United States Patent Application Publication	20250256828
Kind Code	A1
Publication Date	August 14, 2025
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PARTIALLY AEROSTATICALLY SUPPORTED RAM AIR CUSHION SHIP

Abstract

The invention provides a new class of transportation with a partially aerostatically supported ram air cushion ship (PASRACS) that can provide safe, fast, efficient global transport services with extraordinary comfort, luxury and amenities. The PASRACS employs inventive synergistic combinations of lift from aerostatic, aerodynamic, hydrostatic and hydrodynamic forces for different modes of operation ranging from a stationary floating configuration on a water surface, to flight in ground effect at high speed. A propulsion system can utilize hydrogen as an energy source driving fluid-dynamic thrusters, to enable zero carbon emissions operations. A transition method is provided for a PASRACS to transition from a floating mode to a takeoff mode to a flight in ground-effect mode in an inventive optimized manner. A transport method for multimodally transporting payload is provided with PASRACS vehicles and systems, with quick turn time operations enabled by the use of payload transfer transport modules and transfer vehicles.

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Appl. No.:	**18/440898**
Filed:	**February 13, 2024**

Publication Classification

Int. Cl.: **B64B1/30** (20060101); **B64B1/58** (20060101); **B64B1/68** (20060101); **B64B1/70** (20060101)

U.S. Cl.:

CPC **B64B1/30** (20130101); **B60V3/06** (20130101); **B64B1/58** (20130101); **B64B1/68** (20130101); **B64B1/70** (20130101);

Background/Summary

BACKGROUND OF THE INVENTION

[0001] As the World's human population grows and as the global economy grows, it is anticipated that demand for transport (including international and intercontinental transport) of both passengers and cargo will also experience very substantial growth in the 21.sup.st Century. Current state of the art airliners such as versions of the Boeing 787 and 777 and 747 and Airbus A330 and A350 and A380 wide-body aircraft (Ref. 1), can typically accommodate in the range of 200 to 600 passengers; while dedicated air freighter versions of wide-body aircraft can typically accommodate cargo corresponding to an equivalent cargo volume of 10 to 30 TEUs (Twenty-Foot Equivalent Units with reference to a 20 foot standard container such as a high-cube container having internal volume of approximately 37 cubic meters or 1300 cubic feet) and corresponding revenue cargo weight of approximately 40 to 120 tonnes (metric tons). It is well-understood in the art of air transportation that payload-denominated aircraft cost metrics such as cash operating cost (CAROC) per passenger-kilometer for passenger payload, or cash operating cost (CAROC) per tonne-kilometer for revenue cargo payload, generally reduce with increasing aircraft size. However, airport limitations such as runway-to-taxiway separations limit the development of aircraft with significantly larger capacities than the wide-body airliners noted above. Current container ships have enormous cargo capacities reaching over 24,000 TEU (Ref. 2) or roughly a thousand times the capacity of a large air freighter, and offer much lower cash operating cost per tonne-kilometer. However, container ship cruise speed is less than 5% that of typical jet air freighters. In a similar manner, cruise ships can accommodate around ten times the number of passengers as large airliners (Ref. 3) while offering much greater luxury & a large portfolio of passenger amenities; but in this case again cruise ships are extremely slow relative to airliners and hence capture a completely negligible market share of international and intercontinental passenger travel, such as traffic volume as in revenue-passenger-kilometers or RPK.

[0002] In view of anticipated continued strong global demand growth for both passenger and cargo transport over the coming decades, and in view of the significant size limitations on conventional jetliners and significant speed limitations of conventional ships, it logically follows that there should be a very large market opportunity if a new class of transport vehicles could offer safe, efficient and economical transport with parameter attributes capturing the best aspects of ships and planes, such as order-of-magnitude payload capacities between 500 and 500,000 passengers and/or between 20 and 20,000 TEU (Twenty-Foot-Equivalent volume) of revenue cargo, without limitation, and economical cruise speeds between 75 km/hr (Mach 0.06 near sea level) and 750 km/hr (Mach 0.6 near sea level), with these order-of-magnitude exemplary ranges of numbers cited without limiting the spirit and scope of the invention as described hereinafter. The innovative class of Partially Aerostatically Supported Ram Air Cushion Ships or PASRACs that are described and claimed herein, are intended to serve and satisfy this very large opportunity to serve humankind's strongly growing transport needs by leveraging innovation to enable parameters that synergistically optimize several of the best vehicle attributes and aspects of current ships and current aircraft. It is widely recognized that the transport and tourism sectors significantly help enable human happiness and well-being and cross-cultural understanding and respect, and the inventor humbly prays that this PASRACS invention may serve the cause of human betterment and well-being, and not be used for purposes of serving as an instrument of death or suffering.

BRIEF SUMMARY OF THE INVENTION

[0003] In summary, this invention provides a partially aerostatically supported ram air cushion ship (PASRACS), a transport vehicle capable of flying in ground effect over an Earth surface such as an ocean surface, while being supported above said Earth surface by forces including a combination of aerostatic lift through use of a lifting gas compartment, on the first hand, and a ram air cushion between said Earth surface on the first hand and a lower surface of the vehicle on the second hand. Flaps can be used to control pressurization of regions of the ram air cushion, and the ram air cushion can in certain embodiments be a power-augmented ram air cushion that is at least partially pressurized by energized flow from a fluid dynamic propulsor. The lifting gas compartment can hold helium or hydrogen lifting gas in certain preferred embodiments. Multiple decks can be used to accommodate passenger and cargo payload. PASRACS will preferably have propulsion and stability and control and trim systems and also be fitted with life-preservation apparatus for passengers and crew. PASRACS will be capable of flight in ground effect over ocean surfaces as well as over land surfaces such as over land corridors as needed, for example and without limitation such as a crossing from the Red Sea to the Mediterranean Sea on a track close to the Suez Canal, and a crossing on a defined land corridor across Central America from the Caribbean Sea to the Pacific Ocean. PASRACS can utilize at least one of hydrostatic and hydrodynamic forces to contribute lift during a landing on a water surface. PASRACS can be used with a transition method to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a flight in ground-effect mode above an Earth surface. Detachable payload modules can be employed to enable quicker turn time operations at a port of destination. PASRACS can provide a transport method for multimodally transporting payload from an origin location to a destination location employing a transfer vehicle that serves as the aforesaid detachable payload module. This new class of vehicle architecture and configuration design combined with appropriate aerodynamic and structural optimization can enable a very large vehicle capable of providing intercontinental (and intracontinental) transport for passengers and cargo to Worldwide destinations with a combination of speed, comfort and very low energy use per passenger-kilometer and per tonne-kilometer as well as near-zero carbon emissions per passenger-kilometer and per tonne-kilometer, as will be further described in the following descriptive portion of the specification, drawings and claims.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIGS. **1**A and **1**B show left side and bottom plan views of a preferred embodiment of a partially aerostatically supported ram air cushion ship.

[0005] FIGS. **1**C, **1**D, **1**E, **1**F and **1**G show transverse cross-sectional views, with scaling for improved understanding, of the preferred embodiment of FIGS. **1**A and **1**B, at longitudinal locations A-A, B-B, C-C, D-D and E-E of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A.

[0006] FIGS. **2**A through **2**F show representative top plan view diagrams of deck layout configurations of different level decks of the preferred embodiment of FIGS. **1**A and **1**B.

[0007] FIGS. **3**A through **3**F show front views of some alternate preferred embodiments of a partially aerostatically supported ram air cushion ship.

[0008] FIGS. **3**G and **3**H show rear views of some alternate preferred embodiments of a partially aerostatically supported ram air cushion ship.

[0009] FIGS. **3**I through **3**L show transverse cross-sectional views of still other preferred embodiments of a partially aerostatically supported ram air cushion ship.

[0010] FIGS. **4**A through **4**G show left side views of some other alternate preferred embodiments of a partially aerostatically supported ram air cushion ship.

[0011] FIGS. **5**A through **5**H show plan views of still other alternate preferred embodiments of a partially aerostatically supported ram air cushion ship.
[0012] FIGS. **6**A and **6**B show a preferred embodiment of a transition method for a partially aerostatically supported ram air cushion ship to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface.
[0013] FIG. **6**C shows corresponding transition methods including takeoff and landing transitions before and after a flight in ground effect phase of operation.
[0014] FIGS. **6**D through **6**H show some alternate preferred embodiments of a transition method for a partially aerostatically supported ram air cushion ship to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface.
[0015] FIG. **7**A through **7**C show some preferred embodiments of a landing transition method for a partially aerostatically supported ram air cushion ship to transition from a forward flight in ground effect mode above an Earth surface, to a landing on a water surface and then to a substantially static floating mode on the water surface.
[0016] FIG. **8**A shows a preferred embodiment of a transport method for multimodally transporting payload from an origin location.
[0017] FIGS. **8**B through **8**E show some alternate preferred embodiments of a transport method for multimodally transporting payload from an origin location.
[0018] FIGS. **9**A and **9**B show some alternate preferred aerodynamic and hydrodynamic features that can be applied on a partially aerostatically supported ram air cushion ship.
[0019] FIGS. **10**A through **10**E show block diagrams of some alternate preferred systems and controls architectures and features that can be applied on a partially aerostatically supported ram air cushion ship.
[0020] FIGS. **11**A through **11**G illustrate some alternate preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship.
[0021] FIGS. **12**A through **12**F show some alternate preferred propulsion, fuels and energy architectures and features that can be applied on a partially aerostatically supported ram air cushion ship.
[0022] FIGS. **13**A through **13**C illustrate some alternate preferred payloads architectures and features that can be applied on a partially aerostatically supported air cushion ship.
[0023] FIGS. **14**A through **14**E illustrate some alternate preferred methods of operation that can be applied for normal and nonnormal operations of a partially aerostatically supported air cushion ship.
[0024] FIGS. **15**A through **15**D illustrate some alternate preferred methods of manufacture, maintenance and repair that can be applied for a partially aerostatically supported air cushion ship.
[0025] FIGS. **16**A through **16**G illustrate representative termini and representative global routes such as round-the-world routes, that could be served with trans-oceanic transportation services provided by partially aerostatically supported air cushion ships (PASRACS).
[0026] FIG. **17** illustrates inventive aspects of longitudinal and lateral trim systems.

DETAILED DESCRIPTION OF THE INVENTION

[0027] Prior to commencing with the detailed description, certain expressions are defined as pertaining to their use in the following detailed description and claims.
[0028] The expression “ship” is to be understood as meaning a vehicle or vessel capable of traversing a geographic region of water such as a region of an ocean or a sea, without limitation.
[0029] The expression “ground surface” is to be understood as meaning any of a solid surface, a frozen water surface or other frozen surface, and a semisolid surface such as a marsh surface, a swamp surface, a mud surface or a slush surface, without limitation.
[0030] The expression “Earth surface” is to be understood as meaning the interface surface

immediately below the atmosphere, and can be either a ground surface at a top surface of the lithosphere or the top surface of a body of water supported by the lithosphere. Examples of a “body of water supported by the lithosphere” can include without limitation an ocean, a lake, a reservoir, a river, a canal, a salt water body, a fresh water body, a bay, an inlet, an estuary, a delta, a lagoon, a channel, and a sound; can include liquid or frozen or partially frozen water; and can include water and solids mixes such as in marsh or swamp or slush or mud or semisolid areas, without limitation.

[0031] The expression “aileron” is to be understood as meaning any of an aileron, a droopable aileron, a flaperon, an elevon and a deployable fluid dynamic control surface capable of generating a rolling moment from fluid dynamic forces acting on a vehicle fitted with the aileron.

[0032] The expression “wing tip fence” is to be understood as meaning any of a series of wing tip devices known in the prior art for reducing spanwise flow and/or induced drag, including a tip fence, a downward winglet, an upward winglet, an up-down winglet, tip feathers, a raked tip and other devices known in this class.

[0033] The expression “ground-effect” is to be construed as applicable to a wing in ground-effect or other vehicle flying above the ground with aerodynamic support, when the induced drag ground-effect influence ratio is no greater than 98.9% or the height above ground to vehicle span ratio is no greater than 2, wherein these two values correspond substantially to each other according to the Hoerner & Borst (Ref. 4) closed-form mathematical model relationship known in the prior-art of aerodynamic flight in ground-effect.

[0034] The expression “weak ground-effect” is to be construed as applicable to a wing in ground-effect or other vehicle flying above the ground with aerodynamic support, when the induced drag ground-effect influence ratio is greater than 98.9% but no greater than 99.9% or the height above ground to vehicle span ratio is greater than 2 but no greater than 10, wherein the latter two values (99.9% and 10 respectively) correspond substantially to each other according to the Hoerner & Borst (Ref. 4, 20-10) closed-form mathematical model relationship presented in the prior-art of aerodynamic flight in ground-effect.

[0035] The expression “prop” is to be understood as meaning a fluid propulsor member such as an unducted or ducted propeller or fan or jet that can convey power or impart thrust to a fluid such as air or water.

[0036] The expression “window” is to be understood as meaning a view panel or a transparent member or a translucent member and further includes subvariants such as a dimmable window and an electrochromic window and a one-way window and a framed window and a frameless window and a fixed window and an openable window and a load-bearing window and a structural window and a transparent composite window and a membrane window and a shatterproof window and a glass window and a safety glass window and a plastic window and an acrylic window and a polycarbonate window and a ETFE window.

[0037] FIG. **1**A shows a left side view of a preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1** with a positive airspeed **24** that is in motion on a travel path **24**T, with partial support in the transition condition shown from each of aerodynamic support from a ram air cushion **20**, aerostatic support from aerostatic lift force **10** from use of a lifting gas **9**, hydrodynamic support from a hydrodynamic lift force **36** from a hydrodynamic lift member **36**M and hydrostatic support from a hydrostatic lift force **17** from a hydrostatic floatation subsystem **15** including a water displacing structure **16**. Thrust force **28** is sufficient to meet or overcome drag force **141**.

[0038] FIG. **1**A further illustrates a PASRACS **1** which includes a payload volume **4**, wherein for a design payload density, the payload volume **4** comprises no more than three-quarters of total volume of the PASRACS **1**, leaving available internal volume in the PASRACS **1** for encompassed lifting volume **9**E in a lifting gas enclosure **8** to contain lifting gas **9** with no increase in wetted area of the PASRACS **1**. Note that depending on requirements and objectives, the design payload density applicable to the payload volume **4** for a particular vehicle design may be specified at a particular value lying in the order of magnitude range between 0.01 pound per cubic foot and 100 pounds per cubic foot, without limitation.

[0039] FIG. **1**B shows a bottom plan view of the preferred embodiment of the partially aerostatically supported ram air cushion ship **1** shown in FIG. **1**A. FIG. **1**B shows how the propulsion system **26** provides pressurized outflow that helps pressurize the ram air cushion **20** under both the wing **61** and body **3**, as shown. The illustrated propulsion system **26** also includes aft body mounted thrusters **28**T with boundary layer ingestion intakes **26**BL that feed air to provide oxygen for at least one of a combustion engine and a fuel cell in the propulsion system **26**. The trailing edge Kutta condition that influences the pressurization under different portions of the wing **61** is set by appropriate trailing edge down deflections of the flaps **90**F, the flaperons **90**FA, and the ailerons **90**A with an aileron droop functionality. While two inboard flaps, one flaperon and one aileron are shown on each wing side, it should be understood that a variety of alternate variant embodiments may employ different combinations of zero to many for each of ailerons, flaperons and flaps, and also be supplemented by spoilers that can provide aerobraking and roll control functionality as known from the art of aircraft spoilers. Flap types can include one or more selected from: a plain flap, a split flap, a translating flap, a hinged flap, a flap with motion along a flap track, a flap mounted on a deployment linkage, a single-slotted flap, a multi-slotted flap, a Fowler flap, a morphing surface flap, a blown flap, and a Coanda effect flap, for example and without limitation. Flexible members such as a flexible seal and/or a flexible connecting membrane may be provided in gap areas between adjacent flap elements or members. Note that both the ailerons **90**A and flaperons **90**FA also perform roll control by differential deflections between the left and right wings. FIG. **1**B shows cargo volume **42** with payload **7** including cargo **43** that can comprise cargo containers **43**A such as Unit Load Devices (ULDs), shown in dashed lines as they are located on the lowest deck of the PASRACS **1**, located just above the base of the vehicle as seen in this bottom plan view. The cargo containers **43**A can be transported to different locations via a cargo transport corridor area **43**T utilizing an internal cargo container transport subsystem such as one using an overhead mobile crane subsystem as one example, or a roller tray and powered rollers subsystem as another example. FIG. **1**B also shows the accommodation of liquid hydrogen **12**L in a liquid hydrogen tank **47**H. The liquid hydrogen tank **47**H is on the payload transfer transport module **47** as illustrated, but it should be understood that in variant preferred embodiments liquid hydrogen tank(s) could be located anywhere in the partially aerostatically supported ram air cushion ship **1**. The liquid hydrogen **12**L can be used both as a fuel for the propulsion system **26** (such as a combustion subsystem and/or fuel cell subsystem) and/or for replenishing hydrogen gas in the aerostatic lift subsystem. FIG. **1**B shows plural payload transfer transport modules **47** (eight shown in four pairs) that can be winched down from the PASRACS **1** and then detached, to move over water preferably in a powered barge mode to a docking facility. Each payload transfer transport module **47** is shown with space for accommodating passengers in a forward region, space for accommodating cargo and baggage in the middle region, and space for accommodating fuel and lifting gas (e.g. hydrogen and/or helium in illustrated tanks, as well as other fuels in tanks that are not shown) in an aft region; with appropriate safety and security separation structure and features between these regions. The payload transfer transport modules will also have tanks/compartments for potable water and for waste (liquid and solid) in suitable spaces such as “nooks and crannies” which are not explicitly called out but can be inferred from transportation and architecture prior art. In addition. FIG. **1**B also shows downwardly winchable emergency evacuation barges **47**E and also shows optional compact payload transfer transport modules **47**C substantially adjacent to a keel **20**K that acts as a keel ventral stabilizer **88**K, which compact payload transfer transport modules **47**C can be winched down and detached, and then subsequently winched up and carried by smaller vehicles such as will be described subsequently in the context of FIGS. **5**A and **5**E. The compact payload transfer transport modules may optionally have onboard power, propulsion, navigation and search and rescue sensors and functionality, and serve as piloted rescue boats and/or autonomous robotic rescue boats that can serve to rescue people or boarding payload or deboarding payload associated with the PASRACS **1** that somehow have gone "overboard" and/or other humanitarian rescue operations.

[0040] FIGS. **1**C, **1**D, **1**E, **1**F and **1**G show transverse cross-sectional views of the preferred embodiment the partially aerostatically supported ram air cushion ship **1** of FIGS. **1**A & **1**B at longitudinal locations A-A, B-B, C-C, D-D and E-E respectively, of the partially aerostatically supported ram air cushion ship **1** as notated on FIG. **1**A. Note that FIG. **1**C is scaled by a linear scaling factor of 4 and FIG. **1**G is scaled by a linear scaling factor of 2, for improved understanding, relative to the other corresponding Figures of this preferred embodiment (namely FIGS. **1**A, **1**B. **1**D. **1**E and **1**F). FIG. **1**C shows a forward cross-section showing the flight deck/cockpit **31**C with windows **149** and with illustrated crew **31** being the flight deck crew such as a pilot and copilot, or Captain and First Officer, for example. The flight deck/cockpit **31**C may be fitted with instrumentation and controls such as a wheel, a control column, a control stick, a sidestick, rudder pedals, a tiller, a joystick, a flat panel display, a multifunction touchscreen display, and other instrument and/or control; as well as with amenities such as movable high comfort seats and furniture for crew, auxiliary crew, and observers. A vehicle control and navigation system **29** is illustrated in an equipment bay beneath the cockpit **31**C, in a manner analogous to electrical and electronics equipment bay ("EE Bay") precedents in commercial airliners. Volume in the body **3** that is behind the flight deck **31**C and/or behind the EE bay, can be used for crew rest purposes for flight crew and optionally other crew members as well. Additional crew rest facilities can be provided in other spaces in the body **3** of the PASRACS **1**. Crew rest facilities can include full-flat sleeping beds with quietness achieved by sound insulation and/or active noise control, and also include amenities such as bathrooms, showers and dressing areas, without limitation. Providing 24-7 flight crew coverage can be achieved with the use of more than one set of flight crew on board, such as for example the use of **3** flight crew sets working 8.67 hours on, 15.33 hours off in rotation, with 20 minute before and after overlaps with preceding and succeeding crews on duty. Additional flight crew can come on board at selected stops, while other flight crews disembark for landside rest periods. Still other protocols for 24/7 coverage can build on precedents from crewing paradigms for hospitals and other emergency response systems. FIG. **1**D shows a forward cross-section with a forward hull **54**F having a bottom hydrodynamic planning surface **36**P; and above these a series of decks **5** that are people decks **5**P at plural levels **6**. Propulsion system **26** elements that are visible include a combustion engine **26**C that uses energy **27**, a propulsor strut **28**S, a propulsor nacelle **28**N and a thruster **28**T. Above the decks **5** there are compartments associated with encompassed lifting volume **9**E containing lifting gas **9**, with helium **11** in helium enclosures **11**E above the decks **5** and below hydrogen **12** in hydrogen enclosures **12**E.

[0041] FIG. **1**E shows a middle cross-section corresponding to C-C on FIG. **1**A, showing similar features to FIG. **1**D but also now showing the left wing **61**L and right wing **61**R, with payload (cargo containers **43**A) on the cargo deck **5**C also being carried in a span-loaded portion **7**S of the payload **7**, optionally going into the wing volumes from the body volume as illustrated. Movement of cargo containers **43**A is facilitated by use of a cargo transport corridor area **43**T, as described earlier with reference to FIG. **1**B. Payload **7** also can include passenger payload in people decks **5**P and a flexible use deck **5**F that are decks **5** at different levels **6**. The uppermost deck **5** has a high ceiling especially outboard, and representative potable water tanks **92**B are shown above the high ceiling that can then provide water to users in all the decks, including galleys and lavatories and showers etc., using primarily gravity feed and optionally pumped feed. Pairs of payload transfer transport modules **47** are also shown on either side of the vehicle, and these can be winched down to the water surface as pairs or singly, and then disconnected after landing from the partially aerostatically supported ram air cushion ship **1**, to carry disembarking payload to a destination dock or pier, with internal power and control and/or connection to a tug vehicle such as a tugboat for providing the power and control needed to move and navigate to the destination dock or pier, for example and without limitation. One or more payload transfer transport modules **47** can be winched down and used in normal operations to enable one set of passengers and cargo to disembark at a port of call, while another set of passengers and cargo embark on one or more replacement payload transport modules **47** that are winched back up to mate with the underside of the partially aerostatically supported ram air cushion ship **1**, in the configuration shown. For emergency or non-normal operations, the full complement of humans including passengers and crew, preferably can all be evacuated from the partially aerostatically supported ram air cushion ship **1** using a combination of the illustrated eight payload transport modules **47** and potentially also emergency evacuation barge(s) **47**E and compact payload transfer transport module(s) **47**C as shown earlier in FIG. **1**B, while cargo is still left on board for possible subsequent recovery.

[0042] The aerostatic lift system shown in FIG. **1**E illustrates a lower location **11**L for helium **11** in a helium enclosure **11**E, located below an upper location **12**U for hydrogen **12** in a hydrogen enclosure **12**E. This configuration enhances safety of people in accommodations below the helium enclosure **11**E, providing physical separation from the hydrogen **12**. Furthermore, in the event of an accidental leak or explosion involving hydrogen gas, that will naturally propagate upward and away from the location of people, in view of the fact that hydrogen is lighter (lese dense) than air and lighter than helium. FIG. **1**E also shows ballonets **91** adjacent to a hydrogen enclosure **12**E and also adjacent to a helium enclosure **11**E, to enable variations in gas volume of lifting gas while maintaining pressure of lifting gas at a desired level or within a desired range of levels. The use of ballonets is known from the prior art of dirigibles and other airships. Note that when some portion of the hydrogen **12** that is used as a lifting gas, is exported through a fuel pipe to be used as a fuel for a thermodynamic cycle engine such as a gas turbine or as a fuel for a fuel cell, then the ballonets **91** can compensate for this hydrogen extraction from the hydrogen enclosure **12**E.

[0043] FIG. **1**E also illustrates that the ram air cushion **20** spans from under the central portion **3**C of the body **3**, to under the left and right wings **61**L and **61**R, up to the outer ends of the wings where outward leakage flow from the ram air cushion **20** is inhibited by wing tip fences **61**T on either side of the vehicle. The bottom ends of the wing tip fences **61**T are shown fitted with optional hydrodynamic planing surfaces **36**P that are variable height hydrodynamic planing surface **36**V, that can also incorporate suspension and shock absorption functionality for when they encounter big waves, for example and without limitation.

[0044] FIG. **1**E thus illustrates a partially aerostatically supported ram air cushion ship **1**, further comprising wing tip fences **61**T at the left end of said left wing **61**L and the right end of said right wing **61**R. FIG. **1**E also illustrates a partially aerostatically supported ram air cushion ship **1**, wherein each said wing tip fence **61**T has a downwardly deployable lower end to reduce wingtip leakage flow for geometric conditions with increased surface clearance below said lower end as caused by one or more of (i) a higher wingtip height for the higher wing in a vehicle bank angle condition and (ii) a trough between waves. FIG. **1**E further illustrates a partially aerostatically supported ram air cushion ship **1**, wherein each said wing tip fence **61**T has a downwardly deployable suspension-mounted hydrodynamic lift member **36**M comprising at least one of a hydroski **36**S and a hydrodynamic planning surface **36**P (shown) and a supercavitating hydrofoil **36**HB and a subcavitating hydrofoil **36**HA.

[0045] FIG. **1**F shows an aft body cross section that further illustrates a cargo deck **5**C as the lowest deck **5**, and immediately above it a flexible use deck **5**F. FIG. **1**F also illustrates an aft portion **46**A of the ram air cushion volume **46** with a transverse cross-sectional area **46**X.

