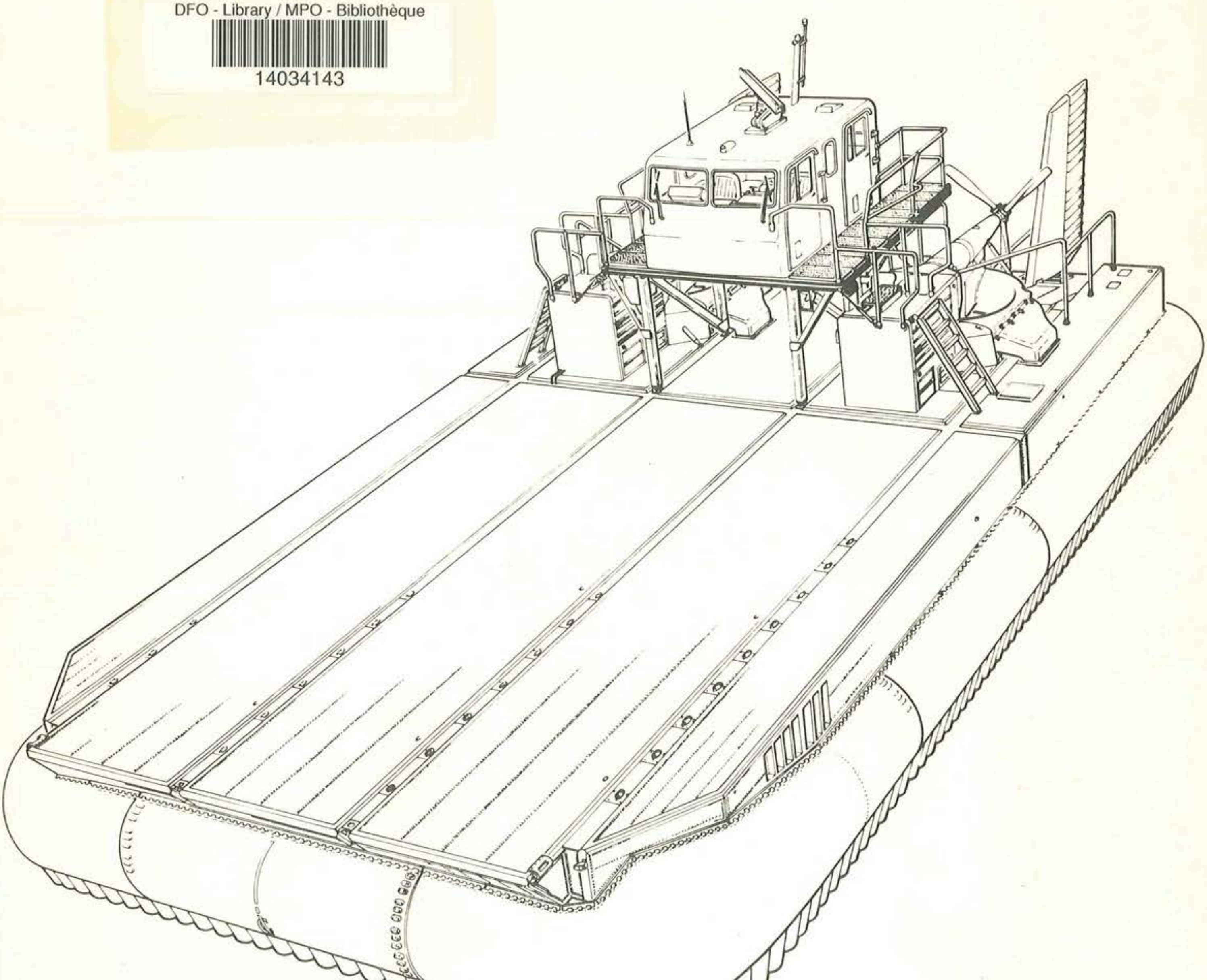
CANADIAN COAST GUARD



VOYAGEUR TRIALS

PHASE 1, 1972

125

MARCH 1973

A REPORT OF PHASE I OF THE CANADIAN COAST GUARD EVALUATION OF THE BELL AEROSPACE CANADA VOYAGEUR HOVERCRAFT

Prepared by: D.O. DUTFIELD,
Senior Captain, A.C.V. Division,
Marine Regulations Branch,
Ministry of Transport.

TRIALS PERSONNEL

B.W. MEAD	- Director, A.C.V. Operations, Northern Transportation Company Limited
A.C. SMITH	- Senior Project Pilot, Hoverwork (U.K.) Ltd.
G.P.J. DUSSEAULT	- Senior Pilot, N.T.C.L.
D.O. DUTFIELD	- Senior A.C.V. Captain, M.O.T.
C. CHADOLA	- Project Chief Engineer, Canadian Coast Guard.
R. THEEDOM	- Trials Officer, Canadian Coast Guard Headquarters.
C. PRESTON	- Data Collection and Analysing, Transportation Development Agency.

Nothing contained in this Report is to be regarded or used as an endorsation of any commercial product or equipment by the Ministry of Transport.

TABLE OF CONTENTS

SUMMARY

On August 29th, 1972, the Ministry of Transport's Transportation Development Agency (TDA) accepted delivery from Bell Aerospace Canada Ltd. of a Voyageur air cushion vehicle Model 7380, Serno 002.

T.D.A. contracted with the Northern Transportation Co. Ltd. (NTCL) to evaluate the vehicle in both Government and Commercial roles; the contract ends on September 30th, 1973.

During the contractual period the Canadian Coast Guard was allotted two periods for trials. The first at commencement of the programme and the second in May and June of 1973.

Between September 25th - December 4th, 1972, inclusive, the Coast Guard trials were conducted over three periods for a total of 126.6 engine operating hours. During these periods the vehicle was evaluated, through numerous trials, under a variety of weather conditions to determine its suitability in a Coast Guard role.

In addition to the NTCL trials personnel, the Coast Guard supplied a Hovercraft Captain, the Trials Officer and two seamen.

In general, the Voyageur was able to do all the tasks required of it, with the exception of the towing of a full sized buoy tender. The Voyageur was able to proceed at higher speeds, in all types of weather, than conventional Coast Guard units could have done, demonstrating its potential as a primary SAR unit as well as establishing its performance in a variety of Aids to Navigation roles.

In demonstrating its performance the hovercraft showed that it could be an effective unit for general Coast Guard duties in all areas of responsibility, except the open Atlantic and Pacific Oceans.

CHAPTER I

INTRODUCTION

The Aim

The aim of the trials was to assess this type of hovercraft for use in a general Coast Guard role with the emphasis on particular areas where the vehicle's amphibious capability and speed would be a primary advantage.

The Vehicle

The Voyageur hovercraft Model 7380 was developed by Bell Aerospace Canada Ltd. in a programme jointly funded by that company and the Federal Department of Industry, Trade & Commerce. The vehicle is the second of two prototypes, having superior power to the first, with modifications that include an internal ballast system, forward yaw ducts and power assisted rudders. The Voyageur is a general purpose amphibious flat bed ACV with a main cargo deck area of 1280 sq. ft. (118.9 sq.m.), a cargo loading capacity of 25 short tons and a maximum gross weight of 88,000 lbs. Powered by two United Aircraft of Canada Ltd. Twin Pac Model ST6T-75, multi fuel turboshaft engines, each rated at 1300 s.h.p. maximum continuous power, the craft can attain speeds in excess of 40 knots and can operate over rough terrain, marsh land, ice and water. It has an approximate range of 320 Nautical Miles.

Dimensions:	Length	64.8 ft. (19.75 m)
	Width	36.7 ft. (10.18 m)
	Height on Cushion	22.0 ft. (6.7 m)
	Height off Cushion	18.8 ft. (5.73 m)

Each Twin Pac engine drives through a Speco gear box both a Hamilton Standard 9 ft. diameter variable pitch propellor and a British Hovercraft Corporation 7 ft. diameter centrifugal lift fan. This fan discharges air through a plenum chamber into a flexible keel, lateral stability trunks and a 4 ft. high peripheral 50% fingered trunk or skirt.

Speed and cushion height are controlled by varying power output from the engines by throttles and by pitch settings of the pusher propellors. Directional control is achieved by foot operated, power assisted rudders, set directly in line with the propellor slipstreams, by differential propellor pitch and by hydraulically actuated yaw ducts in the fore part of the vehicle. An internal fuel ballast system provides longitudinal trim.

The operating controls, instruments and navigation equipment are housed in an 8 ft. square cabin elevated on a pedestal above the deck between the engines and has seating for the pilot, nivigator and four additional passengers.

The cabin contained:

- A Decca 202 high definition marine radar
- HF-AM Variable Frequency Radio
- VHF-AM Variable Frequency Radio
- VHF-FM Radio
- Marine Gyrosyn Compass
- Automatic Direction Finder
- Loud Hailer System

The radios, ADF, Intercom and Loud Hailer are integrated in two selector boxes, situated between the pilot and navigator. All deck surfaces are coated with a non-skid paint and the forward deck area is equipped with 58 cargo tie down fittings each stressed to 10,000 lbs. The cargo deck has a design pressure limit of 1,000 lb/sq. ft.; a deck loading plan is contained in Appendix F.

During the majority of the trials a 10 ft. travel trailer was carried on the deck, just forward of the control cab, to accommodate extra personnel and equipment.

Bell Aerospace designed and fabricated a buoy lifting package, consisting of a hydraulic crane, motor, winch and carriage with a forward sheave, which was installed in late November prior to trials to assess the vehicle's capability in this role.

Vehicle Operators

Three experienced ACV pilots operated the vehicle during the trials. These pilots, just prior to the trials, had undergone a short period of training on this model of vehicle and some allowance should be made that each particular trial was a new experience for them with this model. Due to his knowledge and experience of Coast Guard procedures and duties, the Coast Guard Captain piloted the vehicle in the majority of the trials.

Trials Area

The trials were conducted in the St. Lawrence River and Great Lakes, bounded by Prescott in the east and Port Lambton on the St. Clair River in the west.

Environment and Meteorological Conditions

NTCL is a subsidiary of Eldorado Nuclear Ltd. and the main base for the craft was at the Eldorado plant at Port Hope, Ontario. An area adjacent to the water, that previously was a car park, was cleared and fenced off and the shoreline was leveled to an incline of approximately 15° to give access to and from the water. The surface area of the base consisted of compacted sand and during dry weather, this surface had to be wetted down to reduce the amount of sand blown up by the vehicle when manoeuvring. On four separate occasions the vehicle was temporarily based elsewhere, twice at the Prescott Marine Agency, where no dry land parking facilities were available, once at the Sub Agency at Amherstburg on the Detroit River, where similar facilities existed and once at Trenton Canadian Forces Base, where space was cleared to allow the vehicle to land on a tarmac area adjacent to the water.

The Murray Canal was transited several times, once in 30 mph winds; this required considerable accuracy of control, as at the bridges, there was only 4 ft. of clearance on either side.

All trials were conducted over water with the exception of a small period, over swamp land at Port Lambton.

During the last four days of trials conducted at Trenton, the Bay of Quinte commenced to freeze over, to a maximum thickness of two inches.

Temperatures during the trials varied from 5°F to 65°F. Winds varied from nil to 50 mph and sea conditions of up to 12 ft. trough to crest were experienced. Visibility varied from 15 miles to zero in fog.

It was planned in the Trials Directive, contained in Appendix B, to duplicate some of the trials under night conditions. However, due to the non-availability of suitable equipment necessary for night operations these trials were not carried out. The vehicle was operated at night, by necessity, and no problems were encountered, except that extreme caution had to be exercised when in the close vicinity of land or other marine craft; this was due to the fact that the vehicle was not equipped with search or head lights. It is an established fact that, with the proper equipment and trained personnel, air cushion vehicles may be safely operated at night or other reduced visibility conditions and there is no reason to suppose, that the Voyageur, properly equipped, does not have this capability.

Areas of Responsibility

A Trials Directive originating from Coast Guard headquarters is contained in Appendix "B". It will be noted that a number of trials planned were not carried out. This was due to non-availability of equipment, breakdown and modification interruptions during the time alloted and the need to keep within the time frame of the overall evaluation of the vehicle.

CHAPTER II

TRIALS MANOEUVRES AND RESULTS

SECTION I

SEARCH AND RESCUE

In 1968 the Coast Guard established a Hovercraft Unit at Vancouver, B.C., to evaluate an SRN-5 hovercraft, primarily in the SAR role and to some extent, other Coast Guard duties. Since that date this vehicle has carried out numerous and widely varied SAR missions and is considered an extremely effective vehicle in the SAR role. Therefore, it was not the purpose of the recent trials to establish whether or not the hovercraft is an effective SAR vehicle. The intent of SAR trials with Voyageur, was to establish whether a larger vehicle is more or less effective in this role. Therefore, a number of trials, duplicating duties presently carried out by the Coast Guard hovercraft, were held to demonstrate Voyageur's effectiveness.

Shoreline Search by Day

Task: To simulate a shoreline search for a missing person in a known area.

Execution: The vehicle was dispatched and requested to search the shoreline in the Presqu'ile Provincial Park and Bay area, approximately 20 miles of shoreline. The vehicle proceeded at maximum speed to the area and searched the entire shoreline, 25 yards offshore, at speeds up to 25 knots in less than ¼ mile's visibility, in one and a half hours.

Results: The vehicle demonstrated that it was effective in this task. Search speed was dependent on the contours of the shoreline, but adequate control was maintained at all times. The cabin height of eye, 18 ft., offered good visibility for a detailed scrutiny of the shoreline and adjacent water.

Survivors from P/C Survivors from Water

Task: To simulate pick up of survivors from a swamped pleasure craft and to pick up a survivor from the water.

Execution: A small open boat was set adrift with two men in it. Wind 15 knots, 2-3 ft. seas. The vehicle approached on cushion, down wind of the boat, until approximately 10 yards away, at which time it was settled in the displacement mode. In this mode the boat was approached twice, bows on and on the vehicle's own starboard side. Both men transferred safely onto the vehicle. This manoeuvre was then repeated on cushion, the vehicle attempting to approach the boat and place it on the starboard bow. This was not successful.

A man wearing a floater suit and lifejacket then entered the water, and the vehicle again approached on cushion to within ten yards, and then manoeuvred in the displacement mode alongside the man. A scrambling net, previously rigged, was placed over the cushion and into the water, and the man boarded the craft without assistance. No attempt was made to repeat this manoeuvre on cushion. At the completion of this task, the boat was hoisted by hand onto the deck and carried back to the base.

Results: The vehicle demonstrated that it was capable of these tasks; however, its size and the position of the pilot hampered it. It was found that the best method for recovering the men from the boat was to pick them up over the starboard side in the displacement mode. The pilot's seat is on that side of the cab and he had difficulty in judging distances over the bow or along the port side, due to the blind spots. The attempt to pick up whilst on cushion, was unsuccessful due to the lightness of the boat and the fact that air escaping from beneath the skirt tended to blow the boat away.

Although the freeboard of the vehicle is only 18 inches, due to it being flat sided and the ballooning of the cushion when in the displacement mode, it was demonstrated that scrambling nets are the only effective method for a man to board from the water.

It was also demonstrated that rather than towing disabled small boats, it is better to carry them on the vehicle. At the time of this trial, the buoy lifting crane was not installed, but its potential in this area can be recognized.

Transfer of Survivors to and from Large Vessels

Task: To assess the vehicle's capability to pick up survivors from larger vessels including stretcher cases and to simulate transfer of survivors, that have been picked up, to a parent vessel.

Execution: This trial was carried out twice with a 40 ft. cutter and CCGS SIMCOE. With the cutter this was done in calm weather with the vehicle approaching the cutter in the displacement mode, and laying side by side. A stretcher case was transferred several times without incident. Trials with CCGS SIMCOE were carried out in a 15 mph wind but in calm water. The vehicle approached on cushion, the lee side of SIMCOE several times, with both units at varying speeds and survivors including a stretcher case were transferred back and forth without incident.

Results: The vehicle demonstrated its capability in this task. With the 40 ft. cutter, the deck of the vehicle, when in the displacement mode, was at the same level as the cutter's gunwhale. The vehicle's cushion maintained a 2 ft. gap between the two craft, but cushion pressure is sufficient to support the weight of a man, and this caused no problems. This trial was done in calm water and no opportunity occurred to repeat this in more adverse weather conditions, but it is felt, that due to the stability of the vehicle when in the displacement mode, that this task could be carried out effectively.

With the CCGS SIMCOE, it was found that transfers were best done on cushion, lessening the height, deck to deck and that the SIMCOE'S propellor suction assisted the vehicle in maintaining position. Had a higher freeboard vessel been used, scrambling nets would undoubtedly have had to have been used and a derrick or crane used for the stretcher case.

This trial also demonstrated that the vehicle could be used as a tender for landing cargo and supplies from larger ships.

Search Patterns

Task: To assess the vehicle's capability to carry out standard SAR search patterns and its degree of accuracy.

Execution: These trials were carried out in two parts. In the first part, a tidal gauge off Cobourg was used as the navigation point and expanding square, expanding circle, and track searches were attempted. In the second part, the CCGS SPINDRIFT was stationed in the search area, to plot the accuracy of the patterns and square and track searches were repeated, using navigational points outside the patterns.

At a later date, a track search was carried out, employing a Jet Ranger Helicopter as the search unit and the hovercraft, proceeding along the track, as the recovery unit.

