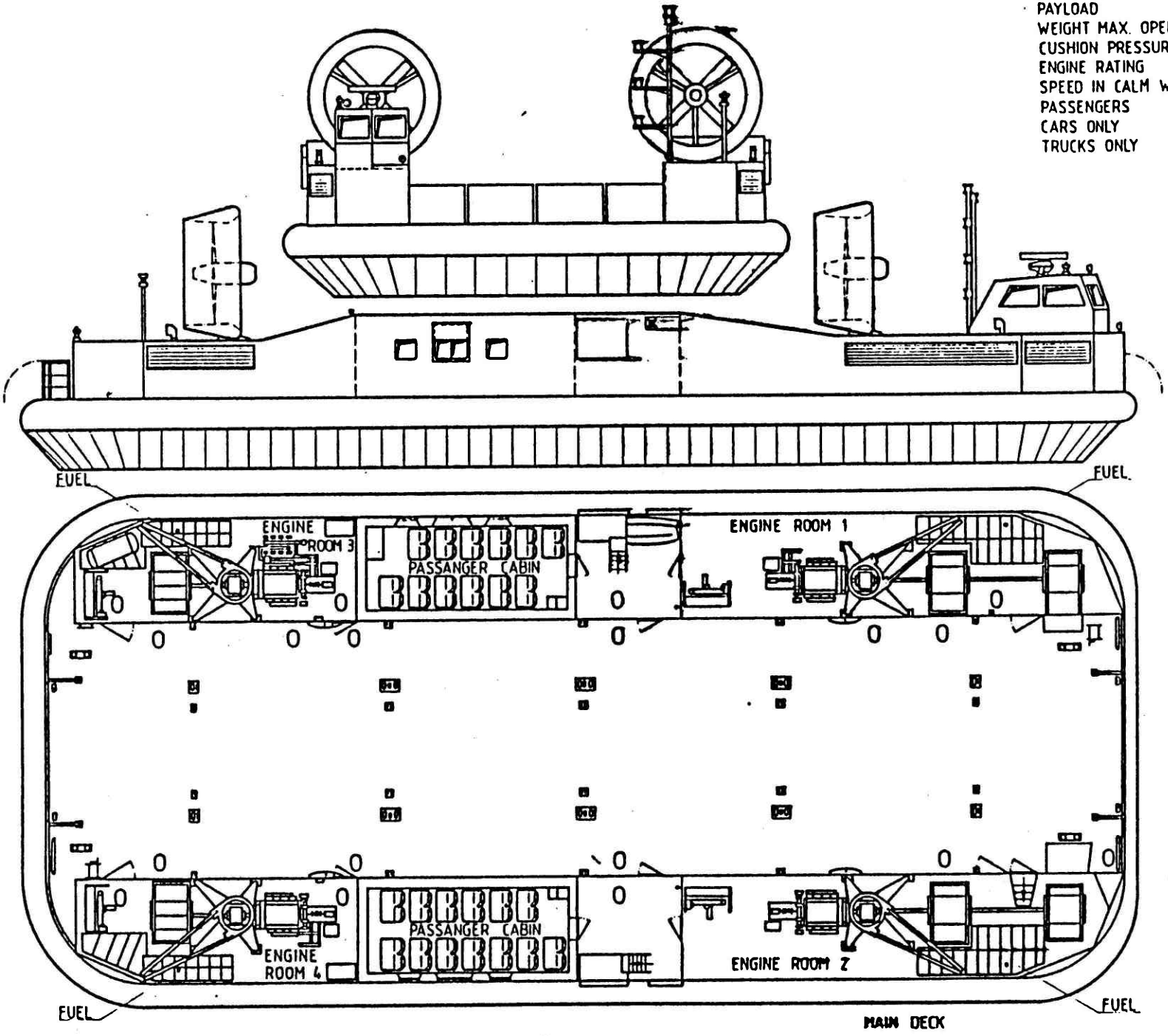
These represent a few of the many potential uses for the "Larus" developed thus far. Once the "Larus" does arrive in Tuktoyaktuk, it is very likely that many more unusual applications for the vehicle will surface.

CONCLUSIONS

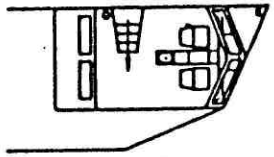
ATL and Wartsila have undertaken this project to assess the technical and commercial viability of operating a state-of-the-art air cushion vehicle in the North American Beaufort Sea. The use of the ACV "Larus" and recent successful experiences with other hovercraft in Alaska, virtually assures the technical reliability of the project while ATL and Wartsila have endeavoured to control costs to enhance commercial viability.

