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REVIEW OF EXISTING AND PROJECTED DESIGNS OF
AIR CUSHION VEHICLES

by
Raymond O. Graff

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AVIATION AND SURFACE EFFECTS DEPARTMENT

Report ASED-352

April 1976

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NOTATION

<u>ENGLISH UNITS</u>	<u>METRIC UNITS</u>
LT - long tons	MT - metric tons
lbs - pounds mass	kg - kilograms
lbs - pounds force	nt - Newtons
psf - pounds/sq foot	nt/m ² - Newtons/sq meter
hp - horsepower	kw - kilowatts
kts - knots	kph - kilometers per hour
nm - nautical miles	km - kilometers
hrs - hours	

CONVERSIONS

1 LT	=	2240 lbs
1 MT	=	2204.6 lbs
1 kg	=	2.2046 lbs mass
1 Newton (nt or N)	=	.2248 lbs force
1 m	=	3.28 ft
1 kW	=	1.341 hp
1 km	=	.5396 nm
1 kph	=	.5396 kts
1 nt/m ²	=	.02089 psf



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TABLE OF CONTENTS

	Page
INTRODUCTION	2
VEHICLE DESCRIPTION	3
SKIMMER-1	3
SR.N5	4
SK-5	6
SR.N6	7
VT-1	9
VT-2	11
BH-7	12
SR.N4	13
N300	15
N500	16
MV-PP5	17
MV-PP15	18
RADUGA	19
SORMOVICH	20
SOVIET NAVY ACV	21
GUS/SKATE	22
AIST	23
VOYAGEUR	24
VIKING	26
JEFF A	27
JEFF B	28
ARCTIC SEV CONCEPT	29
ARCTIC SEV CONCEPT	30
ARCTIC SEV CONCEPT	31
TWIN CUSHION SEV	32
REFERENCES	34

ABSTRACT

This report presents a concise review of the general characteristics of the most significant, fully skirted, air cushion vehicles that exist in the world today. Sidewall air cushion vehicles, known as captured air bubble craft or surface effect ships are not included. Recent projected designs of air cushion vehicles are also presented to illustrate the potential growth and applications that are envisioned for air cushion vehicles.

ERRATA SHEET

The conversion factor for cushion pressure in pounds per square foot (psf) to cushion pressure in nt/m^2 is 47.88.

$$P_C \text{ (psf)} \quad 47.88 = P_C \text{ (nt/m}^2\text{)}$$

Also, the cushion pressure for the JEFF(A) and the JEFF(B) is 100 psf (4788 nt/m^2). (Pages 27 and 28)

INTRODUCTION

The purpose of this report is to compile a general description and the basic characteristics of the most relevant air cushion vehicles and recent air cushion vehicle designs into a concise format. Included herein are domestic and foreign vehicles and proposed vehicle designs that have contributed most to the operational and design experience in air cushion vehicles that exists in the world today. The various military applications of these existing vehicles are also discussed.

The terms of air cushion vehicle (ACV), hovercraft, surface effect craft and surface effect vehicle (SEV) will be used synonymously in the discussions presented herein.

The geometry and subsystem characteristics of each vehicle are tabulated in both english and metric units. A photograph of each operational vehicle or conceptual design is presented along with a brief description of several of the unique features or uses of the vehicle.

Please note that the propulsion and lift power listed in the maximum continuous power for a single engine. The speed indicated is the cruise speed and the range is the one-way distance at cruise speed. The surface conditions in terms of surface roughness or sea state, headwinds and air temperature for the cruise speed value vary considerably and have not been presented herein.

It is believed that this report will be a valuable and easy to use reference for anyone who needs general information and data on air cushion vehicles. More detailed information on the vehicles and conceptual designs presented can be found in References 1-5.



SKMR-1

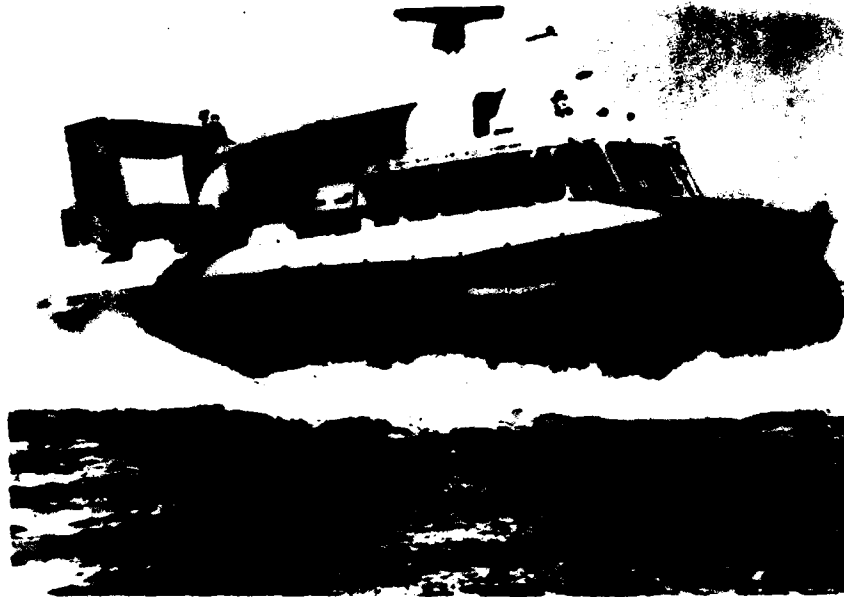
The Bell Hydroskimmer was originally an annular jet craft that was later fitted with a peripheral flexible skirt system. The skirts gave SKMR-1 a 1 meter obstacle clearance capability. The U.S. Navy tested this vehicle extensively for amphibious operations. It was also tested as operating in and out of the dry well deck of an LSD, in mine laying and mine sweeping roles and as a small gun platform.

Funding for the SKMR-1 program was unavailable in 1971 and the vehicle was eventually declared surplus Navy equipment.

GROSS WT. - LT(MT)	- 29 (29.6)	POWER LIFT - hp(kw)	- 1080 (805)*
PAYLOAD - lbs(kg)	- 10000 (4536)	PROPULSION ^N - hp(kw)	-
FUEL - lbs(kg)	- 10880 (4935)	ENGINES LIFT	- 4 Solar Saturn GT
LENGTH - ft(m)	- 65.5 (20.0)	PROPULSION	-
BEAM - ft(m)	- 27 (8.23)	FANS (DIA = 1.98 m)	- 4 mixed flow
HEIGHT - ft(m)	- 23.5 (7.16)	PROPELLERS (DIA = 3.05 m)	- 2 3-bladed shrouded
SKIRT HT. - ft(m)	- 4 (1.22)	SPEED - kts(kph)	- 70 (130)
CUSHION P - psf(nt/m ²)	- 47 (2250)	RANGE - nm(km)	- 240 (445)
		ENDURANCE - (hrs)	-

MANUFACTURER - Bell Aerospace Co.
FIRST TRIALS USE - April 1963

*maximum continuous power per engine



SR.N5 - Warden Class

The Warden Class was the first hovercraft to be put into quantity production in Britain. It has been operated in all parts of the world from the Canadian Arctic to the African desert. Designed to carry 19 passengers, it can also be outfitted for uses including firefighting, crash rescue, and as a commercial transport with 2 MT payload.