Results: It was established that the vehicle can be effectively used in this task. The cabin height of eye (18 ft.) and the all round visibility allowed for detailed searching. The speed of the vehicle (average speed on search 26 knots) greatly reduces the time required to search an area; however, at this and greater speeds there could be a danger of the searchers missing a small object (a man's head) in the water. Initially it was attempted to carry out the search patterns on a time basis, but this due to wind conditions and a defective speed indicator, led to some inaccuracy of the patterns.

In using navigational points there were inaccuracies as well; this was due to the radar, which was not stabilized and the compass being difficult to see from the navigator's seat. The radar also had no variable range marker. A further difficulty encountered was the lack of facilities and space for plotting the search on a chart. The trial with the helicopter demonstrated that the vehicle proceeding directly along the track line, whilst the helicopter carried out the search, would greatly reduce the time of the search and subsequent recovery, as the vehicle's speed was compatible to that of the helicopter's speed of advance along the track line.

Towing

Task: To assess the vehicle's ability, from speed and control aspects, to tow vessels; also to establish the maximum size of vessel, in this ability.

Execution: Three sizes of vessels were used in these trials, a 40 ft. cutter, the CCGC SPINDRIFT, 70 ft. and the CCGS SIMCOE 179 ft. The vehicle has six towing points aft and as at that time, the strength factors of these points were unknown, a double bridle of nylon rope was used, attached to 4 of the towing points to distribute the stresses. The towing lines were 200 ft. and 300 ft. of nylon rope.

Method Used: Prior to the trials the bridle was rigged and lashed down between the engines. The vehicle was manoeuvred immediately ahead of the vessel to be towed and for safety reasons, the engines were shut down whilst the towing line was passed for attachment to the bridle. Engines were then re-started and the vehicle came to full cushion. Engine power and propellor pitch was gradually increased until 1300 s.h.p. was being developed on each engine. The tow was then continued for approximately 30 minutes on each trial to assess the controllability and forward speed. In the 40 ft. cutter trial, winds were 5 mph with calm seas.

CCGS SPINDRIFT trials, winds were 15 mph, seas 2-3 ft.

CCGS SIMCOE trials, winds were 15 mph in river water.

Results: The 40 ft. cutter was successfully towed at 10-12 knots at all angles to the wind. The 70 ft. cutter was successfully towed at 8 knots at all angles to the wind.

The vehicle was able to move the SIMCOE at approximately 2 knots but due to wind conditions was unable to maintain effective steering control. The vehicle demonstrated that it is well capable of towing vessels up to 70 ft. and that this capability can probably be extended to vessels of up to 100 ft. in length. It also demonstrated that it may be able to hold larger disabled vessels, from drifting.

Mercy Missions

Task: To assess patient comfort and capability of administering medical aid whilst in passage.

Execution: Two trials were carried out. The Assistant CGRO Trenton acted as the patient and a Trenton CFB surgeon attended. The first trial was a run from Presqu'ile to Port Hope with the patient and the doctor accommodated in the travel trailer. On the return trip, the patient and doctor were in the control cabin. Weather on both runs: Wind 10 mph; Sea: 2 ft chop with a 1 ft. ground swell.

The second trial was conducted at Trenton CFB, the intention was to carry an ambulance on the vehicle, but this was not available. However, a radio truck of similar design and size was substituted and the doctor and patient were carried in it for about 40 minutes whilst the vehicle made runs up and down the Bay of Quinte.

Results: The doctor's report and "patient's" comments are contained in Appendix C.

Fire Fighting

Task: To determine whether vehicle control is affected by water jet reaction.

Execution: A WAJAX portable fire pump of 100 psi capacity was loaded on board and positioned as far forward of the vehicle's Centre of Gravity, as possible. The vehicle was first tested for water jet reaction in the displacement mode and then on full cushion.

Results: These were inconclusive, due to the smallness of the pump. No reaction to the water jet was noticeable; nor was there any necessity for counter control. The pump was inclined to lose suction as the vehicle rose on cushion although the suction hose remained submerged.

Search and Rescue Appraisal

With the exception of towing CCGS SIMCOE, the Voyageur hovercraft effectively carried out all the tasks required of it. Its speed and amphibious capability gives it added advantages over more conventional units. The vehicle was able to proceed at greater speeds, in every type of weather met, than other CG vessels. The worst weather conditions encountered were 50 mph winds and seas of 10 to 12 feet, and the vehicle was able to maintain speeds in excess of 20 knots.

In some of the trials, the size and weight of the vehicle could be considered a disadvantage, when compared to the SRN-5 presently used in the SAR role. When manoeuvring close to small boats or persons in the water, it is very difficult to see and judge distances; this may be offset by pilots gaining more experience. However, size and payload would have its compensations, such as in major marine disasters, involving a large amount of persons or lifting small disabled p/cs on board, greatly reducing mission time.

In its present configuration, the cabin is too small for SAR operations. The minimum crew for SAR operations would be three, leaving room for only three survivors. The method of gaining access to the cabin up ladders and along catwalks would make it extremely difficult to handle stretcher cases, and injured or exhausted survivors. Considerable thought would have to be given to the design or deck modules to meet these requirements.

It was found during the search pattern trials that space allowed for navigation is inadequate; this was also apparent in the Aids to Navigation trials. The results of the fire fighting trials are inconclusive, and trials with larger pumps are indicated, but on the evidence of the vehicle's speed, manoeuvrability and carrying capacity, it should prove to be an effective unit in this role.

In the Mercy mission role, the vehicle's response time and speed will prove a definite advantage; however, the doctor's report in Appendix C is not very encouraging. There is no doubt that noise and vibrations will have adverse effects on a seriously ill patient. Due to the length of the craft and higher cushion pressure, the vehicle is very uncomfortable in short chop sea conditions and it would be extremely difficult to give medical aid under these conditions. It is possible that a module can be designed to exclude noise and vibration, but at this time it is felt that the vehicle is not compatible to this role except for transporting persons in as short a time as possible to the nearest medical facility.

The 10 hour fuel endurance of the vehicle is adequate for most purposes but in considering it as a shore based unit, this allows for only a 160 miles radius of action. In most areas of SAR responsibility this range is sufficient as additional fueling points could be available. However, in isolated areas the vehicle would probably have to be fitted with auxiliary fuel tanks or fuel caches established. Preferably the former as refueling from caches is a lengthy process.

In assessing the vehicle's performance and capability during the SAR section of the trials it is considered that the Voyageur hovercraft may be effectively used in SAR operations in sheltered coastal and inland waters.

SECTION 2

LIGHTHOUSE SUPPLY AND LOGISTICS

Trials were conducted in this role to assess the ability of the vehicle to land at light stations, to discharge supplies and personnel, to service unwatched beacons and to ascertain if any special construction, such as ramps, would be needed, should the vehicle be required for this role.

The vehicle in its present configuration and with a full fuel load has a payload of 34,000 lbs.; however, if used in general Coast Guard duties, this payload would be reduced by approximately 12,000 lbs. with the necessity to carry crew modules, equipment and buoy hoist/cargo crane, leaving 22,000 lbs. available payload, which is approximately equivalent to two barge loads, of the type presently in use on lighthouse supply vessels.

This section of trials was planned as Items 23-29 inclusive, in the Trials Directive,but due to the programme being interrupted only items 23 & 24 were carried out. However, an opportunity arose to test the vehicle under actual work conditions from the Marine Sub Agency at Amherstburg which was extremely useful.

Loading on & off at Agency on Land & Water

Tasks: To ascertain the most effective methods of loading and discharging. To ascertain deck loading configurations.

Execution: The vehicle transited from the Port Hope base to Prescott Marine Agency. There is no dry landing area available within the Agency and the vehicle was docked alongside the wall in the inner decking area. At this time the buoy hoist/cargo crane had not been fabricated. An Agency mobile crane was used for loading. Before commencing loading, it was necessary to lay planking over the vehicle's deck to distribute loads.

Various types of buoys were loaded aboard, including one 6 ft. fibreglass, one 2 ft. Spar, six boat type and six Mississippi buoys. None of the buoys were equipped with lanterns or radar reflectors. No stones, counterweights or moorings were loaded.

A second trial was held when the vehicle was based at Trenton during the buoy working trials. At this time the vehicle was equipped with its own crane, and whilst parked on the ramp, buoys, stores and moorings were loaded and discharged a number of times.

Results: The trials at Prescott Agency showed that the amount of buoys loaded, covered approximately 60% of the available deck space, the travel trailer was also on board at this time. The 6 ft. fibreglass buoy due to its weight had to be stowed close to the centre line. This buoy was stowed on end, and caused a considerable reduction in forward visibility from the cabin. None of the other buoys caused this, but it was clearly seen that considerable care had to be taken during the loading, both in placing and distributing the buoys, due to the danger of sharp edges or protruding lugs damaging the aluminum deck and care had to be taken to have the weight of the buoys evenly distributed on either side of the vehicle's centre line.

It was also shown that if buoys or cargo were loaded or discharged by the vehicle's own crane that the vehicle would have to be docked bows on as the crane only extends to 21'6" at 3,000 lbs. which if docked alongside would barely plumb over the dock.

As the vehicle's deck was only 18" below the dock side, some thought was given to loading buoys or cargo by fork lift, but it was thought that the fork lift's foot print load would be too great for the allowed deck loading pressures.

The trials on the ramp at Trenton, showed that the vehicle would have to be carefully parked near a cargo or buoy source to effectively use its crane.

Lighthouse Approaches

Task: To assess the vehicle's capability, in as many different landing situations and sea states.

Execution: These trials were effected on an opportunity basis during the first two periods of the trials. Approaches and landings were attempted at the following Light stations and Beacons:

Lake Ontario: Peter Rock, Scotch Bonnet, Point Petre, False Duck Is., Main Duck Is., Presqu'ile and Proctor Point.

Lake Erie: Long Pt., Southeast Shoal, Colchester Reef, Middle Sister and Pelee Passage.

St. Clair R.: 16 Light Towers.

Weather conditions ranged from calm to 40 mph winds with 6-8 ft. seas.

As the pilots were unfamiliar with the stations and beacons with respect to underwater terrain and obstructions, caution was exercised and in the majority of cases the vehicle was kept on full or partial cushion at the landing sites. In only two cases was there sufficient space for the vehicle to leave the water and park close to the light. With the larger beacons, the vehicle remained on partial cushion, whilst transferring technicians and equipment and then backed off and waited in the displacement mode until the light had been serviced. This method was also used whilst servicing the St. Clair River Light Towers. Two technicians were used on this task and having landed a technician at one tower, the vehicle proceeded to the tower on the opposite side of the river and landed the second technician, by which time, the first was ready for pick up. At Squirrel Is., back range light, the vehicle traversed about one-half a mile of 5 ft. high swamp grass and was placed against the light tower.

Results: At all the Light stations and Beacons visited, the vehicle was able to make controlled approaches and landings. It demonstrated that either beaching or on partial cushion, it provided a stable platform, for discharging supplies, equipment or personnel. At all the Light stations visited the vehicle was able to get close enough to storage areas so that a minimum of handling of supplies would have been required.

Only at Long Point and Main Duck Is. was the vehicle able to leave the water completely. At the latter,this was onto a small private landing strip at Schoolhouse Bay, about half a mile from the light, from which there was a road to the light. The vehicle also approached the light itself and demonstrated that it coujld be held against a low sea wall to discharge cargo.

At Southeast Shoal an exchange of Lightkeepers and their belongings was effected in 25-30 mph winds and seas of 3-4 ft. The access ladder to the light was on the weather side, the vehicle approached bows on the landing, but once against the light, weather cocked until it lay port side to.

When servicing the light towers on the St. Clair River, the vehicle's speed and manoeuvrability proved to be a distinct advantage over present methods. The Amherstburg's Sub Agent's letter contained in Appendix D, confirms this and also the extreme difficulty that would have been encountered in servicing the range light at Squirrel Is. However, one problem arose when hovering alongside lights, this being that a large amount of spray was blown up on the deck causing a lot of discomfort to the deck crew. It is felt that this can be resolved.

Items 25, 26, 27 & 28: -

Item 25, Lighthouse Supply by Voyageur and Jet Ranger

It was not possible to carry out this trial, but the Jet Ranger Helicopter was landed on the deck of the vehicle, both alongside the dock and on the open water, whilst in the displacement mode.

The helicopter also landed and discharged drums of fuel, in a sling load, onto and from the vehicle's deck.

Item 26 & 27, Lighthouse Fueling and Supply by Truck

These trials were not attempted, due to the unavailability of equipment and the foot print pressures of available trucks.

Item 28, Lighthouse Construction

No opportunity was presented to test the vehicle in this role.

Lighthouse Supply & Logistics Appraisal

Whilst it was not possible to carry out many of the planned tasks, it is felt, that with the knowledge of the vehicle's payload, speed and its demonstrated capability in landing situations that it could be effectively used in this role. Under actual work conditions the vehicle showed that it was particularly suited to servicing unwatched aids and that in this role there would be a considerable time and possible cost saving, over present methods.

The vehicle demonstrated that in adverse weather conditions it provided a more stable and controllable platform than small boats or barges presently used for supply work and Lightkeeper exchange. It was generally agreed that due to the weather it would not normally have been possible to effect the Lightkeeper exchange at Southeast Shoal.

Little work with a helicopter was possible but it is felt that the two units used in conjunction could considerably increase efficiency in supply and construction work.

SECTION 3

BUOY TENDING

Trials in this role were considered the most important aspect of the trials and originally four weeks were scheduled for this phase. However, due to the Buoy Lifting Package not being available and the lateness of the season, this period was drastically reduced both in time and area. Total time available for this period was four days and operations were restricted to the Bay of Quinte in the vicinity of Trenton CFB.

It cannot be said that any true trials were carried out, rather that it was an exercise for personnel to familiarize themselves in the equipment, methods of operation and to establish proof of the vehicle and its equipment's ability to lift and lay buoys of the type in use in the Hay River Marine Agency, so that a more detailed trial programme could be carried out in that area in 1973.

Based upon experience gained from Hovercraft Trials carried out at Hay River in the Fall of 1970 a contract was issued to Bell Aerospace Canada, for the design and manufacture of a buoy tending arrangement that would enable buoys to be lifted and layed over the bow of the vehicle.

The arrangement consisted of a carriage that traversed on rails, bolted to the deck, which served as a base for a HIAB 950 Hydraulic crane, a Gearmatic Hydraulic Winch, Model 11, these were powered by a Ford Industrial Diesel of 242 cc. The carriage included a boom with a roller sheave and chain guide that extended three feet from the bow, when in the working position. The lifting arrangement was designed to lift 7,000 lbs. at 9'6" boom radius and 3,000 lbs. at 21'6" boom radius. The hydraulic system contained relief valves that operated when these weights were exceeded.

The deepest depths found for the trials were 24 ft., established by a portable echo sounder. The Bay of Quinte has little or no current in the area worked. Sub-freezing temperatures were experienced throughout the period and there was a maximum of 2 inches growth of ice on the Bay.

A deck crew total of three (3) men were used throughout including the crane operator.

Lifting Method

On the vehicle being manoeuvred into position at the buoy, the crane hook or sling was hooked to the buoy's lifting lug and the buoy lifted clear of the water so that the buoy's bridle and mooring chain was positioned close to the roller sheave. The messenger wire on the winch was run aft to a snatch block attached to the deck below the control cab and then back to the roller sheave. A chain hook was attached to the messenger and hooked onto the mooring chain just below the buoy's bridle. The weight of the mooring was taken on the messenger and the chain detached from the bridle. The buoy was then swung clear and landed on deck. The mooring was then picked up by the messenger until the stone was clear of the water. The maximum length of mooring chain used was 30 ft. As the distance from the sheave to the snatch block was 40 ft. the chain was recovered in one stage. The crane hook was then attached to the mooring stone and the same lifted on deck.

Laying Method

The buoy, mooring chain and stone were made up as one unit and positioned close to the bow, the buoy was then lifted and placed in the water. The chain hook was attached to the crane and hooked into the mooring chain about 1 ft. above the stone, which was then brought around and positioned by the roller sheave. The messenger wire was then shackled on to a lug on the bottom of the chain hook. When it was required to slip the stone, an upward strain on the messenger reversed the hook allowing the chain to slip out.

Buoy Types Used

4'6" dia. Electric
Boat Type
2' dia. Winter Steel Spar
Ottawa River Spar
1,000 lbs. moorings used for all buoys

Trials

The first trials were carried out with the Ottawa River Spars and a whole morning was spent practising laying, picking up and improving methods until the average to lay buoy was eight minutes and to pick up, six minutes. Three Ottawa River Spars were layed in string approximately ¼ mile apart and then picked up, times were the same as before.

In an effort to simulate picking up a buoy in strong current conditions, an attempt was made to pick up an Ottawa River Spar whilst on cushion. There was some difficulty in this, as when on cushion the deck was too high for a man to guide the crane hook into the buoy's lifting lug. However, pick up was effected by dropping a chain noose over the buoy so that it tightened around the mooring chain below the buoy. No attempt was made to lay a buoy whilst on cushion.

The boat type buoy was layed in 13 minutes and picked up in 15 minutes. Some difficulty was experienced in the pick up as a four-part lifting sling had to be used and due to the height of the cage the bridle was too long, to enable the crane to lift the buoy's mooring bridle clear of the water so that mooring might be detached.