[0046] FIG. **1**G is the aftmost cross-section illustrated, and is the cross-section at the aft longitudinal location where the horizontal tail **88**H is located. A keel **20**K that acts as a keel ventral stabilizer **88**K is illustrated, which serves in parts as a ventral fin and ventral strake. Body side flaps **90**S provide lateral constraint to the ram air cushion **20**. The body side flaps **90**S can incorporate members that translate up and down, and can optionally be narrow finger-like members that can better seal spanwise flow beneath the flap bottom and above the water surface **18** even if the water surface has undulations such as waves. The finger like members may also include flexible portions and air-blowing/air curtain portions as known from the prior art of hovercraft skirt design as applied to a PASRACS **1**. A person **39** who is a passenger **40** is also shown as part of the payload **7** in a deck **5** at a level **6**. Twin tail booms **88**B are also shown which are structurally connected to twin vertical stabilizers (or vertical tails or fins) **88**V, with rudders **90**R at the trailing edge of the vertical stabilizers **88**V. Near the lower ends of the vertical stabilizers **88**V, there are installations of auxiliary power units (or APUs) **26**A. The use of auxiliary power units is known from vehicle prior art, notably in commercial aircraft where the auxiliary power units utilize some kind of source energy such as fuel or hydrogen and convert that source energy into a usable form such as electrical energy, transmitted through wiring as electrical power to user systems in the vehicle and also optionally to user electrically powered propulsors or thrusters. Air to feed the APU may come from a fixed or deployable air scoop (not shown) or a boundary layer suction system with holes in a vehicle external skin surface. Exhaust from the APU may exit through fixed or openable exhaust ports or nozzles as known in the art. In the illustrated embodiment some of the thrusters **28**T may be electrically powered, without limitation. The conversion process in the APU **26**A may entail use of a combustion engine, fuel cell, and/or other energy conversion device. The type of APU **26**A may also entail the use of one or more of a gas turbine engine, a piston engine, a diesel engine, a wankel rotary engine, an inside-out wankel rotary engine, a detonation engine, a pulse detonation engine, a rotating detonation engine, a continuous detonation engine, a turbocharger, a supercharger, a fuel injector and a combustor.

[0047] The following paragraphs will provide further descriptive material on the preferred embodiment shown in FIGS. **1**A through **1**G, which descriptive material can also apply to further variants of this preferred embodiment. The descriptive material will include various nominal numerical values and/or ranges of values, but it should be understood that the invention encompasses variant embodiments with other potential numerical values which may vary by multiple orders of magnitude, within the spirit and scope of the invention as described in the claims, figures and descriptive portion of the specification.

[0048] For the preferred embodiment of FIGS. **1**A through **1**G, the illustrated partially aerostatically supported ram air cushion ship **1** has a body **3** (which can also be considered to be a fuselage) and has a ship structure **2** that includes said body **3** as well as a wing **61** and a horizontal stabilizer (or tail) **88**H and a vertical stabilizer (or tail) **88**V. The ship structure **2** can utilize materials, components, parts, assemblies and structural architecture and structural design elements known from the prior art of vehicle structures including aircraft structures, marine vehicle structures such as ship structures, and ground vehicle structures. Structures can be designed and sized to sustain normal and nonnormal internal and external loads, and also be provisioned with hard points or hard zones to carry extra loads such as optional external stores, auxiliary and/or drop tanks (for water or fuel or other fluids), or modules or barges, for example and without limitation. Appropriate applications of structural joint architectures can include one or more of: bonded, riveted, welded, stir-welded, friction stir-welded, brazed, bolted, one-side fastener connected, and linear-connected (e.g., zippered) joint architectures and designs. Portions of the structure that might encounter impact loads, such as the forward portions of the hulls **54** that might encounter impacts from floating debris or flotsam, a log, a floating dead fish or sea mammal etc., can employ impact resistant and impact absorbing structural architectures and features that leverage prior art technologies from vehicle design, bumper design, locomotive cow-catcher design and other weight-effect and cost-effective impact capable structures. The PASRACS **1** will be fitted with systems for the detection and management of structural faults and failures, including one or more selected from: an overload failure, a crippling failure, a crack, a buckling failure, a shear failure, a bending failure, a compression failure, a tension failure, a fatigue failure, an aeroelastic effects failure including divergence and flutter, a composite structure failure including delamination and interlaminar failure, and a sandwich structure failure.

[0049] The partially aerostatically supported ram air cushion ship **1** is shown in a representative transition mode of operation with a positive airspeed **24** moving along a travel path **24**T, wherein the airspeed **24** is below a full flight in ground-effect airspeed and hence the weight of the partially aerostatically supported ram air cushion ship **1** in this transition mode is supported by a combination of a hydrostatic lift force **17** and a hydrodynamic lift force **36** in addition to an aerostatic lift force **10** and an aerodynamic lift force **25** that is associated with a ram air cushion **20** below said partially aerostatically supported ram air cushion ship **1** and above an Earth surface **21** that is illustrated as a water surface **18**, in FIG. **1**A. The aerostatic lift force **10** is created with use of a lifting gas **9** in an encompassed lifting volume **9**E, where the lifting gas may be helium **11** and/or hydrogen **12** in certain species of this preferred embodiment, as shown in FIG. **1**E. The hydrostatic lift force **17** is created with the use of a hull member when it displaces water below a water surface **18**, such as the aft hull member **54**A shown in FIG. **1**A. The hydrodynamic lift force **36** is created when a hydrodynamic lift member **36**M moves through water with a nonzero velocity and wherein the hydrodynamic lift member lower surface is inclined so as to downwardly deflect water that is encountered, as shown in FIG. **1**A. The body **3** has a centerline longitudinal shape as seen in FIG. **1**A, that is an aerodynamic shape such as the illustrated modified Clark Y airfoil section with approximately 25% t/c or thickness to chord ratio. The body **3** acts as a lifting body when the vehicle is in flight in ground effect, contributing aerodynamic lift. In plan view as shown in FIG. **1**B, the body **3** is seen to have a central region with substantially constant chord, in the region spanwise between the two vertical tails **88**V. On either side of this central region, the body **3** is illustrated with aerodynamically smooth planform left and right lateral contours, each of which is approximately a half contour from a Gottingen **776** 25% t/c or thickness to chord ratio symmetrical airfoil shape. The use of thicker airfoil shapes in both side and plan view is beneficial in allowing the body **3** to have aerodynamically desirable properties with minimal flow separation and associated drag, while maximizing the volume within the body **3** for use for both encompassed lifting volume **9**E for aerostatic lifting gas **9** and for payload volume **4**, as illustrated. It will be understood that different body 3-dimensional surface contour shapes can be developed using known methods in the art of optimizing aerodynamic body shapes for usable volume maximization along with ground-effect aerodynamic lift-to-drag ratio optimization and weight minimization for the partially aerostatically supported ram air cushion ship **1**. It will also be readily understood that the use of plural decks **5** to carry payload **7** enables large efficiency gains and increases in figures of merit such as total payload deck area divided by total vehicle wetted area, and total payload deck area divided by total vehicle volume, while still leaving substantial internal volume for encompassed lifting volume **9**E for lifting gas **9** providing aerostatic lift to help support the weight of the partially aerostatically supported ram air cushion ship **1**.
[0050] The illustrated wing **61** includes a left wing **61**L and right wing **61**R, which are shown with modified Clark Y airfoils and 18% t/c or thickness to chord ratio, and with representative 3 degrees incidence angle relative to the body **3** so that these wings will be operating at a higher lift coefficient even when the body **3** is at zero or low angle of attack relative to the Earth surface **21** that is illustrated as a water surface **18**, in FIG. **1**A. A part of the ship structure **2** is the structure of the wing **61**, and can include structural spars **2**S, with **3** spars illustrated and not construed to be limiting. Note that prior art wing box structural architectures with one or more of a front spar, middle spar(s), rear spar, ribs and stringers can be accommodated in wing structural architecture in the ship structure **2**, in variant embodiments of the invention. The illustrated structural spars **2**S include flange elements forward and aft of a cargo payload volume in the outboard portions of the wing **61**, and these structural spars **2**S are structurally connected to near-planar structures **2**P that carry loads across the body **3**, wherein the near-planar structures **2**P can preferably include at least two of (i) below the cargo deck **5**C. (ii) above the cargo deck **5**C, and (iii) above the flexible use deck **5**F. The ram air cushion **20** encompasses spaces below both the body **3** and the left wing **61**L and right wing **61**R, as illustrated. The aft edges of the ram air cushion **20** comprise the trailing

edge regions appropriate for the well-known aerodynamic Kutta condition (a) under downwardly deployable body side flaps **90**S that run along the aft left edge **85**L and aft right edge **85**R of the body **3** wherein the lateral distance between the aft left edge **85**L and aft right edge **85**R reduces in an aftward direction, and (b) under the trailing edges of downwardly deployable flaps **90**F at the back ends of the left wing **61**L and right wing **61**R. Lateral leakage flow from the ram air cushion **20** is minimized through the use of wing tip fences **61**T that reduce the available height for leakage flow between the bottom ends of the wing tip fences **61**T and the Earth surface **21** that is illustrated as a water surface **18**.

[0051] The illustrated propulsion system **26** uses thirty thrusters **28**T such as thrusting fans (which may be propellers and/or unducted fans and/or ducted fans and/or augmentor fans), of which some also serve to pressurize the ram air cushion **20** for takeoff and landing flight phases of the partially aerostatically supported ram air cushion ship **1**. Varying numbers and types of thrusters can be utilized in variant embodiments of the invention, as needed to balance or overcome drag force **141**, that can include both aerodynamic drag (with components such as skin friction or parasite drag, laminar drag, turbulent drag, induced drag associated with aerodynamic lift, form drag, profile drag, trim drag, excrescence drag and compressibility wave drag) and hydrodynamic drag (with components such as hull drag, skin friction drag, laminar drag, turbulent drag, wave making resistance, wave drag, spray drag, planing drag, step drag, hump drag, induced drag and excrescence drag). It will be understood that a partially aerostatically supported ram air cushion ship **1** or PASRACS **1** can incorporate aerodynamic drag reduction features and technologies and hydrodynamic drag reduction features and technologies to reduce the total thrust that is required to be provided by the propulsion system **26**. Examples of such features and technologies known from the art of aircraft and marine craft design include, without limitation: skin friction reduction with natural laminar flow, skin friction reduction with hybrid laminar flow, skin friction reduction with riblets, skin friction reduction with sharkskin surfacing, skin pores for suction, skin pores for blowing, vortex generators to inhibit flow separation, span load optimization to reduce lift-induced drag, detailed surface features design to reduce excrescence drag, hull loft optimization to minimize hydrodynamic drag, step design to minimize hydrodynamic drag and enable vehicle rotation for takeoff, air injection for hull drag reduction, bubble injection for hull drag reduction, optimization of planing surface lofts for drag reduction & lift optimization, optimization of hydroski lofts for drag reduction & lift optimization, optimization of hydrofoil lofts for drag reduction & lift optimization, and optimization of combined hydrofoil and hydroski lofts for drag reduction & lift optimization.

[0052] The ram air cushion **20** when pressurized at least in part by a thruster **28**T, becomes by definition a power-augmented ram air cushion **20**P. A thruster **28**T may be structurally connected to propulsor nacelle **28**N that in turn is structurally connected to primary ship structure **2** of the partially aerostatically supported ram air cushion ship **1** through a propulsor strut **28**S, as shown in FIG. **1**D. Power to drive the thruster may come from an electric motor and/or a fuel cell and/or a heat engine (such as a combustion engine **26**C) that may burn a fuel such as hydrogen from a lifting gas module and/or a separate gaseous or cryogenic liquid hydrogen tank, and/or a hydrocarbon fuel such as a biofuel that may be sourced from plant material such as algae or jatropha without limitation. A heat engine may be of a variety of thermodynamic cycles such as the Brayton Cycle (e.g. gas turbine), Otto Cycle or Diesel Cycle (e.g. including piston engine or Wankel engine), Rankine Cycle (steam engine) and/or other thermodynamic cycles known in the art of heat engines (Stirling Cycle, Humphrey Cycle, Carnot Cycle and others). A heat engine such as a combustion engine **26**C may incorporate performance enhancement features and technologies such as at least one of: turbocharging, supercharging, water injection, intercooling, a topping cycle, and afterburning, within the spirit and scope of the invention.

[0053] The horizontal stabilizer (or tail) **88**H is fitted with a controllable control surface that is an elevator **90**E, which when deflected trailing edge down will cause an increase in lift on the horizontal stabilizer **88**H, which increase in lift has a larger quantitative value because of the aerodynamic ground effect with the horizontal stabilizer **88**H being not too high relative to the Earth surface **21** that is illustrated as a water surface **18**. The air flow below the horizontal stabilizer **88**H will also be a ram air cushion in this situation, with an aerodynamic Kutta condition below the trailing edge of the downwardly deflected elevator **90**E in this scenario. The increase in lift on the horizontal stabilizer **88**H can contribute one or more of lift augmentation, heave control, pitch control and pitch trim, as known in the art of air vehicle aerodynamic lift, control and trim. Optional dual vertical stabilizers **88**V are shown, wherein each illustrated vertical stabilizer **88**V is fitted with a rudder **90**R, and left or right trailing edge deflections of the rudder **90**R can cause left or right yawing moments to act on the partially aerostatically supported ram air cushion ship **1**. While symmetric airfoils are illustrated for both horizontal and vertical stabilizers in the preferred embodiment of FIGS. **1**A through **1**G, variant embodiments may utilize asymmetric airfoils with nonzero camber. Stabilizer trim systems may optionally be provided to enable adjustable stabilizer incidence angles relative to the body **3**.

[0054] The preferred embodiment of the partially aerostatically supported ram air cushion ship (PASRACS) **1** shown in FIGS. **1**A through **1**G must be designed to meet all requirements and to meet some of the objectives specified for the vehicle and its operation. As known in the art of vehicle design, the term “requirements” are to be construed to refer to parameters or attributes that must be fully satisfied such as safety requirements and certification requirements, while the term “objectives” are to be construed to refer to parameters or objectives that are captured as desirable, but may be traded off relative to other objectives to enable balanced achievement of one or more objective functions or measures of merit. Requirements may be published in one or more of a certification document/standard, a safety document/standard, and a requirements document/standard. Some examples of requirements and objectives that could apply can be found in a publication of the International Maritime Organization MSC.1/Circ. 1592 Guidelines for WIG Craft, where WIG stands for Wing-in-Ground effect. This set of Guidelines treats requirements and objectives across many known areas of vehicle requirements and objectives including: [0055] Buoyancy, stability and subdivision [0056] Structures [0057] Accommodation and escape measures [0058] Directional, attitude and altitude control systems [0059] Anchoring, towing and berthing [0060] Fire safety [0061] Life-saving appliances and arrangements [0062] Machinery [0063] Auxiliary systems [0064] Remote control, alarm and safety systems [0065] Electrical installations [0066] Navigational equipment [0067] Radiocommunications [0068] Operating compartment layout [0069] Aerodynamic stabilization systems [0070] Handling, controllability and performance [0071] Operational provisions [0072] Inspection and maintenance provisions [0073] Safety assessment and safety management (including: Use of probability concept; Safety assessment for WIG craft systems; Safety management) [0074] Form of Wing-in-ground Craft Safety Certificate and Record of Equipment [0075] Form of Permit to Operate WIG Craft [0076] Ice accretion applicable to all types of craft [0077] Methods relating to the intact stability investigation of hydrofoil assisted wing-in-ground craft [0078] Residual stability [0079] Criteria for testing and evaluation of revenue and crew seats [0080] Open reversible liferafts [0081] Procedures for demonstration of operational safety

[0082] Preferred embodiments of the partially aerostatically supported ram air cushion ship (PASRACS) **1**, as described and claimed herein, can be designed, engineered and built to meet applicable requirements along with appropriate balanced partial achievements of objectives as described above.

[0083] For the embodiment of FIGS. **1**A through **1**G, the illustrated partially aerostatically supported ram air cushion ship **1** has a very large size, and the following representative data indicate this large size and representative associated parameters, without limiting the invention as claimed and described herein:

TABLE-US-00001 Plan View Body Area 1,252,000 sq. ft. Plan View Area Wings 187,150 sq. ft.

Effective Wing Area 1,439,150 sq. ft. Body width 730 ft. Vehicle Width = Total Wing Span 1,600 ft. Wing Effective Mean Chord 899 ft

[0084] Note that the wing effective mean chord is equal to the effective wing area divided by the wing span.

Geometric Wing Aspect Ratio (AR) **1.779**

[0085] Note that geometric wing aspect ratio is defined as the ((wing span)**2)/(effective wing area) It is well understood in the art that the effective wing aspect ratio for a wing flying in ground-effect (IGE) can be substantially greater than the geometric AR, because the wing tip leakage flow associated with lift is constrained to flow outward through a much-constrained height beneath a wing tip fence **61**T, and because with the in-ground-effect (IGE) aerodynamic flow can be modelled by an imaginary "mirror" vehicle reflected underneath the ground plane. Effective aspect ratio will be discussed further later, in the context of induced drag analysis.

TABLE-US-00002 Wing Max Chord 2,292 ft

[0086] Note that the wing max chord is equivalent to the vehicle length excluding the cockpit and tail elements of the vehicle (which are included in the Vehicle Length), because the lifting body can be considered a part of the effective wing.

TABLE-US-00003 Vehicle Length 2,603 ft Body wetted area 4.00 million sq. ft. Overall vehicle wetted area 5.165 million sq. ft. Body volume 540. million cu. ft. Lifting volume 250. million cu. ft.

[0087] For an approximate assumption of 0.07 lb aerostatic lift/cu.ft, of lifting gas based on an average of hydrogen lift and helium lift in representative operational conditions:

TABLE-US-00004 Approximate aerostatic lift 17.5 million lb. Approximate vehicle overall 16 million lb. empty weight (OEW)

[0088] This OEW assumes appropriate use of lightweight materials, architectures and structures and systems designs optimized to keep weight sufficiently low, leveraging technical knowledge from the state of the art of vehicle designs pertaining to vehicles in general and weight-sensitive aircraft in particular.

TABLE-US-00005 Approximate full payload weight 27 million lb. Approximate liquid fuel weight 2 million lb.

[0089] Note that liquid fuel could be a hydrocarbon fuel such as jet fuel or biofuel or liquid hydrogen, and that this liquid fuel weight excludes hydrogen lifting gas weight wherein hydrogen lifting gas can also optionally be used as fuel through the course of a trip of a PASRACS. Note that the lifting volume of 250 million cu.ft. may optionally be around half hydrogen and half helium in different lifting envelopes as will be described further below, and that 1000 cu.ft, hydrogen gas (H.sub.2) weighs around 5.21 lb and provides around 73, lb of aerostatic buoyant lift in representative operational conditions. The representative "full payload" weight of 27 million pounds is based on 632 cargo containers (1264 TEU) and 50,000 passengers at representative filled container density of around 9 pounds per cubic foot and representative passenger weight including carry-on baggage of 285 pounds per passenger.

TABLE-US-00006 Nominal Maximum Takeoff Weight (MTOW) 45 million lb.

[0090] Note that with these representative numbers, aerostatic lift is around 39% of nominal MTOW, and so the remaining 61% of nominal MTOW in the event of a maximum takeoff weight condition during takeoff, must be balanced with a combination of aerodynamic lift (e.g., ram air cushion under the vehicle operating in ground-effect) and hydrodynamic and hydrostatic lift.

TABLE-US-00007 Normal cruise speed 250 miles per hour (mph) Maximum cruise speed 280 mph

[0091] This representative maximum cruise speed corresponds approximately to indicated airspeed (IAS) of 245 knots, which is below the 250 knots airspeed limit below 10,000 feet altitude that is regulated by the FAA in United States airspace.

[0092] At the nominal cruise speed of 250 mph or 366.7 ft/sec, drag is estimated as follows, with assumptions of surface skin friction drag coefficient of 0.00137 and effective aspect ratio in ground-effect of 6:

TABLE-US-00008 Cruise parasite/skin friction drag 1,130,000 lb Cruise lift induced drag 173,000 lb Total cruise drag 1,303,000 lb Aerodynamic lift/drag ratio 21.1 Vehicle overall lift/drag ratio 34.5

[0093] It should be understood that all these numbers are nominal estimates for a described preferred embodiment of the invention, and should not be construed to limit the invention as described and claimed.

[0094] In a takeoff, once the PASRACS **1** is clear of the water, the nominal MTOW needs to be matched by just aerostatic and aerodynamic lift, with the needed 27.5 million lb, of aerodynamic lift corresponding to a liftoff speed (wherein hydrodynamic lift from elements such as hydroskis and/or hydrofoils and/or planing surfaces goes down to zero) of 86.4 mph (126.7 ft/sec) at a nominal lift coefficient of 1.0 flight in close ground-effect, denominated by the effective wing area. The aerodynamic lift force **25** of the PASRACS **1** includes aerodynamic lift components from the wing **61**, body **3**, and horizontal stabilizer **88**H. Note that due to square-cube law effects, the use of very large vehicle size for a partially aerostatically supported ram air cushion ship (PASRACS) **1** allows the use of multiple decks for ultra-comfortable passenger accommodations and amenities while still leaving volume for substantial aerostatic lifting gas, and maintaining really very good metrics for passenger vehicle figures of merit such as wetted area per passenger, a figure of merit known in the art to be important to minimize to reduce aerodynamic skin friction drag or parasite drag. The square-cube law effects will be detailed further with reference to FIG. **11**A subsequent. For the representative numbers noted above, wetted area per passenger is approximately 103 sq.ft, per passenger, similar in magnitude as for a representative intercontinental service airliner like the A380 that has a wetted area per passenger of approximately 120 sq.ft, per passenger (Ref. 5, Ref. 6). Aerodynamic skin friction drag per passenger for PASRACS will be much lower than for an airliner due to the lower cruise speed (drag scales with speed squared) and lower dynamic pressure, while comfort and amenities will be tremendously better as will be seen from the drawings and descriptive portion and claims of the PASRACS invention herein presented.

[0095] It should be noted that the “full payload” noted above is between typical payload quantities for state-of-the-art jet airliners and transoceanic ships, while the cruise speed is also between typical cruise speeds of jet airliners and transoceanic ships. At the nominal cruise speeds noted above it should be possible for a single partially aerostatically supported ram air cushion ship **1** to circumambulate the World in one week, while stopping at many stops to board and deboard payload at those stops that serve as origins and destinations. Examples of the “many stops” possibly numbering into the regime of multiple dozens or more, will be described further with reference to FIGS. **16**A through **16**G following, that show World circumambulation routes with a majority of flight lengths over water but also with limited flight over designated land segments, such as a Red Sea to Mediterranean Sea segment over Egypt and a Caribbean Sea to Pacific Ocean segment crossing over Costa Rica and Nicaragua, for example and without limitation. It follows that a fleet of partially aerostatically supported ram air cushion ships **1** (PASRACS) could serve destinations around the World while providing economical, safe, and fast transportation for large numbers of passengers as well as large quantities of cargo/freight/baggage.

[0096] While some representative numerical values have been cited in the context of the preferred embodiment shown in FIGS. **1**A through **1**G, it should be understood that the invention can encompass variant embodiments with other potential numerical values with wide variation ranges for all parameters, including potential variations by multiple orders of magnitude, within the spirit and scope of the invention as described in the claims, figures and descriptive portion of the specification.

[0097] FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G collectively illustrate a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4** with plural decks **5** at plural levels **6** for carrying payload **7**; said ship structure **2** connected to a lifting gas enclosure **8** (shown in FIG. **1**D) configured to contain a lifting gas **9** (shown in FIG. **1**D) providing an aerostatic lift force **10** (shown in FIG. **1**D for the hydrogen enclosure illustrated) acting on said ship **1**, said lifting gas **9** comprising at least one of helium **11**, hydrogen **12** and a low-density lifting gas **13** with density lower than that of an atmosphere **14** immediately outside said ship **1**; a hydrostatic floatation subsystem **15** (shown in FIG. **1**A) comprising a water displacing structure **16** connected to said ship structure **2**, said water displacing structure **16** configured to provide a hydrostatic lift force **17** acting on said ship **1** in a period of time when said water displacing structure **16** is displacing a water volume below a water surface **18** below said atmosphere **14**; an aerodynamic lift subsystem **19** comprising a ram air cushion **20** when said ship **1** has positive airspeed **24**, said ram air cushion **20** below a lower surface **1**L of the ship **1** and above an Earth surface **21**, wherein said aerodynamic lift subsystem **19** comprising said ram air cushion **20** is configured to contribute an aerodynamic lift force **25** acting on said ship **1** when said ship **1** has said positive airspeed **24**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; and a vehicle control and navigation system **29** configured to enable said ship **1** to move and maneuver on a travel path **24**T; wherein weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said hydrostatic lift force **17**, when said ship **1** is in a substantially stationary mode **34** (not the mode illustrated in FIG. **1**A) on said water surface **18**; wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25**, when said partially aerostatically supported ram air cushion ship **1** is in a flight in ground-effect mode **35** (not the mode illustrated in FIG. **1**A); and wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25** and at least one of said hydrostatic lift force **17** and a hydrodynamic lift force **36**, when said partially aerostatically supported ram air cushion ship **1** is in a transition mode **37** (illustrated in FIG. **1**A) comprising a landing transition mode **37**L.

[0098] It should be understood that payload **7** could comprise one or more of passengers and crew and baggage and cargo. The ram air cushion **20** is in part under the wing **61** and serves to contribute a portion of the aerodynamic lift force **25** acting on the wing **61** when it is operating in a wing in ground effect flight mode. A substantially stationary mode **34** could occur when the partially aerostatically supported ram air cushion ship **1** or PASRACS **1** is floating on a water surface **18** in a port region for normal operations to load and unload payload, or floating on a water surface **18** for non-normal operations such as emergency evacuation, following an emergency water landing or controlled ditching maneuver.

[0099] It should be understood that a transition mode **37** could comprise either a landing transition mode **37**L (as illustrated in FIG. **1**A) or could alternatively be a takeoff transition mode **37**T. As known in the art of aircraft equipped with flaps, flap deflections may be lower for a takeoff transition mode of a PASRACS type of vehicle with associated high values of lift to drag ratio, than for landing transition mode where higher lift coefficient can be obtained with greater flap deflection to enable lower landing speed, notwithstanding higher drag coefficient typically associated with greater flap deflection for the landing transition case.

[0100] FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G also collectively illustrate a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a body **3** configured to accommodate payload **7**, said body **3** encompassing (i) a cabin **38** configured to accommodate persons **39** comprising at least one of passengers **40** and crew **41** and (ii) a cargo volume **42** configured to accommodate at least one of baggage **44** and cargo **43**; and (iii) a lifting gas enclosure **8** configured to contain a lifting gas **9** providing an aerostatic lift force **10** acting on said ship **1**, said lifting gas **9** comprising at least one of helium **11**, hydrogen **12** and a low-density lifting gas **13** with density lower than that of an atmosphere **14** immediately outside said ship **1**; a hydrostatic floatation subsystem **15** comprising a water displacing structure **16** connected to said body **3**, said water displacing structure **16** configured to provide a hydrostatic lift force **17** acting on said ship **1** when said water displacing structure **16** is displacing a water volume below a water surface **18** below said atmosphere **14**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; a left catamaran sidewall **45**L and a right catamaran sidewall **45**R both connected to said body **3** and defining at least one ram air cushion volume **46** that is beneath said body **3**, above an Earth surface **21** and at least in part between said left and right catamaran sidewalls **45**L and **45**R, wherein said ram air cushion volume **46** is configured to decrease in transverse cross-sectional area **46**X (shown in diagonal hash line area in FIG. **1**F) moving aft from a forward portion **46**F of said ram air cushion volume **46** to an aft portion **46**A of said ram air cushion volume **46**; an aerodynamic lift subsystem **19** utilizing said ram air cushion volume **46** configured to create a ram air cushion **20** providing aerodynamic lift force **25** acting on said body **3** when said ship **1** has a positive airspeed **24**, propelled by said propulsion system **26**; and at least one payload transfer transport module **47** configured to receive disembarking payload **7**D comprising at least a partial subset of said passengers **40** and said baggage **44** and said cargo **43** from at least one of said cabin **38** and said cargo volume **42**, and said payload transfer transport module **47** further configured to separate from said ship **1** and carry said disembarking payload **7**D from said ship **1** starting at a transfer time **48**.