GROSS WT. - LT(MT)	- 6 (6.1)	POWER LIFT - hp(kw)	- 900 (671)
PAYLOAD - lbs(kg)	- 3500 (1588)	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	- 2100 (952.6)	ENGINES LIFT	- Rolls Royce,
LENGTH - ft(m)	- 38.75 (11.8)	PROPULSION	- Gnome GT
BEAM - ft(m)	- 23 (7.01)	FANS (DIA = 2.13 m)	- 1 12-bladed cent.
HEIGHT - ft(m)	- 16.3 (4.97)	PROPELLERS (DIA = 2.74 m)	- 1 4-bladed CP
SKIRT HT. - ft(m)	- 4 (1.2)	SPEED - kts(kph)	- 50 (92.6)
CUSHION P. - psf(nt/m ²)	- 28 (136.7)	RANGE - nm(km)	- 220 (407.4)
		ENDURANCE - (hrs)	- 3.6

MANUFACTURER - EHC
FIRST TRIALS USE - 1964



SR.N5

This is a photograph of the SR.N5 as used by the Canadian Coast Guard (CCG). It is used for coastal patrol and search and rescue missions. The CCG has tested this craft extensively and have developed methods of operation for each mission.



SK-5

The SK-5 is the U.S. designation of the SR.N5 with design changes for military applications. This was built in 1966 by Bell Aerospace Corporation under licensing agreements with British Hovercraft. By increasing the power with GE LM-100 1250 HP (932 kw) G.T. engines, the gross weight is increased to 6.1 LT (6.2 MT). The payload is now 2458 lbs. (1115 kg) and the cruise speed is still 50 kts (92.6 kph). Puff ports for improved control and an improved finger skirt which reduced spray were also added. Both the U.S. Army and Navy used the craft in Vietnam.

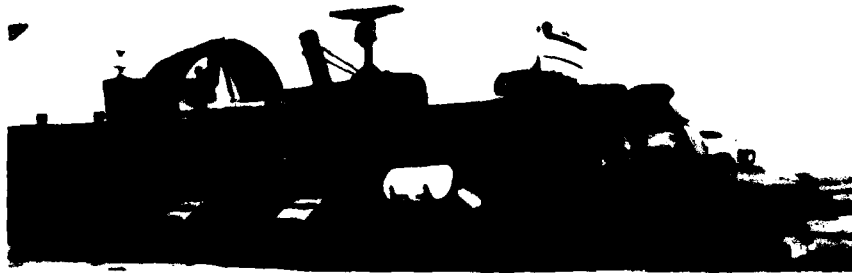


SR.N6 - Winchester Class

This craft was designed as a fast ferry for operation in sheltered waters. The SR.N6 can accommodate 38 passengers. Besides passenger services, the craft has been operated in many commercial services including freight-carrying, hydrographic/seismographic survey, offshore support, communications, crash rescue, and firefighting.

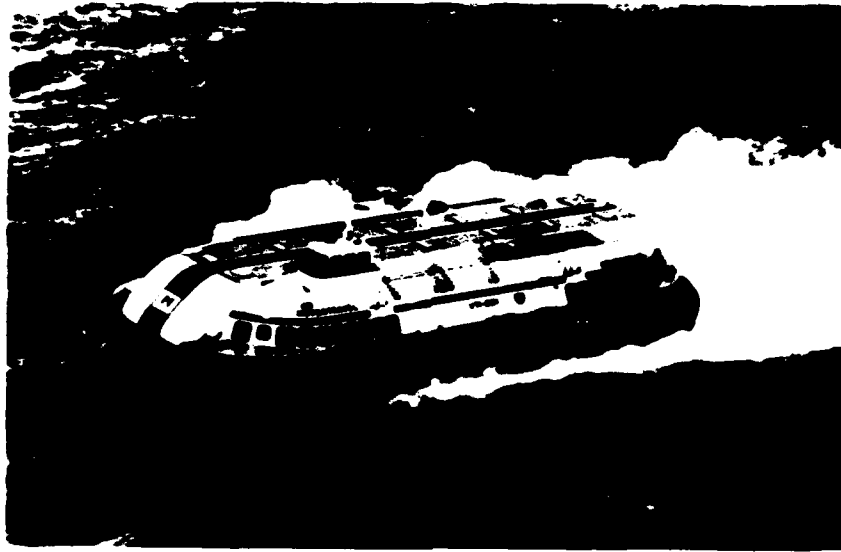
GROSS WT. - LT(MT)	- 8.9 (9.1)	POWER LIFT - hp(kw)	- 900 (671)
PAYLOAD - lbs(kg)	- 7000 (3175)	PROPULSION - hp(kw)	- 1 Rolls Royce,
FUEL - lbs(kg)	- 2100 (953)	ENGINES LIFT	- Gnome GT
LENGTH - ft(m)	- 48.42 (14.76)	PROPULSION	- 1 12-bladed, Cent.
BEAM - ft(m)	- 23 (7.01)	FANS (DIA = 2.13 m)	- 1 4-bladed CP
HEIGHT - ft(m)	- 17.33 (5.28)	PROPELLERS (DIA = 2.74 m)	- 52 (96.3)
SKIRT HT. - ft(m)	- 4 (1.22)	SPEED - kts(kph)	- 200 (370.4)
CUSHION P - $\text{psf}(\text{nt}/\text{m}^2)$	- 30 (146.5)	RANGE - nm(km)	- 3.6
		ENDURANCE - (hrs)	

MANUFACTURER - BEC
FIRST TRIALS USE - 1966



SR.N6 Military Configurations

The SR.N6 has been outfitted with 4 blade shrouded propellers that produced the same thrust yet the noise is reduced 10dBA. The propellers are 6.83 ft (2.08 m) in diameter. The SR.N6 can be used as a troop carrier with 45 troops or 6 LT (6.1 MT) of mixed stores. The SR.N6 is also used as a fast attack craft with one Hispano Suiza A.32 30 mm twin barrel cannon and one 7.62 mm machine gun. This craft has also been outfitted with long range fuel tanks that increases the range to 7 hours.



Vosper Thornycroft VT-1

The VT-1 is a passenger/car craft. It is capable of carrying 146 passengers and 10 vehicles or 250 passengers. It is fitted with two skegs within the cushion to allow for use of controllable pitch water propellers. The craft can be operated from existing terminals or simple low cost slipways and pontoon terminals. This craft has undergone extensive tests and evaluation particularly to evaluate its reliability and seakeeping ability.

GROSS WT. - LT(MT)	- 77.7 (78.9)	POWER LIFT - hp(kw)	- 1850 (1342)
PAYLOAD - lbs(kg)	- 49000 (22000)	PROPULSION - hp(kw)	- 2 Avco Lycoming,
FUEL - lbs(kg)	- 11000 (4990)	ENGINES LIFT	- TF-25 GT
LENGTH - ft(m)	- 95.5 (29.1)	PROPULSION	- 8 centrifugal
BEAM - ft(m)	- 44.5 (13.56)	FANS (DIA = 1.52)	- 2 3-bladed CP
HEIGHT - ft(m)	- 32 (9.75)	PROPELLERS (DIA = .64 m)	- 40 (74)
SKIRT HT. - ft(m)	- 5.5 (1.68)	SPEED - kts(kph)	- 160 (296)
CUSHION P - psf(nt/m ²)	- 49 (239)	RANGE - nm(km)	- 4
		ENDURANCE - (hrs)	

MANUFACTURER - Vosper Thornycroft (Hovercraft Division)
 FIRST TRIALS USE - July 1969



VT-1 Military Configuration

This craft has increased horsepower with 2 TF-35 gas-turbines each rated at 2750 shp as 60 F. The fuel capacity is 20 LT (20.32 MT). At a cruise velocity of 43 Kts (79.6 kph). The range is 600 n.m. (1111 km) or 7-14 hours of endurance. This craft has a water propeller.