The project has also endeavoured to make this a Canadian project by registering the "Larus" in Canada and employing/training of Canadian crew. This will lay the framework for expansion of the project should commercial viability be achieved. Expansion of the project might entail extension of the lease of the "Larus" or construction of an air cushion vehicle designed specifically for North American Arctic.

LENGTH MAX	33.0 M
BREADTH MAX	14.7 M
SKIRT DEPTH	0.8 M
PAYLOAD	22 T
WEIGHT MAX. OPERATING	100 T
CUSHION PRESSURE	2500 PA
ENGINE RATING	2600 KW
SPEED IN CALM WATER	10 M/S
PASSENGERS	50
CARS ONLY	16
TRUCKS ONLY	2

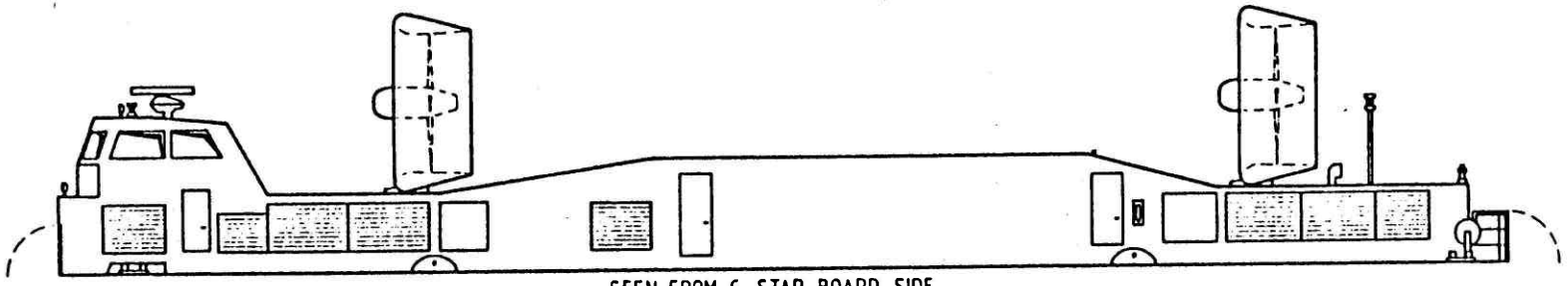


MAIN DECK

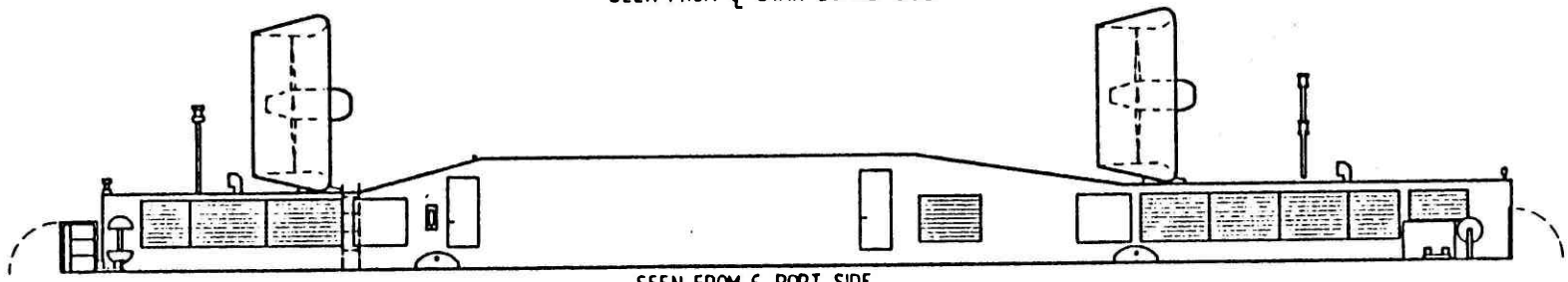


WHEEL HOUSE

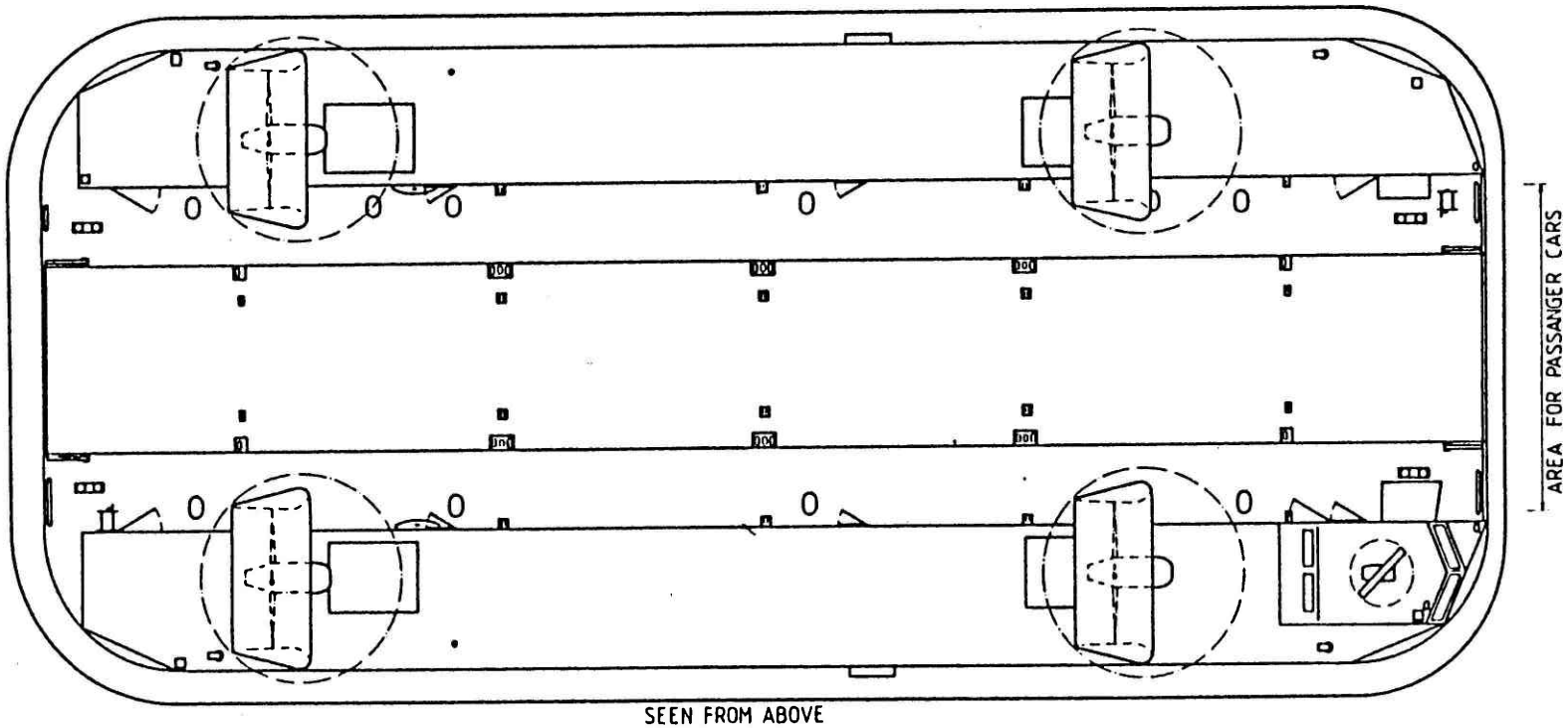
WÄRTSILÄ