[0101] FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G also collectively illustrate a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a body **3** configured to accommodate payload **7**, said body **3** encompassing (i) a cabin **38** configured to accommodate persons **39** comprising at least one of passengers **40** and crew **41** and (ii) a cargo volume **42** configured to accommodate at least one of baggage **44** and cargo **43** and (iii) a lifting gas enclosure **8** configured to contain a lifting gas **9** providing an aerostatic lift force **10** acting on said ship **1**; wherein said a central portion **3**C (shown in FIG. **1**E) of said body **3** is encompassed by a body lower surface **3**LS spanning above a ram air cushion volume **46** located between said body **3** and an Earth surface **21**, a body left side surface **3**L, a body right side surface **3**R and a curved body top surface **3**T connecting said body left side surface **3**L and body right side surface **3**R and wrapped around an upper boundary **8**U of said lifting gas enclosure **8**; wherein said ram air cushion volume **46** is bounded on upper left and right sides by side flaps **90**S in a region beneath an aft body **3**A portion of said body **3**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; wherein said ram air cushion volume **46** is configured to decrease in transverse cross-sectional area **46**X (shown in diagonal hash line area in FIG. **1**F) moving aft from below said central portion **3**C to below said aft body **3**A; an aerodynamic lift subsystem **19** utilizing said ram air cushion volume **46** configured to create a ram air cushion **20** providing aerodynamic lift force **25** acting on said body **3** when said ship **1** has a positive airspeed **24**, propelled by said propulsion system **26**; and an aerostatic lift subsystem utilizing said aerostatic lift force **10** provided by said lifting gas **9**. Note that the side flaps **90**S can include fixed and/or movable panel members, wherein movable panel members if used can include movement by translation and/or rotation. FIGS. **1**A, **1**B. **1**C. **1**D, **1**E, **1**F and **1**G also collectively illustrate partially aerostatically supported ram air cushion ship **1**, further comprising a keel ventral stabilizer **88**K in said ram air cushion volume **46** in said transverse cross-sectional area **46**X below said aft body **3**A, wherein said keel ventral stabilizer **88**K separates said ram air cushion volume **46** into left and right portions and contributes to at least one of a roll stability contribution and a yaw stability contribution acting on said partially aerostatically supported ram air cushion ship **1** with said positive airspeed **24**. In loading and normal or non-normal operational conditions when the keel **20**K that acts as a keel ventral stabilizer **88**K penetrates below the local water surface **18** (which may also be nonlevel with waves), the keel **20**K also serves in a contributing capacity as a hull **54**.

[0102] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B,

1C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**E, shows a partially aerostatically supported ram air cushion ship **1**, wherein said ship structure **2** is connected to plural lifting gas enclosures **8** comprising at least one helium enclosure **11**E in a helium encompassing volume **11**V and at least one hydrogen enclosure **12**E in a hydrogen encompassing volume **12**V, and wherein said helium encompassing volume **11**V is configured with a location **11**L being below said hydrogen encompassing volume **12**V and with said location **11**L being above said payload volume **4**, and wherein said hydrogen encompassing volume **12**V is configured with an upper location **12**L being noncontiguously above said payload volume **4**. A safety benefit of configuring the hydrogen encompassing volume to be above the helium encompassing volume is that in the event of any possible localized accident involving the hydrogen (for example and without limitation such as a localized gas containing envelope rupture combined with ignition of a hydrogen fire as hydrogen escapes into the atmosphere and encounters oxygen in the air in the atmosphere), the localized accident is spatially separated from the payload volume **4** by the helium encompassing volume **11**V which acts as an intermediate spatial buffer, and with the localized hydrogen accident spewing upward rather than downward as hydrogen is a lighter-than-air gas.

[0103] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**B and FIG. **1**A, shows a partially aerostatically supported ram air cushion ship **1**, wherein said ram air cushion **20** comprises a ram air pressurized region **83** spanning from (i) a left region **83**L under a left wing **61**L forward of a left trailing edge **84**L of the left wing **61**L, through (ii) a central region **83**C under the body **3** of said partially aerostatically supported ram air cushion ship **1** and forward of an aft left edge **85**L and an aft right edge **85**R of an aft portion **85** of the body **3**, and to (iii) a right region **83**R under a right wing **61**R forward of a right trailing edge **84**R of the right wing **61**R, when said partially aerostatically supported ram air cushion ship **1** is moving on said travel path **24**T with said positive airspeed **24**.

[0104] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**B and FIG. **1**A, also shows a partially aerostatically supported ram air cushion ship **1**, wherein said hydrostatic floatation subsystem **15** comprises at least three hull members **54**H, comprising a left hull member **54**L on a left side of said partially aerostatically supported ram air cushion ship **1**, a right hull member **54**R on a right side of said partially aerostatically supported ram air cushion ship **1**, and at least one of an aft hull member **54**A in an aft region of said partially aerostatically supported ram air cushion ship **1** and a forward hull member **54**F in a forward region of said partially aerostatically supported ram air cushion ship **1**.

[0105] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**B and FIG. **1**A, also shows a partially aerostatically supported ram air cushion ship **1**, wherein said propulsion system **26** comprises plural energy conversion devices **26**E that are configured to transfer drive energy **26**D to drive plural fluid thrusting effectors **86**. An example of an energy conversion device **26**E is a thermodynamic cycle engine such as a gas turbine engine, without limitation.

[0106] Other examples of an energy conversion device **26**E could be a piston engine, a rankine engine, a sterling engine, a wankel engine, or a fuel cell. An example of a component to transfer drive energy **26**D is a drive shaft. An example of a fluid thrusting effector **86** that acts on air and/or water can be any one of: a propeller, an unducted prop, a ducted prop, a fan, an unducted fan, a ducted fan, a ring fan, a geared fan, an augmentor fan, a water propeller, a waterjet, and an azipod thruster, wherein some of these will be further presented subsequently.

[0107] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIGS. **1**C. **1**E and **1**G, also shows a partially aerostatically supported ram air cushion ship **1**, wherein said plural decks **5** at plural levels **6** for carrying payload **7** include (i) a people deck **5**P with a cabin **38** configured to accommodate persons **39** comprising passengers **40** and crew **41** and (ii) a cargo deck **5**C with a cargo compartment **73**C configured to accommodate at least one of cargo **43** and baggage **44**.

[0108] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, also shows a partially aerostatically supported ram air cushion ship **1**, further comprising a keel **20**K below said body **3** with a majority of a length dimension of said keel length being located below an aft portion of said body **3**, wherein said keel **20**K separates a left ram air cushion portion **46**L from a right ram air cushion portion **46**R both of which are parts of said ram air cushion volume **46** that is beneath said body **3**, and wherein said keel contributes to at least one of roll stability and yaw stability of said partially aerostatically supported ram air cushion ship **1** at said positive airspeed **24**. It should be noted that water contacting members such as one or more of the following can also contribute to one or more of roll stability, yaw stability, and pitch stability: a hull **54**, a hydrodynamic planing surface **36**P, a hydroski **36**S, a hydrofoil **36**H, a combined hydrofoil and hydroski **36**HS, a step **36**T, and any other water contacting member on the PASRACS **1**.

[0109] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, **1**C. **1**D, **1**E, **1**F and **1**G, also shows a partially aerostatically supported ram air cushion ship **1**, wherein an encompassed lifting volume **9**E of said lifting gas **9** is configured to be at least 25% of an encompassed vehicle volume **1**E of said partially aerostatically supported ram air cushion ship **1**. It should be noted that for a sufficiently large PASRACS **1** such as that illustrated, the required internal volume to accommodate a maximum weight-limited payload will be less than 75% of encompassed vehicle volume, which implies that the at least 25% of encompassed vehicle volume can be used to accommodate lifting gas with no wetted area or aerodynamic skin friction drag penalty at the vehicle level.

[0110] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B. **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**E, also shows a partially aerostatically supported ram air cushion ship **1**, wherein a transverse cross-section **46**FX of said partially aerostatically supported ram air cushion ship **1**, at a longitudinal location corresponding to a forward portion **46**F of said ram air cushion volume **46**, is characterized by (i) a left wing **61**L. (ii) said left catamaran sidewall **45**L. (iii) a central portion **3**C of said body **3**. (iv) said right catamaran sidewall **45**R, and (v) a right wing **61**R; wherein said a central portion **3**C of said body **3** comprises a body lower surface **3**LS above said ram air cushion volume **46**, a body left side surface **3**L, a body right side surface **3**R and a curved body top surface **3**T connecting said body left side surface **3**L and body right side surface **3**R and wrapped around an upper boundary **8**U of said lifting gas enclosure **8**. Note from FIG. **1**B that the ram air cushion volume **46** is a volume of air under the partially aerostatically supported ram air cushion ship (PASRACS) **1**, which volume of air serves as an air cushion contributing supporting lift force on the ship by having air pressure higher than the ambient air pressure of the outside atmosphere at some distance separated from the PASRACS; and wherein the ram air cushion volume **46** is laterally constrained by a plurality of members selected from: (a) body side flaps **90**S on left and right sides of the body **3**. (b) the left catamaran sidewall **45**L and right catamaran sidewall **45**R, and (c) wing tip fences **61**T at the outer ends of the left wing **61**L and right wing **61**R. The plurality of members for lateral flow constraint will preferably be controlled by a high lift control system, in conjunction with members for rear constraint of the air cushion that further include a plurality of rear constraint members selected from: flaps **90**F on the left wing **61**L and right wing **61**R, and at least one body flap **90**B. Control settings implemented by the high lift control system can control the pressure field under the partially aerostatically supported ram air cushion ship (PASRACS) **1** so as to provide a targeted amount of lift as well as to provide at least one of pitching moment and rolling moment and yawing moment, that can be created through the use of appropriate control laws and commands to yield tailored pressure distributions in the air cushion.

[0111] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A, **1**B, 1C, 1D, 1E, 1F and 1G, with particular reference to FIGS. 1B and 1A and 1F, also shows a partially aerostatically supported ram air cushion ship **1**, wherein an aft body **3**A of said partially aerostatically supported ram air cushion ship **1** includes a body lower surface **3**LS and downwardly deployable body flaps **90**B at left and right ends of said body lower surface **3**LS, inwardly tapering surfaces for body left side surface **3**L and body right side surface **3**R in an aftward direction **21**A on said aft body **3**A, and a curved body top surface **3**T connecting said body left side surface **3**L and body right side surface **3**R and wrapped around an upper boundary **8**U of said lifting gas enclosure **8**.

[0112] The preferred embodiment as illustrated in and described with reference to FIGS. **1**A. **1**B, **1**C, **1**D, **1**E, **1**F and **1**G, with particular reference to FIG. **1**E, also shows a partially aerostatically supported ram air cushion ship **1**, wherein said ram air cushion **20** providing aerodynamic lift force **25** acting on said body **3**, provides span-loaded support **83**S for a span-distributed portion **7**S of said payload **7**, with said span-loaded support **83**S spanning from left to right sides of at least one of said forward portion **46**F and said aft portion **46**A of said ram air cushion volume **46**. It is well known from the art of aerodynamically supported vehicle design that the use of span-loaded payload can reduce structural loads such as wing root bending moment, and can accordingly reduce structural gages and reduce empty weight of such aerodynamically supported vehicles. It will be evident from FIG. **1**B that the planform shape of the area with the ram air cushion **20** includes a forward area with a large span that spans from under the left wing **61**L through under the forward body **3**F and center portion **3**C to under the right wing **61**R, and further includes an aft area which tapers to reduced spans under the aft body **3**A.

[0113] FIGS. **2**A through **2**F show representative top plan view diagrams of deck layout configurations of different level decks of the preferred embodiment of a partially aerostatically supported ram air cushion ship **1** as shown in FIGS. **1**A and **1**B.

[0114] FIG. **2**A shows a representative plan view diagram of a deck layout configuration of the bottom payload accommodating deck (cargo deck **5**C) of the preferred embodiment of a partially aerostatically supported ram air cushion ship las shown earlier in FIGS. **1**A and **1**B. Please note the left-right inversion relative to FIG. **1**B, as that is a bottom plan view while FIG. **2**A is a top plan view. Note that the payload volume **4** that is the cargo volume **42** is above the floor of the cargo deck **5**C and is also at a level just above the primary top surface of the payload transfer transport module **47** when the payload transfer transport module **47** has been winched up and locked in its mated-to-the-ship configuration connected to the PASRACS **1**, as shown. Payload volume **4** includes the cargo deck **5**C and the crew quarters **5**Q; as well as a vehicle parking area **142**T for at least one of a bus, a car, a three-wheel vehicle, a two-wheel vehicle, a track supported vehicle, a floating vehicle, an amphibious vehicle and an air vehicle. Note that design features enable all the types of payload to be transferred between the cargo deck **5**C and the eight payload transfer transport modules **47** that are suspended below the cargo deck **5**C in the illustrated preferred embodiment (with the exception of tower portions of the payload transfer transport modules that go up through the cargo deck **5**C up to the next higher deck, the flexible use deck **5**F that will be described further with reference to FIG. **2**B following). These design features include the cargo transport corridor area **43**T (shown) as well as other design features including enablers for payload transfer known in the prior art (not shown) comprising but not limited to: a crane, an overhead mobile crane, a freight elevator or freight lift, a roller tray, a ball mat, powered rollers, a winch, a pallet transfer system, a container transfer system, a roadway for driving upon and a ramp for driving up and/or down.

[0115] In FIG. **2**A the crew use areas including crew quarters **5**Q are preferably separated from the cargo accommodating areas in the cargo volume **42** by fire-resistant partitions **2**F, though openings may be provided for firefighting crew to enter the cargo compartment for firefighting purposes, as known in the prior art of cargo aircraft. Crew quarters **5**Q are illustrated in both the front and back parts of the deck **5**, and preferably include some windows **149** for external view. Crew quarters **5**Q can include a plurality of crew quarters features and amenities known from the prior art of vehicle crew quarters for marine, air and land vehicles-including but not limited to plural features and amenities selected from: seats, sleeper seats, beds, bunk beds, berths, stowage areas, closets, lockers, bathrooms, toilets, showers, bath tubs, kitchen, galley, cafeteria, dining areas & features, recreational areas & features, sport area & features, exercise & fitness area & features, entertainment area & features, socialization area & features, training/education area & features, multipurpose rooms, medical area & features, quarantine area & features, childcare area & features, and area & features for persons of limited mobility or other handicap. Common and/or separate facilities and amenities may be provided for various categories of crew comprising a plurality selected from: flight crew, a pilot, a flight engineer, a navigator, a flight attendant, a purser, hospitality crew, a consultant, a translator, a ship guide, maintenance crew, repair crew, health crew, a physician, a nurse, a medical assistant, food services crew, beverage services crew, an entertainer, a musician, an athlete, special services crew, tourism crew, education crew, stores and inventory management crew, security crew, safety crew, government services crew, crowd management crew, complaint management crew, funeral services and morgue crew, other crew and multirole crew. Volume in the deck that is not payload volume **4** is flexible use volume **4**F, and in variant embodiments can be utilized for one or more of: structures elements, systems elements, propulsion elements, payloads elements, crew-use elements, operational elements, ballast system elements, eg control elements, water system elements, waste system elements, stores, supplies, service elements, modular elements, maintenance elements, repair elements and other elements. As an example of ballast system elements, ballast volumes **33**B are shown at fore and aft and left and right spaced representative locations. It should be understood that a variety of locations could be used for a variety of ballast types including liquid pumpable ballast (such as water sourced from a controllable inlet/outlet in a hull) and solid movable ballast.

[0116] The ship structure **2** includes structural spars **2**S in the wings, with **3** spars illustrated in each wing but variant embodiments could use any number of spars. The spars **2**S may comprise one or more of: a manufactured spar, a truss spar, an extruded spar, a composite spar, a metallic spar and a hybrid spar. The spars **2**S may utilize various structural components such as flanges and webs and trusses. The spars **2**S in the wings are shown with constant chord, but in a variant embodiment the spars may increase in chord for the regions where the spar flanges bifurcate into reduced-depth planar members **2**P that are located below and above the illustrated cargo deck in the body **3**, and transfer loads betwixt the left wing **61**L, body **3** or fuselage, and right wing **61**R, as shown earlier in FIGS. **1**A and **1**B. Planar members **2**P may comprise one or more of: a near-planar structure, a rib, a frame, a floor, floor coverings such as at least one of a carpet and a mat and a nonskid surface, a wall and a bulkhead. Planar elements **2**P can incorporate panel, sandwich panel, truss, and/or topology-optimized structural sub-elements. FIG. **2**A also illustrates structural columns **2**C that that can carry vertical loads, that are part of the ship structure **2** and that are shown in the body **3** aft of the cargo container storage volume. These structural columns **2**C will also be evident in FIGS. **2**B, **2**C, **2**E and **2**F showing decks **5** above the cargo deck **2**C, and carry vertical loads connecting all these decks with the overall vehicle structure **2**. Near the location of these structural columns **2**C in FIG. **2**A, means for crew and other persons and goods and baggage and freight to move from the illustrated crew quarters **5**Q to other decks **5** include the illustrated freight elevator **143**F and elevator **143**E and stairway **143**S (which may optionally be a moving stairway/escalator, and as illustrated connects the illustrated cargo deck **5**C which includes the crew quarters **5**Q, to the deck immediately above which is the flexible use deck **5**F that will be described with reference to FIG. **4**B in the following. Additional stairway(s) and/or elevator(s) may be provided in the forward crew quarters **5**Q illustrated in FIG. **2**A and the flight deck/cockpit **31**C illustrated in FIG. **2**A and FIG. **2**B, but these are not specifically illustrated or called out. Note that stairway(s) and elevators(s) will preferably include fire propagation prevention features such as fire doors or deployable fire screens to prevent propagation of potential fires across deck boundaries and/or personnel area to cargo area boundaries and/or other fire containment volume boundaries, as known in the art of fire propagation prevention in occupiable volumes.

[0117] There is still space beneath the floor of the cargo deck **5**C for cargo containers **43**A such as Unit Load Devices (ULDs) and/or **40**, **45**, **53** or other foot long standard geometry shipping containers or high-cube containers, to be located in a single layer on the top surface of the payload transfer transport module **47**. The cargo deck **5**C will preferably have openable cargo transfer floor openings **43**F to enable a ceiling mounted mobile crane (not shown but known in the prior art of mobile cranes) to engage and lift up to the cargo deck **5**C, cargo containers **43**A that were brought to the ship **1** on the payload transfer transport module **47**. The cargo transfer floor openings **43**F may be fitted with closure means such as sliding or hinged closure panels. Once lifted up to the cargo deck **5**C, the mobile crane can then transport the lifted cargo container **43**A both longitudinally and laterally in cargo transport corridor areas **43**T in the cargo deck **5**C to the place where it is to be deposited for transport, then drop said cargo container **43**A down on the floor of the cargo deck **5**C. Means to constrain and/or lock the cargo container **43**A in position could include a variety of pallet lock and/or container lock and/or barrier rail and/or bumper bar and/or bollard and/or container restraint mechanisms and subsystems as are known from the art of container restraint subsystems for aircraft and for ships and for freight trains and for container-carrying trucks. FIG. **2**A shows a representative full load of **598** cargo containers **43**A in designated spaces on the cargo deck **5**C. The cargo containers **43**A are preferably ultra-lightweight cargo containers designed to minimize container tare weight, while sharing geometric aspects and fittings aspects with current standard air and sea shipping containers known in the art of containers shipping. Illustrated cargo containers **43**A include 45 foot high-cube cargo containers **43**B. 53 foot high-cube cargo containers **43**C and refrigerated containers **43**R. Forty-foot containers and twenty-foot containers could also be carried, as well as other containers of different geometries and weight specifications. Since the 40 foot, 45 foot and 53 foot containers are all nominally considered as two “twenty-foot equivalent units” or TEUs, the **598** containers corresponds to nominally **1196** TEUs of containerized cargo capacity. Note that a mix of high-cube and standard-height and non-normal height containers could be accommodated in the cargo deck **5**C. Containers of other non-standard dimensions (length, width) could also be accommodated. An area for storage of baggage **44** is also illustrated on the cargo deck **5**C. This area could have either fully automated, fully manual, or a hybrid mix of baggage handling so baggage can be stowed and then retrieved to be reunited with the owner or designee for each piece of baggage. An area for oversize cargo **43**XL is also shown, to enable carriage of oversize cargo **43**XL that is larger in at least one dimension relative to the 53-foot high-cube cargo container **43**C. These areas for oversize cargo **43**XL are preferably located directly above the stowed locations of payload transfer transport modules **47**, and as an option it will be possible to have oversize cargo **43**XL sitting on and secured to the upper surface of a payload transfer transport module **47**, and projecting up through an openable opening (not shown) in the undersurface of the body **3**, into the space shown herein in FIG. **2**A. In a similar manner the illustrated fuel tanks **82**B are supported on the payload transfer transport module **47** below, and project upwards through an opened opening (not shown) in the undersurface of the body **3**, into the space in the illustrated cargo deck **5**C. Note that the fuel tanks **82**B may carry a liquid fuel such as jet fuel or diesel fuel or gasoline or biofuel or may be cryogenic fuel tanks that act as liquid hydrogen tanks **47**H. Appropriate safety and fire protection systems known in the art from aircraft and ships can be incorporated to address leakage, ignition and fire risks and meet appropriate certification requirements. Appropriate connectors and hoses can be used as known in the prior art, to connect the fuel system of the partially aerostatically supported ram air cushion ship **1** to the fuel tanks **82**B on the first hand, and to the propulsion system **26** on the second hand. The fuel system will preferably incorporate a plurality of safety features as known in the art of vehicle fuel systems, including features to prevent, inhibit, or suppress risks like ignition, fire and/or explosion (including one or more selected from: a fuel inerting subsystem, a fire detection subsystem, a fire suppression subsystem, an internal fire truck, a pumper truck, a fire hydrant, an unmanned fire-fighting device such as a robotic device or an autonomous device, nitrogen inerting subsystem, a halon fire suppressant, and a non-halon fire suppressant). Water piping system including hydrants to pumper truck or device can connect to. Potential sea water suck and feed system if on board fresh water is insufficient for major fire. Nitrogen inerting? Halon or halon replacement? and an explosion containment subsystem as examples cited without limitation). In the case of liquid hydrogen tanks **47**H as illustrated, appropriate connectors and hoses can access the liquid hydrogen in these tanks to be used as fuel for the propulsion system **26** and/or to be used with boiloff of the liquid hydrogen into gaseous hydrogen to refill and/or pressurize gaseous hydrogen **12** used as a lifting gas **9** to contribute an aerostatic lift force **10**, as described earlier in the description of the preferred embodiment shown in FIGS. **1**A through **1**G.

[0118] It should be noted that some of the cargo containers **43**A may be refrigerated and a portion of area for oversize cargo **43**XL may also be refrigerated, in various sub-embodiments of the invention. It should also be noted that some of the cargo containers **43**A and/or some portion of area for oversize cargo **43**XL may also be provisioned for humane live animal carriage, with suitable provisions for air, water, food, and all aspects of health and comfort of the animals and protection of the animals from having to experience pain, fear, suffering or distress whether physical or mental. This should enable partially aerostatically supported ram air cushion ships **1** or PASRACS **1** to offer live animal carriage with high standards for animal health, welfare, comfort, care, and avoidance of mortality and morbidity, including for large animals such as zoo or aquarium species from the animal kingdom. Similarly, PASRACS **1** can offer pet accommodation and sanitation areas with high standards for animal health, welfare, comfort and care. An optional veterinary care facility can be provided in a proximal location on board.

[0119] FIG. **2**A also illustrates waste containers **142**W that collect waste from drain lines from lavatories, sinks, galleys etc from various decks **5** of the PASRACS **1** and accommodate one or more of solid waste and/or liquid waste. Per waste management best practices, all or most of the waste lines can gravity feed into the waste containers **142**W for normal floating and flight attitudes of the vehicle; while waste pumping systems such as grinder pumps can be used as and where necessary, if at all. The waste containers **142**W may also optionally collect other types of solid waste such as garbage, and in variant embodiments separate garbage and/or compacted garbage may be collected in garbage containers that can have the form and fittings of cargo containers such as standard Unit Load Devices (ULDs) and be separate from drain fed waste containers **142**W that can take the form of tank type containers.