Armament:

One 35 mm twin Verlikon cannon and 4 Exocet missile launches. Search radar, fire control radar, fire control systems for guns and missiles and ECM equipment.



VT-2 Fast Patrol, Lightly Armed

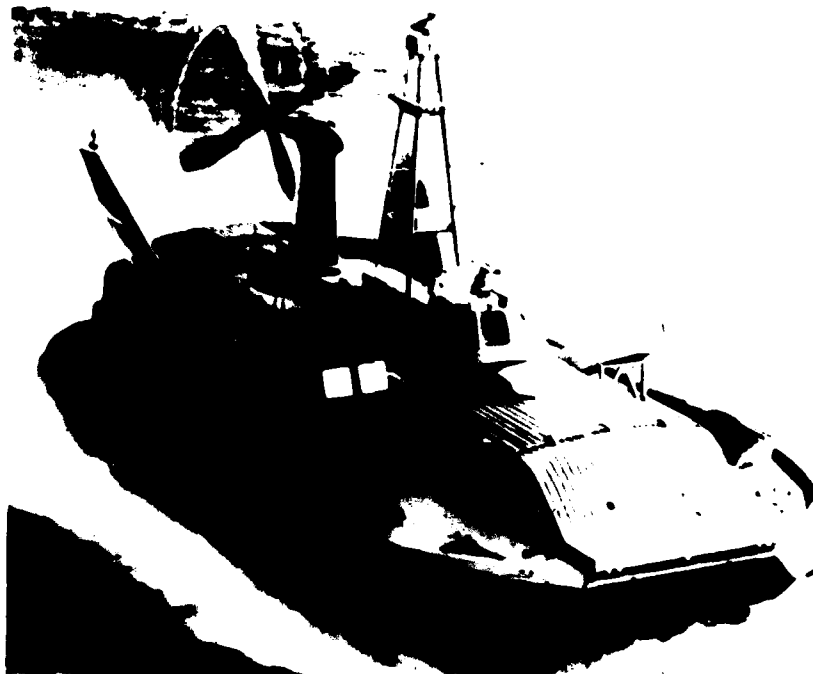
This fully amphibious hovercraft is similar in overall size and configuration to the VT-1. The VT-2, however, employs air propulsion in place of water propulsion to allow for amphibious operations. The VT-2 is intended for military applications including the fast patrol, lightly armed version pictured above. The other versions available are:

- Logistic Support (unarmed)
- Multi-Purpose Logistic Support
- General Purpose Patrol
- Fast Patrol, Heavily Armed

An additional 10.7 MT of fuel increases the range of 1852 km.

GROSS WT. - LT(MT)	- 10.27 (104.3)	POWER LIFT - hp(kw)	- 3800 (2834)
PAYLOAD - lbs(kg)	- 11200 (5080)	PROPULSION - hp(kw)	- 2 Rolls Royce,
FUEL - lbs(kg)	- 54900 (24900)	ENGINES LIFT	- Marine Proteus GT
LENGTH - ft(m)	- 99 (30.17)	PROPULSION	- 4 Cent.
BEAM - ft(m)	- 46.5 (14.17)	FANS (DIA -	- 2 ducted fans, CP
HEIGHT - ft(m)	- 30.25 (9.22)	PROPELLERS (DIA = 4.14m)	- 60 (111)
SKIRT HT. - ft(m)	- 5.5 (1.67)	SPEED - kts(kph)	- 700 (1300)
CUSHION P - psf(NT/m ²)	- 48.7 (238)	RANGE - nm(km)	- 11.5
		ENDURANCE - (hrs)	

MANUFACTURER - Vosper Thornycroft
FIRST TRIALS USE - 1974

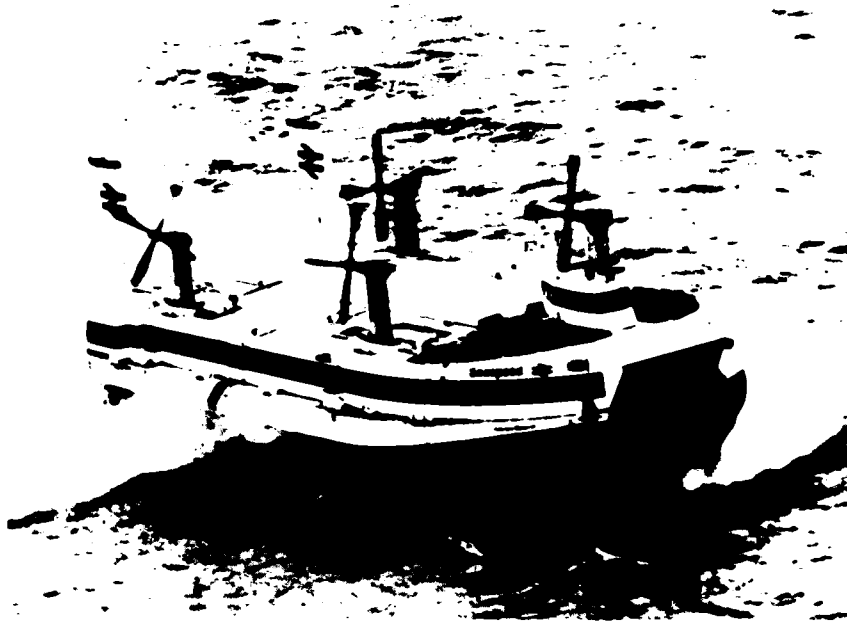


Wellington BH-7

The BH-7 was designed as a military hovercraft. It has been outfitted as a fast attack, coastal patrol, and logistic support craft. Typical military payloads can include (a) 152 fully equipped troops, seated or (b) 4, 3 1/4 MT trucks, laden or (c) 3 Ferret Scout cars, laden or (d) 5 105 mm pack howitzers plus ammunition or (e) 20 NATO pallets or (f) any combination of the above totalling less than 14.22 MT weight. The BH-7 is shown above with four Exocet/Otomat type missile launch canisters.