Considerable practice, in laying and picking up the 4'6" Electric buoy, was done until the average time to lay was 12 minutes and to pick up, 18 minutes.

A simulation of replacing the 4'6" Electric buoy with the 2' dia. Winter steel spar, without lifting the moorings was effected in 15 minutes.

Simulation of changing a lantern on the 4'6" buoy without picking up, was effected in 8 minutes and the simulation of replacing a battery, in 10 minutes.

Whilst carrying out buoy pick ups, it was found that as soon as the stone was clear of the water, the vehicle could come to cushion height and proceed at 15 knots, whilst the stone was being lifted on deck. It is possible that the men could have continued working on deck at greater speeds but in sub-freezing temperatures, the wind chill factor caused considerable hardship coupled with the fact of icy decks, being a hazard.

Buoy Tending Appraisal

The vehicle demonstrated that it has the capability and controllability to perform effectively in the buoy tending role, in areas where the largest buoy is of the 4'6" Electric type.

The equipment,and methods used during trials, was untried and operated by personnel unfamiliar with it. The effectiveness of any buoy tending unit relies upon its equipment, method of use and personnel. The buoy tending package is adequate for trials use,and with certain alterations contained in the Recommendations Chapter, should prove to be an effective system for operational work.

SECTION 4

MISCELLANEOUS TRIALS

Periods of time were allotted to Locking Trials, Oil Pollution Control and Noise Evaluation.

Locking Trials

Specific trials had been planned to evaluate the vehicle's ability to negotiate locks, but these proved unnecessary, when the vehicle was seconded to the Sub-Agency at Amherstburg, and transited the Welland Canal both ways.

The first transit took place over two days. On the first day the vehicle was locked in tandem with another vessel through Lock #1. Due to the other vessel in the lock, it was necessary for the vehicle to tie up to the lock wall; however, owing to the hazard of lines snaring the propellors or entering the lift fans it was requested of the Seaway Authority that either the vehicle be allowed to lock through without lines, or to wait until the engines were shut down and the propellors stopped before tying up. On leaving Lock #1 the vehicle was tied up for the night at Port Welland.

On the second day, the vehicle transitted the remainder of the Canal in three and one-half hours. It was not necessary to tie up in any of the locks as no other vessels were locking through at the same time. Initially it was attempted to lock through in the displacement mode, but when the lock was being flooded, it was extremely difficult to control the vehicle. Consequently, all the remaining locks were transitted on partial or full cushion to minimize the effects of water tubulence. This method caused a great deal of spray and hampered the men on deck, handling fenders.

On the reaches between the locks, the vehicle attained speeds of 30 knots. Its manoeuvrability and stopping capability was recognized by the Seaway Authorities and it was allowed to overtake other vessels. At no time did the vehicle interfere with the navigation of other vessels.

On the return transit, the pattern was slightly different. Again the vehicle was able to lock through alone, but as, when the locks are 'dropped', there is minimal turbulence, the vehicle was able to lie quietly in the displacement mode. The return transit was effected in about three and one-half hours.

On both transits a Seaway Authority Inspector was aboard acting as advisor on radio and navigation procedures.

Oil Pollution Control Trials

The purpose of these trials was to establish whether the vehicle could be used to any effect in this role.

The vehicle proceeded to the Dept. of the Environment facilities at Burlington where a section of PVC oil boom was loaded aboard. The vehicle then proceeded to deploy the section from a finger pier to the main wharf. This was effected with minimum effort. The vehicle then proceeded to make several passes, at full cushion over the boom, observed by DOE personnel, to determine how much the boom was depressed by the vehicle's action. The boom was observed to depress slightly but with the vehicle's speed little oil would have escaped.

There was 2000 ft. of PVC oil boom on the wharf and although no attempt was made to load aboard the vehicle, it could be seen with the known payload of the vehicle that all this boom could have been carried with space and payload to spare.

Noise Evaluation Tests

These were carried out by the Defence Research Board; a copy of the report is contained in Appendix E. Noise will be further discussed in the Chapter on Habitability.

Appraisals

Locking and Canal Transits

The vehicle demonstrated that it can be safely operated through canal and locking systems.

However, it should be realized the vehicle's short transit times were the result of the Seaway Authority's co-operation, in allowing the vehicle to use the locks on its own and in relaxing certain controls and regulations. This same co-operation was given by the authorities controlling the Murray Canal, which the vehicle transitted several times.

If the vehicle was on regular operation in the St. Lawrence seaway, it could be expected that it would have to lock through with other vessels, necessitating it tying up, and transit times would be considerably lengthened.

Oil Pollution Trials

In this role, it is felt that the most effective use of the vehicle, would be the rapid deployment of equipment and personnel. It was demonstrated that it is relatively easy to stream the PVC oil boom from the deck. The payload and deck space available would allow the vehicle to transport a minimum of 2,000 ft. of boom and it could also transport drums of dispersant.

Since the trials, it has been learned that offshore booms are being manufactured and will be contained in modules of 40'L x 12'B x 8'H; it is estimated that two such modules could be transported by the vehicle.

During the trials a Doctor of Chemical Engineering suggested that the vehicle may have sufficient mixing energy in the mass air flow, that dispersant could be injected into the plenum chamber. However, it is felt that the vehicle does not create sufficient turbulence on the water surface for this to be effective nor is it known what the chemical effects might be on aluminum surfaces. Due to air flow design, air is taken into the engine from the plenum chamber and this could seriously effect engine lubrication.

CHAPTER III

HABITABILITY

Throughout the course of the trials this was assessed wherever possible and opinions were sought from whoever travelled aboard the vehicle and reports obtained where possible.. The results of these are in essence, discouraging. However, certain factors have to be taken into account.

Voyageur 002, is a prototype vehicle, purchased by the Federal Government to evaluate it in both Government and Commercial roles. As the evaluation proceeds as much technical data is fed to the manufacturer as possible so that the production model may be improved. Habitability is part of that data, and no doubt the production model will be greatly improved in this area. The vehicle was designed as a freight carrier requiring minimal crew, although with its clean flat deck construction other roles were envisioned. As a freight vehicle, its main feature is payload, this being 25 tons for distances requiring 2 to 3 hours fuel, and the cabin was designed only for an oper ational crew of two, with provision for four extra persons.

Considering short periods of operation in a freight hauling role, the discomforts stated in the medical reports and noise levels, in the Defence Research Board report, could be considered acceptable but in a Coast Guard role, where crews are required to work long hours on searches or to work in inclement weather conditions on Navigational Aids, the vehicle in its basic configuration, cannot be considered habitable. Regardless of where personnel were, the control cab, the travel trailer, or on deck, ear protection was mandatory at all times and the DRB report raises doubts as to whether such protection is sufficient. Clearly, therefore, the control cab and any deck modules will require a great deal of sound proofing.

The doctor's and "patient's" reports referred to vibration and turbulence in relatively calm sea states. This is particularly evident in the control cab. The pilot's and navigator's seats are adjustable and free riding and therefore quite comfortable; however, the rear seat is of the bench type and uncomfortable for any period of time in all but flat calm conditions. Due to the cab being on a pedestal, in short seas especially there is a "whip lash" motion which becomes very fatiguing and all seats should be fitted with shoulder harness to reduce this effect.

In the basic configuration there appears to be sufficient room for six persons in the cabin for short trips. For the trials (and in the CG role) considerable space was sacrificed for avionics and test equipment and leg room for rear seat occupants was reduced. The lack of room to move around, caused considerable discomfort after about two hours.

It was found during the buoy tending trials, when it was necessary for the vehicle to remain at idle speeds in the displacement mode, that there was considerable ingestion of engine exhaust fumes into the cabin. It was not ascertained whether this ingestion was through the cabin ventilation and heating system or through bad seals; however, the cabin occupants suffered considerable discomfort and had the choice of opening windows, thereby increasing noise levels and reducing temperatures or of suffering the effects of the gases with stoicism. To accommodate extra trials' personnel, a travel trailer was purchased as a temporary measure and could not be considered as adequate accommodation for anything but short trips, again from high noise levels, vibration, turbulence effects and lack of room. As a CG Unit, the vehicle would have to be fitted with properly designed deck module(s), even considering it in a day tender role.

Spray was a problem throughout the trials and often made work on deck very difficult. Personnel were provided with wet weather gear but working under conditions where they were continually being drenched, especially in freezing temperatures, was most unpleasant and dangerous at times. It is possible that spray may be reduced by improved operating techniques.

For the vehicle to be used in the CG role considerable thought must be put to improving habitability.

CHAPTER IV

OPERATING AND ENGINEERING APPRAISALS

Operating

During the CG trials, the pilots had to contend with a wide range of operations and manoeuvring and in all cases it was felt that the vehicle handled well.

The three pilots involved in the trials all had extensive experience with SRN-5/6 type vehicles and it is natural enough that they compared Voyageur with these types.

In the first stages of the trials the pilots were still self-training and as situations arose, new techniques were developed so that as the trials progressed and pilot experience grew, so did the effectiveness of the vehicle.

From a control aspect, the handling of four engines with six throttles caused some problems at first but each individual soon developed his own technique. There were many control situations where one pair of hands sometimes seemed inadequate. This was due to the throttles and pitch controls being on opposite sides of the pilot and the fact that the yaw ducts switch on the centre console was spring loaded and had to be held open for individual yaw duct use. In tight control situations where yaw ducts were required, it became necessary for the navigator to operate the throttles with the pilot handling all other controls. It is therefore suggested that thought be given to shifting the yaw duct controls, to foot operation, possibly as extensions of the rudder pedals. A considerable plus factor in control, was the throttle/fuel control system. The fuel control units to which the throttles are linked are activated by pneumatic air from the engine compressors, and the engines therefore do not require overspeed or overtemping cut outs. The knowledge that heavy throttle handling or faulty electrical systems, would not cause sudden power cuts, lent considerable confidence to pilots, when operating in difficult situations.
Controls generally responded quickly with positive results, although at slow speeds the rudders were not too efficient, but this could be countered by propellor differential. On cushion, over land or water the vehicle has positive back up ability, which is a considerable advantage. This ability coupled with differential propellor control and puff ports, makes the vehicle far superior in manoeuvrability to SRN-5/6 type vehicles.

Due to the weight of the vehicle greater allowances for slip on turns at speed had to be made, but this was a function of pilot experience. The vehicle proved to be extremely docile in emergency stopping, plough in or assymetrical engine failure situations.

In heavy weather the vehicle handled extremely well and maintained good speeds. Knowledge of the vehicle's structural strength assisted pilots in these conditions in that vehicle fragility was not a prime factor of heavy weather operation. The all-round visibility of the craft is an asset and visibility from the control position was good in warm weather conditions but poor in below freezing temperatures as it was only possible to heat the windscreen. The pneumatic powered windscreen wipers were a source of annoyance, as at engine idle speeds there was often insufficient pressure to operate them. These should be altered to electrical operation.

Following the Radio Equipment retrofit, radios and intercom systems were generally good, but the pilot's transmit switch should be shifted from its position on the centre console to the starboard N2 throttle. The Automatic Direction Finder is inadeq-ate for SAR operations as it cannot be tuned HF-AM distress frequencies.

Control instrumentation is well sited and easy to read, but the warning light system is inadequate to give sufficient warning of malfunctioning oil systems. Several times during the trials oil system malfunctions occurred and had oil content and pressure gauges been provided, the malfunctions would have been recognized much sooner. No battery condition indication is provided and it is felt that this indication is mandatory.

The fuel ballast trim system gives inadequate trim authority and the rear ballast tanks should be increased in size to be comparable to the forward tanks. Ballast fuel can be used as emergency fuel but it is a lengthy process transferring to main tankage, necessitating beaching the vehicle and shutting down the engines. However, this could be greatly improved by substituting two electrically controlled shut off valves, operable from the cab, for the present manual ones.

Space for navigational duties is minimal and insufficient for SAR and light Aids tendering roles. Recommendations to increase this are contained in Chapter V.

It is felt that pilot conversion to this vehicle from single engine vehicles can be effected relatively quickly, providing that sufficient experience has been gained on single engine vehicles. This experience is felt to be: 200 hours direct control time in single engine vehicles of SRN-5/6 type, 4 to 5 hours training for type rating and 25 to 30 hours further experience to achieve Command status.

Engineering

When the vehicle was accepted from the manufacturers there was a total of 84.3 engine operating hours on it. These had been accumulated in the manufacturer's test programme, the Certification Test Programme and Acceptance trials. A further 60.5 hours were accumulated by crew training, so that at the commencement of the CG trials, total hours on the vehicle were 144.8.

As the vehicle was a prototype and many of its systems had little test time on them, it was expected that maintenance might be a major task. However, although a considerable amount of defects were experienced, the majority were readily repairable with minimum resources and equipment. There were several major defects that required manufacturer rectification, but only one of these occurred during the CG trials period.

The project Chief Engineer had prepared maintenance schedules which were adhered to as closely as possible and inspections were carried out on a progressive basis to increase the operational time as much as possible.

The major interruption of the CG programme was caused by the damage and loss of the lateral stability bags; this happened prior to the planned Radio Equipment Retrofit, scheduled for October 6th and 5 days were lost from the CG programme due to this defect. The CG programme ended one half day earlier than was planned when Nos. 3 and 4 engines commenced stalling. The cause of this was found to be excessive erosion of the first stage compressor blades and badly worn bleed air valves. These defects were caused by inadequate air filtration, presently being investigated by Bell Aerospace and United Aircraft Canada Ltd.

An encouraging side of the maintenance was the operation carried out from Amherstburg, when the vehicle was on detachment for eight days. This period was trouble-free apart from some minor skirt damage caused during operations. Throughout this period, the vehicle was maintained by two mechanics with no interference to operations.

It is too early to form any definite opinions on the maintainability of the vehicle but initially it appears encouraging.

CHAPTER V

RECOMMENDATIONS AND GENERAL CONCLUSIONS

RECOMMENDATIONS

The following alterations and additions are recommended, for the vehicle to become effective in the Coast Guard Role:

Control Cabin: More space should be allocated to navigation. It is suggested that the control cab be considered as a ship's bridge and not for personnel accommodation. Extra space could be obtained by removing the rear bench seat and installing a chart table in half the space, behind the pilot's position. The navigator's seat could be set on runners, with a suitable locking arrangement and be of a swivel type. The navigator would then be able to push back from the radar into the navigating area. To assist in taking sextant angles and transits, the cat walks should be extended around the rear of the cab.

Noise levels in the cab have to be considerably reduced if crews are expected to work long hours. Bell Aerospace are adding more insulation to the production model's cab and should be consulted on this.

Ballast System: The system has inadequate trim authority especially when the buoy handling packages is on board. It is recommended that the rear tanks (140 gals each) be increased in size and made compatible to the forward tanks (330 gals each). All valves should be electric and controlled from the pilot's position.

Buoy Handling Package: It is recommended that the system be made more flexible; this would probably entail changing the crane to a type that incorporates a winch and fall. Minor modifications are presently being made to package to make it more efficient for Phase 2 of the trials.

Crew Modules: Regardless of what type of duties are envisioned for the vehicle in the CG role, crew modules will be mandatory. These will require careful design, with emphasis on noise insulation. For a general CG role, crew size and content has not yet been established and the dimensions of modules that would be required are not yet known. However, certain advance planning is being done for design and costing on a module 10'L x 24'W x 8'H capable of supporting a crew of six for 3 or 4 days.

Skirt Modifications: During trials, where the vehicle was required to remain in static hover, spray over the deck was a major disadvantage. It may be possible to lessen spray by improving operating methods, but it is recommended that the design of an anti-spray apron be investigated. Arctic Systems Ltd., the manufacturers of the ACT-100 Transporter, incorporated an anti-spray apron on the skirt of that vehicle, which effectively reduces spray by about 80%. It is felt that a similar modification could be applied to Voyageur.

Working Deck: For the vehicle to be effectively used in a buoy tending role, the working deck area should be permanently decked over with wood; this would spread point pressure loads and reduce the risk of damage to the aluminum structure. During the buoy tending trials, deck icing became a problem. The incorporation of an anti-spray apron may reduce this b ut it is recommended that a de-icing method be investigated.

GENERAL CONCLUSIONS

In Phase I of the trials, the vehicle demonstrated its ability and potential in a variety of tasks. With the recommended modifications, it is felt that the vehicle could be effectively used for general Coast Guard duties in sheltered coastal and Inland water areas, where the largest floating Navigational Aid does not exceed the 4'6" electric type buoy.

It is felt that the vehicle has sufficient flexibility to allow it to be of potential benefit in other related government tasks; these could include: Hydrographic Survey, Marine Traffic Control, Seismic Survey, Ice Observing and Arctic Supply.

In assessing the vehicle's effectiveness for the Coast Guard role, no comparison with conventional C.G. units, regarding either Capital or Operating and Maintenance costs, is made. This should be the subject of a separate study and it is hoped that some data regarding this will be gained from Phase II of the trials.