[0120] FIG. **2**B shows a representative plan view diagram of a deck layout configuration of the next above the bottom deck (cargo deck **5**C) of the preferred embodiment of a partially aerostatically supported ram air cushion ship **1** as shown in FIGS. **1**A and **1**B, which as illustrated comprises the flexible use deck **5**F that includes windows **149**. The flexible use deck **5**F comprises features to flexibly and modularly accommodate different items for different uses including items for people (passengers and/or crew) and items for cargo (freight and/or baggage), and also encompassing a payload volume **4** with a flexible use volume **4**B. FIG. **2**B shows representative spaces including installations/modular installations on the flexible use deck **5**F, for items for people shown including: a payload accommodating compartment **73** with a lounge area **142**A; special service area **142**B to accommodate & service special needs for persons of reduced mobility (PRM) or other categories of human handicaps; restroom **142**C with a toilet and sink; bathroom **142**D with a toilet and sink and at least one of a shower and a bath tub; a baggage management area **142**E for at least one of baggage check and baggage reconciliation and baggage claim; a government formalities area **142**F for at least one of customs processing and immigration processing and emigration processing and security processing and police station and jail and agriculture/food screening; a medical area **142**G for at least one of a traveler health aid station, a first aid station, a basic life support station, an advanced cardiac life support station, a nurse station, a medical

station, a medical clinic, a telemedicine station, a medical transport area, an ambulance, a powered gurney (such as a robotic gurney for transport of patients to a clinic or corpses to morgue area and final rites at a different location, without limitation), a medevac unit, a climate control module, an oxygen control module and a disease containment module; a general service area **142**H for at least one of a welcome center, traveler aid station, customer support, customer complaints, customer counsel, language translation, financial services and lost & found; a food service area **142**J for at least one of food service, snack service, meal service, vending machines, microwave oven area, refrigerator area, beverage service, food cart or trolley, beverage cart or trolley, cafe service, bar service, food truck service and vendor cart service; a wellness fostering area **142**K comprising at least one of a gym, a fitness center, a yoga area, a massage chair area, a massage area, and a spa area; a sporting game area **142**L comprising at least one of a game arcade area, a video game area, a simulator area, a table game area, a darts area, a table tennis area, a billiards area, a racquet sports court, a basketball hoop area, a skate area for people using roller skates or in-line skates or skateboards, a games of chance area and a racing game area; a walkway **142**M for people to take a walk as well and/or jog and/or run with optional designated lanes; a children's area **142**N with at least one of a playground, a swing, a slide, a merry-go-round, a rocking device, a riding device, a climbing device, a hanging device, a sand pit, a simulated beach area, a wading pool, and a splash area; a learning area **142**P with at least one of a library area, a reading room, a periodicals area, a bookstore area, a tourist information area, a video area, and an interactive learning area; a deboarding gate area **142**Q for accommodating people who will deboard at the next destination or stop of the vehicle, with areas for standing and/or sitting people and appropriate as-needed lighting, windows, heating, air conditioning, ventilation, air purification, drinking water, restrooms and facilities; a muster area **142**R for accommodating and organizing people for evacuation in the event of an emergency (to enable direct transit onto an adjacent emergency evacuation barge **47**E and/or onto an adjacent payload transfer transport module **47**, as shown with access to the tower portion of the eight payload transfer transport modules **47** that project up into the illustrated flexible use deck through an opening in the cargo deck **5**C, as shown and as noted earlier in the context of FIG. **2**A). The deboarding gate area **142**Q can also serve as a boarding gate area, and a location where elderly or handicapped passengers or others needing assistance can obtain assistance from cabin crew who may be human or robotic, as well as transit to onboard mobile carts or mobile chairs that can transport people and their bags internally in the PASRACS **1** to their seating or cabin locations, using internal roadways **120** and the spiral ramps **143**R that are ramps **122** to transit between different payload levels. Note that the muster area **142**R can share space with the deboarding gate area **142**Q while having additional items to enable crew to appropriately muster and organize people for emergency evacuation scenarios; a store **142**S comprising at least one of a general store, an essential items store, a grocery store, a souvenir store, a drug store or pharmacy, a department store, a snacks store, a coffee & tea store, a cold beverages store, and a specialty store for merchandise, tourist goods, clothing, fashion, shoes, footwear, eyewear, health/wellness, electronics, hardware, hobbies, toys, jewelry, and/or world goods; and a flexible use volume **4**F.
[0121] FIG. **2**B also illustrates that the ship structure **2** that includes planar members **2**P that may comprise one or more of: a near-planar structure, a rib, a frame, a floor, a wall and a bulkhead. Vertically oriented planar members **2**P are shown in FIG. **2**B at the outboard left and right side ends of the body **3** near the wing roots. These planar elements **2**P can incorporate panel, sandwich panel, truss, and/or topology-optimized structural sub-elements, and as shown these planar elements **2**P can provide loads and structural connection between elements including the illustrated structural columns **2**C that are part of the ship structure **2** and are shown in the body **3** near the inboard ends of the wings **61**R and **61**L and also elements shown earlier in FIG. **1**B and FIG. **2**A, namely (a) the wing spars **2**S in the wings and (b) the horizontal planar members **2**P traversing the body **3** and located below and above the cargo deck **5**C in the body **3**. The vertically oriented planar members in FIG. **2**B and the associated structural columns **2**C can contribute to carrying loads flowing

through load paths from the winching system for the payload transfer transport modules **47** as well as carrying loads along load paths that are encompassed by the wings **61**R and **61**L and the body **3** between them that in turn encompasses both payload volume **4** and lifting gas enclosures **8** as shown earlier with reference to FIGS. **1**A through **1**G. Additional structural columns **2**C are also shown in FIG. **2**B near the centerline of the body **3** at longitudinal locations corresponding with the interfloor traversal columns **143** with spiral ramps **143**R shown in FIG. **1**B, wherein these structural columns **2**C in conjunction with the interfloor traversal columns **143** serve as parts of the ship structure **2** that can carry vertical loads as well as other loads in the body **3**. Access to the illustrated flexible use deck **5**F from the passenger decks **5**P above it can be via one or more of the illustrated elevator **143**E, freight elevator **143**F and spiral ramp **143**R elements of the illustrated interfloor traversal column **143**, wherein the particular preferred embodiment shown has one interfloor traversal column **143** in a middle region of the body **3** and another in an aft region of the body. FIG. **2**B also shows a stairway **143**S in the aft body going down to the crew quarters **5**Q in the cargo deck **5**C as described earlier in the context of FIG. **2**A, plus two additional stairways **143**S (wherein any of the stairways can optionally be a moving stairway or escalator) that connect forward left and right regions of the flexible use deck **5**F up to a passenger deck **5**P immediately above (that will be described further with reference to FIG. **2**C). Note that variant embodiments of the invention may be fitted with various combinations of stairways(s), escalator(s), elevator(s), freight elevator(s), spiral ramp(s) and other ramp(s) to enable one or more of persons and baggage/cargo to traverse between different decks **5** as well as to payload transfer transport module(s) **47** and/or emergency evacuation barge(s) **47**E, in manners that are understood from the prior art. Note that stairway(s) and elevators(s) will preferably include fire propagation prevention features such as fire doors or deployable fire screens to prevent propagation of potential fires across deck boundaries and/or personnel area to baggage area boundaries and/or other fire containment volume boundaries, as known in the art of fire propagation prevention in occupiable volumes.

[0122] FIG. **2**C shows a representative plan view diagram of a deck layout configuration of the next above the flexible use deck **5**F of FIG. **2**B. Thus FIG. **2**C shows the deck **5** that is the 1.sup.st or lowest passenger deck **5**P of a payload accommodating compartment **73** of a partially aerostatically supported ram air cushion ship **1** as shown in FIGS. **1**A and **1**B. Access to the illustrated passenger deck **5**P in FIG. **2**C from other decks in the partially aerostatically supported ram air cushion ship **1** can be via one or more of the illustrated elevator **143**E, freight elevator **143**F and spiral ramp **143**R elements of the illustrated interfloor traversal column **143**, wherein the particular preferred embodiment shown has one interfloor traversal column **143** in a middle region of the body **3** and another in an aft region of the body. The spiral ramps **143**R may feature one or more of: a walk area or lane, a wheeled vehicle area or lane, a driving area or lane, an internal vehicle train area or lane (e.g. for rubber tire vehicle trains, for example and without limitation), separate up and down lanes, and reversible lanes. Lifts **118**L that are also elevators, are shown also at the aft of walkways **118** to enable access to passenger deck **5**P locations in the vertical stabilizers **88**V, which may provide, for example, luxury cabins and/or suites for ultra-premiere classes of travel even above First Class, that may be branded in a variety of ways such as “Luxury Class” or “Elite Class” or “UltraLux Class” or “Royal Class” or “Stellar Class” for example and without limitation, and that can be fitted with luxury amenities as well as large picture windows on both sides, that may be structural windows.

[0123] A cabin **38** includes an expansive cabin space **145** in the aft portion of the illustrated passenger deck **5**P, where the expansive cabin space **145** can be characterized as a “People's Park” for persons **39** such as passengers **40** and crew **41** to enjoy. The park area can include benches and chairs for people to sit on, and walking and jogging paths and play areas with greenery, for example and without limitation. The cabin space **145** is fitted with windows **149** to enable persons to have a view to the outside of the PASRACS **1**, of scenery while at a destination or en route. The aft portion of the illustrated passenger deck **5**P also includes a pool **147**P, that is nominally Olympic size as illustrated and can be used for swimming and/or diving and/or as a splashdown pool at the bottom of a waterslide **4**WS (that will also be described in the following in the context of FIG. **2**E). To enable the pool **147**P to be used for diving, a deep end may have a pool floor that drops to some extent into volume of the next lower deck, namely the flexible use deck **5**F described earlier in the context of FIG. **2**B. Diving boards and entry stairs and varying depths are known from prior art and can be incorporated as design and implementation features of the pool **147**P within the spirit and scope of the invention. In view of the weight sensitivity of vehicles capable of flight, one preferred variant embodiment of that shown in FIG. **2**C may forego the water depth needed for diving so as to enable reduced water weight and associated impacts on the vehicle weight of the PASRACS **1**. Water **92** for the pool **147**P as well as for a potable water supply for the vehicle can be sourced from one or more of (a) upload using a fill system from a payload transfer transport module **47** (not shown in FIG. **2**C) through a potable water piping system **92**C and (b) upload from a water scoop system on a hull **54** (not shown in FIG. **2**C) followed by a water purification system that can include one or more of desalination and filtration and ultraviolet radiation (UV) purification subsystems, as known in the prior art of water purification systems. Water systems will be further described subsequently in the context of FIG. **13**A.

[0124] FIG. **2**C also illustrates several features and amenities. FIG. **2**C shows a special service area **142**B, a general service area **142**H, a wellness fostering area **142**K, a walkway **142**M, a children's area **142**N, and a learning area **142**P. The illustrated walkway **142**M also serves as a closed loop track **146**, that can be used for one or more of walking, jogging, running, rollerskates, rollerblades, and cycling. FIG. **2**C further illustrates the interfloor traversal columns **143** with the associated elevator **143**E, freight elevator **143**F and spiral ramp **143**R elements.

[0125] FIG. **2**C also illustrates a stairway **143**S in an atrium **144** that allows persons to traverse from the 1.sup.st or lowest passenger deck **5**P up to the next or 2.sup.nd passenger deck **5**P that is above the deck shown in FIG. **2**C. Note that FIG. **2**C shows both an aft atrium **144**A and a forward atrium **144**F, while it should be understood that variant embodiments may have zero, one or plural atriums. A vegetation feature **148** that could comprise one or more of a lawn, a garden, a hydroponic garden, flowers, shrubs and trees, plant boxes and/or hanging basket plants, is shown in the forward atrium **144**F but such features can clearly be included in other locations within the PASRACS **1**, within the spirit and scope of the invention.

[0126] FIG. **2**C illustrates a water feature **147**, that could be one or more of a fountain, a waterfall, a wading pool, a splash pool, other water feature for decoration and other water feature for use.

[0127] FIG. **2**C also shows: [0128] a recreational area **150** that can include one or more of a kids playground, jungle gym, game room, skate park or other recreational item; [0129] an eatery **151** that can include one or more of a restaurant, a café, a bistro, a food court, a dessert/ice cream bar, a food facility and a beverage facility; [0130] a store **152** that can include one or more of a merchandise store, a tourist goods store, a drug store, an essentials store, a clothing store, a fashion store, a shoe store, a department store, a health/wellness store, an electronics store, a hardware store, a hobby store, a toy store, a fashion store, a jewelry store, a world goods store, and a specialty store; [0131] a medical facility **153** that can include one or more of a clinic, a hospital, an emergency aid station, a telemedicine facility, an isolation facility, a surgery room, a dental facility, an eye care facility, a medical specialty facility, an urgent care facility, an emergency room, a preventive medicine facility, a pediatric facility, a geriatric facility, a defibrillator & CPR station, and a nonallopathic health facility; [0132] a human facilities area **154** that can include one or more of a restroom, a bathroom, a men's room, a women's room, and facilities for persons of reduced mobility (PRM) and/or other handicap; [0133] a sporting game area **155** that can include one or more of table tennis, billiards, croquet, mini-golf, badminton, tennis, volleyball, basketball, a bowling alley, another sport area, and another game area; [0134] a flexible use room **156** and a conference room **156**C that can serve as a business use room.

[0135] Reference is now made to FIG. **2**D, which schematically illustrates an enlarged view of section **404**, which is marked in FIG. **2**C by a broken line in a region on the right side of the deck **5** that is the 1.sup.st or lowest passenger deck **5**P of the illustrated payload accommodating compartment **73** in the body **3** of the partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. The enlarged view is scaled up by approximately 20:1 to better show the features within the section **404**.

[0136] FIG. **2**D illustrates representative persons **39** that are seated persons **39**S in representative seats **157** that will preferably be of a class comprising at least one of a cushioned seat and a reclinable seat and sleeper seat and full-flat seat, all of which are known in the art of vehicle design and furnishing to enable comfortable vehicular travel by persons such as passengers **40**. The seats **157** are shown arranged in a pattern that enables people seated in the seats to see outside the PASRACS **1** through at least one window **149** fitted in the body right side surface **3**R in the illustrated preferred embodiment. The pattern shown is representative but not limiting, and utilizes slightly increased angles for more inboard seats to enable better viewing angles through the window elements, and five abreast seating modules facing each other across an aisle **119** that is a transverse aisle. The transverse aisle connects to a longitudinally oriented aisle **119** that separates the window seats passenger accommodation area from an area with cabins **38** such as a minicabin passenger accommodation area that is inboard of the longitudinal aisle **119** as illustrated. A stowage volume **44**S comprising a closet is shown facing the longitudinal aisle **119**, and an additional stowage volume **44**S is shown in the cabins area inboard of the longitudinal aisle, as illustrated. It will be understood that a variety of stowage members known in the prior art of vehicles, including a closet, an overhead stowage bin, underseat stowage, furniture-integrated stowage, wall-mounted stowage, ceiling-mounted stowage, and floor-mounted stowage can be utilized in various passenger accommodation areas within the spirit and scope of the invention.

[0137] The illustrated cabins **38** include a private cabin **38**P for a person **39** such as a passenger **40**, which private cabin **38**P can be a luxury cabin. The private cabin **38**P is shown equipped with a bed **158** with some shown with a single person bed and some with a two-person bed such as a Queen bed or King bed without limitation. The illustrated two-person bed in a preferred version could be of a sofabed or futon configuration so that it can occupy a smaller footprint and be used as for seating accommodation, at times when it is not in the illustrated deployed configuration suitable for full-flat lying and sleeping. One of the single person beds is shown occupied by a person **39** who is a person lying down **39**L. Similarly one of the two-person beds is shown as a multi-person bed accommodating three persons lying down **39**L, with the persons **39** comprising two adults (such as parents) and a child shown all occupying the bed. The representative single person cabins **38** are shown with a door **38**D for entry and egress and privacy, and also shown with a toilet **153**T and a washbasin **153**W that can be a sink. The representative multiperson cabins are shown with a door **38**D for entry and egress and privacy, and also equipped with a toilet **153**T and a washbasin **153**W that can be a sink, as well as a shower area **153**S. The cabins area inboard of the longitudinal aisle is also shown with a human facilities area **154** such as a restroom or bathroom, including a door **159** that may be lockable (with emergency crew override) and including a toilet **153**T and a washbasin **153**W that can be a sink and a bathing facility **153**B that can include a tub and/or shower. Space-efficient and functional and aesthetic restroom or bathroom design features are known in the art of vehicle design and equipage, with special note of recreational vehicles such as motorhomes or travel trailers or fifth-wheels, yachts, ships, airplanes and trains. Bathroom amenities can include one or more of: a mirror, a vanity, toilet paper, sanitary pads, dignity protection underwear, cleaning wipes, paper towel, and robotic resupply and cleaning provided to keep the bathroom(s) clean and sanitary. The restroom or bathroom design features can also include personal protective equipment (PPE) and safety features and features for persons of reduced mobility (PRM) and/or other physical or mental limitations or handicaps.

[0138] It will be understood that a wide variety of alternate preferred embodiments for seating area and cabin area and combined area arrangements, as well as seating amenities & features and cabin amenities & features, are all possible based on vehicle and feature prior art.

[0139] FIG. **2**E shows a representative plan view diagram of a deck layout configuration of the 10th lowest passenger deck **5**P, or **10** deck levels above the flexible use deck **5**F shown in FIG. **2**B. Portions of this passenger deck **5**P accommodate seats **157** and cabins **38** in a manner similar to those described in the context of FIG. **2**D, for example on the starboard (right) and port (left) sides of the body **3** inboard of the wings **61**R and **61**L and in the aft sides of the body **3**. This passenger deck **5**P is also fitted with a plurality of features and amenities including the following in the forward portion of the passenger deck **5**P: a plaza **127**; an expansive cabin space **145** such as a “people's park”; vegetation features **148** (which could involve one or more of a bush, a shrub, a tree, a plant, a garden, and a lawn); a store **152**; an eatery **151**; a human facilities area **154**; a sporting game area **142**L; a children's area **142**N, a learning area **142**P; and private cabins **38**P such as luxury cabins (such as First Class cabins) with views to the outside of the vehicle through windows or views into the atrium **144** that is the forward atrium **144**F through windows and/or view decks.

[0140] Moving aft into the region of the passenger deck **5**P between the left wing **61**L and right wing **61**R, the passenger deck **5**P is also fitted with a plurality of features and amenities including the following: ultra-large private cabins **38**P with external view windows **149**; a special service area **142**B; a wellness fostering area **142**K that may include one or more amenities such as a massage chair and an oxygen bar; a general service area **142**H: a flexible use room **156**; a Table Tennis (or ‘Ping-Pong’) area **155**P; and an eatery **151** that is behind the interfloor traversal column **143** in this region (that also includes elevator **143**E and freight elevator **143**F and a spiral ramp **143**R).

[0141] Moving further aft into the region of the passenger deck **5**P aft of the left wing **61**L and right wing **61**R, the passenger deck **5**P is fitted with a plurality of features and amenities including the following: more private cabins **38**P; a lounge area **142**A; human facilities area **154**; an arcade of booths **150**A (that may be for one or more of games and entertainment and shopping and snacking and drinking); a food court **151**F aft of an atrium **144** that is the aft atrium **144**A in the illustrated embodiment; a stairway (or moving stairway/escalator) **143**S to facilitate people moving from deck-to-deck in said atrium **144**; a recreational area **150** that may include one or more of a kids playground, skate park, jungle gym, game room and other recreational feature; stores **152** that may include more than one of a merchandise store, a tourist goods store, a drug store, an essentials store, a clothing store, a fashion store, a shoe store, a department store, a health/wellness store, an electronics store, a hardware store, a hobby store, a toy store, a fashion store, a jewelry store, a world goods store, and a specialty store; and a medical facility **153**.

[0142] Moving to the aftmost region of the passenger deck **5**P and associated payload accommodating compartment **73** in payload volume **4** in FIG. **2**E that is behind the aftmost interfloor traversal column **143**, the passenger deck **5**P is fitted with a plurality of features and amenities including the following: a theatre **160** that may be one or more of a screen-fitted theatre, movie theatre, stage-equipped theatre, concert hall, opera hall, live-action theatre and other theatre; outboard seat **157** and cabin **38** features for passenger accommodation; recreational area **150**; windows **149**; vegetation feature **148**; and a sloped multiuse volume **4**S that contiguously and in a sloped manner traverses multiple decks so as to enable and incorporate features that comprise more than one of a sliding slope **4**SK such as a real or artificial ski or sledding slope, a zipline **4**SZ, an incline lift **4**SL such as a chairlift, cablecar, gondola, telepherique, incline railway, T-bar, J-bar, rope tow or other lift, a waterslide **4**WS, stairs **4**ST, ramp **4**SR, climbing surface **4**SC such as a climbing wall or simulated mountain climb, slide **4**SS and a wheeled sport slope **4**SW area or track for use by one or more of a skateboard, rollerski, scooter, mountain bike, cart, soap box derby car, and riding cart. Note that the waterslide **4**WS shown on FIG. **2**E ultimately goes down through the sloped multiuse volume **4**S down to the pool **147**P shown earlier with reference to FIG. **2**C.

[0143] Behind the occupiable spaces and the sloped multiuse volume **4**S in FIG. **2**E, the area horizontally behind cuts through a lifting gas enclosure **8** and then the vertical tails **88**V with the lifts **118**L that can take passengers up to the exclusive accommodation deck areas that are contained within the vertical tails.

[0144] FIG. **2**F shows a representative plan view diagram of a deck layout configuration of the topmost passenger uses deck of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, which per the illustrated embodiment is highest (or the 22.sup.nd lowest) passenger deck **5**P, being 22 deck levels above the flexible use deck **5**F shown in in FIG. **2**B. In view of higher ceiling heights especially towards outboard sides of this topmost passenger use deck (as seen earlier in FIGS. **1**D, **1**E and **1**F), this topmost passenger use deck is particularly suitable for facilities such as sporting facilities that need or benefit from higher ceiling heights. Several of these, without limitation, are shown in FIG. **2**F. FIG. **2**F also shows in dashed lines the installation of potable water tanks **92**B above high parts of the high ceilings, to enable gravity feed of water to users on the topmost deck as well as all decks below. These are the same locations earlier shown in FIG. **1**E.

[0145] The passenger deck **5**P illustrated in FIG. **2**F is fitted with a plurality of features and amenities including the following in the forward portion of the passenger deck **5**P: a bridge **31**B where crew can optionally control the partially aerostatically supported ram air cushion ship **1** from a higher location than the much lower location of the cockpit or flight deck **31**C (as an option to provide redundant control locations in the event of an emergency condition arising from natural and/or man-made causes); plaza **127** that also serves as an open area for passenger and crew use; a room **126**; a lounge **142**A; a special service area **142**B; an eatery **151** (that could be one or more of a restaurant and a cafe and a bistro and a food court and a dessert bar and an ice cream bar and a beverage bar and a snack bar); a bowling alley **155**A; a field **155**F for team sports such as one or more of soccer and US football and Canadian football and rugby and baseball and cricket and field hockey and track & field sports and frisbee and other field sport/activity); volleyball court **155**C; tennis court **155**T; bench/bleacher seating **157**B suitable for viewing sports or other activities; human facilities area **154**; and stores **152**.

[0146] Moving aft into the region of the passenger deck **5**P of FIG. **2**F that is between the left wing **61**L and right wing **61**R, the passenger deck **5**P is also fitted with a plurality of features and amenities including the following: a tennis court **155**T; a basketball court **155**B; the (forward) interfloor traversal column **143**; a velodrome **155**V that can have banking in curved portions of the track; and a skybridge **155**K illustrated so persons can gain walking access into the infield area of the velodrome **155**V.

[0147] Moving further aft into the region of the passenger deck **5**P of FIG. **2**F that is aft of the left wing **61**L and right wing **61**R, the passenger deck **5**P is fitted with a plurality of features and amenities including the following: a tennis court **155**T; a badminton/shuttle-cock court **155**BS; a table tennis/ping-pong area **155**P; a children's area **142**N: a learning area **142**P: a closed-loop track **146** suitable for one or more of walking, jogging, running, rollerskates, rollerblades, and cycling; a skating rink **155**S (that could be an ice or roller skating rink, and is shown in the size of an Olympic size ice rink in FIG. **2**F); a racquetball/squash court **155**R; human facilities area **154**; a general service area **142**H; a wellness fostering area **142**K; a special service area **142**B; a medical facility **153** that may include one or more of a sports medicine facility, a clinic, a hospital, an emergency aid station, a telemedicine facility, an isolation facility, a surgery room, a dental facility, an eye care facility, a medical specialty facility, a nonallopathic health facility, an urgent care facility, and an emergency room; a store **152**; an eatery **151**; and locker room(s) **155**L such as men's and women's locker rooms with one or more of changing areas and showers and lockers and restroom areas. With regard to one or more stores **152**, it should be understood that a wide variety of store sizes, configurations, layouts and designs are possible, ranging from a large supermarket or department store down to small modular booths located in aisleways and public spaces on board the PASRACS **1**.

[0148] Moving to the aftmost region of the passenger deck **5**P and associated payload accommodating compartment **73** in payload volume **4** in FIG. **2**F that is near or behind the aft interfloor traversal column **143**, the passenger deck **5**P is fitted with a plurality of features and amenities including the following:

[0149] a skatepark **150**S that provides an area for users of skateboards or longboards or other wheel-borne equipment; a flexible use room **156** as well as flexible use undesignated open spaces on the passenger deck **5**P; and a sloped multiuse volume **4**S that contiguously and in a sloped manner traverses multiple decks so as to enable and incorporate features that comprise more than one of a sliding slope **4**SK such as a real or artificial ski or sledding slope, a zipline **4**SZ, an incline lift **4**SL such as a chairlift, cablecar, gondola, telepherique, incline railway, T-bar, J-bar, rope tow or other lift, a waterslide **4**WS, stairs **4**ST, ramp **4**SR, climbing surface **4**SC such as a climbing wall or simulated mountain climb, slide **4**SS and a wheeled sport slope **4**SW area or track for use by one or more of a skateboard, rollerski, scooter, mountain bike, cart, soap box derby car, and riding cart. Note that the waterslide **4**WS shown on FIG. **2**F ultimately goes down through the sloped multiuse volume **4**S down to the pool **147**P shown earlier with reference to FIG. **2**C.

[0150] Behind the occupiable spaces and the sloped multiuse volume **4**S in FIG. **2**F, the area horizontally behind cuts through a lifting gas enclosure **8** and then the vertical tails **88**V with the lifts **118**L that can take passengers up to the exclusive accommodation deck areas that are contained within the vertical tails.

[0151] The specific features and features count illustrated in FIG. **2**F serve illustrate certain preferred options for features and amenities serving a variety of passenger pleasing purposes, and it should be understood that many variations as well as deletions and/or additions are possible within the spirit and scope of the invention.

[0152] The preferred embodiment based on the geometry illustrated in FIGS. **1**A-**1**G and **2**A-**2**F, comprises a partially aerostatically supported ram air cushion ship **1**, configured with a ratio of a total plan-view deck area **98** of all said decks **5** combined, divided by a total wetted area **99** of said partially aerostatically supported ram air cushion ship **1**, that when multiplied by 100%, exceeds 15%. While the illustrated preferred embodiment of FIGS. **1**A-**1**G and **2**A-**2**F has a total of 24 decks to enable this area ratio to be comfortably achieved, it should be understood that variant embodiments of the invention with at least 4 decks can also be configured to achieve the above area ratio with values exceeding 15%, even while providing adequate internal volume for lifting gas **9** to provide contributory aerostatic lift force **10** for the PASRACS **1**.

[0153] FIGS. **3**A through **3**F show front views of some alternate preferred embodiments (relative to the preferred embodiment of FIGS. **1**A through **1**G and FIGS. **2**A through **2**F) of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, with interior features at middle longitudinal locations near maximum cross-sectional area longitudinal locations shown in dashed lines. FIGS. **3**G and **3**H show rear views of some alternate preferred embodiments (relative to the preferred embodiment of FIGS. **1**A through **1**G and FIGS. **2**A through **2**F) of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. FIGS. **3**I through **3**L show cross-sectional views of still other preferred embodiments of PASRACS **1**. Note that the configurations illustrated in FIGS. **3**A through **3**L can have variations including different scales of lateral width, different scales of vertical height, and different scales of longitudinal length in subspecies of these illustrated preferred embodiments, as will be understood from the prior art of vehicle design, vehicle engineering and vehicle optimization.