HELSINKI SHIPYARD



SEEN FROM ℄ STAR BOARD SIDE



SEEN FROM ℄ PORT SIDE

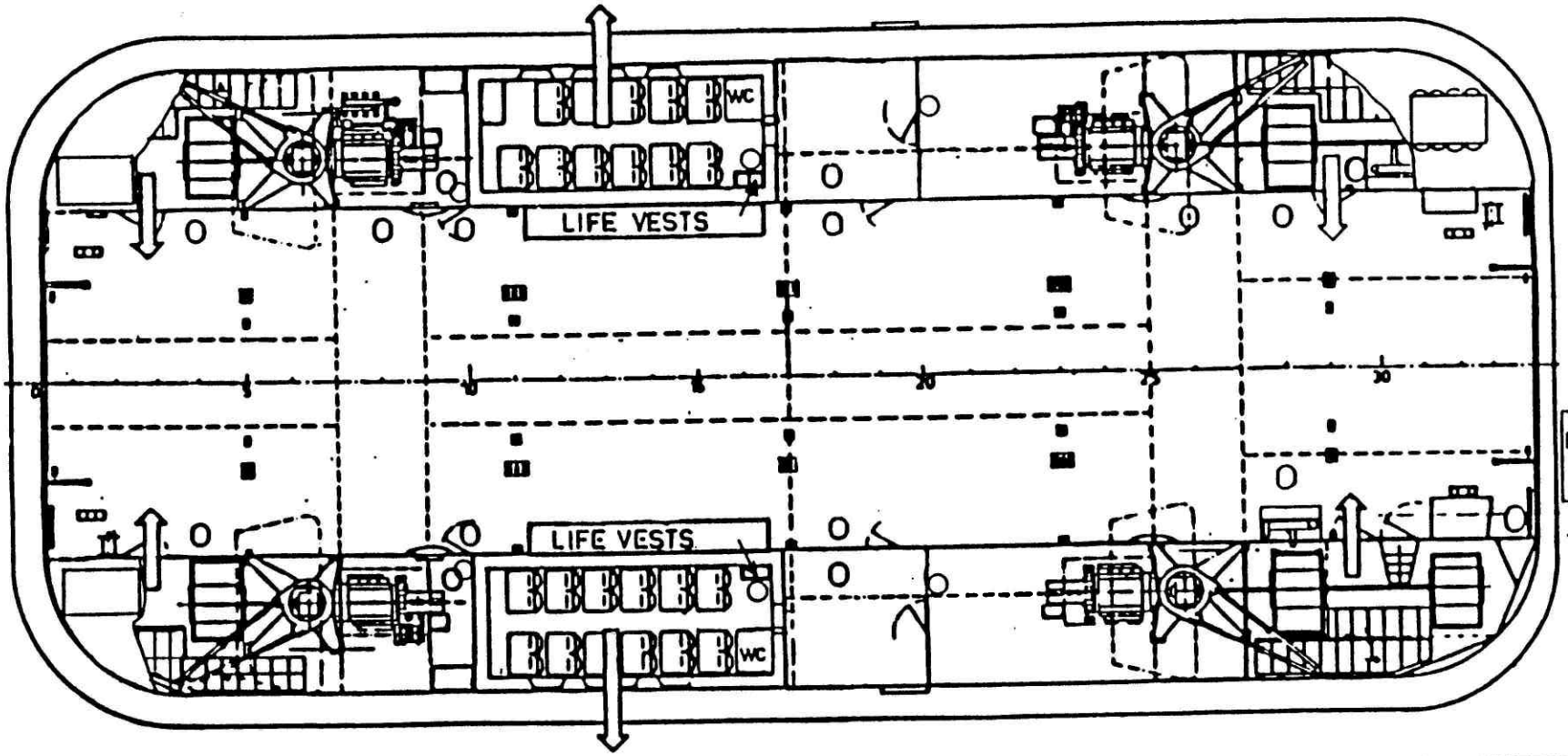


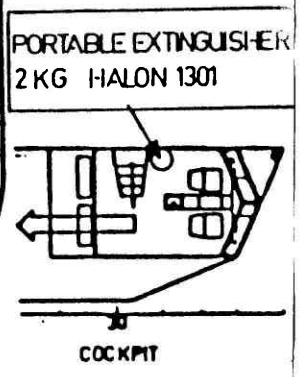
SEEN FROM ABOVE

WÄRTSILÄ
HELSINKI SHIPYARD