****

APPENDIX "A"

CHRONOLOGICAL RECORD OF TRIALS

CHRONOLOGICAL RECORD OF TRIALS

DATE	OVERNIGHT LOCATION OF VEHICLE	ENGINE OPERATING TIME			SERVICEABILITY STATE	
		DAY HRS.	C.G. TOT. HRS.	TOTAL HOURS	0800	REMARKS
Sept. 25	PORT HOPE	8.3	8.3	153.1	S	CCG trials commence; shoreline search, lighthouse approaches.
26	PORT HOPE	6.0	14.3	159.1	S	CG trials; survivor pick up search patterns.
27	PORT HOPE	6.8	21.1	165.9	S	CG trials; mercy run, search patterns, tow by 70' cutter.
28	PORT HOPE	5.3	26.4	171.2	S	Tow of 40' & 70' cutters. Transit Port Hope to Kingston.
29	KINGSTON	1.8	28.2	173.0	S	Transit Kingston to Prescott buoy loading trials.
30	PRESCOTT	5.8	34.0	178.8	S	Transit Prescott to Port Hope.
Oct. 1 2 3 4	PORT HOPE				U/S	Lateral stability bags torn and missing, during transit on 30th
5	PORT HOPE	2.4		181.2	U/S	Transit to Toronto for radio retrofit
6 to 9	TORONTO				U/S	Undergoing radio retrofit and replacement of lateral stability bags.
30	TORONTO	1.5		182.7	U/S	Transit to Port Hope
Oct. 31 Nov. 1	PORT HOPE				U/S	Completion of radio retrofit.
2	PORT HOPE	5.7	39.7	188.4	S	Transit to Burlington, oil pollution trials. Transit of Lock #1 Welland Canal.

CHRONOLOGICAL RECORD OF TRIALS

DATE	OVERNIGHT LOCATION OF VEHICLE	ENGINE OPERATING TIME			SERVICEABILITY STATE	
		DAY HRS.	C.G. TOT. HRS.	TOTAL HOURS	0800	REMARKS
..ov. 3	PORT WELLAND	3.7	43.4	192.1	S	Transit of Welland Canal to Port Colborne
4	PORT COLBORNE	8.0	51.4	200.1	S	Transit Port Colborne to Amherstburg (232 miles)
5	AMHERSTBURG	2.8	54.2	202.9	S	Nav. aid servicing Lake Erie.
6	AMHERSTBURG	5.5	59.7	208.4	S	Nav. aid servicing St. Clair River.
7	AMHERSTBURG	5.0	64.7	213.4	S	Nav. aid servicing Lake Erie.
8	AMHERSTBURG	8.9	73.6	222.3	S	Lightkeeper exchange and transit to Port Colborne.
9	PORT COLBORNE	6.5	80.1	228.8	S	Welland Canal Transit to Port Hope.
10	PORT HOPE	5.3	85.4	234.1	S	Firefighting and ambulance trials Trenton CFB.
11) 12)	PORT HOPE				S	Vehicle being loaded for heavy haul handling trial
13	PORT HOPE	1.9	87.3	236.0	S	DRB noise measurement.
14	PORT HOPE	0.5		236.5	S	Demonstration.
15	PORT HOPE	1.9		238.4	S	Heater inoperative heavy haul handling trials at 83,000 lbs.
16	PORT HOPE	2.1		240.5		Heavy haul at 88,000 lbs.
17) 18)	PORT HOPE				U/S	Transmission shafts removed due faulty bolts
19	PORT HOPE	1.5		242	S	Heavy haul at 90,500 lbs.
20	PORT HOPE	1.3		243.3	S	Demonstration

CHRONOLOGICAL RECORD OF TRIALS

DATE	OVERNIGHT LOCATION OF VEHICLE	ENGINE OPERATING TIME			SERVICEABILITY STATE	
		DAY HRS.	C.G. TOT. HRS.	TOTAL HOURS	0800	REMARKS
Nov. 21	PORT HOPE	6.9	94.2	250.2	S	Transit to Trenton CCG VIP demonstrations.
22	PORT HOPE	4.5	98.7	254.7	S	Transit Port Hope to Prescott.
23	PRESCOTT	3.3	102.0	258.0	S	Helicopter trials "SIMCOE" tow and survivor transfer.
24	PRESCOTT	8.9	110.9	266.9	S	Transit Prescott to Port Hope.
25) 26) 27) 28) 29)	PORT HOPE				S	Installation and testing of buoy handling package.
30	PORT HOPE	3.6	114.5	270.5	S	Transit Port Hope to Trenton.
Dec. 1	TRENTON	3.7	118.2	274.2	S	Buoy handling
2	TRENTON	4.2	122.4	278.4	S	Trials
3	TRENTON	2.7	125.1	281.1	S	
4	TRENTON	1.5	126.6	282.6	S	CCG trials end.

APPENDIX "B"

COAST GUARD HEADQUARTERS TRIALS DIRECTIVE

TRIALS DIRECTIVE

COAST GUARD VOYAGEUR 002 TRIALS 1972

OPERATION ORGANIZATION

Coast Guard H.Q., Ottawa.

All participating authorities are requested to co-ordinate activities with Coast Guard H.Q., Trials Officer, Ottawa.

UNITS INVOLVED

Voyageur 002 - Hovercraft
CCGS GRIFFON) Ship Group
CCGS SIMCOE)
Bell 212) Air Group
Bell Jet Ranger)

AUTHORITIES IN LIAISON WITH H.Q.

Transportation Development Agency
Northern Transportation Company Limited
St. Lawrence Seaway Authority
DMA Prescott
CGRO Trenton
D,N.D.

SITUATION

The Transportation Development Agency has purchased a Voyageur Hovercraft from Bell Aerospace Canada. The Agency has contracted with Northern Transportation Company Limited for an extended evaluation of the craft's capability as a transportation vehicle in a variety of roles and areas. The evaluation period extends until September 1973. The Canadian Coast Guard has been allotted a period for trials on the Great Lakes and the Mackenzie River for evaluation of the vehicle in the SAR role and as an aids tender.

Commandant, Coast Guard has therefore directed Coast Guard H.Q., to plan for and direct the Coast Guard Voyageur Evaluation and has designated Trials Officer, H.Q., as Coast Guard OIC with control over elements assignment.

MISSION

The Coast Guard will evaluate the Voyageur in the following roles:

(a) Search and Rescue
(b) Lighthouse Supply
(c) Buoy Tending

. . . /2

The Trials Team will arrange exercises in each of the above roles to determine the suitability of the Voyageur in terms of technical capability for permanent service in the Coast Guard Fleet. Assistance will be provided to operational authorities as a secondary objective if workload is within existing capability.

Execution

The schedule of execution of the trial exercises will be as follows:-

Search and Rescue

Day 1	- Items 1 & 2
Day 2	- Item 3
Day 3	- Items 4 & 5
Day 4	- Items 7, 8, 9, & 10
Day 5	- Items 12 & 16
Day 6	- Items 13 & 16 (con'd)
Day 7	- Item 14
Day 8	- Items 15 & 17
Day 9	- Items 18 & 19 & 19A
Day 10	- Items 20, 21 & 22
Day 11	- Item 6 (on an opportunity basis)
Day 12	- Item 23
Day 13	- Item 24
Day 14	- Item 25
Days 15 & 16	- Item 26
Day 17	- Item 27
Day 18	- Item 28
Day 19	- Item 29
Day 20	- Item 30
Day 21 - 25	- Items 31 & 32
Day 26	- Items 33 & 34
Day 27	- Items 35 & 26
Day 28	- Items 37 & 38
Day 29	- Items 39 & 40
Day 30	- Items 41 & 42
Day 31	- Items 43 & 44
Day 32	- Items 45 & 46
Day 33	- Items 47 & 48
Day 34	- Item 49
Day 35	- Item 50
Day 36	- Item 51
Day 37	- Item 52
Day 38	- Item 53
Day 39	- Item 54
Day 40	- Item 55

Command and Communication

Director, Air Cushion Vehicle Operations, Northern Transportation Company Limited has overall control. Commandant, Coast Guard retains operational control of the Coast Guard Trials Team through CGRO Trenton.

The daily 0800 message required by CGO should be sent by Voyageur throughout the Coast Guard Trial period.

Priorities

The primary function of the craft during the period will be as a test vehicle and actual operations to meet Prescott or CGRO Trenton requirements and will only be conducted on an opportunity basis. Before the craft can be detached from Coast Guard work, during this period clearance will be required from the Commandant, Canadian Coast Guard.

Issued under the authority of

J. A. Gallant

(For) I. Green,
A/Commandant,
Canadian Coast Guard.

Sept. 5, 1972.

DISTRIBUTION

Transportation Development Agency (2)
Chief Air Cushion Vehicle Division (1)
DMA - Prescott (2)
Master CCGS GRIFFON (1)
Master CCGS SIMCOE (1)
CGRO - Trenton (2)
NTCL, ACV Operations (1)
Trials Officer - Ottawa (1)
St. Lawrence Seaway Authority (1)
Master CCGS SPINDRIFT (1)
Senior Pollution Contingency Officer (1)

A N N E X "A"

Detailed Trials Program of Coast Guard Voyageur Hovercraft Trials by Items.

ITEM #1

The Landing and Carrying of a Helicopter

With the Voyageur down on land an attempt is to be made to land a Jet Ranger on its deck. If successful the Jet Ranger is to attempt a landing when the Voyageur is waterborne. After securing the Jet Ranger on deck Voyageur should undertake a 20 mile run to assess her ability to carry a helicopter. The helicopter should then depart for shore before Voyageur arrives back at base.

ITEM #2

Refueling a Helicopter

While the helicopter is on deck an attempt should be made to refuel the Jet Ranger either from a drum or the Voyageur's own fuel tanks.

ITEM #3

Locking

Voyageur should be run to Welland and the first lock, and a locking be done to assess Voyageur's locking ability. One locking in each direction is all that is required.

ITEM #4

Shoreline Search Day

A body package is to be placed in the water about 10 feet offshore. Voyageur is then to be given a general area information such as is normally given in SAR incident. The time taken for the recovery of the body package and the return to base will be assessed against the time required for a cutter under similar conditions.

ITEM #5

Shoreline Search, Night

In this trial the body package will be placed on shore at 15-25 miles distance. Using the scanty, SAR information given, Voyageur is to recover the body package and return to base.

/2..

ITEM #6

Heavy Weather Trials

At first available opportunity Voyageur should proceed to sea during a period of heavy weather and her ability to remain manageable with the sea on the bow, on the beam, on the quarter, and on the stern should be assessed.

ITEM #7

Square and Track Search Pattern by Day

The search patterns are to be done by the Voyageur alone. The cutter will anchor clear of the area and plot Voyageur at each turn. The results when plotted on top of the intended Search Patterns will show accuracy.

ITEM #8

Square and Track Search Pattern by Night

The above patterns will be repeated at night.

ITEM #9

Search Pattern by Day with a Radar Buoy

The track and expanded square search patterns should be repeated using a radar reflecting buoy placed at the most probable position.

ITEM #10

Search Patterns by Night with a Radar Buoy

The above patterns will be repeated at night.

ITEM #11

Search with Helicopter

A square search pattern will be done by Voyageur and a helicopter. With the helicopter able to vary her speed an optimum speed for searching with Voyageur should be found. Also the possibility of the Voyageur being the rescue vehicle and the helicopter, the search vehicle should be considered.

ITEM #12

Long Range Mercy Run

An interested third party will be considered injured and be stretcher laden. A long range run around Prince Edward County will be done.

From this, an assessment from the third party will be procured stressing comfort etc. An attempt will be made to have a doctor in attendance to assess the first aid ability of the craft.

An average speed figure for the run will be produced along with the doctor's report.

ITEM #13

Long Range Mercy Run with Ambulance

The aforementioned mercy run is to be repeated with an ambulance placed on deck. The patient and doctor assessing the merit of bringing the ambulance onboard the craft instead of containing the patient in the main cabin.

ITEM #14

Oil Pollution

Voyageur should attempt a spraying and an oil boom laying operation. Also a slick licker should be placed on deck so an assessment of the modification necessary for a hovercraft mounted slick licker can be determined.

ITEM #15

Survivors from P/C

With the ability to contribute to SAR work Voyageur should be able to recover casualties from a swamped P/C. A small boat should be procured and the above done.

Survivors from Water

Voyageur should pick up survivors from the water and her ability at this is to assessed.

P/C on Deck

Considering the relative size of Voyageur and time being of the essence it might be less time consuming to hoist the P/C on deck than to tow it back to base.

To find out a P/C should be swamped and Voyageur should attempt to bring it back on deck. The P/C should be approached at various speeds.

ITEM #16

Firefighting

A fire pump is to be mounted on Voyageur and its ability to fight fires within the limits of the equipment provided should be assessed. The controlability of the craft when a high pressure pump is operating and its ability to maintain a position upwind of the fire are to be determined.

Voyageur ability to mount a fire truck should also be determined by actually mounting a fire vehicle.

ITEMS #17 & 18

70' Tow 44' Tow

Voyageur should tow both a 70' cutter and a 44' cutter. These tows are to be prolonged to establish an average rate of advance.

ITEM #19

Simulated Refueling

A hose will be passed from a 70' cutter to the Voyageur astern. Then a run will be done to assess Voyageur's capability to being refueled while underway.

ITEM #19A

Tow by 70' Cutter

Voyageur should be able to be towed with little difficulty. A prolonged tow by a 70' cutter is to establish Voyageur's characteristics under tow.

ITEM #20 & 21

Survivors to and from SIMCOE including injured

Survivors are to disembark from "SIMCOE" via scrambling nets and an injured party is to be transferred by stretcher. After a short run to assess accommodating such a larger number of survivors the men should be transferred back to "SIMCOE" via the same method. This will assess transfer aboard a larger vessel.

ITEM #22

SIMCOE Tow

Voyageur should take a towline from CCGS SIMCOE and attempt to tow her for a prolonged duration. This is to establish an average rate of advance of towing a vessel that size.

ITEM #23

Loading on and off at agency on land and water

Voyageur should be loaded and unloaded both in the water and on the land at the Prescott Agency. This will be an assessment of the best method of loading.

ITEM #24

Lighthouse approach

Available lighthouses should be approached and assessments should be made concerning modifications necessary. This is to attempt to outline a standard approach ramp.

ITEM #25

Lighthouse supply by Voyaguer & Jet Ranger

A run should be made with the Voyageur passing close to several lighthouses. A Jet Ranger in attendance should shuttle makeshift cargo ashore. Several trips should be made at each light.

ITEM #26

Lighthouse Fueling

An attempt should be made to simulate lighthouse fueling by barrel, truck and balloon. The different discharge rates should be measured and assessed.

ITEM #27

Lighthouse supply by truck

Delivery by a truck right to the lighthouse door should be tried with Voyageur bringing the truck as close to the lighthouse as possible.

ITEM #28

Lighthouse Construction

Voyageur should take a lighthouse tower to a predetermined area and attempt to erect a proper light.

ITEM #29 & 30

Undetermined Tasks

These items are vacant and set aside for item previously aborted or to investigate new trial areas which come to light throughout the trials.

ITEM #31

Park Establishment

Voyageur will take all the required buoys necessary for the trials from Prescott and establish a buoy park on a designated island.

ITEM #32

Crew Workup

Several days of buoy lifting using Ottawa River spars will be done. This is to get all concerned fully familiar with buoy tending by hovercraft.

Buoy Laying and Retrieving

Using 6 of one type of buoy retrieval runs will be done with the buoys placed at $\frac{1}{2}$ then 1, 2 & 5 mile intervals. The placing of these buoys will constitute the buoy laying trials.

These runs will be repeated with four different types of buoys with different handling characteristics.

ITEM #33

Ottawa River spars $\frac{1}{2}$ mile separation.

ITEM #34

Ottawa River spars 1 mile separation.

ITEM #35

Ottawa River spars 2 mile separation.

ITEM #36

Ottawa River spars 5 mile separation.

ITEM #37

Boat type buoy ½ mile separation.

ITEM #38

Boat type buoy 1 mile separation.

ITEM #39

Boat type buoy 2 mile separation.

ITEM #40

Boat type buoy 5 mile separation.

ITEM #41

Mississippi type ½ mile separation.

ITEM #42

Mississippi type 1 mile separation.

ITEM #43

Mississippi type 2 mile separation.

ITEM #44

Mississippi type 5 mile separation.

ITEM #45

2' steel spar ½ mile separation.

ITEM #46

2' steel spar 1 mile separation.

ITEM #47

2' steel spar 2 mile separation.

ITEM #48

2' steel spar 5 mile separation.

ITEM #49

General buoy 10 mile intervals.

ITEM #50

General buoy 20 mile intervals.

ITEM #51

Largest buoy workable

Voyageur should attempt larger sized buoy and determine the maximum size of each that can be safely handled by her. An evaluation should also be done to determine Voyageurs maximum load of each with and without moorings.

ITEM #52

Buoy servicing strong current

Voyageur should attempt to lay pickup and service a buoy in strong current.

ITEM #53

Bell 212 and Voyageur

In conjunction with the Bell 212 Voyageur should attempt a buoy retrieving operation with the Bell 212 removing the buoys from the Voyageur's deck and placing them in a buoy park.

ITEM #54

Run against CCGS SIMCOE

A buoy should be assumed to have been damaged and both Voyageur and CCGS SIMCOE should depart base to replace it the time difference should be assessed.

ITEM #55

Breakdown of Park

The buoy park should be broken down and all equipment returned to Prescott.