GROSS WT. - LT(MT)	- 44.6 (45.4)	POWER LIFT - hp(kw)	- { 3800 (2834)
PAYLOAD - lbs(kg)	- 33600 (15240)	PROPULSION - hp(kw)	- {
FUEL - lbs(kg)	- 20000 (9144)	ENGINES LIFT	- { 1 Rolls Royce,
LENGTH - ft(m)	- 77.2 (23.5)	PROPULSION	- { Proteus Marine GT
BEAM - ft(m)	- 45.5 (13.87)	FANS (DIA = 3.5 m)	- 1 12-bladed Cent.
HEIGHT - ft(m)	- 38.5 (11.73)	PROPELLERS (DIA = 5.8 m)	- 1 4-bladed CP
SKIRT HT. - ft(m)	- 5.5 (1.68)	SPEED - kts(kph)	- 50 (92.6)
CUSHION P - psi(nt/m)	- 60 (293)	RANGE - nm(km)	- 120 (222.2)
		ENDURANCE - (hrs)	- 3

MANUFACTURER - BHC
FIRST TRIALS USE - 1969

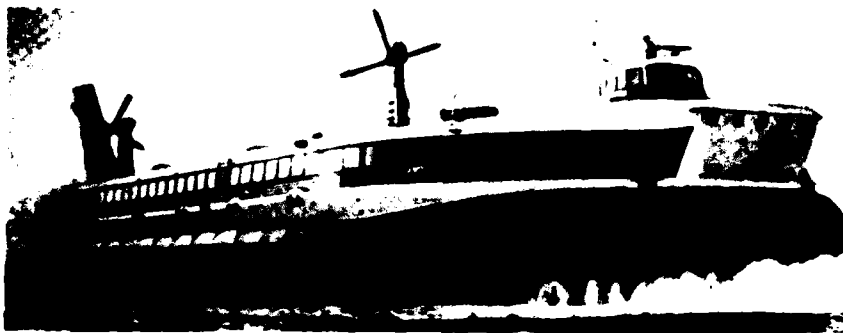


SR.N4 - Mountbatten Class - Mk 1

This craft, the free world's largest hovercraft, is currently in service across the English Channel. Fully loaded it can carry 254 passengers and 30 cars. It's design employs four controllable pitch (CP) propellers and four centrifugal lift fans. One fan and one propeller are powered by one Rolls Royce (R.R.). Marine Proteus gas turbine (GT). The propellers on the SR.N4 are mounted on swiveling pylons which enable the craft to be easily maneuvered and controlled in crosswinds.

GROSS WT. - LT(MT)	- 169 (172)	POWER LIFT - hp(kw)	- 3400 (2535)
PAYLOAD - lbs(kg)	- 118000 (53850)	PROPULSION - hp(kw)	- 4 Rolls Royce,
FUEL - lbs(kg)	- 36000 (16330)	ENGINES LIFT	- Marine Proteus GT
LENGTH - ft(m)	- 130.17 (39.68)	PROPULSION	- 4 fixed pitch 12-bladed
BEAM - ft(m)	- 78 (23.77)	FANS (DIA = 3.5 m)	- 4 4-bladed CP
HEIGHT - ft(m)	- 37.7 (11.49)	PROPELLERS (DIA = 5.79 m)	- 60 (111)
SKIRT HT. - ft(m)	- 8 (2.44)	SPEED - kts(kph)	- 170 (314.8)
CUSHION P - psf(nt/m ²)	- 50 (244)	RANGE - nm(km)	- 2 - 5
		ENDURANCE - (hrs)	

MANUFACTURER - British Hovercraft Corporation (BHC)
 FIRST TRIALS USE - August 1968



SR.N4 - Mountbatten Class - Mk 3
(Proposed)

This is a design study for a 'stretched' SR.N4. It would be capable of carrying 396 passengers and 53 vehicles. To maintain the performance the Rolls Royce engine were uprated to 2834 kw. This craft would be capable of operating in .61 m higher waves with less adverse motions than experienced on the Mk 1.

GROSS WT. - LT(MT)	- 236 (240)	POWER LIFT - hp(kw)	- 3800 (2834)
PAYLOAD - lbs(kg)	- 242000 (109728)	PROPULSION - hp(kw)	- 4 R.R. Marine,
FUEL - lbs(kg)	-	ENGINES LIFT	- Proteus GT
LENGTH - ft(m)	- 177 (53.95)	PROPULSION	- 4, Fixed Pitch, 12 Blade
BEAM - ft(m)	- 87 (26.5)	FANS (DIA -	- 4, 4 bladed, CP
HEIGHT - ft(m)	- unknown	PROPELLERS (DIA = 6.4m)-	- unknown
SKIRT HT. - ft(m)	- 10	SPEED - kts(kph)	- unknown
CUSHION P - psf(wt/m^2)	- 44.7 (218)	RANGE - nm(km)	- unknown
		ENDURANCE - (hrs)	- unknown

MANUFACTURER - BHC
FIRST TRIALS USE - Design Study

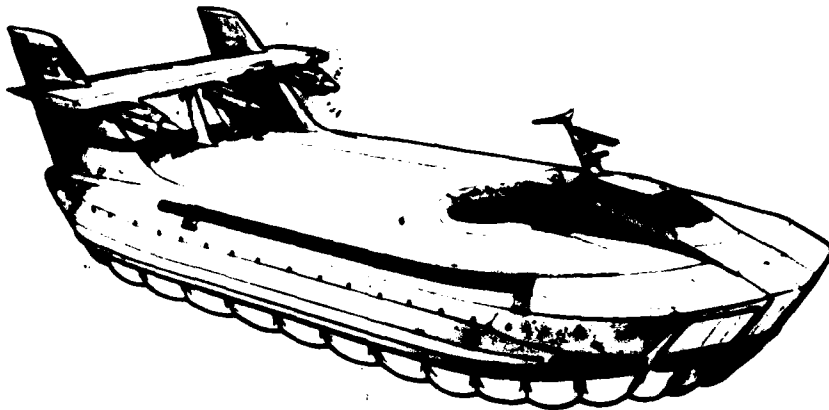


SEDAM N 300 Naviplane

The N300 is in ferry service for Gironde Department. It can carry 90 passengers or 4 cars and 35 passengers. It incorporates four axial fans and employs the Bertin Jupe-type skirt system which allows this craft to be fully amphibious. Military versions for use in coastal patrol, salvage, rescue, assault landings and logistic supply are being studied, but to date none have been built.

GROSS WT. - LT(MT)	- 24 (24.5)	POWER LIFT - hp(kw)	- 1250 (932)
PAYLOAD - lbs(kg)	- 28660 (13000)	PROPULSION - hp(kw)	- 2 Turbomecca,
FUEL - lbs(kg)	-	ENGINES LIFT	- Turmo, III N3
LENGTH - ft(m)	- 78.75 (24)	PROPULSION	- 4 11-bladed, axial
BEAM - ft(m)	- 34.42 (10.5)	FANS (DIA = 1.9 m)	- 2 3-bladed CP
HEIGHT - ft(m)	- 24.58 (7.5)	PROPELLERS (DIA = 3.6 m)	- 45 (83.3)
SKIRT HT. - ft(m)	- 6.58 (2)	SPEED - kts(kph)	- 130 (241)
CUSHION P - psi(nt/m ²)	- 34.5 (168.4)	RANGE - nm(km)	- 3
		ENDURANCE - (hrs)	

MANUFACTURER - Societe D'Etudes Et De Development Des Aeroglisseurs Marins (SEDAM)
 FIRST TRIALS USE - Dec 1967