[0154] FIG. **3**A shows a preferred embodiment of a PASRACS **1** in a transition mode still in contact with an Earth surface **21** that is a water surface **18**, with the PASRACS **1** including ship structure **2** and a body **3**. Payload volume **4** suitable for accommodating persons such as passengers, and/or cargo/baggage types of payload, are shown below an encompassed lifting volume **9**E bounded by a lifting gas enclosure **8** and filled with a lifting gas **9** that is a low-density lifting gas **13** such as helium and/or hydrogen without limitation. The atmosphere **14** is outside the lifting gas enclosure **8**. The low-density lifting gas **13** in the lifting gas enclosure **8** yields an aerostatic lift force **10**. The illustrated payload volume **4** includes a cabin **38** and plural decks **5** at different levels **6**, said plural decks **5** including at least one people deck **5**P (two illustrated). The illustrated embodiment has angled stabilizers **88**A with an inverted V tail configuration shown without limitation. The angled stabilizers **88**A may have control surfaces behind them, not visible in this front view, which control surfaces may be ruddevators or combinations of rudder and elevator type control surfaces. Forward of the payload volume **4** the PASRACS **1** has a flight deck/cockpit **31**C including a window **149** and including a crew input device **31** (central floor mounted control quadrant shown, similar to where throttle controls are mounted in airliners) that is usable by crew **41** (flight crew shown). The PASRACS **1** may also have crew stations and crew input devices for one or more of the following specialized crew member types: captain, first officer, navigator, flight engineer, loadmaster, chief safety officer, chief security officer, chief onboard regulations officer (for deployment and enforcement of onboard code of conduct and providing guidance to onboard security personnel if arrest or restraint actions are warranted for violators who pose threats to other people or themselves), chief communications officer, meteorologist, chief sea conditions officer, chief maintenance officer, chief repair officer, chief mechanic, chief steward, purser, chief monitoring officer, master chef, inventory management officer, terminal operations officer, chief guest officer, chief amenities officer, chief government affairs officer, and chaplain, without limitation. A variety of crew roles can be defined and multirole crew members can benefit from crew training and apprenticeship programs to be available to perform multiple roles depending upon circumstances and demand, including an "on call" system for unusual circumstances with high demand in specific roles. A vehicle navigation and control system **29** is shown in an equipment bay below the cockpit **31**C, similar to an electronics equipment bay ('EE bay') used under cockpits of airliners. A PASRACS **1** may be fitted with plural EE bays and equipment centers to service needs of different portions of the vehicle in an optimally distributed way that reduces weight and complexity but still provides desired redundancy and backup capabilities.

[0155] The ship structure **2** includes a central portion with a hull **54** with a hydrodynamic planning surface **36**P, and left and right portions that include a left wing **61**L and right wing **61**R on either side of said hull **54**. The wings are fitted with wing tip fences **61**T, and the wings and wing tip fences together provide upper and side bounds to a ram air cushion **20** in a ram air cushion volume **46**, with the upper bounds at the lower surface **1**L of the wings. The propulsion system **26** utilizes energy **27** to drive thursters **28**T such as fans (ducted or unducted fans or propellers), where the thrusters **28**T are connected to propulsor ducts **28**D that may encompass an engine such as a gas turbine engine or other engine or electric motor, without limitation. The propulsor ducts **28**D are supported from the left and right wings **61**L and **61**R by propulsor struts **28**S, as shown.

[0156] FIG. **3**B shows another preferred embodiment of a PASRACS **1** in a transition mode still in contact with an Earth surface **21** that is a water surface **18**, with the PASRACS **1** including ship structure **2** and a body **3**. The left wing **61**L and right wing **61**R are below the encompassed lifting volume **9**E as in the embodiment of FIG. **3**A, but now the PASRACS **1** does not have a central hull **54**, with the wing tip fences **61**T serving as tip floats that provide buoyancy from water displacement from a displaced volume below the water surface **18**, when the vehicle is in a static state with a loading condition that is net heavier-than-air. The embodiment of FIG. **3**B is shown with the encompassed lifting volume **9**E containing lifting gas **9** now including both a lower helium enclosure **11**E containing helium **11**, and an upper hydrogen enclosure **12**E containing hydrogen **12** which generates greater aerostatic lift than an equivalent volume of helium, but should be separated from payload volumes to the extent practicable because of the flammability of hydrogen gas. FIG. **3**B also shows a separate enclosure for cold hydrogen **12**C such as can come from boil-off of liquid hydrogen **12**L from a liquid hydrogen tank in the PASRACS **1**. The cold hydrogen **12**C can optionally provide a cooling source for a HVAC (heating, ventilation and air conditioning) system on the vehicle, as will be discussed further subsequently in this disclosure. Gas from the cold hydrogen **12**C location shown can optionally be piped to the propulsion system **26** for use as a fuel in a combustor or fuel cell, and can optionally be piped to other hydrogen enclosures **12**E for replenishment of lifting gas as needed. Mechanical means, pump means, and ballonet means can be utilized for enabling movement of gases and varying gas enclosure volumes, as known in the art of gas management in airships. The embodiment of FIG. **3**B also differs from that of FIG. **3**A in that FIG. **3**B shows an empennage with a horizontal stabilizer **88**H and a vertical stabilizer **88**V, rather than the use of angled stabilizers **88**A. A T-tail configuration is shown, but low tail or cruciform tails could be used within the spirit and scope of the invention.

[0157] FIG. **3**C shows a front view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, which is in a flight in ground-effect, banked configuration with a bank angle or roll angle of 2.5 degrees, shown for illustration and without limitation. The front view is slightly angled by 2.5 degrees, so the weight vector **33** aligned with the Earth's gravity vector is also tilted by 2.5 degrees, as illustrated, as is also the aerostatic lift force **10** which is a vector diametrically opposite to Earth's gravity vector, and the water surface **18** that is perpendicular to the Earth's gravity vector. This embodiment has an encompassed lifting gas envelope **9**E with a boundary that is approximately a half circle rather than a full circle, while it should be understood that still other embodiments can have lifting gas envelopes that are various parts of a circle or ellipse or oval or other shape, without limitation. The embodiment of FIG. **3**C has a hull **54** and is also shown with angled stabilizers **88**A but now in a V-tail configuration, as opposed to the inverted V-tail configuration shown earlier in FIG. **3**A. The embodiment of FIG. **3**C is shown with short stub wings for the left wing **61**L and right wing **61**R, and these stub wings may be fitted with trailing edge control surfaces not visible in this front view, which trailing edge control surfaces may be one or more of aileron, flap, flaperon or elevon type control surfaces. The wing tip fences **61**T that are illustrated are integrated with variable height planning surfaces **36**V beneath them, and are shown with the left and right variable height planning surfaces **36**V at different heights so as to better seal spanwise leakage flow from the left and right sides of the ram air cushion **20** in the ram air cushion volume **46**, even is this kind of flight condition with a bank angle that would otherwise result in very different leakage flow gaps on left and right sides. By improving spanwise flow gap sealing, the overall lift induced drag of the PASRACS **1** in a banked configuration can be reduced, while persons on board can be more comfortable and possibly be free of sensing the floor tilt if the vehicle executes a “coordinated turn” with a bank angle such that the following coordinated turn criterion known from flight physics is at least approximately satisfied in consistent units:

[00001]Gravitationalacceleration * tan(bankangle) = (forwardvelocity squared) / turnradius

[0158] For the illustrated bank angle of 2.5 degrees, with gravitational acceleration being 32.2 ft/sec.sup.2 and at a nominal cruise speed (forward velocity) of 367 ft/sec (250 miles/hr), this yields a turn radius of approximately 95,800 ft or 18 miles, which should pose no issues for heading corrections in intercontinental enroute cruise tracks. These numbers should be treated as representative, and not limiting, and of course vary with both speed and bank angle according to the equation above noted, with smaller turn radius, tighter turns possible at lower speeds and/or higher bank angles.

[0159] The variable height hydrodynamic planing surfaces **36**V can be rotationally and/or translationally variable height, can optionally be integrated with tip floats in addition to the wingtip fences **61**T, and can use an actuation controlled and/or suspension mounted variable height system (both presumed in the illustrated embodiment). The planing surfaces **36**V can be of hydroski or hydrofoil or other planing surface type within the spirit and scope of the invention.

[0160] FIG. **3**D shows a front view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, wherein the body **3** acts as a lifting body with support from a ram air cushion **20** beneath the body **3**. This preferred embodiment is not fitted with wings. Tail surfaces for stability and control are included, but are not visible in this front view. The tail surface can comprise at least one of a horizontal surface, a vertical surface and an angled surface. The body **3** includes a lifting gas **9** that is a low-density lifting gas **13**, in an encompassed lifting volume **9**E enveloped by a lifting gas enclosure **8** that in turn provides separation of the lifting gas **9** from the outside atmosphere **14**. The lifting gas **9** creates an aerostatic lift force **10** as shown. Payload volume **4** includes decks **5** at levels **6** and also includes a cabin **38**. A flight deck or cockpit **31**C is fitted with windows **149** and accommodates crew **41**. Operation of the PASRACS **1** can be controlled with inputs from the crew **41** using at least one crew input device **31** and with inputs from a vehicle control and navigation system **29**. The ram air cushion volume **46** is bounded on top by a lower surface **1**L, at the rear by side flaps **90**S that deploy downwards from the body **3**, and at the sides (at longitudinal locations forward of the side flaps **90**S) by the hulls **54** at the forward left and right sides of the body **3**. Another hull **54** is located at a centerline aft location under the body **3**, and separates left and right sides of the ram air cushion **20** under the aft body in a similar manner to the keel **88**K shown in the embodiment of FIG. **1**G, and in a similar manner contributing to roll stability and yaw stability of the PASRACS **1**. The propulsion system **26** includes thrusters **28**T connected to nacelles **28**N that in turn are connected to the PASRACS **1** through propulsor struts **28**S, as illustrated. The thrusters **28**T contribute to pressurizing the ram air cushion **20** when the side flaps **90**S are deployed, thereby making the ram air cushion **20** a power-augmented ram air cushion **20**P. When the PASRACS **1** is in contact with an Earth surface **21** that is a water surface **18**, the propulsion system **26** further comprises controllable water thrusters **28**W attached under hulls **54**. The illustrated water thrusters **28**W are “azipod thrusters” known from the prior art of highly maneuverable watercraft such as tugboats and cruise ships, where the azipod thrusters use at least one of (i) a yaw-vectorable propeller, (ii) a yaw-vectorable waterjet thruster, (iii) a yaw-vectorable magnetohydrodynamic drive, (iv) an azimuth thruster, and (v) a cyclorotor such as a Voith Schneider propeller. The use of water propulsion and maneuvering with azipod thrusters enables quiet and very precise operations of a PASRACS **1** on a water surface **18**, for operations such as rendezvous, alignment and mating and unmating of payload transfer craft (e.g., the payload transfer transport modules **47** that serve as boarding barges in the embodiment described with reference to FIGS. **1**A through **2**F), without limitation.

[0161] FIG. **3**E shows a front view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, which has a body **3** of a round cross-section that can be near-circular and includes a lifting gas **9** that is a low-density lifting gas **13**, in an encompassed lifting volume **9**E enveloped by a lifting gas enclosure **8** that in turn provides separation of the lifting gas **9** from the outside atmosphere **14**. The lifting gas **9** creates an aerostatic lift force **10** as shown. Payload volume **4** includes decks **5** at levels **6** and also includes a cabin **38**. An empennage comprising a T-tail is shown, with a horizontal stabilizer **88**H near the top of a vertical stabilizer **88**V. A thruster **28**T of the propulsion system **26** is shown wherein energized air from the thruster **28**T can augment the control effectiveness of control surfaces comprising a rudder behind the vertical stabilizer **88**V and one or more elevator(s) behind the horizontal stabilizer **88**H. The rudder and elevator(s) are not seen in this front view. The propulsion system **26** illustrated also includes a forward central member and plural members above a left wing **61**L and a right wing **61**R, wherein the wings have anhedral and wingtip members that also serve as hulls **54**. The bottoms of the hulls include hydrodynamic planning surfaces **36**P as known in the prior art of flying boats, seaplanes, hydroplanes and speedboats. A ram air cushion **20** in a ram air cushion volume **46** is created under the left wing **61**L and right wing **61**R, with increased pressure from trailing edge downward deployment of flaps **90**F as well as drooping of ailerons **90**A. Note that differential aileron droop can provide aerodynamic rolling moment, as known in the prior art of airplanes with ailerons and drooping ailerons that may also be categorized as flaperons.

[0162] FIG. **3**F shows a front view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1** wherein thick members for a left wing **61**L and right wing **61**R together make up a “body” **3** even though a traditional fuselage is not included in this configuration. This configuration can be considered to be a span-loader wing in ground effect wherein the wings also include a lifting gas **9** that is a low-density lifting gas **13**, in an encompassed lifting volume **9**E enveloped by a lifting gas enclosure **8** that provides multiple cells or “gas bags” and also provides separation of the lifting gas **9** from the outside atmosphere **14**. The lifting gas **9** creates an aerostatic lift force **10** as shown. A specific payload configuration is not shown but it should be understood that payload can be accommodated in payload volume **4** in one or more of the wings **61**L and **61**R and the plural hulls **54**. A ram air cushion **20** in a ram air cushion volume **46** is created under the left wing **61**L and right wing **61**R and above an Earth surface **21** that is a water surface **18**, with increased pressure from trailing edge downward deployment of flaps **90**F as well as drooping of ailerons **90**A. Note that differential aileron droop can provide aerodynamic rolling moment, as known in the prior art of airplanes with ailerons and drooping ailerons that may also be categorized as flaperons. The propulsion system **26** includes thrusters **28**T connected to propulsor nacelles **28**N that in turn are connected to the PASRACS **1** through propulsor struts **28**S, as illustrated. As in the embodiment of FIG. **3**E, the embodiment of FIG. **3**F also features a T-tail. The embodiment shown in FIG. **3**F also illustrates at least one payload transfer transport module **47** that is configured as a vehicle **115** serving as a transfer vehicle **69**. This vehicle **115** can be winched down and detached from the PASRACS **1**, to carry disembarking payload to a destination location. Example types of vehicle **115** include, without limitation, a boat, a catamaran, a trimaran, a yacht, a barge, a hydrofoil boat, a vehicle train, a hovercraft, an amphibious vehicle capable of traversing on both water and land, a landing craft, and an amphibious air vehicle capable of traversing on both water and through the air (such as a helicopter or helistat fitted with water landing gear). For onboarding payload the same type of vehicle **115** can board payload at an origin location, traverse to a mating location where it locates itself under the PASRACS **1**, and is then winched up to mate securely to the underside of the PASRACS **1**.

[0163] FIG. **3**G shows a rear view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, which is similar to the preferred embodiment described with reference to FIGS. **1**A through **2**F, but wherein the location of the thrusters **28**T of the propulsion system **26** is now above the wings which comprise the left wing **61**L and the right wing **61**R. The propulsor struts **28**S project upwards from the wing in a manner similar to certain aircraft with overwing propulsors, such as the HondaJet or the VFW **614** or the Dornier Do X. The propulsor struts **28**S support the propulsor nacelles **28**N and thrusters **28**T in representative overwing locations as shown. This rear view also illustrates the flaps **90**F deployed downward at the wing trailing edges, and the side flaps **90**S and body flaps **90**B deployed downward from the body **3** of the PASRACS **1**. Other features are the same as or similar to those that were earlier described in the description of the preferred embodiment of FIGS. **1**A through **2**F. Note that with the overwing propulsor configuration of FIG. **3**G, the ram air cushion **20** is no longer a power-augmented ram air cushion. However, an advantage of the configuration of FIG. **3**G is that the propulsors are located at a higher elevation relative to the water surface **18**, and so less likely to suffer from problems associated with being impacted by spray impingement or contact with the tops of waves in adverse weather conditions. For this same reason, this configuration allows greater weather tolerance for smaller scale versions of the vehicle, with lesser length and width and height and smaller payload capacity than the preferred embodiment of FIGS. **1**A through **2**F.

[0164] FIG. **3**H shows a rear view of another preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, which is similar to the preferred embodiment described with reference to FIGS. **1**A through **2**F, but with the empennage now comprising a U-tail or H-tail configuration and having no body mounted vertical tail(s). The vertical tails **88**V are now structurally connected to and supported by the outboard ends of the horizontal tails **88**H, as illustrated. The bottom parts of the vertical tails **88**V serve as stabilizer endplates **88**E for the horizontal tails **88**H, with hydroskis **36**S underneath to provide hydrodynamic reaction with the water surface **18** upon contact. The hydroskis **36**S may optionally be suspension-mounted and may optionally be height-adjustable (in which case they would comprise variable height hydrodynamic planing surfaces **36**V). The propulsion system **26** that is illustrated comprises thrusters **28**T forward and slightly under the left wing **61**L and right wing **61**R, which provide energized flow under the wings and make the ram air cushion **20** under the wings into a power-augmented ram air cushion **20**P, under the wings and forward of a Kutta condition at the trailing edges of the deployed flaps **90**F. The propulsion system **26** as illustrated also includes thrusters **28**T forward and under the body **3**, which provide energized flow under the body **3** and make the ram air cushion **20** under the body into a power-augmented ram air cushion **20**P, under the body and forward of a Kutta condition at the trailing edges of the deployed body flaps **90**B and side flaps **90**S. The propulsion system **26** also illustrates optional thrusters **28**T located forward and slightly under the horizontal tails **88**H, that energize flow in the ground-effect flow region beneath the horizontal tails **88**H, and can provide a power-augmented ram air cushion there as well when trailing edge elevators **90**E on the horizontal tails **88**H are moved to a deflected trailing-edge down configuration by elevator actuators. For clarification, the elevators **90**E are shown in FIG. **3**H in a centered position and not in a trailing edge down position. Other features are the same as or similar to those that were earlier described in the description of the preferred embodiment of FIGS. **1**A through **2**F.

[0165] FIG. **3**I shows a cross-sectional view from the front of another embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, similar to that described earlier with reference to FIG. **1**E, but with much smaller span wings **61**.

[0166] FIG. **3**J shows a cross-sectional view from the front of another embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, wherein the body **2** has a near-circular cross-sectional configuration with a concave structure **2**V, with the lowermost portion of the body **2** having decks **5** at various levels **6** and all the non-lowermost portions having volume for lifting gas comprising helium **11** and hydrogen **12**, with hydrogen enclosures **12**E separated from the lowermost portion housing payload, by helium enclosures **11**E. Water contacting portions of the vehicle are limited to left and right wingtip portions and a central aft portion. The illustrated ship structure **2** includes the aforementioned concave structure **2**V as well as at least one tension member **2**W, a structural column **2**C, and near-planar structure **2**P. The tension members **2**W and structural column **2**C contribute to up-down load paths near the center region of the vehicle, down to the center hull. The illustrated embodiment has space for two stacked layers of containerized cargo in cargo containers **43**A, within the envelope of the wing **61**. The ram air cushion **20** comprises a ram air pressurized region **83** including a right region **83**R, center region **83**C and left region **83**L, as shown.

[0167] FIG. **3**K shows a cross-sectional view from the front of another embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, wherein the body **3** has three lobes with left and right lobes on either side of a central lobe, and with lifting gas in all three lobes and constrained by concave structure **2**V as shown. The center lobe is shown with helium lifting gas in an enclosure below an enclosure for hydrogen lifting gas. The left and right lobes are shown with only helium lifting gas, though this should not be construed as limiting. Decks **5** including a cargo deck **5**C and one or more passenger decks **5**P are located below the lifting gas enclosures, and include at least one deck that enables passengers to traverse laterally from the left to right lobe of the PASRACS configuration. A ram air cushion **20** is located below the vehicle and between a left catamaran sidewall **45**L and right catamaran sidewall **45**R associated with hulls **54** designed to contact a water surface **18**. Payload transfer transport modules **47** can mate with the vehicle and be secured to it, just outboard of the hulls **54**.

[0168] FIG. **3**L shows a cross-sectional view from the front of another embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, wherein the body **3** is smoothly faired into and integrated with the wing **61** in a configuration that is a blended wing body **3**B, as shown. The upper portion of the body **3** includes lifting gas **9** in a lifting gas enclosure **8** and a laterally separated second lifting gas enclosure **8**B. The ram air cushion **20** comprises a ram air pressurized region **83** including a right region **83**R, center region **83**C and left region **83**L, as shown.

[0169] FIGS. **4**A through **4**G show side views of some other alternate preferred embodiments of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. Illustrated decks **5** include a cargo deck **5**C and passenger decks **5**P.

[0170] FIG. **4**A shows a left side view of a preferred embodiment of a PASRACS **1** that is considerably smaller in scale than the preferred embodiment with the corresponding side view shown in FIG. **1**A. The embodiment of FIG. **4**A shows a PASRACS **1** with a ship structure **2** and body **3**, wherein the body **3** includes a lifting gas **9** (such as helium **11**) in an encompassed lifting volume **9**E enveloped by a lifting gas enclosure **8** that in turn provides separation of the lifting gas **9** from the outside atmosphere **14**. The lifting gas **9** creates an aerostatic lift force **10** as shown. On the sides of the body **3** and structurally connected to it by means such as wing-body join structure as known in the prior art of aircraft design, are wings including the visible left wing **61**L fitted with a flap **90**F and a wing tip fence **61**T. Aerodynamic lift force **25** is produced both by the wing **61** and the body **3** as illustrated, when the PASRACS **1** has a positive airspeed **24**. The body aerodynamic lift comes at least in part from a ram air cushion **20** beneath the lower surface **1**L of the body **3**. The PASACS **1** is able to maintain a positive airspeed **24** on a travel path **24**T while countering drag forces, due to operation of a propulsion system **26** that uses energy **27** (such as chemical or electrical energy) to drive an illustrated thruster **28**T near the front of the body **3**, which comprises a propeller or fan in a duct **28**D, such as a ducted prop or a ducted fan, as shown. The thruster **28**T is connected to and supported by the ship structure **2** in the body **3**, through a propulsor strut further comprises a **28**S and a propulsor nacelle **28**N. Another thruster **28**T circumscribed by a duct **28**D is visible above the aft part of the body **3**, supported by a propulsor strut **28**S and propulsor nacelle **28**N. This aft thruster **28**T is a fluid dynamic propulsor **55** that is an air propulsor **55**A that also serves as a vectored thrust propulsor. The vectored thrust propulsor functions through the use of propulsor flow vectoring members **28**F comprising controllable aerodynamic surfaces (also called “control surfaces”) **90** that here entail vertically oriented yaw control vanes and horizontally oriented pitch control vanes in the slipstream of the aft thruster **28**T. The aft end of the body **3** is fitted with a vertical stabilizer **88**V that serves as a vertical tail providing a contribution to yaw stability for the PASRACS **1**, and also providing support for at least one rudder **90**R that serves as a control surface **90** that provides yaw control to the vehicle as it moves over an Earth surface **21** that is a water surface **18**.

[0171] The body **3** further comprises left and right catamaran type members, and the left catamaran sidewall **45**L on the left side of the left catamaran type member is visible in this left side view.

[0172] Payload volume **4** includes decks **5** at levels **6** and also includes a cabin **38**.

[0173] FIG. **4**A also shows a partially aerostatically supported ram air cushion ship **1**, wherein an encompassed lifting volume **9**E of said lifting gas **9** is configured to be at least 25% of an encompassed vehicle volume **1**E of said partially aerostatically supported ram air cushion ship **1**.

[0174] FIG. **4**B shows a left side view of another preferred embodiment of a PASRACS **1** that is very similar in configuration to the preferred embodiment with the corresponding side view shown in FIG. **1**A, but now fitted with structures and systems to enable it to serve as an aerial water-bomber or aerial firefighting vehicle that can fly over wildfires or forest fires and effectively combat those undesirable and highly damaging fires. The front hull **54**F is shown configured with water contact and hydrodynamic features known from the prior art of flying boat hull design, including a hull forebody **36**FB in the form of a vee hull with tailored optimally varying deadrise on either side of a keel line, a step **36**T behind the forebody. **36**FB, and a hull afterbody **36**AB behind the step **36**T, which hull afterbody **36**AB is also in the form of a vee hull with tailored optimally varying deadrise on either side of a keel line. Hull chines **36**C are shown on the upper side edges of the hull forebody **36**FB, as well as optional hull spray strips **36**SS that inhibit spray patterns from adverse effects such as harming view for the flight crew or impacting propulsion system parts in a harmful way. Similar hull features can be included on other hulls also within the spirit and scope of the invention. The PASRACS **1** is shown in flight in ground-effect at some significant height above an Earth surface **21**, and shown at a nominal 2-degree angle of attack of the bottom of the body **3** relative to said Earth surface **21**. One preferred concept of operations of this embodiment is that it can collect water from a water body while stationary, taxiing or taking-off on or from that water body, store the water in a tank volume **4**T in the PASRACS **1**, and then dump, spray, drop or otherwise discharge the water onto a fire to extinguish or suppress or reduce said fire. FIG. **4**B shows several representative spray nozzles **161** that are discharging water that will fall on the Earth surface **21** at or near desired target locations to suppress or extinguish a fire **162** such as a forest fire or wildfire or other fire on the Earth surface **21**. The spray nozzles **161** are shown at representative locations on the left hull **54**L at the rear face of the step, on the wing tip fence **61**T, the front hull **54**F near its trailing edge, and the body left side surface **3**L. These representative locations are not to be construed as limiting, as a variety of different spray nozzle locations could be provided anywhere around the PASRACS **1**, including the body **3** and wings **61** in addition to hulls **54** and other vehicle locations. The spray nozzles **161** may spray either water or other fire suppression or fire extinguishing material or liquid, solid, gaseous or mixed phases in variant preferred embodiments of the invention. For the case of water, the water may be supplied from the illustrated water volume **4**T that corresponds approximately to the two lowest decks of the PASRACS **1**, with suitably strong and watertight floor, wall and ceiling members. The tank volume **4**T may optionally be filled by water scoop **162** fitted to the keel **88**K of the PASRACS **1**. Deployment of the water scoop **162** is from a stowed configuration (shown in dashed lines) to a deployed configuration (labeled and shown in solid lines), and water can be scooped in when the PASRACS **1** is moving forward at speed right above a water surface with the intake of the water scoop **162** just under the water surface to enable very rapid filling of the tank volume **4**T, in a manner known from the prior art of fire fighting flying boat aircraft such as the Viking/Canadair CL-**415** “Super Scooper.” The embodiment shown in FIG. **4**B also illustrates the use of vectored thrust propulsors **28**V with two different size vectored thrusters shown, and these vectored thrust propulsors can be used beneficially for the aforementioned water scooping maneuver as well as other maneuvers of the PASRACS **1** while flying in ground-effect and while in transition modes such as taxiing on water, climbing the “hump” which is a well known phenomenon of seaplanes and flying boats during their takeoff maneuver, taking off, climbing, approaching, alighting, landing and decelerating with a combination of aerodynamic, aerostatic, hydrodynamic and hydrostatic forces and moments acting on the PASRACS **1**. The vectored thrust propulsors **28**V may feature controlled vectoring through the use of electric and/or hydraulic actuation and/or the use of a powered jackscrew similar to an aircraft stabilizer jackscrew. The vectored thrust propulsors may also optionally be rotors, ducted fans, unducted fans, and/or cyclorotors, and may be located at plural different locations on the PASRACS **1**. For the case where the vectored thrust propulsors use a gas turbine, the vectored gas turbine exhaust or efflux may contact a water surface when in flight over a water surface, and evaporate some water to create steam that further augments the pressure in the ram air cushion **20** that is a power augmented ram air cushion **20**P.