ANNEX "B"

EQUIPMENT REQUIREMENTS COAST GUARD VOYAGEUR HOVERCRAFT

Binoculars

2 Sextants

2 Station Pointers (Plastic)

Parallel Rulers, Dividers

Chart folio 22

6 work vests

6 safety hats

6 Ottawa River spars

6 boat type buoys

6 Mississippi type buoys

6,2' Steel can Spars or substitute

1 4'6" buoy

4 assorted lanterns with power source

1 towing bridle (see diagram)

chain nipper and buoy hooks

6 assorted stones and moorings

10 ear defenders or ear plugs

Turnbuckles, ropes and buoy blocks for tie down

Light repair box and tools

Marker buoy and stone

Drogue buoy with radar reflector

Senhouse slip

Wire slings with and without hooks

Cargo net

Boathooks

Hand lead line

Wood planking for deck

Stretcher

Portable sounder

Fire pump

Doctor - fire monitor

Truck ramp

Helicopter mats

Helicopter fuel (drums)

Helicopter fueling pump

APPENDIX "C"

DOCTOR'S AND "PATIENT'S" REPORTS

COAST GUARD RESCUE OFFICER

HOVERCRAFT TRIALS

ASSESSMENT OF PATIENT TRANSPORT/EVACUATION

1. ON TWO OCCASIONS THE UNDERSIGNED HAD OPPORTUNITY TO FLY ONBOARD THE MOT HOVERCRAFT IN THE SIMULATED CAPACITY OF MEDICAL ATTENDANT. THE PURPOSE OF THESE TRIPS WAS TO ASCERTAIN AND ASSESS THE MACHINE'S EFFECTIVENESS IN CARRYING ILL OR INJURED PERSONNEL. IN THE FIRST INSTANCE, ON SEPTEMBER 27, 1972 ACCOMMODATIONS ASSESSED WERE (A) A TRAILER BODY ATTACHED TO THE DECK IMMEDIATELY IN FRONT OF THE CONTROL CABIN SUPERSTRUCTURE AND (B) THE CONTROL CABIN ITSELF. THE NEXT OCCASION OF ASSESSMENT WAS 10 NOVEMBER 1972 WHEN A TRIAL WAS MADE USING AN "AMBULANCE" LASHED TO THE DECK IN FRONT OF THE TRAILER BODY MENTIONED ABOVE. THE FOLLOWING COMMENTS THEN ARE DERIVED FROM PERSONAL OBSERVATION AND EXPERIENCE AND ARE SUBMITTED FOR YOUR CONSIDERATION.

2. THE INITIAL RIDE WAS MADE IN THE TRAILER, FROM PRESQU'ILE TO PORT HOPE AT AN AVERAGE SPEED OF 31 KNOTS. SEA STATE WAS ESTIMATED AS A ONE FOOT WAVE IN A 7-8 MILE WIND THAT WAS BLOWING ACROSS THE COURSE OF THE CRAFT. THE CAPTAIN REPORTED A SWELL OF ONE FOOT AS WELL AS THE WAVE ACTION.

3. ON START UP ENGINE NOISES WERE ESTIMATED TO BE ABOUT THOSE ENCOUNTERED IN ARGUS OR HERCULES AIRCRAFT. AT IDLING SPEED IT WAS NECESSARY TO SHOUT TO MAKE FACE TO FACE COMMUNICATION. ON INCREASING SPEED IN ORDER TO BECOME AIRBORNE AND UNDERWAY, THERE WAS A DECIDED INCREASE IN PITCH AND DECIBEL LEVELS. AS A RESULT, CONVERSATION IS AT A MINIMUM DUE TO THE EXCESSIVE EFFORT REQUIRED FOR SUCH COMMUNICATION.

4. IN RECOGNITION OF THIS HAZARD THE CREW WAS SUPPLIED WITH A SOUND ATTENUATION DEVICE KNOWN AS THE WILSON SOUND BAND. THOUGH THE WEARING OF THESE AURAL PROTECTORS IMPROVED VOICE COMMUNICATION (AS EXPECTED) THE ATTENUATION WAS NOT AS GOOD AS THAT PROVIDED BY MY OWN STETHESCOPE (LITMAN) WITH THE PICK UP HALF COCKED. OIL SEAL EAR MUFFS WERE NOT ASSESSED. THE INTERCOM SYSTEM WAS RECOGNIZED AS BEING INADEQUATE AND HAS SINCE BEEN MODIFIED, (WITH ONLY MODERATE SUCCESS AT IMPROVEMENT).

5. IN TERMS OF PHYSICAL COMFORT DURING THE RIDE, THE SEA STATE MENTIONED ABOVE WAS CAUSATIVE OF CONSIDERABLE VIBRATION. THE VERTICAL MOTION IS EQUIVALENT TO THE SEVERE TURBULENCE THAT CAN BE EXPERIENCED OCCASIONALLY IN CONVENTIONAL AIRCRAFT. THERE ARE TWO POINTS OF DIFFERENCE. THE HOVERCRAFT IS NOT SUBJECT TO LARGE AIR POCKETS AND THEREFORE ONE IS NOT SUBJECTED TO THE SINKING SENSATION WITH ASSOCIATED ORGAN DISPLACEMENT, THAT CAN OCCUR IN AEROPLANES. HOWEVER, IN THE HOVERCRAFT THE VIBRATION IS CONTINUOUS. THIS COULD PROVE TO BE EXTREMELY FATIGUING AND MORE THAN UNUSUALLY UNCOMFORTABLE, FOR PATIENT, ATTENDANTS, AND CREW. THE NECESSITY OF REPORT WRITING WOULD HAVE TO BE HELD TO A MINIMUM AS THE VIBRATION MAKES THIS ACTIVITY NEXT TO IMPOSSIBLE.

6. THE ACCOMMODATION PROVIDED BY THE TRAILER IS MUCH LESS THAN SATISFACTORY FOR PURPOSES OF CARRYING PATIENTS. HEAD ROOM IS INSUFFICIENT FOR PEOPLE WHO MEASURE MORE THAN 5 FEET 10 INCHES. THE TOP BUNK CANNOT BE CONSIDERED FOR HOLDING A PATIENT BECAUSE OF POOR ACCESS. IF A PATIENT IS LAID OUT IN THE BOTTOM BUNK THIS ELIMINATES SEATING ACCOMMODATION FOR ATTENDANTS AND CREW. THE DOOR TO THE PRESENT TRAILER DOES

NOT PERMIT INGRESS OF A PATIENT WHO COULD NOT BE REMOVED FROM A LITTER. THE NOISE AND VIBRATION MENTIONED ABOVE MAKES PHYSICAL EXAMINATION IMPOSSIBLE IN TERMS OF DETERMINING PULSE RATES, BLOOD PRESSURES, HEART SOUNDS AND CHEST SOUNDS. IN SHORT, PATIENT ASSESSMENT IS LIMITED TO WHAT CAN BE GROSSLY SEEN OR SMELLED.

7. THE RETURN TRIP FROM PORT HOPE WAS SPENT IN THE CONTROL CAB. THOUGH THERE IS A FULL LENGTH BENCH SEAT IN THIS LOCATION THE HAZARDS OF THE TRAILER SPOKEN OF ABOVE ARE EQUALLY AS GREAT. THERE IS IN FACT LESS ROOM FOR ATTENDANTS, NOISE REMAINS A PROBLEM, AND THE VIBRATORY MOTION IS COMPOUNDED BY A DISTINCT SWAY RESULTANT FROM THE CAR LOCATION ON A PEDESTAL THAT PLACES IT FURTHER AWAY FROM THE FULCRUM ON A SWINGING ARM.

8. THE CONCLUSION MADE FROM THIS RIDE CAN BE QUICKLY SUMMARIZED IN ONE SENTENCE. <u>THE PRESENT CONFIGURATION OF PERMANENT AND SEMIPERMANENT SUPERSTRUCTURES ON THE DECK OF THE HOVERCRAFT MAKE IT IMPRACTICAL AS A METHOD OF TRANSPORTING ILL OR INJURED PATIENTS REQUIRED LITTER CARE.</u>

9. THE TRIAL RUN IN THE "AMBULANCE" WAS A COMPLETELY DIFFERENT STORY. NOISE AND VIBRATION WERE CONSIDERABLY REDUCED. THIS WAS PROBABLY DUE TO A LOCATION FURTHER FORWARD OF THE HOVERCRAFT ENGINES, AND TO THE INHERENT SPRINGING AVAILABLE IN THE VEHICLE AND SHOCK ABSORBING EFFECT OF VEHICLE. SUSPENSION AND ELASTICITY OF THE TIE DOWN HAWSERS. <u>IN SHORT</u> PATIENT TRANSPORT IN AN AMBULANCE TIED TO THE DECK OF THE HOVERCRAFT IS PROBABLY BETTER

THAN THAT PROVIDED BY THE MOTIVE POWER OF THE AMBULANCE WHEN DRIVEN ON THE ROAD. SUCH TRANSPORT IS QUITE ACCEPTABLE AND WOULD BE LIMITED ONLY BY THE FACILITIES REQUIRED FOR PUTTING THE AMBULANCE ONBOARD.

ORIGINAL SIGNED

J.A. MACDOUGALL, MAJOR
SO SURG
3839

MEMORANDUM

CLASSIFICATION

TO / A: Commandant Coast Guard
Ottawa, Ont.

Attention: Mr. R.C. THEEDOM
Hovercraft Trials Officer

YOUR FILE No. / Votre dossier: 9150-83

OUR FILE No. / Notre dossier: 4080 (CGRO)

FROM / De: CGRO Trenton, Ont.

DATE: 8 Nov 72

SUBJECT / Sujet: MEDICAL TRIALS OF VOYAGEUR HOVERCRAFT - 27 Sept 72

Trials Description

The trials took place in three phases. The first was a patient transfer in a stretcher from the Hovercraft to CG112 and back again.

The second phase was patient transfer from Presquile to Port Hope in the trailer on the main deck of the Hovercraft.

The third phase was patient transfer from Port Hope to Presquile in the control cabin.

The first phase took approximately 25 minutes, and the second and third phases took approximately 1 hour each at an average of 41 miles per hour.

The patient was myself and the Dr. was Major J. MacDougall from the Command Surgeons Office, CFB Trenton.

Weather Conditions

Sea and wind conditions throughout the trials remained steady with winds of 7 to 10 kts from the NNW causing 1 to 2' waves. Weather overcast with good visibility. Barometer steady at 1023.5 millibars. (Corrected to sea level.)

Patient Transfers

The patient was transferred from the Hovercraft to CG112 which then proceeded to a different position, and was again approached by the Hovercraft at which time the patient was transferred from CG112 to the Hovercraft. Both transfers took place in a metal wicker basket stretcher.

The first transfer took place after the CG112 came alongside the Hovercraft which was stopped. The second transfer came about after the Hovercraft came alongside the CG112 and was stopped.

.../2

Patient Transfer (cont'd)

The actual transfers occasioned no discomfort to the patient in either case. However, when the Hovercraft came alongside the CG112, spray from the fans of the Hovercraft was a small discomfort on the afterdeck of CG112 until the Hovercraft was stopped alongside.

Transit Presquile to Port Hope

This transit took place with the patient and Dr. in the trailer on the main deck. Part of the transit was spent with the patient sitting up as an ambulatory case. The other part with the patient lying down as a stretcher case.

The noise level in the trailer was such that the Dr. was unable to hear heart beats or take blood pressure even with the use of a stethoscope. Vibration caused by 1 to 2' waves precluded the taking of pulse rate. A good deal of the noise was blocked out by the use of ear plugs, but consideration must be given to the patient with ear or head injuries who is unable to use ear plugs. A weak patient would be unable to converse with the Dr. as it was necessary to speak quite loudly. As a patient, I would not want to put a glass thermometer in my mouth under the conditions of vibration which were present.

The above conditions were observed while sitting up or lying down. The effect of vibration was more noticeable, however, while lying down. Pronounced bouncing of the stomach and head while lying down was evident.

A sensation of motion was felt even after disembarking at Port Hope. This sensation lasted for a period of 5-10 minutes.

Transit Port Hope to Presquile

This transit took place with the patient and the Dr. riding in the control cab. Due to space limitations the entire trip was spent sitting, as an ambulatory case.

As in the trailer, the noise level and vibration precluded any vital signs being taken.

Due to the increased height above the water, the motion of the Hovercraft was more exaggerated than at the main deck level.

Summary

The riding abilities of the Hovercraft on this particular day could be compared to those of a station wagon on a humpy back road.

The ability of the Hovercraft to cover great distances in a short time should give some consolation to a patient.

.../3

Recommendations

1. An entrance sufficiently large to enable a stretcher to be placed in the cabin while keeping the stretcher level, should be considered when building permanent accommodation.

2. The accommodation should be constructed so as to be as sound proof as possible to eliminate the need for ear plugs to be worn by the patient. This would also assist the Dr. in that he would be able to obtain vital signs from the patient.

3. A special stretcher support to eliminate vibration effects to the patient, should be investigated as this can make a great difference to someone with, for example, a broken neck or back.

4. When transferring patients, where a small vessel is involved, it would be more suitable for the vessel to approach the Hovercraft if possible to eliminate discomfort from the spray.

Original signed by

J.G. Calvesbert,
Assistant CGRO, Trenton.

JGC/blm

APPENDIX "D"

MEMO FROM SUB-AGENT AMHERSTBURG

AS A

REPORT ON THE WORK PROGRAMME

CANADA

DEPARTMENT OF TRANSPORT
MINISTÈRE DES TRANSPORTS

YOUR FILE
VOTRE RÉF: 9150-33

IN REPLY QUOTE
RÉF. À RAPPELER:

370 Dalhousie Street,
Amherstburg, Ontario.
N9V 1X3.

November 14, 1972.

Mr. R. Theedom,
20th Floor, O.M.C.P.,
Tower C,
Place de Ville, OTTAWA.

Dear Sir:

Hovercraft was assigned to Amherstburg Depot from November 4th to November 8th, 1972.

November 5 - Hovercraft departed Amherstburg for South East Shoal and return, to repair light. Total time 3 hours, calm, therefore no sea or swell to hinder the repair operation. This operation would take about 12 hours with Kenoki and by land and tender 5 hours.

November 6 - Departed 0845 for St. Clair River to check out light towers, 13 lights were checked and secured Port Lambton 1205. Departed Port Lambton 1300 and checked 3 lights in South Channel and secured Amherstburg 1500.

The back range, Squirrel Island is 3506 feet from the Front Range. This is low land, mostly covered by water this year and every year until the water goes down. There is a high growth of grass and weeds, but no trees between the two lights. This craft was ideal for this job. The Captain put the bow against the leg of the tower and stayed there while the light was checked. For men to walk into this light it is almost impossible considering the growth cover and water.

I could not see where any damage was done to the ground except the tops of the grass and weeds were broken off and thrown around. There were probably some muskrats that were frightened and also some ducks left in a hurry.

To cover this same work with the Kenoki the time would be two working days and the weather would affect her operation.

The same work would take a day and a half by depot personnel with the outboard and would be required to stay overnight.

November 7 - Departed Amherstburg 0900 and checked Middle Sister light, stopped at Scudder Wharf, Pelee Island and onto Pelee Passage Lighthouse, where technicians were about two hours working in the lighthouse. Hovercraft to Leamington to wait time. Departed Pelee Passage Lighthouse and checked Colchester Light and arrived Amherstburg 1530.

Kenoki to do this work would be a time of 11 hours. This work would require good weather for the ship's personnel to do it.

Depot personnel to service Pelee Passage Lighthouse is a minimum of seven hours and no work done.

Again the work can only be done weather permitting, whereas with the Hovercraft weather was not a factor to land personnel onto the lights and shore stations.

Weather can delay the checking and maintenance of these lights by days, even up to a week. The time factor for transportation is a considerable saving.

This craft has its limitations and would have to be worked accordingly. In freezing weather it would not be practical to be on the water as spray would form ice and would be unsafe to work on water. It would work well, I believe, in dry powdered snow as it would not stick and freeze to the vehicle.

Temperatures above 35°F would probably be safe to work without ice building up. The wind chill factor would come into effect here also.

A new suit would need to be designed to keep personnel dry. A one piece suit to include heavy duty soles for walking on deck and over land as required.

These are my personal observations. As I have not seen the full operation these views will not suit all situations.

Yours truly,

MINISTRY OF TRANSPORT

John T. Bennett

John T. Bennett,
Sub Agent

JTB/g

c.c. D.M.A.
Prescott

APPENDIX "E"

DEFENCE RESEARCH BOARD NOISE SURVEY

IN REPLY PLEASE QUOTE
RÉFÉRENCE À RAPPELER

DCIEM 8901-01-1 (Beh)

DEFENCE RESEARCH BOARD — **CONSEIL DE RECHERCHES POUR LA DÉFENSE**

DEPARTMENT OF NATIONAL DEFENCE
MINISTÈRE DE LA DÉFENSE NATIONALE
CANADA

DEFENCE AND CIVIL INSTITUTE
OF ENVIRONMENTAL MEDICINE
1133 Sheppard Ave. W.
P.O. Box 2000, Downsview, Ont.

INSTITUT MILITAIRE ET CIVIL DE
MÉDECINE DE L'ENVIRONNEMENT
1133 Sheppard Ave. W.
C.P. 2000, Downsview, Ont.

Telephone (416) 633-4240

13 December, 1972

Mr. R.C. Theedom
O.M.C.P.
Ministry of Transport
20th Floor
Tower C
Place de Ville
OTTAWA, Ontario

Dear Mr. Theedom:

Preliminary results and recommendations arising from our recent noise survey of the Bell CH-NTL Voyageur Hovercraft, conducted by Mr. R.A. Stong and Mr. R.B. Crabtree, are presented herein for your information. A complete report of this study is in preparation, a copy of which shall be forwarded to you as soon as it is available.