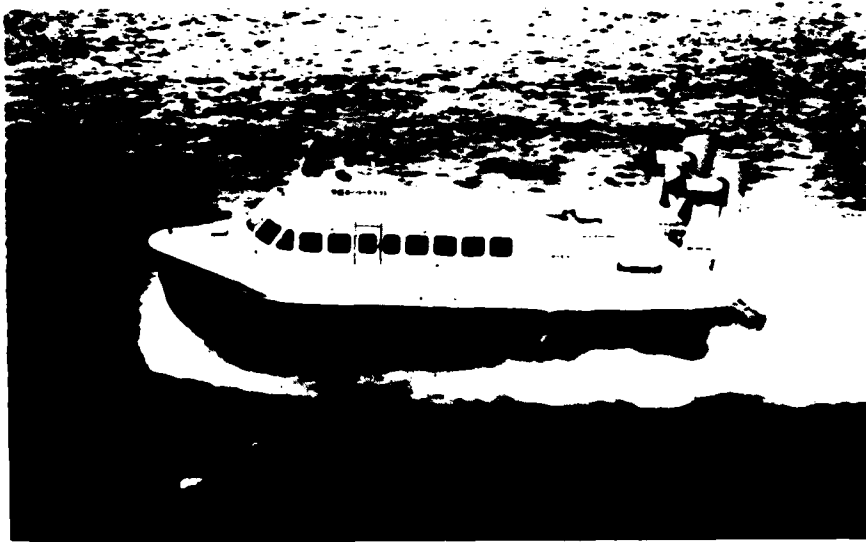


SEDAM N500 Naviplane

The N500 is a mixed-traffic ferry currently in production. The projected payload is 385 passengers and 65 cars. Like the N300, the N500 utilizes the Bertin Jupe-type skirt system.

GROSS WT. - LT(MT)	- 225 (228.6)	POWER LIFT - hp(kw)	- 3200 (2386)
PAYLOAD - lbs(kg)	- 187400 (85000)	PROPULSION - hp(kw)	- 3 TF-40
FUEL - lbs(kg)	- 44100 (20000)	ENGINES LIFT	- 2 Avco Lycoming TF-40
LENGTH - ft(m)	- 177.17 (54)	PROPULSION	- 3 TF-40
BEAM - ft(m)	- 78.75 (24)	FANS (DIA = 14 m)	- 2 13-bladed, Axial
HEIGHT - ft(m)	- 55.75 (17)	PROPELLERS (DIA = 21.3 m)	- 4 bladed, CP
SKIRT HT. - ft(m)	- 11.8 (3.6)	SPEED - kts(kph)	- 76 (141)
CUSHION P - psf(nt/m ²)	- 36.1 (176)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	- 5

MANUFACTURER - SEDAM
FIRST TRIALS USE - Design Study



Mitsui MV-PP5

The MV-PP5 is intended for fast ferry services on Japanese coastal and inland waters. The craft is now in production at the rate of 4 per year. This craft uses retractable water rods for increased maneuverability. The MV-PP5 is a passenger ferry that carries 50 passengers.

GROSS WT. - LT(MT)	- 12.5 (12.7)	POWER LIFT - hp(kw)	- 1050 (783)
PAYLOAD - lbs(kg)	- 12000 (5590)	PROPULSION - hp(kw)	- 1 General Electric,
FUEL - lbs(kg)	-	ENGINES LIFT	- 1M 100 GT
LENGTH - ft(m)	- 52.5 (16.0)	PROPULSION	- 1 13-bladed axial
BEAM - ft(m)	- 28.17 (8.6)	FANS (DIA = 2.3 m)	- 2 3-bladed CP
HEIGHT - ft(m)	- 14.4 (4.4)	PROPELLERS (DIA = 2.6 m)	- 45 (83.3)
SKIRT HT. - ft(m)	- 3.9 (1.2)	SPEED - kts(kph)	- 160 (296)
CUSHION P - psf(nt/m ²)	- 42.3 (206.6)	RANGE - nm(km)	- 4
		ENDURANCE - (hrs)	

MANUFACTURER - Mitsui Shipbuilding and Engineering Co. Ltd.
FIRST TRIALS USE - August 1968



Mitsui MV-PP15

The Mitsui MV-PP15 was developed as a larger version of the PP5. The MV-PP15 is designed for high speed passenger ferry services. It can carry 155 passengers. This craft uses retractable rubber-tired wheels that act as rudders and brakes. These wheels also provide ground contact for beaching and amphibious maneuvers.

GROSS WT. - LT(MT)	- 44.6 (45.4)	POWER LIFT - hp(kw)	- 1950 (1454)
PAYLOAD - lbs(kg)	-	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	-	ENGINES LIFT	- 2 Avco Lycoming,
LENGTH - ft(m)	- 80.1 (24.7)	PROPULSION	- TF-25 GT
BEAM - ft(m)	- 41.67 (12.7)	FANS (DIA = 2.3 m)	- 2 13-bladed Cent.
HEIGHT - ft(m)	- 25.9 (7.9)	PROPELLERS (DIA = 3.2 m)	- 2 4-bladed CP
SKIRT HT. - ft(m)	- 5.25 (1.6)	SPEED - kts(kph)	- 50 (92.6)
CUSHION P - psf(ut/m ²)	- 33.6 (164)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	- 4

MANUFACTURER - Mitsui
FIRST TRIALS USE - Autumn 1972



Raduga

This is an experimental vehicle used to develop control techniques and provide amphibious experience and data on skirt design. There is a crew of one and 5 passengers could be carried.

GROSS WT. - LT(MT)	- 2.68 (2.72)	POWER LIFT - hp(kw)	- 220 (164)
PAYLOAD - lbs(kg)	-	PROPULSION - hp(kw)	- 220 (164)
FUEL - lbs(kg)	-	ENGINES LIFT	- 1 AI-14R
LENGTH - ft(m)	- 30 (9.40)	PROPULSION	- 1 AI-14R
BEAM - ft(m)	- 13.5 (4.12)	FANS (DIA = 1.8 m)	- 12-bladed
HEIGHT - ft(m)	- 11.2 (3.4)	PROPELLERS (DIA =	- 2-bladed
SKIRT HT. - ft(m)	-	SPEED - kts(kph)	- 59.4 (110)
CUSHION P - psf(NT/m ²)	- 16.6 (81)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	- 3

MANUFACTURER - Krasnoye Sormovo Shipyard
 FIRST TRIALS USE - 1963

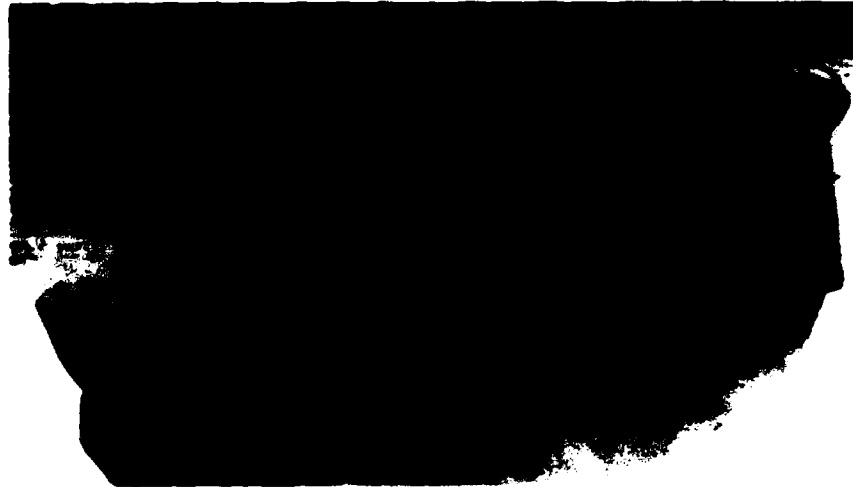


Sormovich

This craft was also designed with a peripheral jet, but when Raduga showed such improvements with the addition of flexible skirts, this craft was also fitted with a skirt system in 1970. The Sormovich also has a patent on a radial air-diffusion system that permits forward and aft lift air distribution from the stern mounted axial fan. This craft is used as a 50 passenger ferry.