LARUS

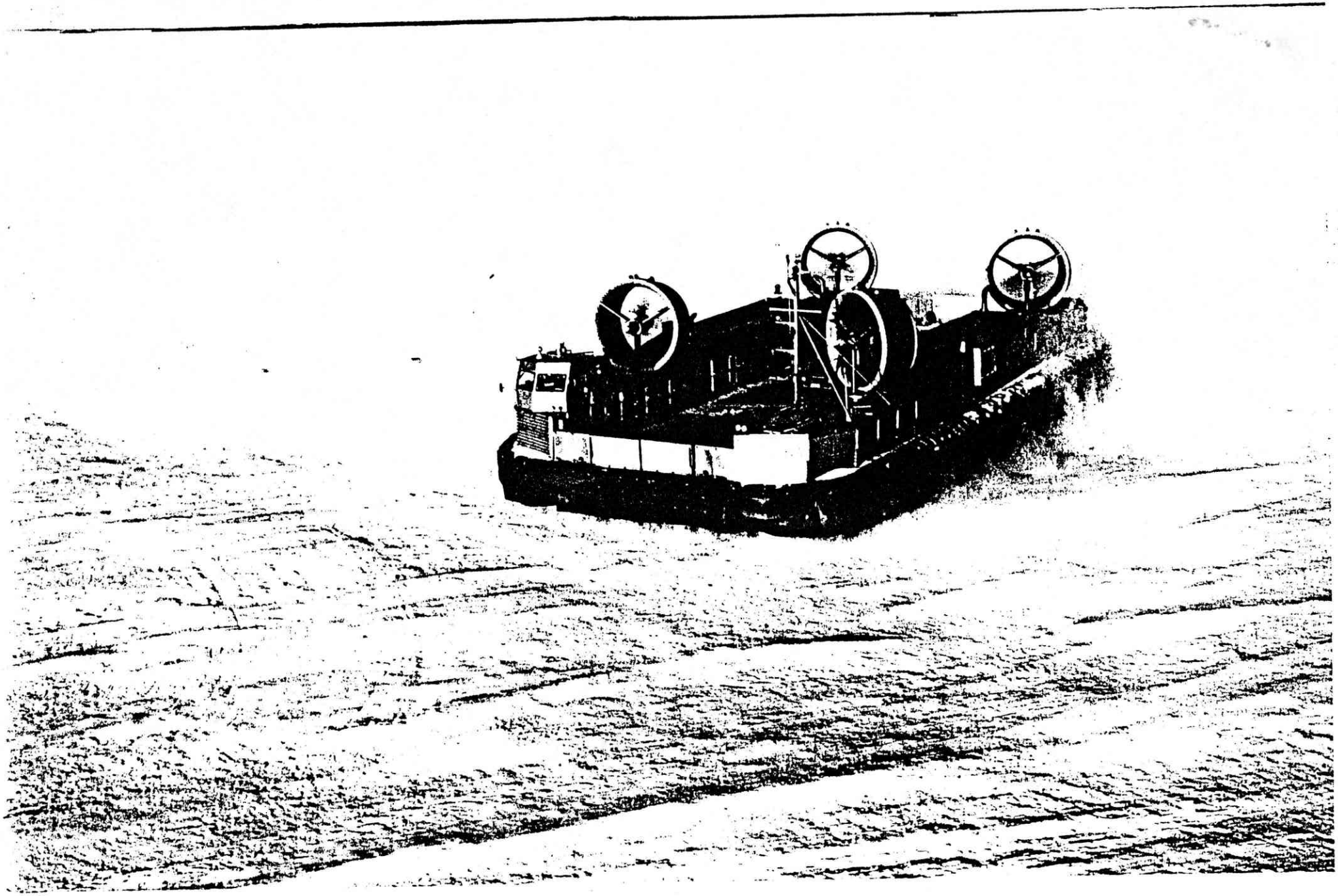
SAFETY PLAN

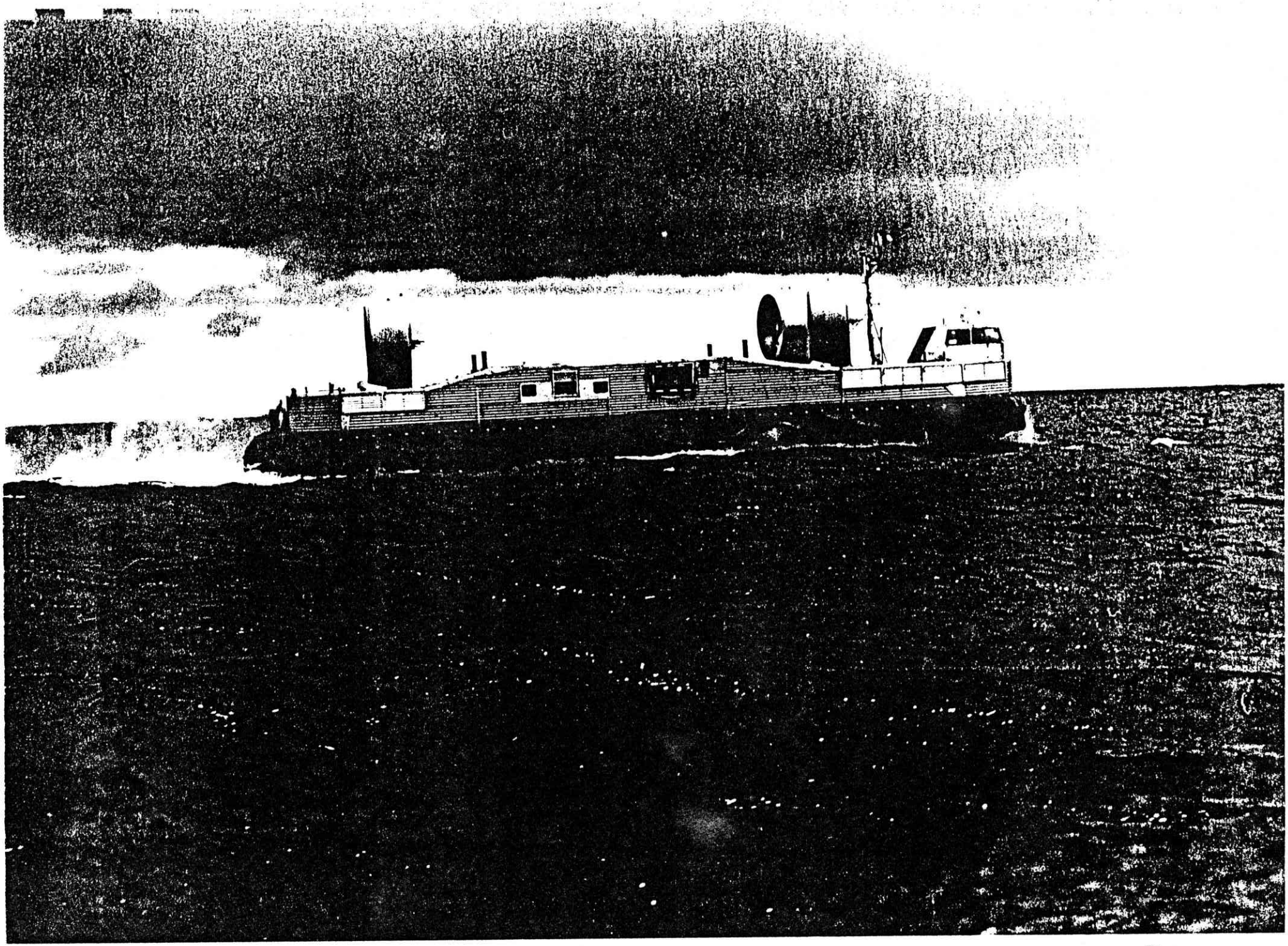


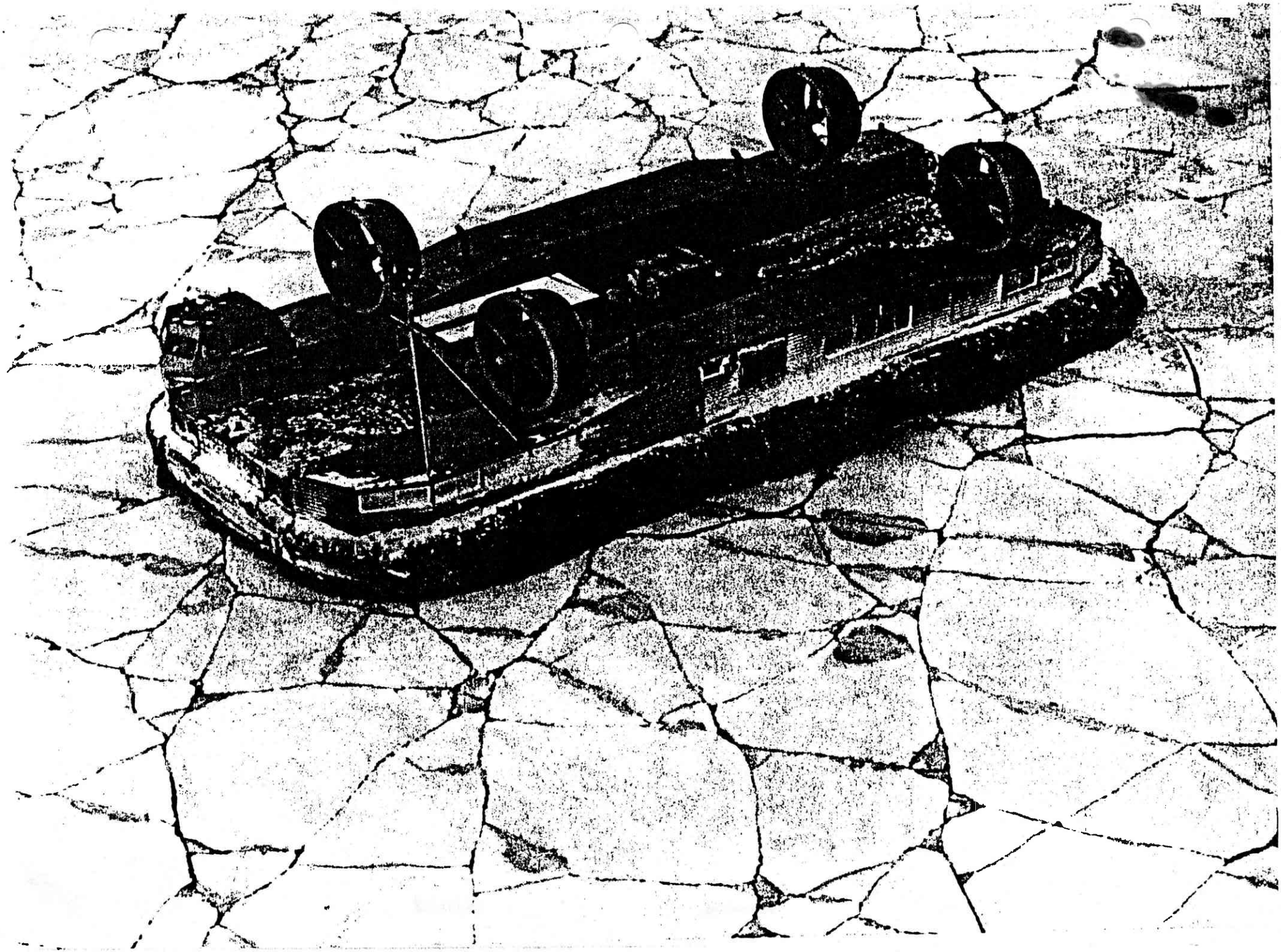


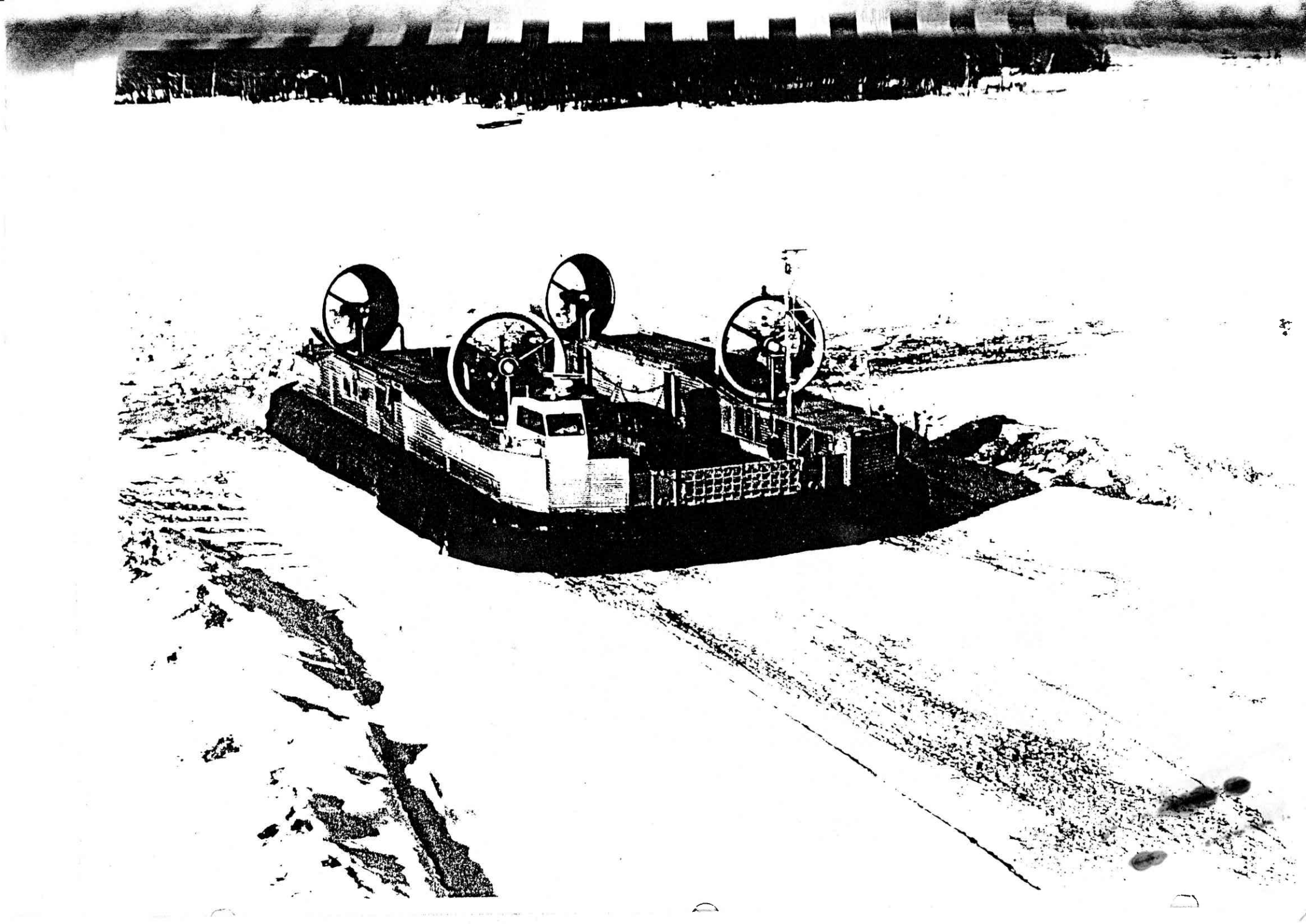