1. Overall and octave-band sound pressure levels in the hovercraft cab and trailer during normal cruise (113-114 dBC, 100 dBA; 45 mph, torque = 74%, N_1 and N_2 = 95%) and during hover (104-110 dBC, 90-94 dBA; torque = 46.5%, N_1 = 92%, N_2 = 94%) indicate:

(i) continuous exposure to this noise for periods greater than two hours per day (Canada Labour Code - Noise Control Regulation SOR/71-584) without the protection of effective noise-attenuating earmuffs or headsets (e.g., Safety Supply Co. Type 258 Earmuff; David Clark Model 10CB Headset/Microphone (low impedance) or 10BB Headset/Microphone (high impedance)) is potentially hazardous in the long term to the hearing of most personnel;

(ii) direct face-to-face voice communication is difficult, but the masking effects of this noise can be minimized by using noise-cancelling microphones (e.g., the M-87 or M-6A/UR of the 10CB and 10BB Headset/Microphones respectively) and an intercab communication-amplification system of appropriate bandwidth and dynamic range.

.../2

2. The noise levels outside the hovercraft cab and trailer are summarized as follows during engine idle and hover conditions (torque = 46.5%, N_1 = 92%, N_2 = 94%).

Location	Engine Idle	Hover
At Engine, cover open	106 dBC, 104 dBA	122 dBC, 118 dBA
Fore deck, stn 100	105 dBC, 99 dBA	111 dBC, 103 dBA
At Trailer door	104 dBC, 97 dBA	120 dBC, 114 dBA
45 ft from skirt, 0-degrees*	88 dBC, 80 dBA	90 dBC, 93 dBA
45 ft from skirt, 45-degrees		108 dBC, 104 dBA
45 ft from skirt, 90-degrees	94 dBC, 86 dBA	118 dBC, 115 dBA
45 ft from skirt, 135 -degrees		118 dBC, 113 dBA
45 ft from skirt, 180-degrees		116 dBC, 111 dBA

*Reference to straight ahead of hovercraft

Clearly, all personnel in the immediate vicinity of the hovercraft (i.e., within about 75 ft) should wear properly fitted hearing protection (earmuffs equivalent to the Safety Supply Co. Type 258 or ear plugs equivalent to the Mine Safety Appliance V-51R or Willson EP100 (see DRET Review Paper No. 771, Appendix I)) when it is operating at all but idle-power conditions. With such protection, exposure durations should not exceed 4 hours daily with earmuffs or 1.5 hours daily with ear plugs (Canada Labour Code - Noise Control Regulation SOR/71-584).

For engine-idle conditions, personnel without hearing protection should not sustain noise exposures around the hovercraft in excess of 1 hour daily; with any of the above hearing protection devices, however, exposures may be up to 8 hours daily.

3. The maximum noise level produced by the hovercraft furing a fly-past (distance = 25 yards, normal cruise) was 113 dBC. Further analyses of our data will be required to determine the A-weighted, octave-band, and perceived noise levels produced by the hovercraft during this operation.

We should be pleased to advise or assist you further in this matter if so requested.

Yours sincerely,

S.E. Forshaw, P.Eng.
for Director-General

APPENDIX "F"

FIGURES:

VOYAGEUR GENERAL ARRANGEMENT
VOYAGEUR GENERAL DIMENSIONS
DECK LOADING LIMITS

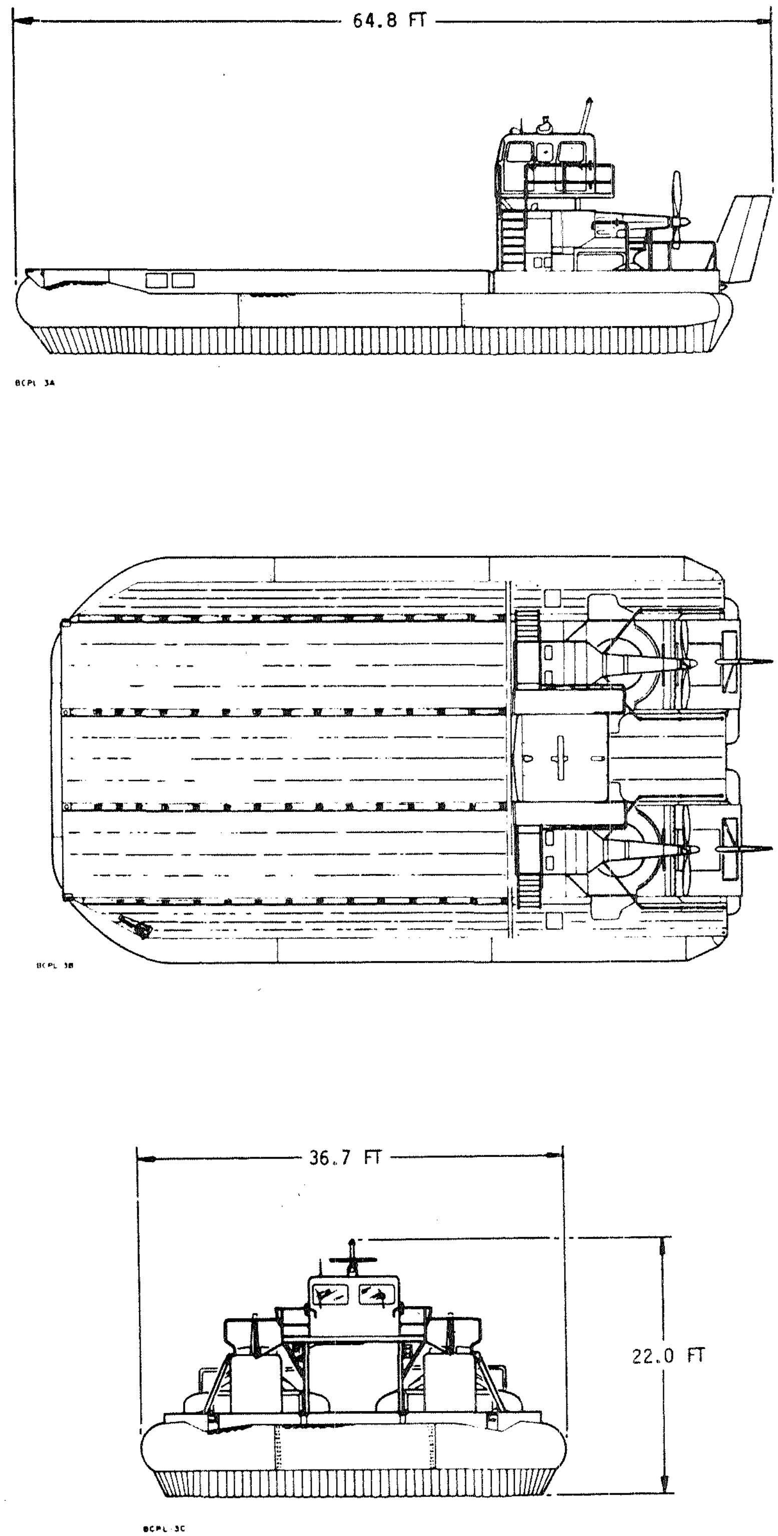
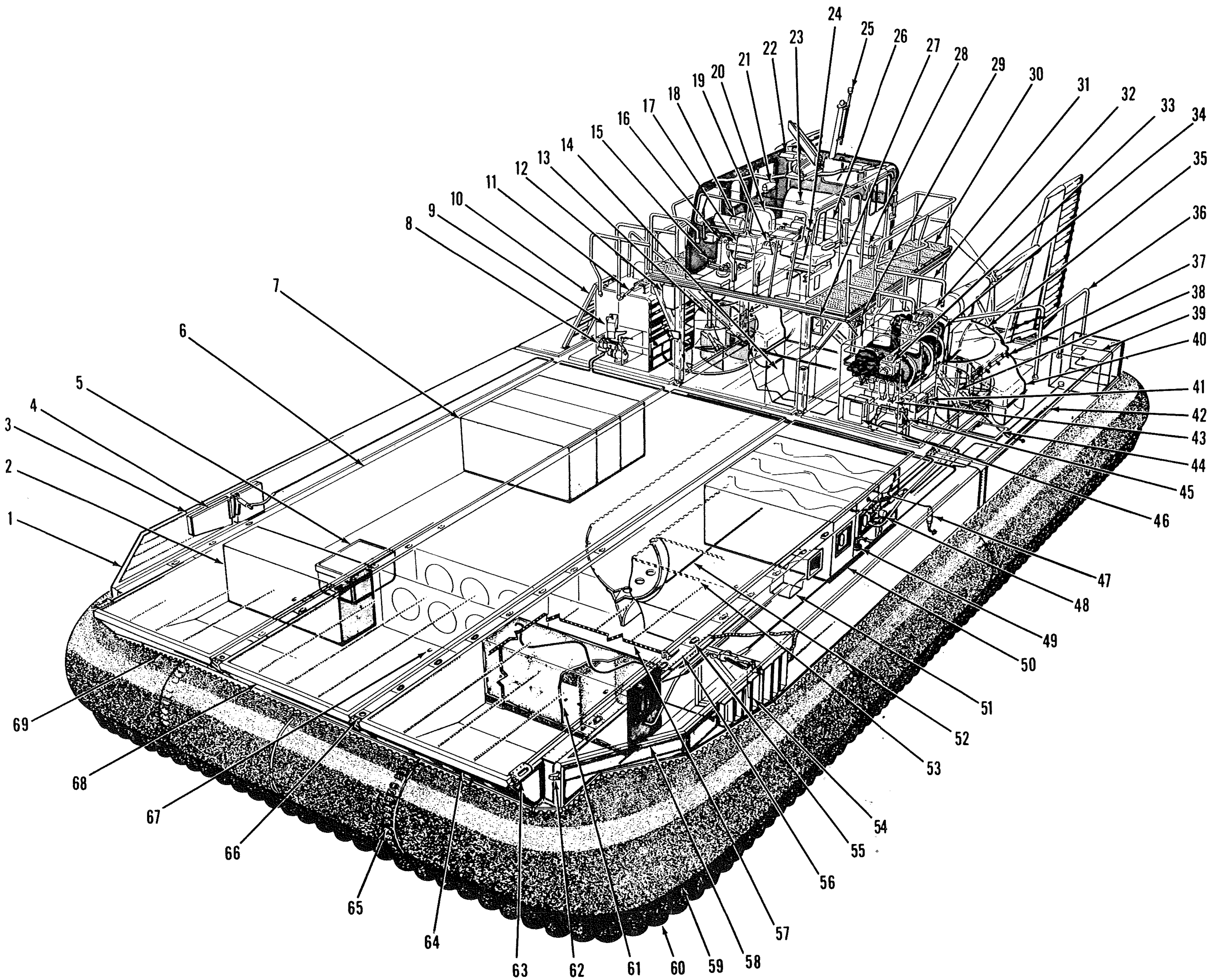


Figure 1-2-1 Voyageur General Dimensions

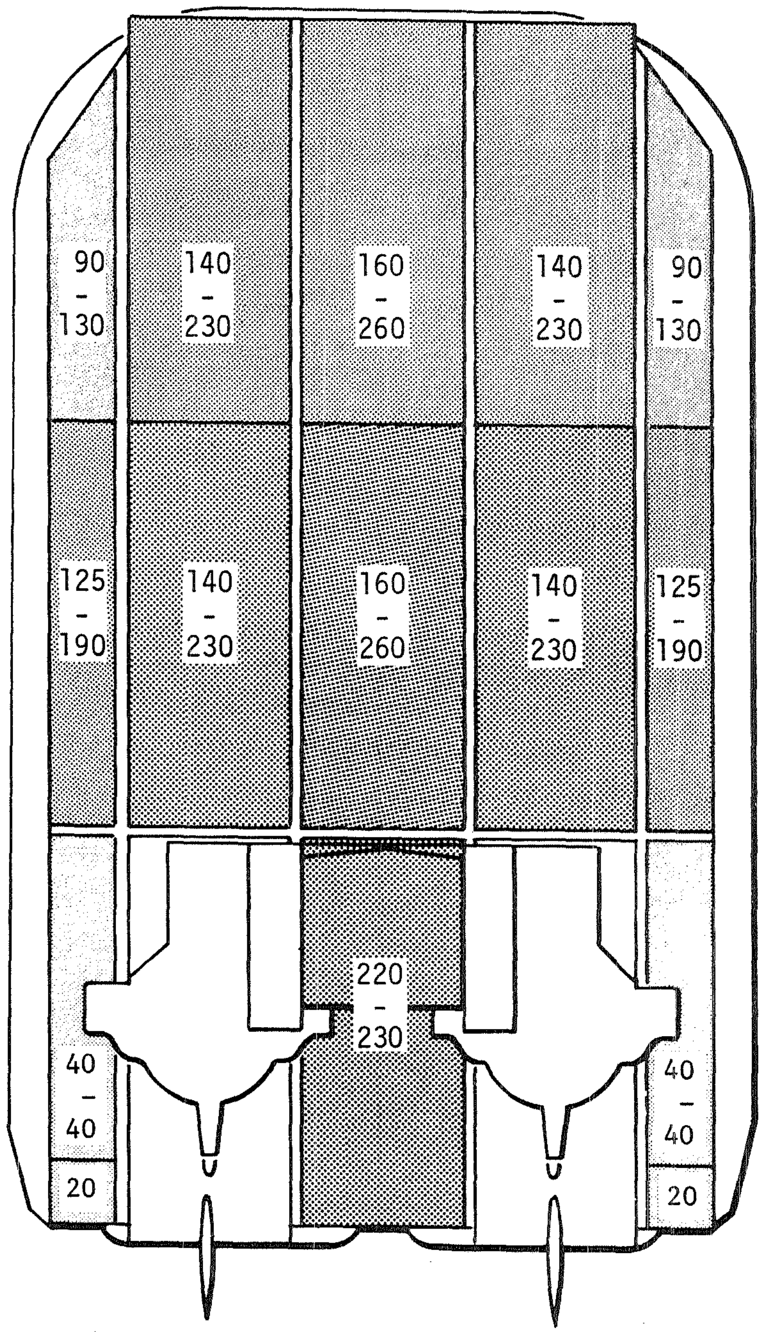


ITEM	INDEX
44	ACCESS HATCH
12	AIR INTAKE FOR CABIN HEATING
39	BALLAST TANK, AFT PORT
2	BALLAST TANK, FORWARD STARBOARD
61	BALLAST TANK BLADDER, FORWARD PORT
46	BATTERY COMPARTMENT, PORT
14	BIFURCATED CENTRE PLENUM DUCT
67	BILGE ACCESS OPENING, TYPICAL
21	BOW NAVIGATION LIGHT
12	CABIN HEATING AIR INTAKE
29	CABLE DUCT
17	CENTRE CONSOLE, CABIN
23	CABIN LIGHT OVERHEAD
22	CABIN VENTILATOR, STARBOARD
37	ENGINE - AIR INTAKE FILTER, PORT OUTBOARD
40	ENGINE - AIR INTAKE PLENUM BLEED AIR DUCT, PORT OUTBOARD
37	FILTER, ENGINE AIR INTAKE, PORT OUTBOARD
47	FILTER, FUEL CELL CAVITY VENT, PORT
60	FINGERS
43	FIRE EXTINGUISHING BOTTLES
6	FLOTATION BOX, FORWARD STARBOARD
64	FLOATATION BOX, FORWARD PORT
68	FLOATATION BOX, FORWARD CENTRE
38	FUEL FILLER PIPE, PORT
45	FUEL BAY, PORT
48	FUEL BOOSTER PUMP, PORT
49	FUEL STRAINER, PORT
50	FUEL TANK, PORT
7	FUEL TANK, STARBOARD
36	GUARD RAIL
31	HAND RAIL
69	HINGES, TRUNK
57	HOLLOW CORE PANEL, TYPICAL
8	HYDRAULIC COMPARTMENT
9	HYDRAULIC TANK
18	INSTRUMENT PANEL
52	KEEL TRUNK
10	LADDER (REMOVABLE) STARBOARD
5	LANDING PAD
13	LIFT - FAN ASSEMBLY, STARBOARD
35	LIFT - FAN AIR INTAKE DUCT, PORT
	LIGHTS - SEE BOW, PORT, AND STERN NAVIGATION LIGHTS, AND CABIN LIGHTS

ITEM	INDEX
27	LOUD HAILER
25	MAST, ROTATING BEACON, AND STERN LIGHT
65	MECHANICAL FASTENERS
26	NAVIGATOR'S SEAT
	NAVIGATION LIGHTS - SEE BOW, PORT AND STERN
23	OVERHEAD LIGHT, CABIN
33	OIL TANK
41	OIL - COOLER BAY, PORT OUTBOARD
59	PERIPHERAL TRUNK
20	PILOT'S SEAT
51	PLENUM - AIR DUCT TO STABILITY TRUNK, PORT
14	PLENUM DUCT, BIFURCATED CENTRE
40	PLENUM BLEED - AIR ENGINE - AIR INTAKE DUCT, PORT OUTBOARD
28	PNEUMATIC RESERVOIR
62	PORT NAVIGATION LIGHT
16	PROPELLER PITCH CONTROL
3	PUFF PORT STARBOARD
4	PUFF PORT DOOR
54	PUFF PORT VANES, PORT
24	RADAR
25	ROTATING BEACON, STERN LIGHTS, AND MAST
15	RUDDER BAR
20	SEAT, PILOT'S
26	SEAT, NAVIGATOR'S
1	SIDE DECK, FORWARD STARBOARD
11	SIDE BRACE, STARBOARD
42	SIDE DECK, AFT PORT
58	SIDE DECK, FORWARD PORT
56	SPLICE PLATE, TYPICAL
53	STABILITY TRUNK, PORT
25	STERN NAVIGATION LIGHT
19	THROTTLE CONTROL
55	TIE - DOWN FITTING, TYPICAL
63	TOW FITTING, OUTBOARD, TYPICAL
66	TOW FITTING, INBOARD, TYPICAL
32	TRANSMISSION GEARBOX
34	TURBOSHAFT ENGINE, TWIN-PAC ST6T-75, PORT
22	VENTILATOR, CABIN, STARBOARD
30	WALKWAY, PORT