GROSS WT. - LT(MT)	- 35.9 (36.5)	POWER LIFT - hp(kw)	- 2300 (1715)
PAYLOAD - lbs(kg)	- 18000 (8128)	PROPULSION - hp(kw)	- Ivchenko AI-20K,
FUEL - lbs(kg)	-	ENGINES LIFT	- shaft turbine
LENGTH - ft(m)	- 96 (29.2)	PROPULSION	- 12 blade CP
BEAM - ft(m)	- 32.79 (10.0)	FANS (DIA = 3.4 m)	- 2 4-bladed ducted CP
HEIGHT - ft(m)	- 23 (7)	PROPELLERS (DIA =	- 54 (100)
SKIRT HT. - ft(m)	- 3.28 (1)	SPEED - kts(kph)	- 320 (593)
CUSHION P - psf(nt/m ²)	- 26.8 (131)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	-

MANUFACTURER - Krasnoye Sormovo Shipyard
FIRST TRIALS USE - Oct 1965



Navy ACV - 1967

In the summer of 1967, this vehicle was first demonstrated to the public at the annual Navy Day Review held on the Neva River in Leningrad.

GROSS WT. - LT(MT)	- 13.4 (13.6)	POWER LIFT - hp(kw)	- 350
PAYLOAD - lbs(kg)	-	PROPULSION - hp(kw)	- 350
FUEL - lbs(kg)	-	ENGINES LIFT	- 1 engine
LENGTH - ft(m)	- 69.9 (21.3)	PROPULSION	- 2 engines
BEAM - ft(m)	- 30 (9.14)	FANS (DIA -	-
HEIGHT - ft(m)	-	PROPELLERS (DIA =	-
SKIRT HT. - ft(m)	-	SPEED - kts(kph)	- 50 (92.6)
CUSHION P - psf(nt/m ²)	- 16 (78.2)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	-

MANUFACTURER - Krasnoye Sormovo Shipyard
FIRST TRIALS USE - 1967



Gus/Skate

Skate is a 50 seat amphibious hoverferry built by the U.S.S.R. Military versions of the Skate, called the Gus, are in production for the Soviet Army and Navy. Variants built so far appear to be employed as fast amphibious transports for Soviet marine's and infantry units.

GROSS WT. - LT(MT)	- 24 (24.5)	POWER LIFT - hp(kw)	- 780 (582)
PAYLOAD - lbs(kg)	-	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	-	ENGINES LIFT	- 1 TVD 10 Marine GT
LENGTH - ft(m)	- 67.6 (20.6)	PROPULSION	- 2 TVD 10 Marine GT
BEAM - ft(m)	- 24 (7.3)	FANS (DIA =	- axial
HEIGHT - ft(m)	-	PROPELLERS (DIA =	- 2 3-bladed CP
SKIRT HT. - ft(m)	-	SPEED - kts(kph)	- 50.0 (92.5)
CUSHION P - psf(nt/m ²)	- 37 (182)	RANGE - nm(km)	- 200 (370)
		ENDURANCE - (hrs)	-

MANUFACTURER - Krasnoye Sormovo
FIRST TRIALS USE - 1969



Aist

The Aist is similar in appearance to the SRN.4. It has been mainly used by the Soviet Navy as a short to medium range heavy logistic craft capable of delivery mechanized infantry and tanks. Bow and stern ramps exist for through loading and a remotely operated rapid fire cannon can be seen ahead of the cabin. The Aist uses four counter rotating, variable pitch propellers.

GROSS WT. - LT(MT)	- 196 (200)	POWER LIFT - hp(kw)	-
PAYLOAD - lbs(kg)	-	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	-	ENGINES LIFT	-
LENGTH - ft(m)	- 145 (44.19)	PROPULSION	-
BEAM - ft(m)	- 55 (16.76)	FANS (DIA =	- Centrifugal
HEIGHT - ft(m)	-	PROPELLERS (DIA =	- 4.VP
SKIRT HT. - ft(m)	-	SPEED - kts(kph)	- 70 () max
CUSHION P. - psf(nt/m) -	-	RANGE - nm(km)	-
		ENDURANCE - (hrs)	-
MANUFACTURER -			
FIRST TRIALS USE -			



Voyageur

The Bell Aerospace Canada Voyageur is an amphibious hovercraft designed to haul up to 25 tons over Arctic ice and tundra. This payload is equivalent to that of most transport aircraft used in supply roles in the north. The craft features modular construction for ease of transportation. The basic flatbed hull of the cargo version allows for easy modification of the Voyageur to a 140 passenger ferry or to a military weapons platform configuration.

GROSS WT. - LT(MT)	- 40 (40.8)	POWER LIFT - hp(kw)	- 1300 (969)
PAYLOAD - lbs(kg)	- 30000 (13600)	PROPULSION - hp(kw)	- 2 Pratt & Whitney,
FUEL - lbs(kg)	- 18400 (8350)	ENGINES LIFT	- STGT-75 Twin Pac GT
LENGTH - ft(m)	- 64.8 (19.8)	PROPULSION	- 2 12-bladed Cent.
BEAM - ft(m)	- 36.7 (11.2)	FANS (DIA = 2.1 m)	- 2 3-bladed CP
HEIGHT - ft(m)	- 22.0 (6.7)	PROPELLERS (DIA = 2.7 m)	- 40 (74), 47 ¹
SKIRT HT. - ft(m)	- 4 (1.22)	SPEED - kts(kph)	- 550 (1020)
CUSHION P - psf(nt/m ²)	- 49.2 (240)	RANGE - nm(km)	- 13.5, 3 ²
		ENDURANCE - (hrs)	

MANUFACTURER - Bell Aerospace Canada
 FIRST TRIALS USE - November 1971

¹maximum speed, calm water

²3 hrs endurance with 60000 lbs payload and 4170 lbs fuel 24



Voyageur Military Configuration

The Voyager has been evaluated by the U.S. Army for Logistics Over The Shore (LOTS) missions. This photograph shows a test conducted by the U.S. Army and Navy. The craft is carrying 2 standard Milvan containers ashore during Exercise OSDOC II (Off-Shore Discharge of Containerships) that was conducted in 1972 at Fort Story, Virginia.



Viking

The Bell Aerospace Canada Viking evolved from the Voyageur to meet the need for a similar but smaller multi-purpose ACV. The Viking is also used by the Canadian Coast Guard for an inshore search and rescue craft.