LIFERAFT 25 MAN	
LIFERAFT 10 MAN	

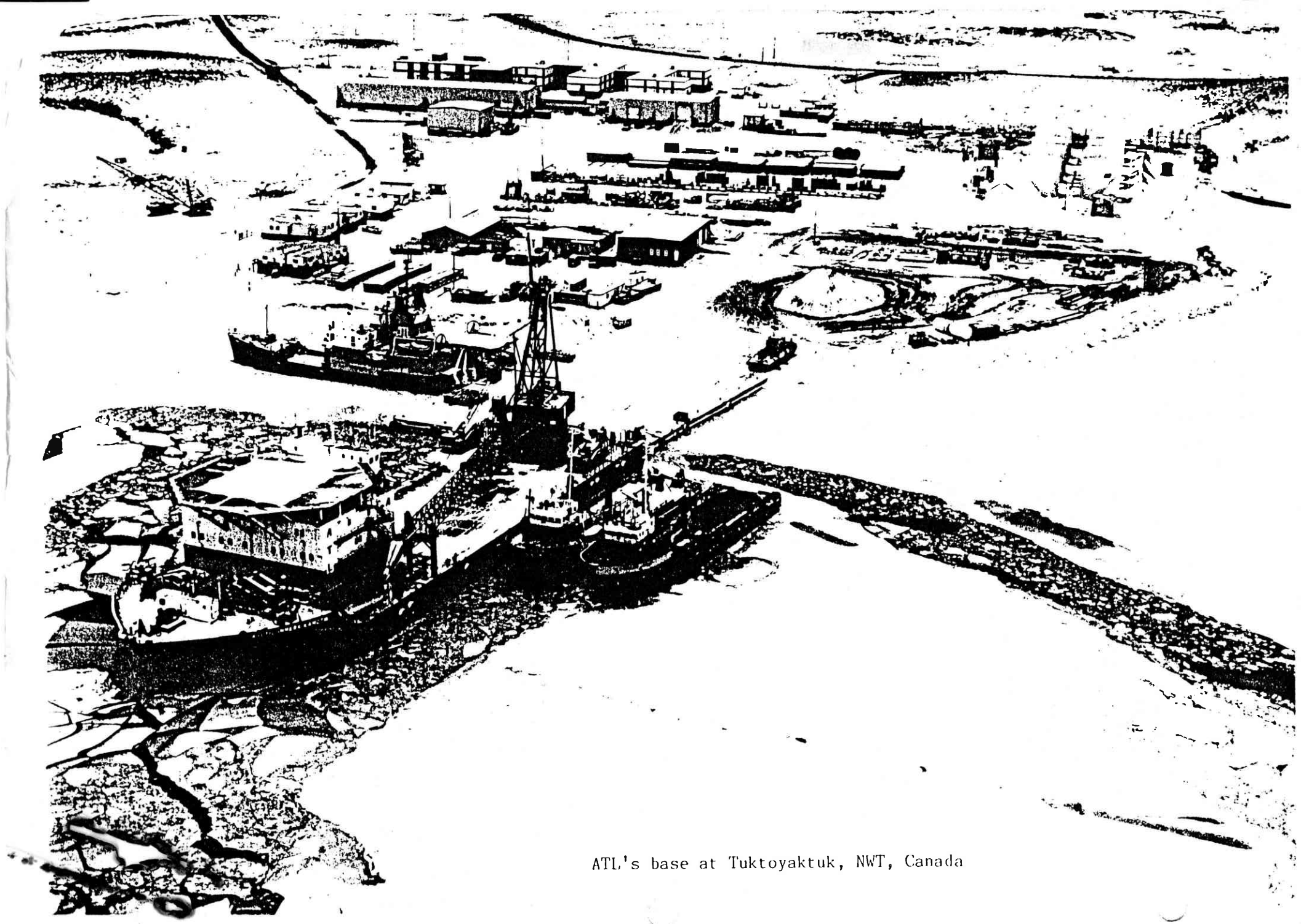
EMERGENCY EXIT	
PORTABLE 2 KG DRY CHEM. EXTINGUISHER CLASS A,B,C,D	











ATL's base at Tuktoyaktuk, NWT, Canada