[0175] FIG. **4**C shows a left side view of another preferred embodiment of a PASRACS **1** that is a partially aerostatically-supported flying wing configuration that is also a span-loaded configuration, in a manner to corresponding to the substantially similar embodiment earlier shown in front view in FIG. **3**F. The PASRACS **1** includes ship structure **2**. In this embodiment the wing **61** including the visible left wing **61**L is a span-loaded wing that also serves as part of the body **3**, in conjunction with hulls **54** including the visible left hull **54**L. Lifting gas **9** can be a low-density lifting gas **13** such as helium or hydrogen both of which have lower density than the air in the atmosphere **14** outside the PASRACS **1**. The lifting gas **9** is contained in lifting gas enclosures **8** that are in the span-loaded wing, and the lifting gas **9** provides an aerostatic lift force **10**. The PASRACS **1** is fitted at an aft location with a vertical stabilizer **88**V that serves as a vertical tail or fin. A horizontal stabilizer **88**H is fitted to the vertical stabilizer **88**V, and may be a fixed or trimmable horizontal stabilizer, as known in the art of airliners. Control surfaces at the trailing edges of the stabilizers comprise an aerodynamic elevator **90**E at the trailing edge of the horizontal stabilizer **88**H and a rudder **90**R at the trailing edge of the vertical stabilizer **88**V. A flap **90**F at the trailing edge of the wing **61** is shown partially deployed trailing edge down, to provide an aerodynamic Kutta condition for a ram air cushion **20** forward of said flap **90**F and below the bottom surface of the wing **61** and above an Earth surface **21** such as a water surface **18**. The ram air cushion **20** works with the wing **61** in providing an aerodynamic lift force **25** when the PASRACS **1** is moving with positive airspeed **24**, propelled by a thruster **28**T supported by a propulsor nacelle **28**N that is in turn supported from the wing **61** and body **3** by a propulsor strut **28**S. The hull **54** is shown to include a payload volume **4** that can be reached for entry and egress via a door **38**D that is a boarding door **66**D that can be used for passengers and crew, and a cargo door **66**C that can be used for cargo including bulk cargo and cargo on pallets and containerized cargo such as Unit Load Devices (ULDs) of various sizes and shape as known in the art of transport vehicles such as air transport vehicles. A flight deck or cockpit **31**C is at the forward end of the left hull **54**L, and windows **149** are shown for both the flight deck **31**C and the cabin **38**. The bottom of the hull **54** is shown with multiple hydrodynamic planing surfaces **36**P and steps **36**T, that allow for high speed and low drag in a hydrodynamic or water contact mode of operation, while still minimizing lateral leakage flow under the hull **54**, from the ram air cushion **20** in the ram air cushion volume **46**, when in a flight mode in ground-effect with small clearance under the hull **54**, as shown in FIG. **4**C. The embodiment of a PASRACS **1** shown in FIG. **4**C can potentially serve as a much smaller feeder route vehicle that feeds passengers and cargo from secondary destinations, into a transport hub or major port or city destination, for transfer to and from a much larger intercontinental PASRACS **1** such as the large embodiment earlier described with reference to FIGS. **1**A through **2**F. Some examples of feeder routes can include the following, for example and without limitation: Persian Gulf feeder route, Black Sea feeder route, Arctic feeder route, Antarctic feeder route, Mississippi River feeder route, St. Lawrence River feeder route, Brahmaputra River feeder route, Ganges River feeder route, Nile River feeder route, archipelago and multi-islands feeder routes for Indonesia and the Philippines and the Hawaiian chain and other Pacific island groups and Caribbean islands.

[0176] FIG. **4**D shows a left side view of another preferred embodiment of a PASRACS **1** that is a tandem wing configuration. The PASRACS **1** includes ship structure **2** and a body **3**. This tandem wing configuration has a forward tandem wing **61** FT and an aft tandem wing **61**AT, as shown, and each fitted with a wing tip fence **61**T that is designed and serves as an induced drag reducing downward winglet for flight in ground-effect. The weight of the PASRACS **1** when in a moving forward on the water mode with positive airspeed **24**, is supported by a combination of aerodynamic lift force **25** provided by both the tandem wings as shown, plus an aerostatic lift force **10** provided by a lifting gas **9** in a lifting gas enclosure **8**, plus a hydrodynamic lift force **36** plus buoyancy from water displacement that is a hydrostatic lift force **17**. Lifting gas **9** can be a low-density lifting gas **13** such as helium or hydrogen both of which have lower density than the air in the atmosphere **14** outside the PASRACS **1**. The PASRACS **1** is fitted at an aft location with a vertical stabilizer **88**V that serves as a vertical tail or fin along with a rudder **90**R, but as shown no horizontal stabilizer is needed or provided, as the tandem wings can adequately provide both pitch stability and pitch trim, while the trailing edge controllable surfaces comprising high rate flaps **90**F on the trailing edges of both the tandem wings, can be controlled collectively and differentially as needed to provide both pitch control and heave control moments and forces acting on the PASRACS **1**. The propulsion system **26** includes thrusters **28**T with propulsor nacelles **28**N supported by both of the tandem wings through illustrated very short struts **28**S in a quasi-slipper-nacelle installations, while full slipper-nacelle installations can also be used. Some of the pressurized slipstream flow from the thrusters **28**T flows under the tandem wings and into the the ram air cushions **20** in the ram air cushion volumes **46** under the wings and above an Earth surface **21** such as a water surface **18**, making these regions into power-augmented ram air cushions **20**P. The aft ends of the ram air cushion volumes **46** are below wing trailing edge mounted flaps **90**F that serve as flaperons as they also have a roll control function as ailerons **90**A, with high-rate actuation using preferably using powered actuators such as hydraulic actuators, electrohydraulic actuators, electromechanical actuators, linear actuators and rotary actuators known from the art of control surface actuator technology. The body **3** includes payload volume **4** comprising decks **5** at levels **6** below the lifting gas enclosure **8**. The front end of the body **3** accommodates a cockpit or flight deck **31**C including a window **149**, and underneath the flight deck **31**C a nose loading door **66**N is provided, shown closed in solid lines. The nose loading door **66**N is also for purposes of illustration shown in its open configuration in dashed lines. The interface shown in FIG. **4**D between the bottom of the PASRACS **1** and the water surface **18**, uses hulls **54** comprising a forward hull **54**F and at least two laterally spaced aft hulls **54**A of which the left hull **54**L is visible in this view. The hulls have shaping to reduce drag at different speeds, including hydrodynamic planing surfaces **36**P, steps **36**T similar to those in flying boat aircraft, and hydroskis **36**S that may be deployable and retractable and that may be fitted with shock absorbers with spring and damper attributes to reduce loads acting on the PASRACS **1** when it moves at speed over a water surface **18** and encounters waves on that water surface.

[0177] FIG. **4**E shows a left side view of another preferred embodiment of a PASRACS **1** that is a canard configuration. This embodiment is similar in many ways to the preferred embodiment illustrated and described with reference to FIGS. **1**A through **2**F, but for longitudinal trim utilizes a canard surface **88**C in the front region of the PASRACS **1** instead of a horizontal stabilizer **88**H in the aft region of the PASRACS **1**. The illustrated canard airfoil section Canard shown is a NACA **64**(**3**) **418** airfoil with a trailing edge flap, but alternate airfoils and high lift devices and planforms and lofts can be used without limitation, within the spirit and scope of this invention. The canard surface **88**C may optionally be trimmable, and is fitted with a trailing edge canard control surface **90**C that serves as a canard flap and an elevator that can impart pitching moment trim and control upon the vehicle. The canard control surface **90**C will preferably have high-rate actuation using powered actuators such as hydraulic actuators, electrohydraulic actuators, electromechanical actuators, linear actuators and rotary actuators known from the art of control surface actuator technology; serves as a longitudinal trim system **87** and may optionally also serve to contribute to roll trim and/or roll control through differential deflection of left and right canard control surfaces. Thrusters **28**T blow pressurized air on the canard control surface and can increase its effectiveness in generating lift and pitching moment when the vehicle is travelling at relatively lower values of positive airspeed **24** and correspondingly relatively lower values of dynamic pressure. The canard control surface **90**C is fitted on an extended length fuselage section portion of the body **3**, that further includes a flight deck **31**C and also serves integrally as the forward hull **54**F. Note that the forward hull **54**F is a member of plural hulls **54** configured to provide hydrostatic forces or water displacement buouyancy forces to help support the weight of the PASRACS **1** when it is floating statically on the water surface **18** supported by a combination of aerostatic lift force and hydrostatic lift force, with stable floatation enabled by having the vehicle center of gravity below an effective metacenter that takes into account both the hydrostatic and aerostatic lift. The PASRACS **1** of FIG. **4**E includes ship structure **2** and a body **3** and a payload volume **4**, wherein payload boarding and deplaning is accomplished via a payload transfer transport module **47**, in a manner similar to the earlier described embodiment of FIGS. **1**A through **2**F. The propulsion system **26** now includes thrusters **28**T with propulsor nacelles **28**N supported by propulsor struts **28**S, and provides thrust force **28** acting on the PASRACS **1**. An auxiliary power unit **26**A is also provided. Some of the pressurized slipstream flow from the thrusters **28**T flows under the wing **61** and body **3** and into the ram air cushion **20** in the ram air cushion volume **46** under the wing **61** and body **3**, forward of the body flap **90**B and side flaps **90**S, and above an Earth surface **21** such as a water surface **18**, making this region into a power-augmented ram air cushion **20**P. A keel **20**K separates the aft portion of the ram air cushion **20** into left and right sides and contributes to vehicle roll and yaw stability. The weight of the PASRACS **1** when in a flight in ground-effect mode with positive airspeed **24** in the atmosphere **14**, is supported by a combination of aerodynamic lift force **25** provided by the ram air cushion **20** and wing **61** and body **3** as shown, plus an aerostatic lift force **10** provided by a lifting gas **9** in a lifting gas enclosure **8**. The PASRACS **1** is fitted at an aft location with a vertical stabilizer **88**V that serves as a vertical tail or fin along with a rudder **90**R, but as shown no horizontal stabilizer is provided for this canard configuration. The aerodynamic lift force **25** in this case is a summation of net lift from the wings **61**, body **3** and canard surface **88**C. A variant "tri-surface" embodiment may be fitted with an optional aft horizontal stabilizer **88**H (not shown) in addition to the illustrated canard surface **88**C, wherein the aerodynamic lift force **25** acting on the PASRACS **1** is a summation of net lift from the wings **61**, body **3**, horizontal stabilizer **88**H and canard surface **88**C.

[0178] FIG. **4**F shows a left side view of another preferred embodiment of a PASRACS **1** that is a configuration with a tail boom **88**B. This embodiment is similar in many ways to the preferred embodiment illustrated and described with reference to FIGS. **1**A through **2**F, but the vertical stabilizer **88**V and horizontal stabilizer **88**H are moved further back to locations in the aft region of a tail boom **88**B located at the aft end of the body **3** of a PASRACS **1**. A walkway **118** goes through the tail boom **88**B for passengers to access payload volume **4** in the vertical tail **88**V. The increased "tail arms" of the vertical and horizontal tails allows them to contribute more greatly to yaw and pitch stability and control for given tail areas, as known from the prior art of aircraft with tail boom mounted vertical and horizontal tails. PASRACS **1** includes ship structure **2** and a body **3**. The horizontal stabilizer **88**H has stabilizer endplates **88**E and aerodynamic elevators **90**E for pitch control and trim. The vertical tail **88**V has a rudder **90**R for yaw control and trim. The body **3** includes a flight deck **31**C and payload volume **4** and lifting gas **9** in a lifting gas enclosure **8**. The bottom region of the body **3** includes hulls **54** capable of providing floatation or hydrostatic lift from water displacement. The hulls **54** also include hydrodynamic planing surfaces **36**P and hydroskis **36**S. The propulsion system **26** now includes thrusters **28**T that provide thrust to counteract aerodynamic drag when the PASRACS **1** is in a forward flight in ground-effect mode of operation. The weight of the PASRACS **1** when in this flight in ground-effect mode with positive airspeed **24** in the atmosphere **14**, is supported by a combination of aerodynamic lift force **25** provided by the ram air cushion **20** and wing **61** with flap **90**F and body **3** as shown, plus an aerostatic lift force **10** provided by the lifting gas **9**. The ram air cushion **20** is in the regions under the wing **61** and body **3**, forward of the body flap **90**B and side flaps **90**S, and above an Earth surface **21** such as a water surface **18**. A keel **20**K separates the aft portion of the ram air cushion **20** into left and right sides and contributes to vehicle roll and yaw stability.

[0179] FIG. **4**G shows a left side view, at a reduced scale relative to FIGS. **4**E and **4**F, of another preferred embodiment of a PASRACS **1** that is a configuration towed by a tow vehicle **1**T. The towed PASRACS **1** is similar to the preferred embodiment illustrated and described with reference to FIGS. **1**A through **2**F, but now has no thrusters **28**T that act on the air in the atmosphere **14**. In other words, as illustrated the PASRACS **1** is a "glider" type of vehicle, that can maintain flight in ground-effect as shown only because of an effective thrust force from tension in the illustrated tow cable **1**C acting on a tow cable fitting **1**F, to counteract the aerodynamic drag acting on the PASRACS **1**. The illustrated PASRACS **1** does have controllable water thrusters **28**W such as the illustrated azipod type controllable thrust and direction of thrust propulsors, to enable propulsion and maneuvering while in a floating-on-water mode of operation such as low speed operations at origin and destination locations. Note that the tow vehicle **1**T is fitted with a propulsion system **26** that has to be sufficiently powerful as to pull the PASRACS **1** along with the tow vehicle **1**T at a desired positive airspeed **24**. The illustrated propulsion system **26** on the tow vehicle **1**T utilizes thrusters **28**T such as a propeller, propfan, unducted fan, ducted fan, turbofan and/or turbojet that exhaust an energized downstream flow of jet efflux including air from the atmosphere **14**, creating thrust. While a variety of tow vehicle types can be utilized, the one illustrated is an aircraft **1**A with an air cushion landing system (ACLS). The aircraft **1**A also has a wing **61** and a vertical tail **88**V (visible) and horizontal tail (not visible in this view of a nominal H-tail configuration). The tow cable **1**C and fittings on either end may include dual or multiple load paths to ensure fault tolerance, and cables may use various materials and architectures known in the art of structural cables, including metallic and/or composite materials, and twisted and braided stranding approaches amongst others. The PASRACS **1** includes ship structure **2** and a body **3**. The horizontal stabilizer **88**H has aerodynamic elevators **90**E for pitch control and trim. The vertical tail **88**V has a rudder **90**R for yaw control and trim. The body **3** includes a payload volume **4** and lifting gas **9** in a lifting gas enclosure **8**. The bottom region of the body **3** includes hulls **54** capable of providing floatation or hydrostatic lift from water displacement. The hulls **54** also include hydrodynamic planing surfaces **36**P and hydroskis **36**S. The weight of the PASRACS **1** when in the illustrated flight in ground-effect mode with positive airspeed **24** in the atmosphere **14**, is supported by a combination of aerodynamic lift force **25** provided by the ram air cushion **20** and wing **61** and body **3** and horizontal stabilizer **88**H, plus an aerostatic lift force **10** provided by the lifting gas **9**. The ram air cushion **20** is in the regions under the wing **61** and body **3**, forward of the body flap **90**B and above an Earth surface **21** such as a water surface **18**. A keel **20**K separates the aft portion of the ram air cushion **20** into left and right sides and contributes to vehicle roll and yaw stability. Note that the type of tow vehicle **1**T illustrated in FIG. **4**G can also be used to tow a normal or powered PASRACS **1** such as the configuration of FIG. **1**A through **2**F fitted with an added tow cable fitting **1**F, when towing is needed or beneficial for some non-normal or emergency conditions. Some examples of such a non-normal conditions include, without limitation, (i) when a PASRACS **1** has had multiple thruster failures, or (ii) when a PASRACS **1** has made an emergency landing on sea ice in the Arctic Ocean and does not have sufficient thrust to take off overcoming drag associated with breaking through some ice for the takeoff run.

[0180] FIGS. **5**A through **5**H show plan views of still other alternate preferred embodiments of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**.

[0181] FIG. **5**A shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. FIG. **5**A can optionally correspond, without limitation, to the side view of the alternate preferred embodiment shown in FIG. **4**A. The optional alternate preferred embodiment configuration of FIGS. **4**A and **5**A in combination, illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4** with plural decks **5** at plural levels **6** (not visible in this view) for carrying payload **7**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** providing an aerostatic lift force **10** acting on said ship **1**, said lifting gas **9** comprising at least one of helium **11**, hydrogen **12** and a low-density lifting gas **13** (specific lifting gases not called out in FIG. **5**A) with density lower than that of an atmosphere **14** immediately outside said ship **1**; a hydrostatic floatation subsystem **15** comprising a water displacing structure **16** connected to said ship structure **2**, said water displacing structure **16** configured to provide a hydrostatic lift force **17** (not shown in the view of FIG. **5**A) acting on said ship **1** in a period of time when said water displacing structure **16** is displacing a water volume below a water surface **18** below said atmosphere **14**; an aerodynamic lift subsystem **19** comprising a ram air cushion **20** when said ship **1** has positive airspeed **24**, said ram air cushion **20** below a lower surface **1**L of the ship **1** and above an Earth surface **21**, wherein said aerodynamic lift subsystem **19** comprising said ram air cushion **20** is configured to contribute an aerodynamic lift force **25** acting on said ship **1** when said ship **1** has said positive airspeed **24**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; and a vehicle control and navigation system **29** (not shown in FIG. **5**A but in an equipment bay that might be, without limitation, under the flight deck **31**C) configured to enable said ship **1** to move and maneuver on a travel path **24**T; wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said hydrostatic lift force **17** (weights and lift force vectors not shown in FIG. **5**A as they are into and out of the page), when said ship **1** is in a substantially stationary mode **34** (not the mode illustrated in FIG. **5**A) on said water surface **18**; wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25**, when said partially aerostatically supported ram air cushion ship **1** is in a flight in ground-effect mode **35** (not the mode illustrated); and wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25** and at least one of said hydrostatic lift force **17** and a hydrodynamic lift force **36**, when said partially aerostatically supported ram air cushion ship **1** is in a transition mode **37** (illustrated) comprising a landing transition mode **37**L.

[0182] It should be understood that payload **7** could comprise one or more of persons **39** including passengers **40** in and crew **41** who can sit in seats **157**, as well as baggage **44** and cargo **43**. The payload volume **4** includes a cabin **38** and a flexible use volume **4**F and a human facilities area **154** such as a restroom. Part of the payload volume **4** is in the left hull member **54**L and right hull member **54**R. A cockpit or flight deck **31**C is provided near the front end of at least one of the hull members. It should also be understood that a transition mode **37** could comprise either the illustrated landing transition mode **37**L or could alternatively be a takeoff transition mode **37**T. Hydroskis **36**S are mounted near the front ends of the left hull member **54**L and right hull member **54**R, to provide restoring pitching moment if the vehicle's nose angles downward into increasing contact with a water surface below. An aft keel **88**K under the body **3** provides a corresponding restoring pitching moment if the vehicle's tail angles downward to a keel water increasing contact configuration, and the bottom ends of wing tip fences **61**T serve a similar purpose for restoring rolling moments in the event of a bank angle causing tip increasing water contact. The payload volume **7** also includes cargo volume **42** including space for cargo **43** and baggage **44**. The propulsion system **26** includes thrusters **28**T with propulsor ducts **28**D, that have pressurized exhaust flow that can be vectored by propulsor flow vectoring members **28**F. Propulsor struts **28**S connect the thrusters **28**T to the body **3**. The wing **61** includes a left wing **61**L and right wing **61**R, flaps **90**F as well as fore-wing members **61**F that can be in the form or a fairing and/or a strake. The horizontal tails **88**H are mounted near the aft ends of the left hull member **54**L and right hull member **54**R, equipped with flaps **90**F that may optionally act as flaperons and/or elevons. An aft-wing member **61**A serves as a fairing or strake that at least partially fills a gap between the body **3** and the left hull member **54**L and right hull member **54**R. A ram air cushion **20** under the body **3** is in a ram air cushion volume **46** bounded at its aft edge by a Kutta condition under body flaps **90**B. A keel **88**K separates the ram air cushion volume **46** into left and aft sides under the aft portion of the body **3**. A vertical tail **88**V is mounted above the aft end of the body **3**. In addition to aerodynamic lift from the ram air cushion **20** under the body **3** and the aerodynamic lift from the wings **61**, aerostatic lift is provided by a lifting gas **9** in a lifting gas enclosure **8**.

[0183] This alternate preferred embodiment configuration of FIGS. **4**A and **5**A in combination further illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a body **3** configured to accommodate payload **7**, said body **3** encompassing (i) a cabin **38** configured to accommodate persons **39** comprising at least one of passengers **40** and crew **41** and (ii) a cargo volume **42** configured to accommodate at least one of baggage **44** and cargo **43**; and (iii) a lifting gas enclosure **8** configured to contain a lifting gas **9** providing an aerostatic lift force **10** acting on said ship **1**, said lifting gas **9** comprising at least one of helium **11**, hydrogen **12** and a low-density lifting gas **13** with density lower than that of an atmosphere **14** immediately outside said ship **1**; a hydrostatic floatation subsystem **15** comprising a water displacing structure

16 connected to said body **3**, said water displacing structure **16** configured to provide a hydrostatic lift force **17** acting on said ship **1** when said water displacing structure **16** is displacing a water volume below a water surface **18** below said atmosphere **14**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; a left catamaran sidewall **45**L and a right catamaran sidewall **45**R both connected to said body **3** and defining at least one ram air cushion volume **46** that is beneath said body **3**, above an Earth surface **21** and at least in part between said left and right catamaran sidewalls **45**L and **45**R, wherein said ram air cushion volume **46** is configured to decrease in transverse cross-sectional area **46**X moving aft from a forward portion **46**F of said ram air cushion volume **46** to an aft portion **46**A of said ram air cushion volume **46**; an aerodynamic lift subsystem **19** utilizing said ram air cushion volume **46** configured to create a ram air cushion **20** providing aerodynamic lift force **25** acting on said body **3** when said ship **1** has a positive airspeed **24**, propelled by said propulsion system **26**; and at least one payload transfer transport module **47** configured to receive disembarking payload **7**D comprising at least a partial subset of said passengers **40** and said baggage **44** and said cargo **43** from at least one of said cabin **38** and said cargo volume **42**, and said payload transfer transport module **47** further configured to separate from said ship **1** and carry said disembarking payload **7**D from said ship **1** starting at a transfer time **48**. The illustrate payload transfer transport module **47** is a compact payload transfer transport module **47**C of a kind also illustrated in FIG. **1**B and FIG. **5**E.

[0184] FIG. **5**B shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is similar to the embodiment shown in bottom plan view earlier in FIG. **1**B, but now a modified configuration with a single vertical stabilizer **88**V instead of twin vertical stabilizers. FIG. **5**B illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** is fitted with wings **61** with a wingtip fence **61**T and flaps **90**F and ailerons **90**A; and an empennage with a horizontal stabilizer **88**H with stabilizer endplates **88**E and elevators **90**E, plus a vertical stabilizer **88**V with a rudder (not visible in this view). The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** and body **3** with a ram air cushion **20** underneath. Flight crew can be accommodated in a flight deck **31**C at the forward end of the body **3**. The propulsion system **26** includes thrusters **28**T that generate a thrust force **28**.

[0185] FIG. **5**C shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is similar to the embodiment shown in bottom plan view earlier in FIG. **1**B, but now a modified configuration with a wider span wing **61** (with left wing **61**L and right wing **61**R) that is mounted higher on the body **3**, has a slight nonzero sweep as shown, and is strut-braced with wing struts **61**S below the wing **61** and connecting down to sponsons **54**S that serve as lower wings as well as stabilizing and planing floats when in contact with a water surface **18**. To further reduce induced drag, the wider span wing **61** is also fitted with winglets **61**W integrated with the wing tip fence **61**T. The use of sponsons and strut-bracing has precedents in older flying boat aircraft. Up-down winglet mention tip sails and spiral winglets etc. It should be understood that the wing **61** can be further optimized as known in the art of wing design, utilizing one or more of variable planforms, different sweeps, different twist distributions, different shear distributions, varying airfoil sections with varying thickness and camber, and varying lofts. FIG. **5**C illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4**; said ship structure **2** connected to a lifting gas enclosure **8** (e.g., shown along body left side surface **3**L) configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** has wings **61** with flaps **90**F and ailerons **90**A; and an empennage with a horizontal stabilizer **88**H with stabilizer endplates **88**E and elevators **90**E, plus a vertical stabilizer **88**V with a rudder (not visible in this view). The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** and body **3** with a ram air cushion **20** underneath. Flight crew can be accommodated in a flight deck **31**C at the forward end of the body **3**. The propulsion system **26** includes thrusters **28**T that generate a thrust force **28**.

[0186] FIG. **5**D shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is similar to the embodiment shown in bottom plan view earlier in FIG. **1**B, but now a modified configuration with a tri-surface configuration with (a) the horizontal tail **88**H and vertical tail **88**V mounted further aft on a tail boom **88**B and with (b) with a canard surface **88**C with a canard control surface **90**C (that serves as a canard flap) mounted forward of the main portion of the body **3**, through the use of a nose boom **88**N that serves as a forward fuselage and forward hull member **54**F as well. FIG. **5**D illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** has wings **61** with wing tip fences **61**T and with flaps **90**F and ailerons **90**A; and in addition to the canard it has an aft empennage with a horizontal stabilizer **88**H with stabilizer endplates **88**E and elevators **90**E, plus a vertical stabilizer **88**V with a rudder (not visible in this view). The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** and canard surface **88**C and body **3** all with a ram air cushion **20** underneath. Flight crew can be accommodated in a flight deck **31**C at the forward end of the nose boom **88**N. The propulsion system **26** includes thrusters **28**T.

[0187] FIG. **5**E shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This configuration shows a partially aerostatically supported ram air cushion ship **1** including a ship structure **2**, wings **61** including a left wing **61**L and right wing **61**R, and a body **3** with a payload volume **4**. The ship structure **2** in the body **3** includes a lifting gas enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The wings **61** have wingtip fences **61**T integrated with winglets **61**W, and flaps **90**F and ailerons **90**A. The illustrated flaps **90**F are blown flaps **90**BF that use blowing that is combined with tailored flap geometry and kinematics typically including some fowler motion, as known in the prior art of blown flaps to enable high lift coefficient increments and associated vehicle short takeoff and landing (STOL) or extreme short takeoff and landing (ESTOL) capabilities for the PASRACS **1** vehicle. ESTOL takeoff field length (TOFL) and landing field length (LFL) may be as small as 200 meters, without limitation. An empennage is fitted to the aft end of the body **3** and comprises a horizontal stabilizer **88**H with elevators **90**E, plus a vertical stabilizer **88**V with a rudder **90**R. A conventional low tail empennage configuration is shown, but variants could use T-tail or cruciform tail or V-tail or inverted V-tail or U-tail or H-tail configurations. The bottom of the body **3** is fitted with hulls **54** in a catamaran configuration, comprising left hull **54**L and right hull **54**R. The hulls **54** are fitted with steps **36**T that enable takeoff rotation and reduce planing drag on the water, and the hulls can optionally include other water planing and floating features as known in the art of seaplane hulls, enabling and improving operations such as taxi, takeoff and landing on a water surface. The hulls **54** are also fitted with extensible wheeled landing gear members **53**W, to enable the PASRACS **1** to operate from a land surface including an ability to land and take off from a runway or other land surface area. The wheeled landing gear members **53**W may optionally be configured to serve as soft ground landing gear with soft ground tires suitable for beaching gear, for example and without limitation.