GROSS WT. - LT(MT)	- 15.7 (16.0)	POWER LIFT - hp(kw)	- 1300 (969)
PAYLOAD - lbs(kg)	- 10000 (4536)	PROPULSION - hp(kw)	- 1 UACL STGT-5,
FUEL - lbs(kg)	- 2700 (1225)	ENGINES LIFT	- Twin - Pac GT
LENGTH - ft(m)	- 44.5 (13.6)	PROPULSION	- Cent.
BEAM - ft(m)	- 26.0 (7.9)	FANS (DIA = 2.1 m)	- 2 3-bladed CP
HEIGHT - ft(m)	- 20.0 (6.1)	PROPELLERS (DIA = 2.7 m)	- 35 (65)
SKIRT HT. - ft(m)	- 4 (1.22)	SPEED - kts(kph)	- 157 (292)
CUSHION P - psf(NT/M ²)	- 39.6 (193.2)	RANGE - nm(km)	- 4.5
		ENDURANCE - (hrs)	-

MANUFACTURER - Bell Aerospace Canada
FIRST TRIALS USE - 1974



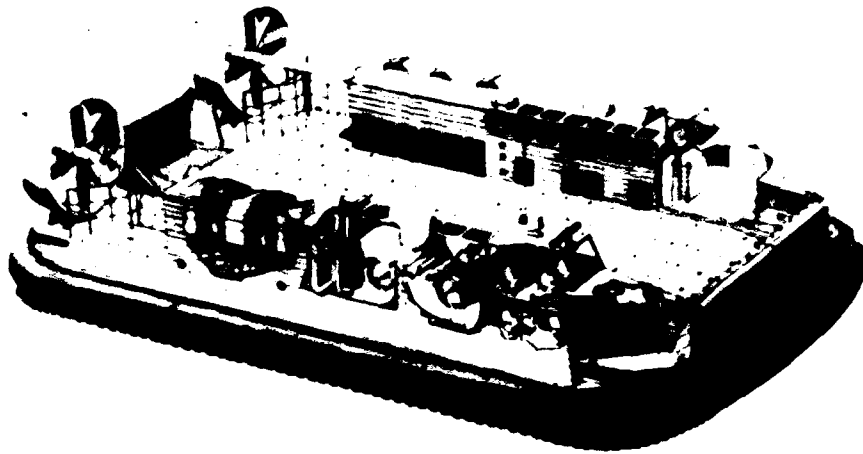
JEFF(A)

This is one of 2 design proposals for the Amphibious Assault Landing Craft (AALC) program. This craft is being built by Aerojet General Corporation. The JEFF(A) has a bag/pericell skirt system. The lift fans and the shrouded propellers are driven by separate gas turbine engines. One engine for each of four shrouded propeller and one engine for four centrifugal lift fans per side. The shrouded propellers are capable of being rotated for craft control and maneuverability. The JEFF(A) is designed to carry up to 150,000 lbs. (68038 kg) of payload in an overload condition.

GROSS WT. - LT(MT)	- 152 (154)	POWER LIFT - hp(kw)	- (2,800 (2,090)
PAYLOAD - lbs(kg)	- 120000 (54430)	PROPULSION - hp(kw)	- (2,800 (2,090)
FUEL - lbs(kg)	- 40000 (18140)	ENGINES LIFT	- 2 AVCO Lycoming TF-40
LENGTH - ft(m)	- 96 (29.26)	PROPULSION	- 4 AVCO Lycoming TF-40
BEAM - ft(m)	- 48 (14.63)	FANS (DIA = 1.22 m)	- 8 Single entry cent.
HEIGHT - ft(m)	- 19 (5.79)	PROPELLERS (DIA = 2.27 m)	- 4 shrouded on pylons
SKIRT HT. - ft(m)	- 5 (1.52)	SPEED - kts(kph)	- 50 (92.7) ¹
CUSHION P - psf(nt/m ²)	- 73.8 (3534)	RANGE - nm(km)	- 200 (370.7) ¹
		ENDURANCE - (hrs)	-

MANUFACTURER - Aerojet General Corporation
 FIRST TRIALS USE - Summer 1977

¹sea state 2, 25 knot headwind



JEFF(B)

This craft is being built by Bell Aerospace Corporation for the AALC program. It has bag/finger skirt system and two fixed mounted shrouded propellers. Movable rudders are mounted in the slipstream of the propellers for craft control. This vehicle incorporates an integrated lift and propulsion system by coupling 3 engines to two double entry fans and one shrouded propeller per side. The JEFF(B) utilizes a bag/finger skirt system with longitudinal and lateral seals that compartmentize the cushion. The JEFF(B) is also designed to carry up to 150,000 lbs. of payload in an overload condition.

GROSS WT. - LT(MT)	- 152 (154)	POWER LIFT - hp(kw)	- 2,800 (2090)
PAYLOAD - lbs(kg)	- 120000 (54430)	PROPULSION - hp(kw)	- 6 AVCO Lycoming TF-40
FUEL - lbs(kg)	- 38800 (17600)	ENGINES LIFT	- 4 Double entry cent.
LENGTH - ft(m)	- 87.5 (26.69)	PROPULSION	- 2 Shrouded (2 bow T)
BEAM - ft(m)	- 47 (14.33)	FANS (DIA = 1.52 m)	- 50 (92.7) ¹
HEIGHT - ft(m)	- 19 (5.79)	PROPELLERS (DIA = 3.58 m)	- 200 (370.7) ¹
SKIRT HT. - ft(m)	- 5 (1.52)	SPEED - kts(kph)	-
CUSHION P - psf(nt/m ²)	- 79.0 (3782)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	-

MANUFACTURER - Bell Aerospace Corporation
 FIRST TRIALS USE - Summer 1977

¹ sea state 2, 25 knot headwind



Arctic Surface Effect Vehicle Concept

This is a conceptual design of a 172.5 MT military Arctic Surface Effect Vehicle. A deep pericell skirt system was developed around the basic JEFF(A) hull design that was enclosed for crew accommodations. The sphere mounted at the stern is the obstacle avoidance radar system used for navigation in the ice ridge fields that are prevalent in the Arctic.

GROSS WT. - LT(MT)	- 169 (172.5)	POWER LIFT - hp(kw)	-	6250 (4660)
PAYLOAD - lbs(kg)	- 60000 (27220)	PROPULSION - hp(kw)	-	
FUEL - lbs(kg)	- 86000 (39,000)	ENGINES LIFT	-	4 Garrett 990
LENGTH - ft(m)	- 86.6 (26.40)	PROPULSION	-	
BEAM - ft(m)	- 42.5 (12.95)	FANS (DIA = 1.58 m)	-	8 Cent., HEBA-B design
HEIGHT - ft(m)	- 44.75 (13.65)	PROPELLERS (DIA = 2.27 m)	-	4 Shrouded
SKIRT HT. - ft(m)	- 9 (2.74)	SPEED - kts(kph)	-	50 (92.7) ¹ , 50 ²
CUSHION P - psf(NT/m ²)	- 103.2 (4941)	RANGE - nm(km)	-	646 (1197) ¹ , 528
		ENDURANCE - (hrs)	-	

DESIGNER - Aerojet

FIRST TRIALS USE - Conceptual Design

¹over water at sea state 2 (no wind)

²over ridge, ice/snow (no wind)



Arctic Surface Effect Vehicle Concept

This is a version of the JEFF(B) design adapted to the Arctic environment. It incorporates a deep bag/finger skirt system with longitudinal and lateral seals that compartmentize the cushion for added stability. The basic JEFF(B) structure has been widened and the open cargo area has been partly enclosed for crew accommodations.