Figure 1-1-1 Voyageur general Arrangenent

NOTE: ALLOWABLE LOCAL LOADINGS ARE GIVEN FOR BOTH MINIMUM AND MAXIMUM TOTAL PAYLOAD CONDITION IN PSF



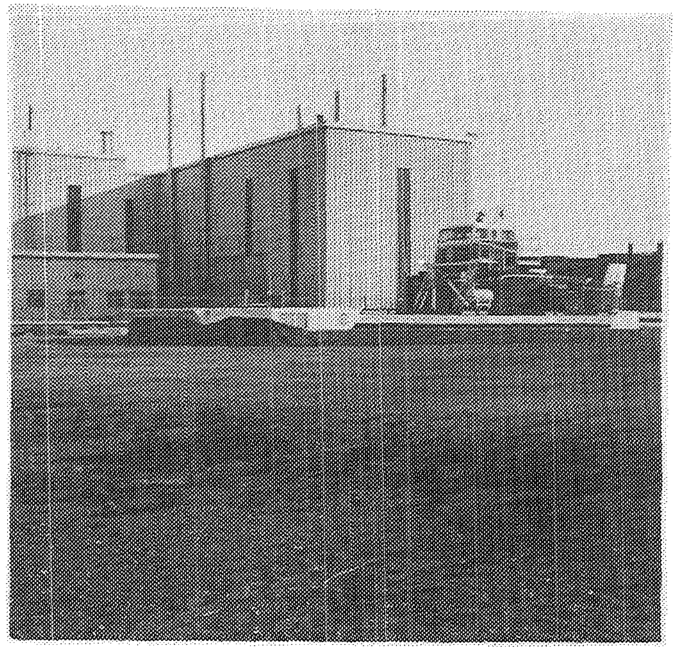
BCPL-211

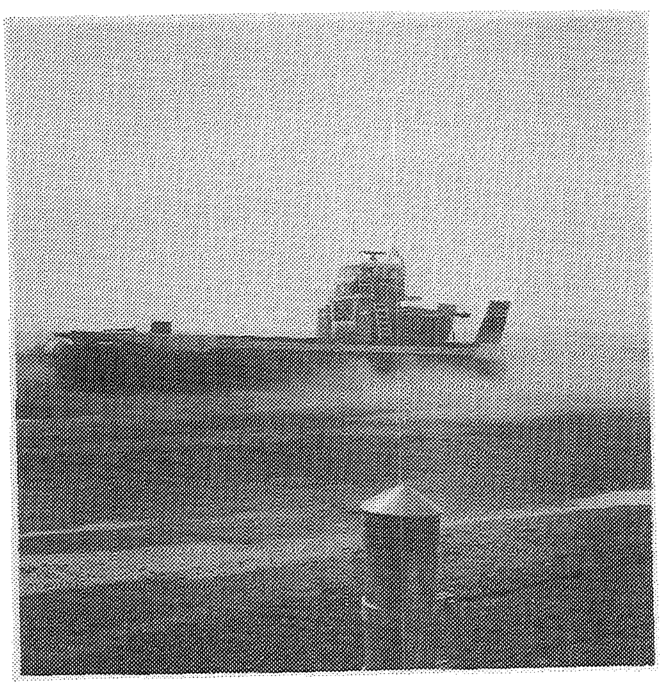
Figure 3-2-2. Maximum Local Intensity Of Loading

APPENDIX "G"