[0188] Thus the PASRACS **1** of FIG. **5**E can be considered to have amphibious landing and takeoff

operations capability (land and water) and triphibian operations capabilities (operations on water, on land and in the air).
[0189] Steering can be provided to some or all of the wheeled landing gear members **53**W as known in the art of aircraft wheeled landing gear, to enable the PASRACS **1** to move and maneuver upon a land surface such as runways, landing fields, taxiways, taxilanes and aprons. Two side by side compact payload transfer transport modules **47**C can be winched up and mated to the bottom of the body **3** as shown, from either land or water. These compact payload transfer transport modules **47**C are payload transfer transport modules **47** of the same configuration shown also earlier in FIG. **1**B and FIG. **5**A, and they can be carried by the different carrier vehicles of FIGS. **1**B, **5**A, **5**E and possible other carrier vehicles in an intermodal manner, within the spirit and scope of the invention.
[0190] Flight crew can be accommodated in a flight deck **31**C at the forward end of the body **3**, and a cabin **38** capable of accommodating passengers **40** who may enter the PASRACS **1** either from the compact payload transfer transport modules **47**C or through a boarding door **66**D (using at least one of a boarding bridge, airstairs or a built-in airstairs). Human facilities areas **154** are shown in the compact payload transfer transport modules **47**C but may also be provided at other locations in the cabin **38**. The PASRACS **1** is also shown to include a cargo volume **42** that is also capable of accommodating baggage **44**.
[0191] An example of operation of the PASRACS **1** vehicle of FIG. **5**E is as a feeder vehicle to a much larger PASRACS vehicle such as that described earlier in the context of FIGS. **1**A through **2**F. As a feeder vehicle, the PASRACS **1** of FIG. **5**E can transport a payload transport transfer module such as a compact payload transfer transport modules **47**C, with payload from an inland origin location with a small runway, airfield, and/or small water body such as a lake or reservoir, to an offshore large water area terminus area for the much larger PASRACS vehicle, and the compact payload transfer transport module **47**C with payload on board can be dropped into the water from the feeder vehicle and then captured and winched up to mate with the much larger vehicle for subsequent over-ocean transport, with the payload transferring into the much larger vehicle from the compact payload transfer transport module **47**C. In reverse operation, disembarking payload from the much larger vehicle can transfer into the compact payload transfer transport module **47**C, get winched down to the water, then connected and winched up to mate with the feeder vehicle of FIG. **5**E, then transported with flight in weak ground effect to an inland destination with a small runway, airfield, and/or small water body such as a lake or reservoir. The nominal span of the feeder vehicle PASRACS **1** of FIG. **5**E is 279 ft., so weak ground effect flight can take place up to 2790 ft, above ground level (AGL) per the initially provided definition of the expression “weak ground-effect”. The feeder PASRACS **1** of FIG. **5**E will preferably be designed for quiet and safe flight over populated areas, incorporating features from prior art quiet STOL aircraft designs and technologies.
[0192] The propulsion system **26** includes thrusters **28**T fitted with propulsion ducts **28**D that help increase efficiency and reduce noise. The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** while propelled by the propulsion system **26**, with some support from aerodynamic lift from the wing **61** with a ram air cushion **20** that is a power augmented ram air cushion **20**P underneath. The PASRACS **1** of FIG. **5**E has an illustrated nominal size, without limitation, of under 80 meters span so it can operate from runway and taxiway and taxilane infrastructure in existing airports that can accommodate large airliners like the Airbus A380. Flight in “weak ground-effect.” when the induced drag ground-effect influence ratio is greater than 98.9% but no greater than 99.8% or the height above ground to vehicle span ratio is no greater than 6, can be performed by the PASRACS **1** of FIG. **5**E at a nominal elevation of 1560 feet above ground level (AGL) for a nominal wingspan of 260 feet. The PASRACS **1** can maintain a relatively constant elevation AGL but follow terrain over land to increasing altitudes to serve inland destinations, with one such example without limitation, being flying from the Gulf of Mexico up to

Denver airport in Colorado. The flight deck **31**C and cabin **38** can optionally be at least one of oxygenated and pressurized for increased comfort and health of human occupants of the PASRACS **1**.

[0193] FIG. **5**F shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is similar to the embodiment shown in bottom plan view earlier in FIG. **1**B, but now a modified configuration with a T-tail empennage and with an inverse delta wing planform for the wing **61**. FIG. **5**F illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** is fitted with wings **61** with a wingtip fence **61**T and trailing edge morphing control surfaces **90**M that serve functionally as flaps and ailerons; and the aforementioned T-tail empennage with a horizontal stabilizer **88**H mounted near the top of a vertical stabilizer **88**V. The horizontal stabilizer **88**H is fitted with elevators **90**E and the vertical stabilizer **88**V is fitted with a rudder (not visible in this view). The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** and body **3** with a ram air cushion **20** underneath. Flight crew can be accommodated in a flight deck **31**C at the forward end of the body **3**. The propulsion system **26** includes thrusters **28**T that generate a thrust force **28**. A thruster **28**T may be powered by a gas turbine burning jet fuel or biofuel or hydrogen or may be powered by an electric motor or may be powered by hybrid energy sources with inputs from plural sources being mechanically summed (as with a combining gearbox with clutch disengagement when needed) or aerodynamically summed (as with two coaxial contrarotating propellers or propfans). In the case of an electric motor being used, the electric power for the electric motor may come from at least one of a battery, a fuel cell, a generator, and an auxiliary power unit. Propeller blade pitch control may be provided for feathering and for reverse thrust through fine or feather, as known in the prior art of air propulsors. Some of the thrusters **28**T may also optionally have a propulsor flow vectoring member or be vectored thrust propulsors.

[0194] FIG. **5**G shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is configured to use twin tail booms **88**B that support a pi-tail empennage, where the tail booms **88**B project backwards from twin hulls **54** in a catamaran arrangement. FIG. **5**G illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** is fitted with wings **61** with wingtip fences **61**T and trailing edge flaps **90**F and ailerons **90**A; and the aforementioned pi-tail empennage with a horizontal stabilizer **88**H mounted near the tops of twin vertical stabilizers **88**V. The horizontal stabilizer **88**H is fitted with elevators **90**E and the vertical stabilizers **88**V are fitted with rudders (not visible in this view). The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** with a ram air cushion **20** underneath. Flight crew can be accommodated in a flight deck **31**C at the forward end of a cabin **38** at the forward end of the body **3**, with access possible via a door **38**D. The propulsion system **26** includes thrusters **28**T that generate a thrust force **28**.

[0195] FIG. **5**H shows a plan view of an alternate preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. This embodiment is configured to use a span-loader wing **61** with double-taper, as shown, while multi-taper variants are also possible. FIG. **5**H illustrates a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** forward that includes a flight deck **31** and further including said span-loaded wing **61** with space for payload **4** in a cabin **38** as well as space for a lifting gas

enclosure **8** configured to contain a lifting gas **9** that provides an aerostatic lift force as its density is lower than that of the surrounding atmosphere **14**. The PASRACS **1** is fitted with wings **61** with a right wing **61**R, left wing **61**L, wingtip fences **61**T and trailing edge flaps **90**F and ailerons **90**A; and an empennage with a horizontal stabilizer **88**H mounted in a cruciform tail configuration part-way up on a vertical stabilizer **88**V. The horizontal stabilizer **88**H is fitted with stabilizer endplates **88**E and with elevators **90**E while the vertical stabilizer **88**V is fitted with a rudder **90**R. The PASRACS **1** can fly with positive airspeed **24** in ground-effect over an Earth surface **21** such as a water surface **18**, with some support from aerodynamic lift from the wing **61** with a ram air cushion **20** underneath. The propulsion system **26** includes thrusters **28**T that generate a thrust force **28**.
[0196] FIG. **6**A shows a preferred embodiment of a transition method for a partially aerostatically supported ram air cushion ship **1** that can be similar to the preferred embodiment earlier described with reference to the side view illustration in FIG. **1**A, to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface. More specifically. FIG. **6**A shows a transition method **49** for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a flight in ground-effect mode **35** above an Earth surface **21**, comprising the sequential steps of: [0197] (i) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**; [0198] (ii) powering a fluid dynamic propulsor **55** to apply a thrust force **28** acting on said ship **1** that exceeds drag force **141** acting on said ship **1**, to propel the ship **1** to forward motion with increasing speed **56** in said water takeoff mode **51**; [0199] (iii) engaging a supplemental fluid dynamic support system **57** in said water takeoff mode **51**, said supplemental fluid dynamic support system **57** comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system **57**, reduces required hydrostatic support **58** and correspondingly reduces water displacement related drag **59** in said water takeoff mode **51**; and [0200] (iv) configuring a ram air cushion **20** under at least one of a wing **61** and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in said flight in ground-effect mode **35** wherein said ship **1** flies at a flight speed **62** in ground effect above said Earth surface **21**, said flight speed **62** no less than a minimum flight speed **62**M.
[0201] FIG. **6**A further illustrates that the partially aerostatically supported ram air cushion ship **1** or PASRACS **1** includes ship structure **2** and a propulsion system **26** that includes said fluid dynamic propulsor **55**. In the water takeoff mode **51** the illustrated hydrodynamic supplemental support system **57**A comprises a hydroski **36**S and can also include one or more of the hydrodynamic lifting member **36**M and hydrodynamic planing surface **36**P and step **36**T and keel **88**K described earlier with reference to FIG. **1**A but not called out explicitly here in FIG. **6**A.
[0202] FIG. **6**B also shows a preferred embodiment of a transition method for a partially aerostatically supported ram air cushion ship **1** that can be similar to that described earlier with reference to FIG. **1**A, to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a forward flight in ground effect mode **35** above an Earth surface **21**. The preferred embodiment shown in FIG. **6**B is very similar to that of FIG. **6**A, but adds some particular details pertaining to the aerodynamic supplemental support subsystem **57**A and the hydrodynamic supplemental support system **57**H, as will be described below.
[0203] FIG. **6**B thus illustrates a transition method **49**, wherein said aerodynamic supplemental support subsystem **57**A comprises a power-augmented ram air cushion **20**P, wherein a trailing edge

84 of said power-augmented ram air cushion **20**P is a reduced height flow passage **113** above said Earth surface **21** and below a downwardly deflected flap **90**F on at least one of a wing **61** and a body **3** of said partially aerostatically supported ram air cushion ship **1**, and wherein said power-augmented ram air cushion **20**P is at least partially pressurized by energized flow **55**E from said fluid dynamic propulsor **55**.
[0204] FIG. **6**B also illustrates a transition method **49**, wherein said hydrodynamic supplemental support subsystem **57**H comprises at least one of a subcavitating hydrofoil **36**HA (not illustrated), a supercavitating hydrofoil **36**HB (not illustrated), a hydroski **36**S (illustrated) and a hydroplane planing surface **36**P (illustrated). The hydroski **36**S may be retractable and deployable, and may incorporate one or more of a suspension subsystem and shock absorber, as described elsewhere in this specification.
[0205] It should be understood that in the transition method **49** of FIGS. **6**A and **6**B, the PASRACS **1** is configured to produce aerostatic lift force **10** that reduces the amount of support needed from the combination of aerodynamic lift force **25** and lift from the hydrodynamic supplemental support subsystem **57**H, and that correspondingly reduces lift-induced drag components associated with aerodynamic and hydrodynamic lift.
[0206] FIG. **6**C also shows a preferred embodiment of a transition method **49**, followed by cruise flight and then followed by a landing transition method **49**L, for a partially aerostatically supported ram air cushion ship **1** that can be similar to that described earlier with reference to FIG. **1**A, to transition according to said transition method **49** from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and traversing a climb path with positive flight path angle then to a forward flight in ground effect mode **35** above an Earth surface **21** in cruise flight, and optionally then to a forward flight in weak ground effect mode **35**W also in cruise flight; with the cruise flight then followed by said landing transition method **49**L with a descent mode **51**D and then to a water landing mode **51**L and then finally back to a substantially static floating mode **50** on a water surface **18** at a destination location. The preferred embodiment shown in FIG. **6**C is very similar to that of FIG. **6**A, but adds some particular details pertaining to the aerodynamic supplemental support subsystem **57**A and the hydrodynamic supplemental support system **57**H similar to those described with reference to FIG. **6**B. Note that scale of the illustration box for the weak flight in ground effect mode **35**W is shown at 20% of the scale of the other boxes, to show flight in weak ground effect near the up to 6 times span criterion after the PASRACS **1** has climbed in altitude. For the nominal vehicle dimension of the embodiment of FIGS. **1**A through **1**G with nominal span of 1600 feet (that is also illustrated in FIG. **6**C), the corresponding weak flight in ground-effect nominal height above ground (as might be measured with a radio altitude sensor) of up to 9600 ft, is shown for illustration. This illustration box for flight in weak ground effect **35**W also shows a representative Earth surface **21** that includes a ground surface **23** with a nominal 1000 ft, hill and a water surface **18** with a nominal 1000 ft, long ship or marine vehicle **115**S, to show one conservative approach to how safe overflight in weak ground effect can be implemented, flying and/or climbing over 'obstacles' that may be natural (e.g., hills, trees, etc.) or man-made (e.g., buildings, land-supported vehicles, water-supported vehicles, etc.). The illustration box for the descent mode **51**D illustrates a PASRACS **1** with negative (or downwardly inclined) flight path angle and the use of a propulsion system with regenerative braking **26**R, that can recharge batteries on board the PASRACS **1**, as well as an optional drag control surface **90**D such as a deployable speedbrake or spoiler. The illustration box for the water landing mode **51**L illustrates forward motion with decreasing speed **56**D, and the use of reverse thrust force **28**R as for example from propeller reverse pitch through fine or feather as known in the art of aircraft propellers.
[0207] FIG. **6**C thus also illustrates a transition method that is here a landing transition method **49**L, wherein said aerodynamic supplemental support subsystem **57**A comprises a power-augmented ram air cushion **20**P, wherein a trailing edge **84** of said power-augmented ram air

cushion **20**P is a reduced height flow passage **113** above said Earth surface **21** and below a downwardly deflected flap **90**F on at least one of a wing **61** and a body **3** of said partially aerostatically supported ram air cushion ship **1**, and wherein said power-augmented ram air cushion **20**P is at least partially pressurized by energized flow **55**E from said fluid dynamic propulsor **55**.

[0208] FIG. **6**C further illustrates a transition method that is here a landing transition method **49**L, wherein said hydrodynamic supplemental support subsystem **57**H comprises at least one of a subcavitating hydrofoil **36**HA, a supercavitating hydrofoil **36**HB, a hydroski **36**S and a hydroplane planing surface **36**P, in a manner similar to that earlier described with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F.

[0209] The aerodynamic supplemental support subsystem **57**A and hydrodynamic supplemental support subsystem **57**H of FIG. **6**C may also optionally include features to improve passenger comfort and ride quality such a ride quality enhancement control system, a landing crab and decrab control system, a landing impact reduction or “soft landing” control system, and “g” control systems such as a gust loads reduction control system and a wave and current loads reduction control system. These optional systems features will be described further with reference to FIG. **10**B below.

[0210] FIG. **6**C further illustrates a PASRACS **1** which includes a payload volume **4**, wherein for a design payload density, the payload volume **4** comprises no more than three-quarters of total volume of the PASRACS **1**, leaving available internal volume in the PASRACS **1** for encompassed lifting volume **9**E in a lifting gas enclosure **8** to contain lifting gas **9** with no increase in wetted area of the PASRACS **1**. Note that depending on requirements and objectives, the design payload density applicable to the payload volume **4** for a particular vehicle design may be specified at a particular value lying in the order of magnitude range between 0.01 pound per cubic foot and 100 pounds per cubic foot, without limitation.

[0211] FIGS. **6**D through **6**H show some alternate preferred embodiments of a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface.

[0212] FIG. **6**D shows a preferred embodiment with the vehicle configuration earlier described with reference to the front view shown in FIG. **3**D, showing a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface.

[0213] More specifically, FIG. **6**D shows a transition method **49** for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a flight in ground-effect mode **35** above an Earth surface **21**, comprising the sequential steps of:

[0214] (i) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**; [0215] (ii) powering a fluid dynamic propulsor **55** to apply a thrust force (out of the page in this front view) acting on said ship **1** that exceeds drag force (into the page in this front view) acting on said ship **1**, to propel the ship **1** to forward motion with increasing speed (out of the page in this front view) in said water takeoff mode **51**; [0216] (iii) engaging a supplemental fluid dynamic support system **57** in said water takeoff mode **51**, said supplemental fluid dynamic support system **57** comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system **57**, reduces required hydrostatic support **58** and correspondingly reduces water displacement related drag (into the page in this front view) in said water takeoff mode **51**; and [0217] (iv) configuring a ram air cushion **20** under at least one of a wing (not included in this embodiment) and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in said flight in ground-effect mode **35** wherein said ship **1** flies at a flight speed (out of the page in this front view) in ground effect above said Earth surface **21**, said flight speed no less than a minimum flight speed.

[0218] With reference to FIG. **6**D, it should be further noted that in the floating mode **50**, the PASRACS **1** can be stationary or can also move at slow speeds with thrust and control of speed and direction and orientation all accomplished by controllable water thrusters **28**W such as azipod thrusters known in the art of marine vehicle propulsion and control. The controllable water thrusters **28**W and thrusters **28**T that operate on the air (such as propellers driven by motors or engines) are both fluid dynamic propulsors **55** and subsystems of the propulsion system **26**. For low speed and quiet maneuvering in the floating mode **50**, just the controllable water thrusters **28**W can be used with individual thrust magnitude and thrust direction for each of the said controllable water thrusters **28**W. The body side flaps **90**S are retracted and so not visible. For faster movement such as high speed taxi operations in the floating mode **50**, both the controllable water thrusters **28**W and the thrusters **28**T can be used in conjunction. For the water takeoff mode **51**, the thrusters **28**T will preferably be used while the controllable water thrusters **28**W may be optionally used, for example at the start of a takeoff run up to a certain speed, and then turned off and optionally retracted into their associated hull **54**. In the water takeoff mode **51** the hydrodynamic supplemental support system **57**H can generate a hydrodynamic lift force **17** and/or the aerodynamic supplemental support system **57**A can generate an aerodynamic lift force **25** that is further increased by trailing edge downward deflection of body side flaps **90**S, as illustrated. In the flight in ground-effect mode **35** the controllable water thrusters **28**W have been retracted and so are not visible, and the body side flaps **90**S are shown with a lower deflection than for water takeoff mode **51**, in view of a higher speed and adequate aerodynamic lift available with a lower overall lift coefficient despite the higher flight elevation. The Earth surface **21** shown om the flight in ground-effect mode **35** is a water surface **18** with significant waves. Selecting the flight elevation can be a careful balance of avoiding risk of wave contact at high speed, e.g. of a “rogue wave” that is higher than the typical waves, while trying to minimize aerodynamic induced drag by staying sufficiently low and the aerodynamic ground-effect staying sufficiently high.

[0219] FIG. **6**E shows a preferred embodiment with the vehicle configuration earlier described with reference to the rear view shown in FIG. **3**D, showing a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a forward flight in ground effect mode above an Earth surface.

[0220] More specifically, FIG. **6**E shows a transition method **49** for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a flight in ground-effect mode **35** above an Earth surface **21**, comprising the sequential steps of: [0221] (i) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**; [0222] (ii) powering a fluid dynamic propulsor **55** to apply a thrust force (into the page in this rear view) acting on said ship **1** that exceeds drag force (out of the page in this rear view) acting on said ship **1**, to propel the ship **1** to forward motion with increasing speed (into the page in this rear view) in said water takeoff mode **51**; [0223] (iii) engaging a supplemental fluid dynamic support system in said water takeoff mode **51**, said supplemental fluid dynamic support system comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system, reduces required hydrostatic support and correspondingly reduces water displacement related drag (out of the page in this rear view) in said water takeoff mode **51**; and [0224] (iv) configuring a ram air cushion **20** under at least one of a wing **61** and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in said flight in ground-effect mode **35** wherein said ship **1** flies at a flight speed (into the page in this rear view) in ground effect above said Earth surface **21**, said flight speed no less than a minimum flight speed.

[0225] With reference to FIG. **6**E, it should be further noted that in the floating mode **50**, the PASRACS **1** can be stationary or can also move at slow speeds with thrust and control of speed and direction and orientation all accomplished by thrusters **28**T that operate on the air (such as propellers driven by motors or engines) that are both fluid dynamic propulsors **55** and subsystems of the propulsion system **26**. Differential control of power and blade pitch for different propellers can be used for desired motion control as commanded by the flight crew and/or autoflight control system. In floating mode **50**, the wing flaps **90**F and body flaps **90**B are retracted and so not visible. For the water takeoff mode **51**, the thrusters **28**T will be used to provide thrust. In the water takeoff mode **51** the hydrodynamic supplemental support system **57**H can generate a hydrodynamic lift force **17** and/or the aerodynamic supplemental support system **57**A can generate an aerodynamic lift force **25** that is further increased by trailing edge downward deflection of body side flaps **90**S and wing flaps **90**F and body flaps **90**B, as illustrated. While typical water takeoffs in modest crosswinds can be “wings-level” for optimal passenger comfort, the particular water takeoff mode **51** is illustrated with a crosswind **163**, and the use of both a small bank angle (half degree bank right shown) and differential deflection of wing flaps **90**F and optionally other flaps. The particular water takeoff mode **51** is illustrated with a crosswind **163** also shows the deflection of rudders **90**R and lateral force control panels **90**L (that may also be considered as side force panels, shown integrated in the trailing edge of the wing tip fence in this particular embodiment. It will be understood from the art of crosswind takeoff techniques applicable to waterborne aircraft that a combination of one or more of pointing into the wind, modest bank angle when needed (e.g. for some stronger crosswind conditions), and use of control surfaces can be beneficially used to enable a smooth takeoff despite combinations of crosswind, water currents and waves. Curved takeoff paths can optionally be used. Differential deployment of hydroskis is also shown and can be beneficially applied for such crosswind circumstances; and air rudder(s), water rudder(s) and differential thrust can also be optionally used singly or in combination. In the flight in ground-effect mode **35** the flaps are still shown deflected in a substantially symmetrical manner for flight at relatively low airspeed, while it will be understood that flaps can be progressively retracted as airspeed increases in the flight in ground-effect mode. Automated takeoff control optimized control can optionally be applied, and can include (i) hydroski and/or hydrofoil optimized deployments, (ii) optimized transitions from floating mode to planing mode (e.g. on a step and/or hydroski), (iii) anti-porpoising control commands, (iv) anti-skipping control commands, (v) anti-ground-loop control commands, and (vi) propulsor-failure compensation commands. Shock absorbers with various spring and damping attributes can optionally be used on deployable members such as hydroskis or hydrofoils, along with deployment and retraction mechanisms and actuators. It should be noted that the use of plural hydroskis and/or surface penetrating hydrofoils can contribute very significantly to heave stability of the PASRACS **1** when in water contact in forward motion.

[0226] FIG. **6**F shows a preferred embodiment with the vehicle configuration earlier described with reference to the side view shown in FIG. **4**A, showing a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface to a water takeoff mode **51** with supplemental fluid dynamic support and then to a forward flight in ground effect mode **35** above an Earth surface.

[0227] FIG. **6**G shows a preferred embodiment with the vehicle configuration earlier described with reference to the side view shown in FIG. **4**B, showing a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface to a water takeoff mode **51** with supplemental fluid dynamic support and then to a forward flight in ground effect mode **35** above an Earth surface.

[0228] More particularly, both FIGS. **6**F and **6**G show a transition method **49** for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a flight in ground-effect mode **35** above an Earth surface **21**, comprising the sequential steps of: [0229] (i) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**; [0230] (ii) powering a fluid dynamic propulsor **55** to apply a thrust force (into the page in this rear view) acting on said ship **1** that exceeds drag force (out of the page in this rear view) acting on said ship **1**, to propel the ship **1** to forward motion with increasing speed (into the page in this rear view) in said water takeoff mode **51**; [0231] (iii) engaging a supplemental fluid dynamic support system in said water takeoff mode **51**, said supplemental fluid dynamic support system comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system, reduces required hydrostatic support and correspondingly reduces water displacement related drag (out of the page in this rear view) in said water takeoff mode **51**; and [0232] (iv) configuring a ram air cushion **20** under at least one of a wing **61** and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in said flight in ground-effect mode **35** wherein said ship **1** flies at a flight speed (into the page in this rear view) in ground effect above said Earth surface **21**, said flight speed no less than a minimum flight speed.

[0233] Other features shown in FIG. **6**F include a waterjet propulsor **55**W, a wing **61**, a body **3** and propulsor flow vectoring members **28**F, a vertical stabilizer **88**V and rudders **90**R, and a water rudder **90**W (that can be used to help maneuver the PASRACS **1** in yaw while in a fully or partially floating mode.

[0234] Other features shown in FIG. **6**G include a hydrodynamic planing surface **36**P and a hydroski **36**S, and a ram air cushion **20** that is a power-augmented ram air cushion **20**P located forward of reduced height flow passage **113** beneath a trailing edge **84** of a deployed body flap **90**B near the aft end of the body **3** of the PASRACS **1**. FIG. **6**G further illustrates a transition method wherein said aerodynamic supplemental support subsystem **57**A comprises a power-augmented ram air cushion **20**P, wherein a trailing edge **84** of said power-augmented ram air cushion **20**P is a reduced height flow passage **113** above said Earth surface **21** and below a downwardly deflected flap **90**F on at least one of a wing **61** and a body **3** of said partially aerostatically supported ram air cushion ship **1**, and wherein said power-augmented ram air cushion **20**P is at least partially pressurized by energized flow **55**E from said fluid dynamic propulsor **55**.

[0235] FIG. **6**H shows a preferred embodiment with the vehicle configuration earlier described with reference to the side view shown in FIG. **4**E, showing a transition method for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface to a water takeoff mode **51** with supplemental fluid dynamic support and then to a forward flight in ground effect mode **35** above an Earth surface.

[0236] More particularly, FIG. **6**H shows a transition method **49** for a partially aerostatically supported ram air cushion ship **1** to transition from a substantially static floating mode **50** on a water surface **18** to a water takeoff mode **51** with supplemental fluid dynamic support **52** and then to a flight in ground-effect mode **35** above an Earth surface **21**, comprising the sequential steps of: [0237] (i) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**; [0238] (ii) powering a fluid dynamic propulsor **55** to apply a thrust force (into the page in this rear view) acting on said ship **1** that exceeds drag force (out of the page in this rear view) acting on said ship **1**, to propel the ship **1** to forward motion with increasing speed (into the page in this rear view) in said water takeoff mode **51**; [0239] (iii) engaging a supplemental fluid dynamic support system in said water takeoff mode **51**, said supplemental fluid dynamic support system comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system, reduces required hydrostatic support and correspondingly reduces water displacement related drag (out of the page in this rear view) in said water takeoff mode **51** with a water takeoff run followed by a rotation mode **51**R; and [0240] (iv) configuring a ram air cushion **20** under at least one of a wing **61** and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in said flight in ground-effect mode **35** wherein said ship **1** flies at a flight speed (into the page in this rear view) in ground effect above said Earth surface **21**, said flight speed no less than a minimum flight speed.