GROSS WT. - LT(MT)	- 156 (159)	POWER LIFT - hp(kw)	- 3575 (2666)
PAYLOAD - lbs(kg)	- 60000 (27200)	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	- 60000 (27600)	ENGINES LIFT	- 6 AVCO Lycoming, TF-40 GT
LENGTH - ft(m)	- 92.58 (28.22)	PROPULSION	-
BEAM - ft(m)	- 68.67 (20.93)	FANS (DIA = 1.52 m)	- 4 double entry cent.
HEIGHT - ft(m)	- 40.67 (12.40)	PROPELLERS (DIA = 3.56 m)	- 2 4-bladed, shrouded
SKIRT HT. - ft(m)	- 10 (3.05)	SPEED - kts(kph)	- 57 (105) ¹ , 60 ²
CUSHION P - psf(nt/m ²)	- 81.4 (3897)	RANGE - nm(km)	- 370 (686) ¹ , 330 ²
		ENDURANCE - (hrs)	-

DESIGNER - Bell Aerospace Corp.
 FIRST TRIALS USE - Conceptual Design

¹over water, sea state 2 (no wind)

²over ridge, ice/snow (no wind)



Arctic Surface Effect Vehicle Concept

This is a 540 ton (490 MT) concept that utilizes centrifugal lift fan, rotatable shrouded propulsors and a deep bag-closed finger skirt system. The deep skirt system allows this vehicle to transverse up to 90-percent of the ice ridge obstacle that exist in the Arctic. The design has sufficient control capability to maneuver at cruise speed between those obstacle it can not safely traverse. The design can accommodate a crew of 22 for up to 14 days on station.

GROSS WT. - LT(MT)	- 482 (490)	POWER LIFT - hp(kw)	- 24,000 (17,900)
PAYLOAD - lbs(kg)	- 213000 (96600)	PROPULSION - hp(kw)	- 2 General Electric,
FUEL - lbs(kg)	- 179500 (81420)	ENGINES LIFT	- LM 2500 GT
LENGTH - ft(m)	- 165.3 (50.38)	PROPULSION	- 12 dbl width/inlet cent
BEAM - ft(m)	- 83.2 (25.36)	FANS (DIA = 1.52 m)	- 4 blade shrouded
HEIGHT - ft(m)	- 53 (16.15)	PROPELLERS (DIA = 4.11 m)	- 80 (148 ¹ , 53 ²)
SKIRT HT. - ft(m)	- 10 (3.05)	SPEED - kts(kph)	- 800 (1480), 530 ²
CUSHION P - psf(nt/m ²)	- 88.0 (4213)	RANGE - nm(km)	-
		ENDURANCE - (hrs)	-

DESIGNER - Boeing
 FIRST TRIALS USE - Conceptual Design

¹over ridge, ice/snow (no wind)

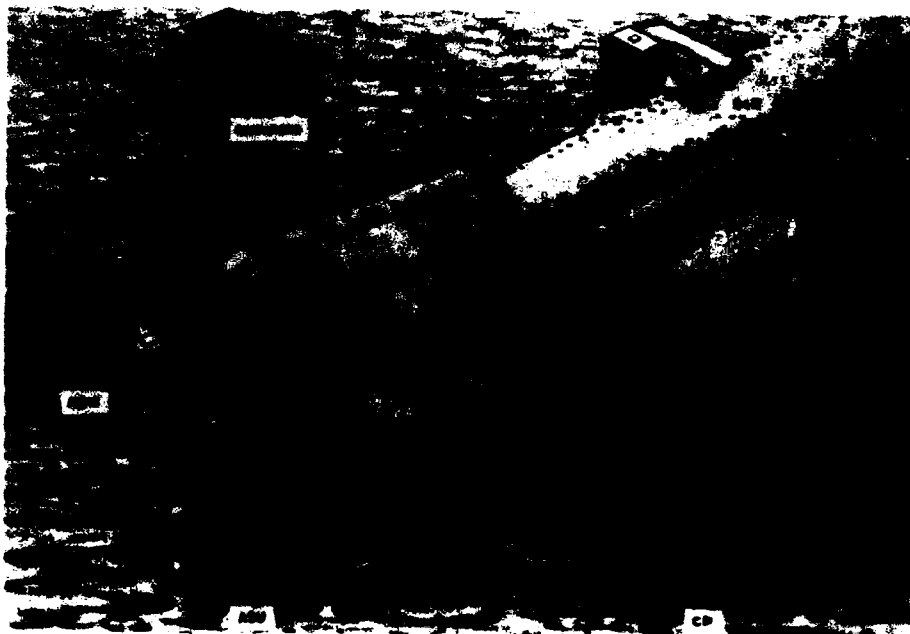
²over water, sea state 2 (no wind)



Twin Cushion SEV Concept

This is a conceptual design that has increased roll stability, increased obstacle clearance and increased efficiency at high speeds over conventional hovercraft. The design has two high length-to-beam ratio cushions separated by an airfoil section. At high speeds the cushion is off-loaded by aerodynamic lift reducing the lift power required. From the separation of the twin cushions, roll stability can be maintained and even increased with an increase in the cushion depth.

Another updated version of the twin cushion concept is discussed on the next page.



Twin Cushion SEV Concept

One of the most attractive missions for the TCSEV could be as a multi-mission craft. It is estimated that a 200 m. tons TCSEV could perform a combination of the following missions in operation with the fleet:

- ASW
- ASU
- Coastal Patrol
- Search and Rescue
- Salvage
- Mine countermeasures
- Transport of standardized containers

The arrangement of the craft with its large deck area and access to the ground would facilitate quick change of mission packages and efficient switching from one role to another. This capability would also make maximum use of a given craft. Though more detailed work needs to be done in the area of mission evaluation of this craft, the advantages of the TCSEV do appear to offer new and improved potential for application of this new surface effect vehicle.

GROSS WT. - LT(MT)	- 200 (203)	POWER LIFT - hp(kw)	- 6250 (4660)
PAYLOAD - lbs(kg)	- 67200 (30500)	PROPULSION - hp(kw)	-
FUEL - lbs(kg)	- 95900 (43500)	ENGINES LIFT	- 4 Garrett GTPF-990-3GT
LENGTH - ft(m)	- 144 (43.9)	PROPULSION	-
BEAM - ft(m)	- 27 (8.23)	FANS (DIA = 1.66 m)	- 10 axial
HEIGHT - ft(m)	- 40 (12.19)	PROPELLERS (DIA = 4.11 m)	- 4 shrouded, 3 blades
SKIRT HT. - ft(m)	- 13.1 (4.0)	SPEED - kts(kph)	- 80 (148) ¹
CUSHION P - psf(nt/m)	- 87(4166) @ 0 kts.	RANGE - nm(km)	- 885 (1640) ¹
	63(3016) @ 80 kts.	ENDURANCE - (hrs)	- 11

DESIGNER - DTNSFDC

FIRST TRIALS USE - Conceptual Design

¹over calm water

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4. "Technical Summary Arctic Surface Effect Vehicle Program Volume I Program Review and History of Related Developments", NSRDC Report 4594, Jun 1975.
5. "Arctic Surface Effect Vehicle Program, Volume II Technical Summary and Design Development", NSRDC Report 4595, Aug 1975.

**LATE
LME**