PHOTOGRAPHS

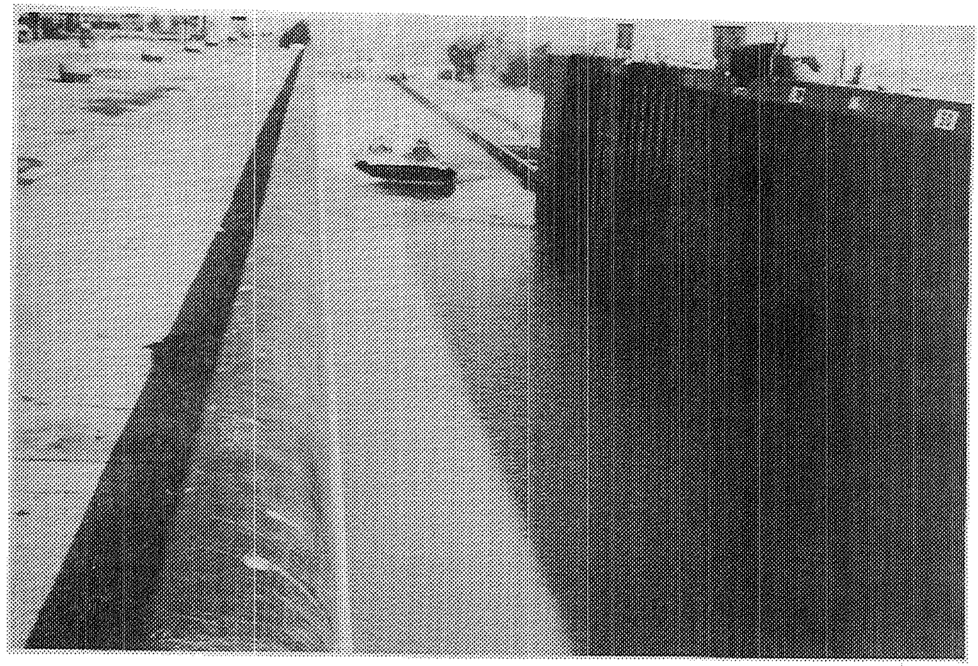
Voyageur on pads

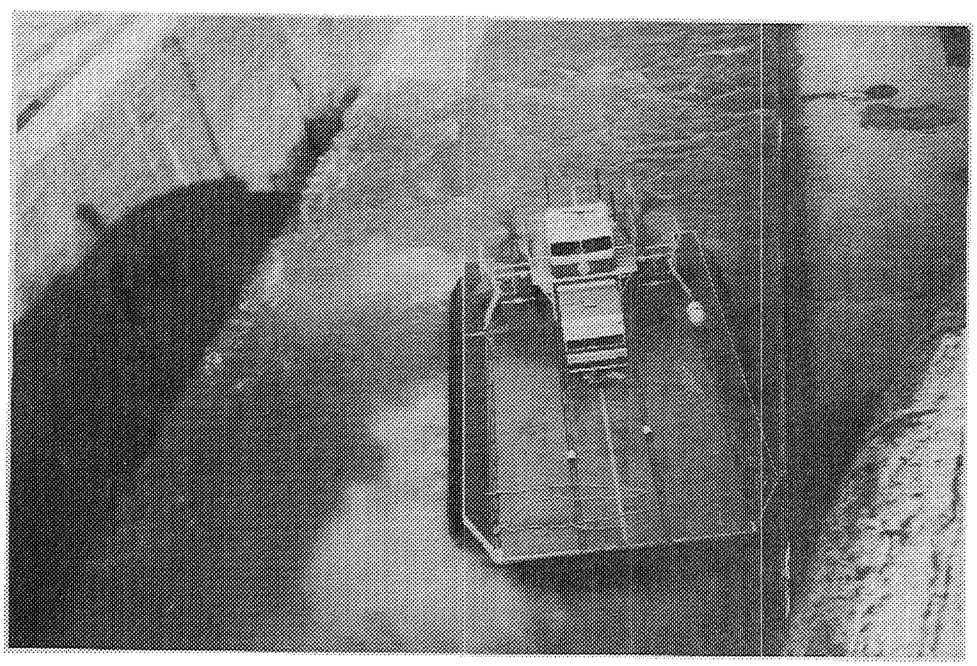




Voyageur at hover, overland

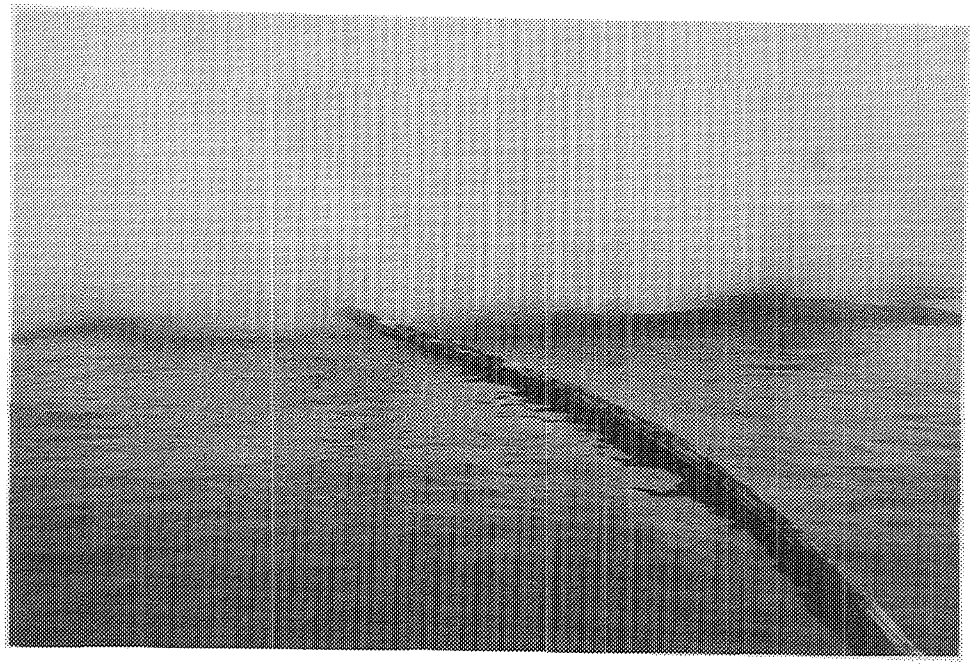
Entering #6 Lock
Welland Canal





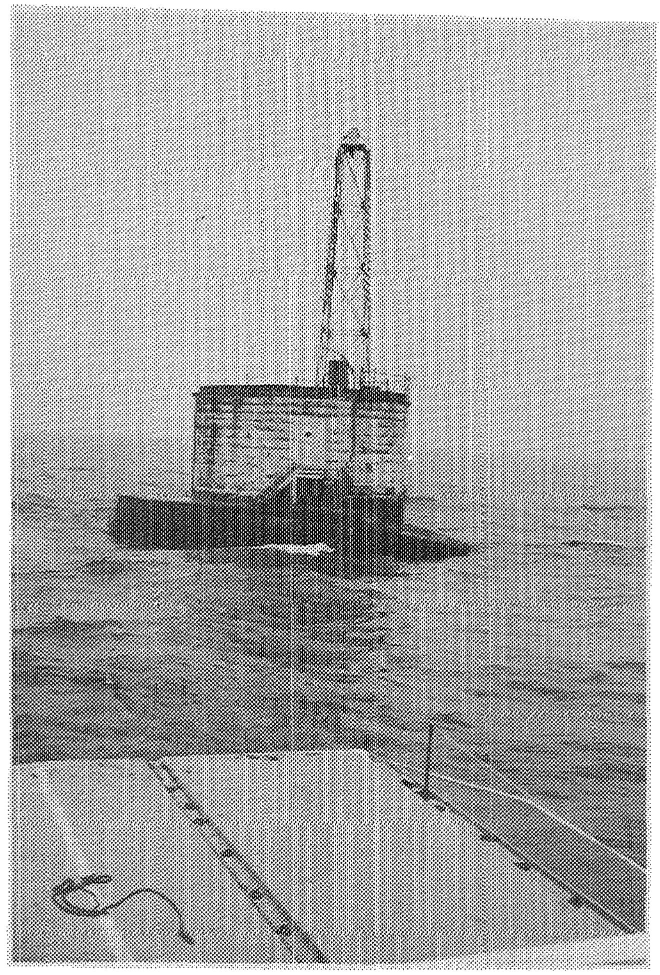
Hovering during flooding
of lock

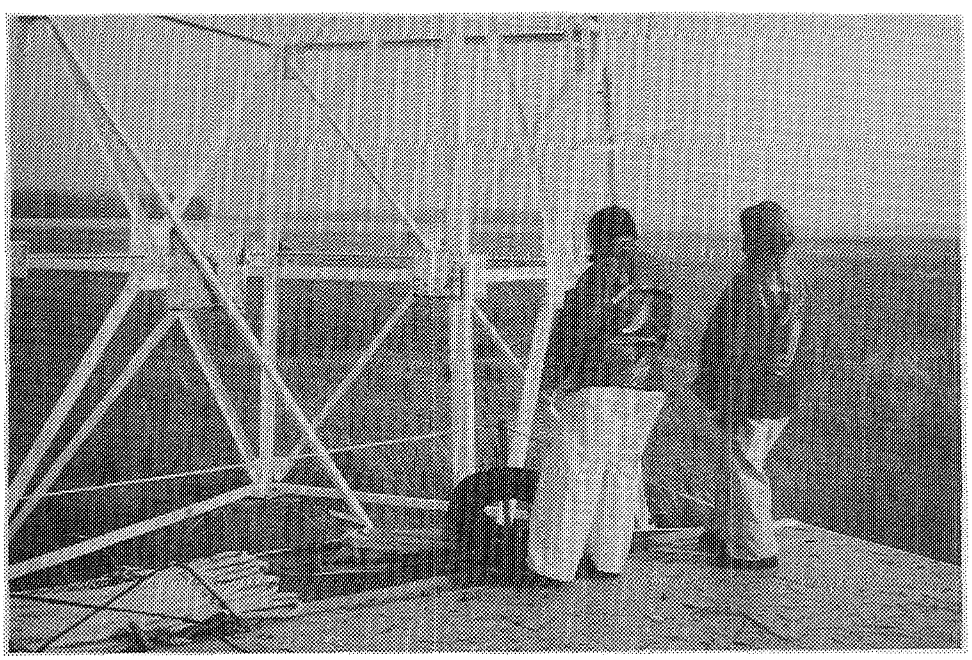
Crossing oil boom



Servicing middle sister light

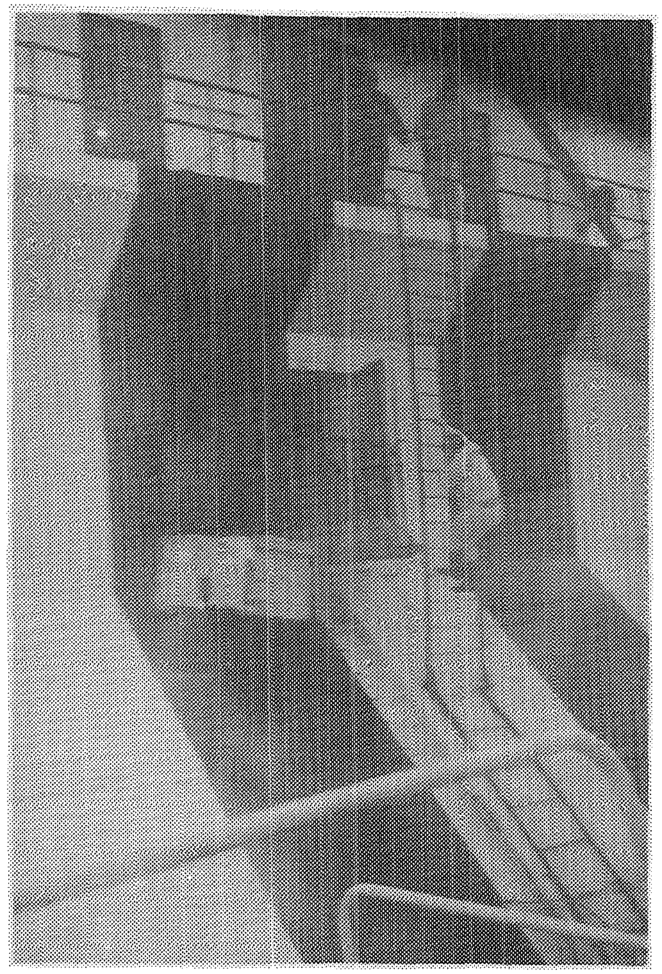
Servicing Colchester light

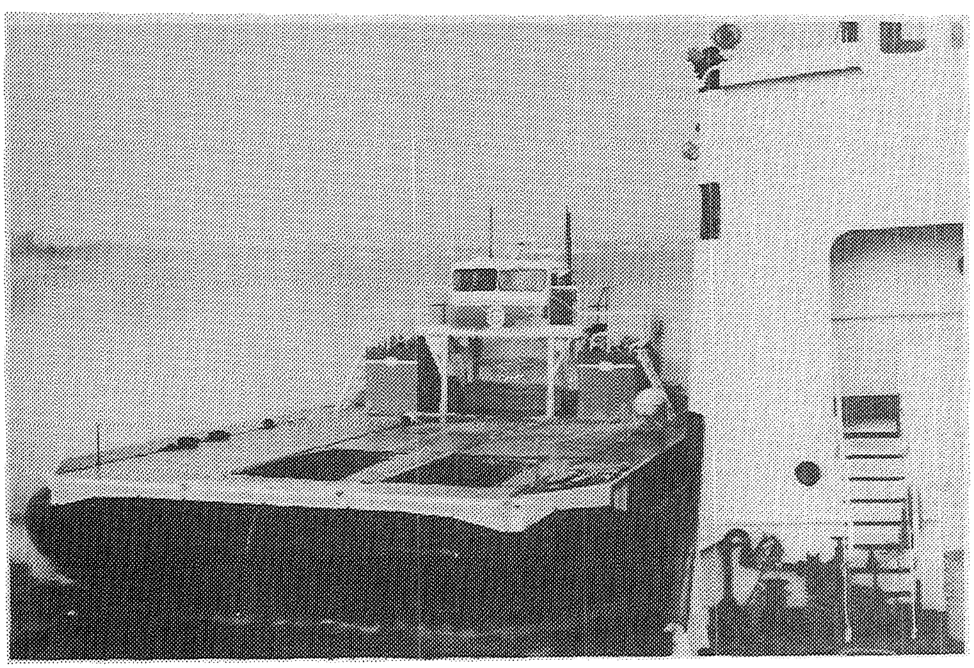




Servicing Squirrel Island back range

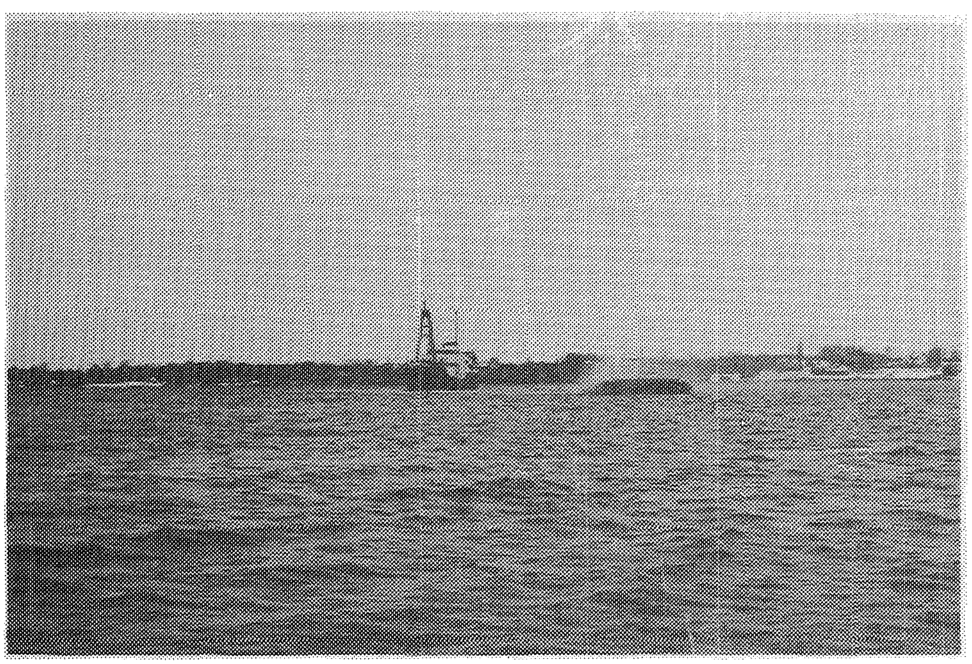
Lightkeeper exchange SE Shoal





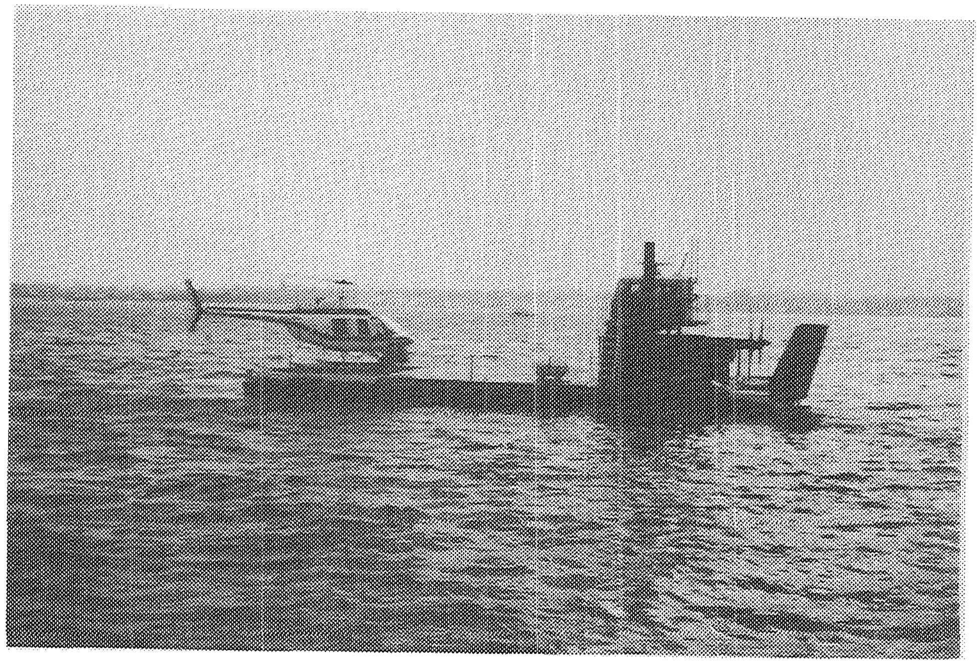
Coming alongside
CCGS SIMCOE

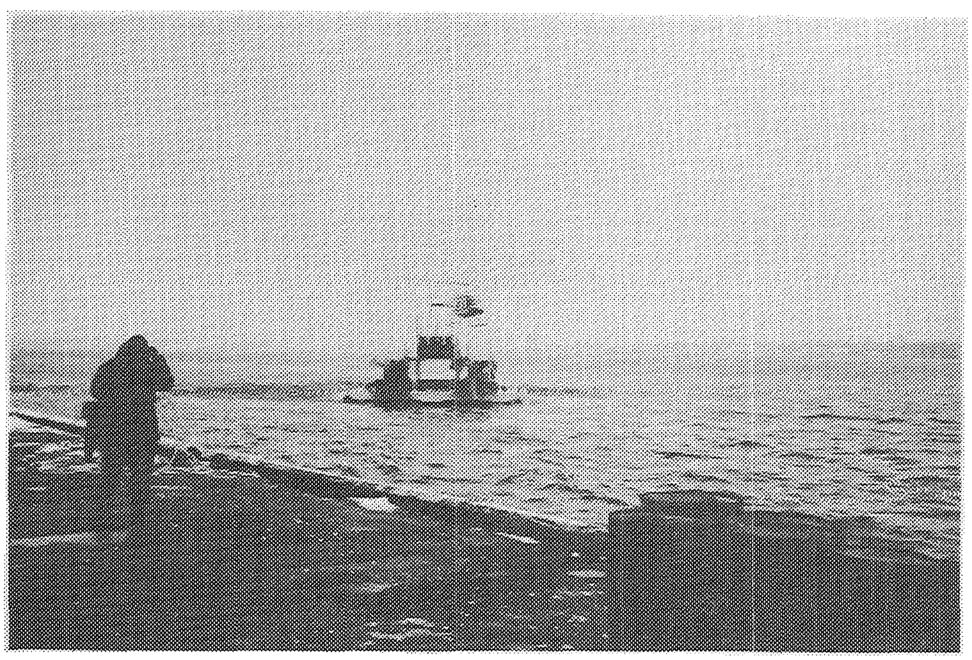
Transferring survivors CCGS SIMCOE



Towing CCGS SIMCOE

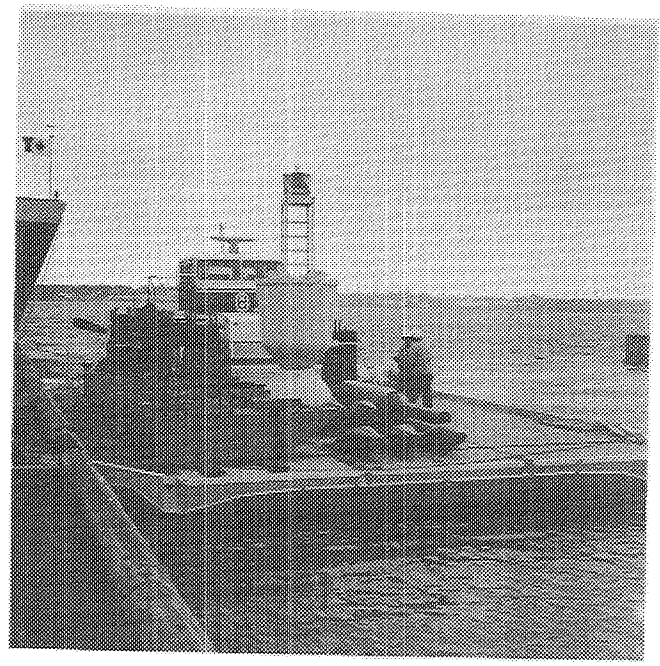
Jet Ranger on deck

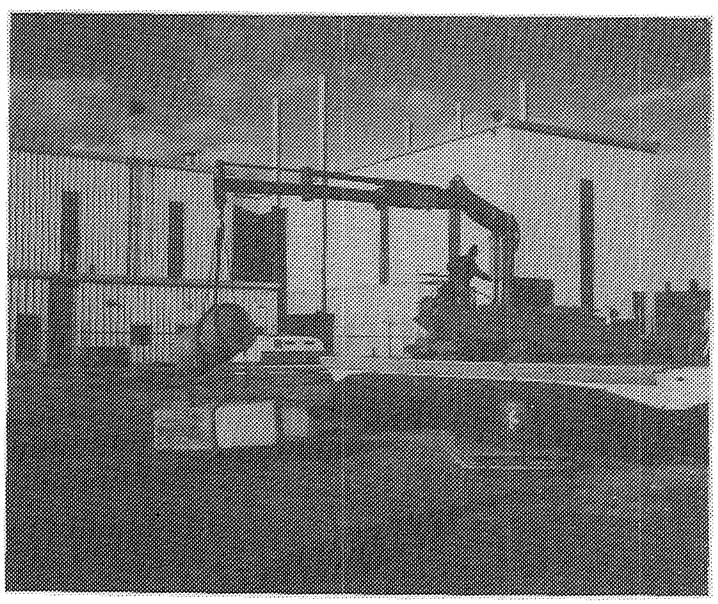




Jet Ranger departing

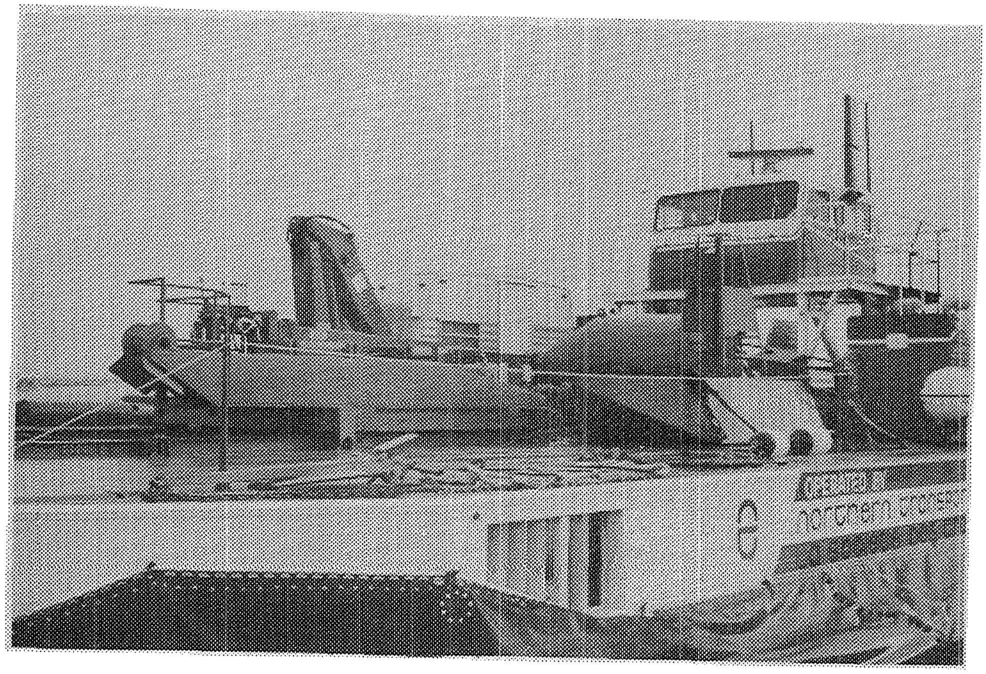
Voyageur, loading buoys at Prescott

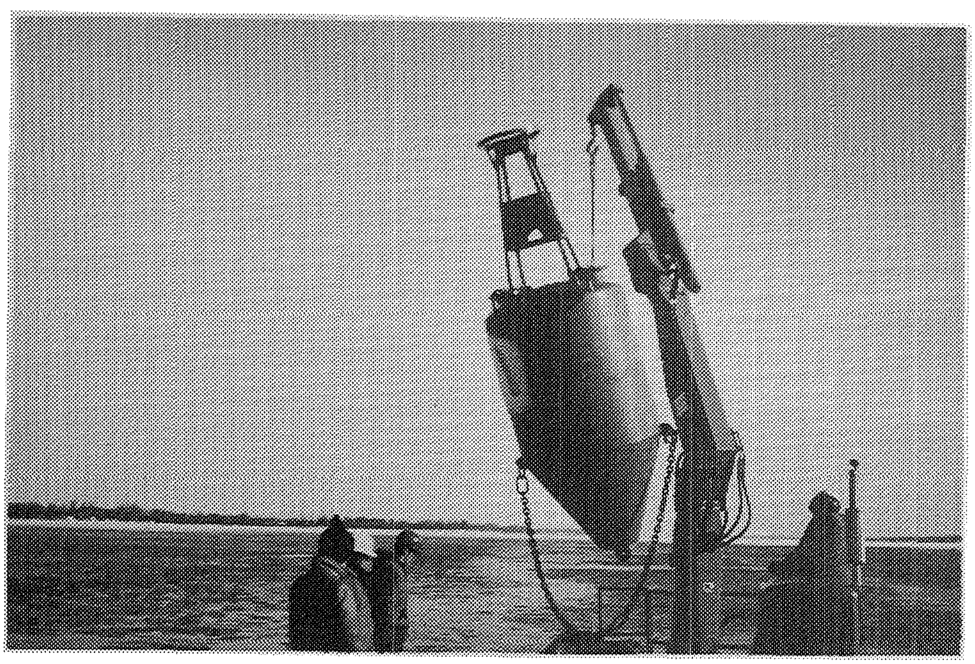




Buoy lifting gear, fully extended
3200 lbs. at 21' 6" radius

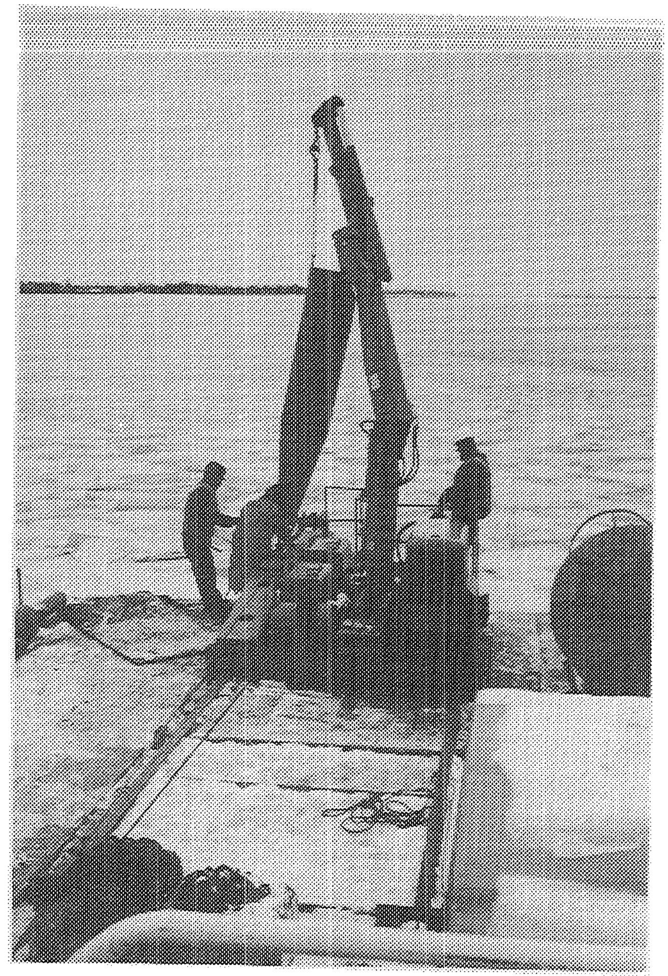
At Trenton, buoy
gear in parked
position





Lifting 4' 6" electric buoy

Lifting 2' winter steel spar



Pilots view of operations