[0241] Note that the rotation mode **51**R shown in FIG. **6**H shows a nose up rotation of the PASRACS **1** by 2.5 degrees nose up for example and without limitation, enabled in part by increased trailing edge down deflection of a canard control surface **88**C by 5 degrees incremental, without limitation. The illustrated level of rotation will still be safe and acceptable for passengers walking on aisles and walkways within the vehicle, based on deck angle precedents from commercial airliners wherein passengers have been found to be able to traverse aisles with angles of up to 3 degrees. Note also that similar use of nose up body angles of up to 3 degrees can be used for landing flare in addition to for takeoff rotation.

[0242] FIG. **7**A shows a preferred embodiment with the vehicle configuration earlier described with reference to the front view shown in FIG. **3**C, showing a transition method for a partially aerostatically supported ram air cushion ship **1** that was in cruise flight in a flight in ground-effect mode **35** (not shown) to thence transition in sequence through a descent mode **51**D and then a water landing mode **51**L and then finally back to a substantially static floating mode **50** on a water surface at a destination or end-of-flight leg region.

[0243] FIG. **7**B shows a preferred embodiment with the vehicle configuration earlier described with reference to the front view shown in FIG. **3**E, showing a transition method for a partially aerostatically supported ram air cushion ship **1** that was in cruise flight in a flight in ground-effect mode **35** (not shown) to thence transition in sequence through a descent mode **51**D and then a water landing mode **51**L and then finally back to a substantially static floating mode **50** on a water surface at a destination or end-of-flight leg region.

[0244] More particularly, both FIGS. **7**A and **7**B show a landing transition method **49**L for a partially aerostatically supported ram air cushion ship **1** that was in cruise flight in a flight in ground-effect mode **35** (not shown) to thence transition in sequence through a descent mode **51**D and then a water landing mode **51**L and then finally back to a substantially static floating mode **50** on a water surface at a destination or end-of-flight leg region, comprising the sequential steps of: [0245] (i) configuring a ram air cushion **20** under at least one of a wing **61** and a body **3** of said ship **1** to provide a portion of an aerodynamic lift force **25** that complements said aerostatic lift force **10** to fully support weight **33** of said ship **1** in flight in said descent mode **51**D wherein said ship **1** flies at a flight speed (out of the page in this front view) in ground effect above said Earth surface **21**, said flight speed no less than a minimum flight speed; [0246] (ii) engaging a supplemental fluid dynamic support system in said water landing mode **51**L wherein said ship **1** is in forward motion with decreasing speed, said supplemental fluid dynamic support system comprising at least one of a hydrodynamic supplemental support subsystem **57**H and an aerodynamic supplemental support subsystem **57**A, wherein said engaging said supplemental fluid dynamic support system, reduces required hydrostatic support and correspondingly reduces water displacement related drag (out of the page in this rear view) in said water takeoff mode **51**; and

[0247] (iii) supporting weight **33** of said partially aerostatically supported ram air cushion ship **1** using a combination of (a) a hull **54** displacing water to provide a hydrostatic lift force **17** and (b) a lifting gas enclosure **8** containing lighter-than-air lifting gas **9** to provide an aerostatic lift force **10**, in said substantially static floating mode **50**.

[0248] FIG. **7**A further illustrates a crosswind landing with a crosswind **163**, wherein a certain measure of a decrab maneuver is used in the crosswind landing, as seen with a 2.5 degree bank angle (quantity of bank representative and not limiting) achieved by optimal control to all control surfaces plus differential downward deployment of left and right hydrodynamic planing surfaces **36**P, as illustrated.

[0249] FIG. **7**B further illustrates a crosswind landing with no bank angle, keeping "wings level" with appropriate control surface deflections shown including differential flaps (that act as flaperons) **90**F and differential elevator **90**E and deployment of a rudder **90**R. FIG. **7**B also shows downward deployment of hydrofoils **36**H from the hulls **54** on left and right sides of the vehicle, where the illustrated hydrofoils are surface penetrating hydrofoils. The surface-penetrating hydrofoils as configured will inherently enhance roll stability and heave stability in landing, and can optionally be fitted with suspension elements such as shock absorbers with spring and damping attributes, to smooth the landing even in the presence of waves on the water surface, as shown.

[0250] FIG. **7**C shows a preferred embodiment with the vehicle configuration earlier described with reference to the side view shown in FIG. **4**D, showing a transition method for a partially aerostatically supported ram air cushion ship **1** that starts in cruise flight in a flight in ground-effect mode **35** to thence transition in sequence through a descent mode **51**D and then a water landing mode **51**L and then finally back to a substantially static floating mode **50** on a water surface at a destination or end-of-flight leg region. The PASRACS **1** includes ship structure **2** and a body **3**. This tandem wing configuration has wings **61** comprising a forward tandem wing **61** FT and an aft tandem wing **61**AT, as shown. The wings **61** provide aerodynamic lift force **25** due to their aerodynamic shaping as well as due to the presence of ram air cushions **20** beneath them; while aerostatic lift force **10** is provided by a lifting gas **9** in a lifting gas enclosure **8** in the body **3**. A propulsion system **26** provides a thrust force **28** that counters drag force **141** acting on the vehicle in flight in ground-effect. The PASRACS **1** is fitted at an aft location with a vertical stabilizer **88**V that serves as a vertical tail or fin along with a rudder **90**R, but as shown no horizontal stabilizer is needed or provided, as the tandem wings can adequately provide both pitch stability and pitch trim. The body **3** includes payload volume **4** as well as other features described earlier with reference to FIG. **4**D.

[0251] As the PASRACS **1** transitions from the flight in ground-effect mode **35** to the descent mode **51**D, the vehicle is rotated nose down in pitch to achieve a desired vehicle flight path vector that is pointed downward at a slight angle, with a−2.5 degree flight path angle shown as an example and without limitation. Control surfaces and thrust are controlled for trimmed flight in descent at a desired flight speed **62** that is still above minimum flight speed **62**M. A propulsive system with regenerative braking **26**R may optionally be enabled for flight use under certain conditions, allowing some use of reverse thrust where needed or beneficial, e.g., for controlled steeper descents when required or for controlled deceleration in descent when required.

[0252] As the PASRACS **1** transitions from the descent mode **51**D to the water landing mode **51**L it will typically pitch nose up while reducing speed to just above minimum flight speed **62**M, and maintain a low sink rate in a final flare and alighting maneuver that then leads to water contact by an aft water hull member **54**A or a extended hydroski **36**S mounted thereto. The vehicle will then derotate to a near-level configuration with all hydroskis contacting the water and then all hulls contacting the water surface **18**, as shown in the illustration for the water landing mode **51**L. The vertical sink rate can be gradually reduced without discomfort to passengers, with the help of shock absorbers in the hydroski suspension plus the effects of the regions with ram air cushion **20**. With appropriate control of the propulsion system **26** and the propulsive system with regenerative braking **26**R, a smooth deceleration can be achieved to enable the PASRACS **1** to finally transition from the water landing mode to a floating mode **50**, where the vehicle can then taxi to a final destination location such as the illustrated location near a port dock **79**D in a port region **79**R, which can be close to both a destination waterfront populated area **81** at the end of a trip and an origin waterfront populated area **65** for the start of the subsequent outbound trip. This particular embodiment of PASRACS **1** is fitted with a nose loading door **66**N, shown open in the floating mode **50** to enable deboarding from and boarding to the payload volume **4**, optionally through use of a boarding ramp **66**R that can be similar to prior art boarding ramps used for boarding and deboarding people and vehicles on marine car ferries.

[0253] FIG. **8**A shows a preferred embodiment of a transport method for multimodally transporting payload from an origin location.

[0254] More particularly, FIG. **8**A shows a transport method **63** for multimodally transporting payload **7** from an origin location **64**, comprising the steps of: [0255] (i) enabling a boarding payload **66** to be accommodated **66**A in a transfer vehicle **69** at an origin location **64**, shown in the first box in bottom view, wherein said boarding payload **66** comprises at least one of (a) a first plurality **40**A of passengers **40** and (b) a second plurality **40**B of items **67** of at least one of cargo **43** and baggage **44**; [0256] (ii) bringing together **69**A said transfer vehicle **69** with a partially aerostatically supported ram air cushion ship **1**, at a mating location **70**, shown in the second sequential box in a bottom view at smaller scale or approximately 15% scale; [0257] (iii) mating **71** said transfer vehicle **69** to said partially aerostatically supported ram air cushion ship **1** utilizing a mating apparatus **70**A configured to contiguously connect **72** said transfer vehicle **69** to said partially aerostatically supported ram air cushion ship **1**, shown in the third sequential box in plan view at the same scale as the first box; [0258] (iv) enabling boarding transfer **69**B of at least a portion of said boarding payload **66** from said transfer vehicle **69** to a payload accommodating compartment **73** in said partially aerostatically supported ram air cushion ship **1**, through a boarding transfer path **74**, shown in the fourth sequential box in the same scale enlarged plan view as the previous box; and [0259] (v) transporting **66**B said boarding payload **66** in said partially aerostatically supported ram air cushion ship **1** on a travel path **24**T as commanded by at least one of crew **41** and a vehicle control and navigation system **29**, said travel path **24**T including a takeoff phase **75** and a flight phase **76** with a positive airspeed **24** wherein said partially aerostatically supported ram air cushion ship **1** is supported in part by an aerostatic lift force (out of the page in this plan view) and in part by an aerodynamic lift force (out of the page in this plan view) leveraging a ram air cushion **20** between a lower surface of said partially aerostatically supported ram air cushion ship **1** and an Earth surface **21**, shown in the fifth sequential box at smaller scale of approximately 7.5% scale as the first box, in plan view.

[0260] The illustrated partially aerostatically supported ram air cushion ship **1** or PASRACS **1** in the description of the transport method **63** shown in FIG. **8**A, is similar to the preferred embodiment earlier described with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. FIG. **8**A further illustrates, in the first box top view, that the illustrated transfer vehicle **69** here comprises a payload transfer transport module **47** that is nominally a boarding barge floating on a water surface **18** and having 21 rows of **30** abreast seating (without limitation), and that is fitted with controllable water thrusters **28**W such as azipods with waterjet and/or propeller effectors. FIG. **8**A further illustrates, in the second box bottom view, that the PASRACS **1** includes a right hull member **54**R with an adjacent payload transfer transport module **47**, as well as other payload transfer transport modules **47** that are also supported under the PASRACS **1** and connected to it. FIG. **8**A also illustrates, in the third sequential box top view, that the PASRACS **1** includes a right hull member **54**R with an adjacent payload transfer transport module **47**. FIG. **8**A illustrates, in the fourth sequential box top view, that the PASRACS **1** includes the connected transfer vehicle **69** here comprising a payload transfer transport module **47**, and features seen earlier in FIG. **2**B (of a deck layout configuration of the next above the bottom deck, i.e. cargo deck **5**C, of the preferred embodiment of a partially aerostatically supported ram air cushion ship **1** as shown earlier in FIGS. **1**A and **1**B), such as boarding and deboarding gate areas **47**G, a special service area **142**B, restroom **142**C and government formalities area **142**F that can be used for functions such as immigration control, emigration control, customs, security checks and other formalities required by origin, destination and stops jurisdictions. Boarding transfer **69**B of passengers **40** can involve one or more of a passenger walking or on a wheelchair or on a motorized wheelchair or on an e-mobility scooter or on a personal transport vehicle **69**P that may, for example and without limitation, be like the illustrated autonomous self-propelled wheeled scooter with a passenger seat and a luggage carrier big enough to carry the passenger's luggage such as a suitcase and a personal item. It will be understood that this type of personal transport vehicle **69**P may be used to enable a passenger to go with his or her baggage all the way from a check-in area at an origin location or terminal, to the payload transfer transport module **47**, to a final cabin or seat destination on a deck in the PASRACS **1**. Personal transport vehicles **69**P may also be configured to carry two or more passengers and their baggage. With regard to the travel path **24**T including a takeoff phase **75** in the fifth sequential box, it should be noted that a space on the water surface **18** can be kept clear of other vessels or objects to enable a safe takeoff of the PASRACS **1** without collision risk. This can be done with manned or robotic patrol boats with warning and tow/push capabilities, and can alternatively or additionally be done by definition of a takeoff and landing “water runway” region on the water surface **18**, with optional perimeter marker buoys and/or perimeter floating fences.

[0261] FIGS. **8**B through **8**E show some alternate preferred embodiments of a transport method **63** for multimodally transporting payload.

[0262] FIG. **8**B shows a transport method **63** for multimodally transporting payload **7** from an origin location **64** as first illustrated in FIG. **8**A, with the first box in FIG. **8**B illustrating the flight phase **76** with positive airspeed **24** that was earlier illustrated and described in the smaller scale plan view of the last box of FIG. **8**A, and further comprising the steps of: [0263] (vi) identifying **7**E a disembarking payload **7**D for a destination location **68**, which disembarking payload **7**D, shown in enlarged plan view in the second box of FIG. **8**B, is in on board **7**F the partially aerostatically supported ram air cushion ship **1** in said payload accommodating compartment **73** in said flight phase **76**, and wherein said disembarking payload **7**D comprises at least one of (a) a third plurality **40**C of passengers **40** and (b) a fourth plurality **40**D of items **67** of at least one of cargo **43** and baggage **44**; [0264] (vii) performing the combined arrival preparation steps **77** within an arrival preparation time window **77**T, as shown in the third box of FIG. **8**B with left and right halves, of (a) enabling disembarking transfer **69**C of said disembarking payload **7**D from said payload accommodating compartment **73** in said partially aerostatically supported ram air cushion ship **1** to said transfer vehicle **69**, through a disembarking transfer path **78**, and (b) landing **79** said partially aerostatically supported ram air cushion ship **1** in a port region **79**R encompassing said destination location **68** (shown at the same scale as the first box, or approximately 7.5% scale relative to the second box and the left side of the third box); [0265] (viii) unmating **80** said transfer vehicle **69** from said partially aerostatically supported ram air cushion ship **1** at an unmating location **80**L, shown in the fourth box in enlarged plan view, utilizing an unmating apparatus **80**A configured to enable separation **80**S of said transfer vehicle **69** from said partially aerostatically supported ram air cushion ship **1**; and [0266] (ix) conveying **69**D said disembarking payload **7**D being accommodated in said transfer vehicle **69** to said destination location **68**, shown in the fifth box at the same scale as the fourth box.

[0267] FIG. **8**B thus illustrates a transport method **63** for multimodally transporting payload **7** to a destination location **68**. The disembarking payload **7**D can comprise some combination of payload **7** from said boarding payload **66** and payload **7** not from said boarding payload **66**. The destination location **68** may be a “gate” or “docking location” or “dock” or “slip” or “terminal” for example and without limitation.

[0268] Disembarking transfer **69**C of passengers **40** can involve one or more of a passenger walking or on a wheelchair or on a motorized wheelchair or on an e-mobility scooter or on a personal transport vehicle **69**P that may, for example and without limitation, be like the illustrated autonomous self-propelled wheeled scooter with a passenger seat and a luggage carrier big enough to carry the passenger's luggage such as a suitcase and a personal item. It will be understood that this type of personal transport vehicle **69**P may be used to enable a passenger to go with his or her baggage all the way from their cabin or seat on a deck in the PASRACS **1**, to the payload transfer transport module **47**, to a final destination location **68** such as a check out area, parking garage, pick-up area or other transit or final destination. Personal transport vehicles **69**P may also be configured to carry two or more passengers and their baggage. With regard to the travel path **24**T including a landing phase **75** in right center box, it should be noted that a space on the water surface **18** can be kept clear of other vessels or objects to enable a safe landing of the PASRACS **1** without collision risk. This can be done with manned or robotic patrol boats with warning and tow/push capabilities, and can alternatively or additionally be done by definition of a landing and takeoff “water runway” region on the water surface **18**, with optional perimeter marker buoys and/or perimeter floating fences.

[0269] The illustrated partially aerostatically supported ram air cushion ship **1** or PASRACS **1** in the description of the transport method **63** shown in FIG. **8**B, is similar to the preferred embodiment earlier described with reference to FIG. **8**A and with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. FIG. **8**B further illustrates, in the first box plan view, a PASRACS **1** in a flight phase **76** such as nearing the end of the flight started earlier as illustrated in the fifth sequential box of FIG. **8**A. FIG. **8**B shows in its first box a starting step of transporting **66**B a payload **7** in said partially aerostatically supported ram air cushion ship **1** on a travel path **24**T as commanded by at least one of crew **41** and a vehicle control and navigation system **29**, said travel path **24**T with positive airspeed **24** wherein said partially aerostatically supported ram air cushion ship **1** is supported in part by an aerostatic lift force (out of the page in this plan view) and in part by an aerodynamic lift force (out of the page in this plan view) with a ram air cushion **20** between a lower surface of said partially aerostatically supported ram air cushion ship **1** and an Earth surface **21**. The second box of FIG. **8**B further illustrates features seen earlier in FIG. **2**B (of a deck layout configuration of the next above the bottom deck, i.e. cargo deck **5**C, of the preferred embodiment of a partially aerostatically supported ram air cushion ship **1** as shown earlier in FIGS. **1**A and **1**B), such as boarding and deboarding gate areas **47**G, a special service area **142**B, restroom **142**C and government formalities area **142**F that can be used for functions such as immigration control, emigration control, customs, security checks and other formalities required by origin, destination and stops jurisdictions. The third and fifth sequential boxes of FIG. **8**B further illustrate a port dock **79**D and terminal **79**T in the destination location **68**. Note that the dock **79**D can be built-up, on pilings, and/or supported by floating dock floatation members, and can include bumpers to enable damageless contact by the transfer vehicle **76** which is here illustrated as a payload transfer transport module **47**. The dock **79**D may be equipped with boarding bridge, ramp, stairway, escalator, elevator, moving sidewalk, crane and other known devices and methods for loading and unloading people e.g., passengers **40**, plus baggage **44** and cargo **43** from (and to) the transfer vehicle **69**. Disembarking payload **7**D is illustrated in FIG. **8**B. Note that the terminal **79**T can include known elements from the prior art of terminals, including without limitation: a terminal building, a parking area or garage, a park and ride, a kiss and ride, a transit center with connections to road and/or rail and/or marine and/or air connection vehicles, a store, a mall, a duty-free facility, a hotel, a restaurant, a parks and/or garden, a water view deck, a medical and/or health care facility, a cultural center, an entertainment/sports facility, a theatre, a stage, a live show venue, a music venue with one or more instruments (such as a piano, organ, keyboard, string instrument, woodwind instrument, brass instrument and/or other instrument), a business center, a convention center, a boarding complex for boarding and deboarding, a concourse, a gate area, a health care center, a gym/exercise/fitness center, a meditation/prayer area/chapel, a yoga area, a pet area, a baggage area, a baggage claim area, a cargo area, an immigration area, an emigration area, a security screening area, a customs area, an agricultural inspection area, a customer service area with customer service agents and/or AI/robotic agents, and an information center. The fourth sequential box in FIG. **8**B shows an unmating method similar to that described earlier in the context of the preferred embodiment of FIGS. **1**A through **1**G and FIGS. **2**A through **2**F, and further illustrates a right hull member **54**R on the transfer vehicle **76** which is here in FIG. **2**B illustrated as a payload transfer transport module **47**.

[0270] The transport method of FIGS. **8**A and **8**B in conjunction with the preferred embodiment described with reference to FIGS. **1**A-G and **2**A-F, show that the boarding transfer path **74** and the disembarking transfer path **78** each comprise at least one of (i) a walkway **118** (shown in FIGS. **8**A and **8**B), (ii) an aisle **119**, (iii) a roadway **120**, (iv) a stairway **143**S. (v) a ramp **122**. (vi) an elevator **143**E. (vii) a moving stairway or escalator, (viii) a hallway, (ix) a room, (x) a plaza, (xi) a floored area **128**, and (xii) a tunnel. PASRACS **1** will preferably be configured with boarding transfer path **74** and disembarking transfer path **78** being suitable for and usable by a Person with Reduced Mobility (PRM), an elderly person, and/or a handicapped person, including ability to accommodate a wheelchair or powered wheelchair and having ground slope levels that are not excessive, such as not exceeding a 1:12 pitch per ADA (Americans with Disabilities Act) ramp guidelines.

[0271] FIGS. **8**C through **8**E show some alternate preferred aspects and embodiments of a transport method **63** for multimodally transporting payload, in the context of the series of steps described earlier with reference to FIGS. **8**A and **8**B. The transport method **63** as shown in each of FIGS. **8**C through **8**E can apply to either or both of transport from an origin location **64** and transport to a destination location **68**.

[0272] The transport method **63** in FIG. **8**C shows a plan view of a transfer vehicle **69** that serves as a payload transfer transport module **47** for carrying payload **7** that can include passengers **40** and baggage **44**, similar to the configuration described earlier in the context of the preferred embodiment of a PASRACS **1** described earlier in FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. The transfer vehicle **69** is here a hydrofoil vehicle **69**Y equipped with plural hydrofoils **36**H that enable the vehicle to by lifted by hydrodynamic forces on the hydrofoils **36**H when they are underwater and the vehicle is moving forward on a water surface **18**, propelled by propulsors such as controllable water thrusters **28**W, as known in the prior art of hydrofoil vehicles. By lifting hulls **54** significantly out of the water the hydrodynamic drag can be reduced and the vehicle speed increased and vehicle ride quality in choppy waters improved. The transfer vehicle **69** is shown docked at a port dock **79**D after arriving along a travel path **24**T. The port dock **79**D is at a location that is either or both a destination location **68** (for disembarking payload) or/and an origin location **64** (for embarking payload for the next leg of travel of a PASRACS **1** to which the transfer vehicle **69** will return). As one alternative, some passengers can deboard or board the transfer vehicle **69** by utilizing a boarding bridge **66**G, as illustrated, while some other passengers can deboard or board the transfer vehicle **69** on a bus **115**B that can traverse to or from the port dock **79**D driving on a boarding ramp **66**R, as shown. The buses **115**B can be considered to also be transfer vehicles, that carry passengers to and from final destinations/origins anywhere on a road system connecting to the port area and port dock **79**D. Recreational vehicles, automobiles, other road vehicles, and tracked or rail vehicles can replace the illustrated buses **115**B in variant embodiments.

[0273] The transport method **63** in FIG. **8**D shows a plan view of three different exemplary transfer vehicles **69** that can transport payload to and from a PASRACS **1**, including a PASRACS **1** of the preferred embodiment described earlier in FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. One illustrated transfer vehicle **69**, shown at the top of the Figure, is a barge **114** that is connected to a tugboat **165** by a tow cable **1**C, with the tugboat **165** pulling the barge **114** along a desired travel path **24**T for either outbound or inbound payload transport. The illustrated transfer vehicle **69** is shown with a view deck **167**, preferably with a safety-provisioned opening to the atmosphere, such as openable window areas with safety grating, or open top with safety grating, with the safety provisions preventing risk of persons falling overboard. It should be understood that in variant embodiments to transfer vehicle **69** and/or the tugboat **165** could be a vehicle of single hull, catamaran, multimaran, hydrofoil boat (with surface penetrating hydrofoils and/or fully submerged hydrofoils), or hovercraft type of vehicle.

[0274] A second illustrated transfer vehicle **69** is compact payload transfer transport module **47**C of the class earlier described in the context of FIG. **1**B. The illustrated compact payload transfer transport module **47**C is propelled by controllable water thrusters **28**W on a desired travel path **24**T to carry passengers **40** on either outbound or inbound transport legs.

[0275] A third illustrated transfer vehicle **69** is a payload transfer transport module **47** that is a hovercraft **69**H. The prior art of hovercraft is well known and includes examples such as the SR.N4 hovercraft that carried payload across the English Channel for many years, before the Chunnel was built. The hovercraft **69**H shown in FIG. **8**D is traveling on a travel path **24**T while propelled by air propulsors **55**A that also provide directional control, and supported on a powered air cushion that is bounded around its perimeter by a combination of one or more of an air cushion bounding skirt **164**S, an air cushion bounding flap **164**F, and sidewall elements such as the bottom edges of the catamaran hulls **54**. As illustrated but without limitation, the air cushion bounding skirt **164**S is a hovercraft skirt at the aft end of the hovercraft **69**H, the air cushion bounding flap **164**F is a leading edge flap such as a Krueger flap at the front end of the hovercraft **69**H, and the sidewall elements are the bottom edges of the hulls **54**. The hovercraft **69**H is an amphibious vehicle **115**R, and can traverse on water and land and ice and swamp and marsh or soft surfaces, and can also serve terminal locations on shoreline ramps ask known with prior art hovercraft, enabling passengers and vehicles and cargo and baggage to transit to and from the hovercraft **69**H via ramps or stairs as known in the prior art of hovercraft terminal operations.

[0276] FIG. **8**E shows a side view of a transport method **63** for multimodally transporting payload, at half the scale of FIGS. **8**C and **8**D. FIG. **8**E shows a transfer vehicle **69** that is a payload transfer transport module **47** similar to that shown carried by PASRACS **1** in FIG. **1**A, now being carried and transported on a travel path **24**T by an aircraft **166** while hanging below connected by plural lift cables **166**L. The aircraft **166** is preferably a vertical takeoff and landing (VTOL) aircraft **166**V, and is illustrated with tandem rotors **166**R providing aerodynamic lift plus aerostatic lift from lifting gas **9** within lifting gas enclosures **8**, in a manner analogous to the prior art “aerocrane” hybrid lighter-than-air (LTA) aircraft. The rotors **166**R provide both lift and tractive force or thrust, as known from the prior art of helicopters and LTAs. After a PASRACS **1** has landed, it can drop off a payload transfer transport module **47** with deboarding payload, onto a water surface **18**, from which it is picked up by the aircraft **166** and transported to a destination location, including flight over land surfaces as illustrated. The process can be reversed for boarding payload, starting from an origin location with carriage under the aircraft **166**, flight over land or water areas, and drop off on a water surface **18** in a region from which a PASRACS **1** can come over the payload transfer transport module **47** and pick it up and mate with it to enable the boarding payload to then get onto the PASRACS **1** for an outbound travel leg.

[0277] FIGS. **9**A and **9**B show some alternate preferred aerodynamic and hydrodynamic features that can be applied on a partially aerostatically supported ram air cushion ship **1**.

[0278] FIG. **9**A shows a left side view of a preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, similar to that shown and described in detail with reference to FIG. **1**A. FIG. **9**A illustrates the use of a laminar flow surface **14**L as an aerodynamic feature that acts to reduce skin friction aerodynamic drag, also called parasite drag, using principles known from the art of aerodynamic devices and their action on airflow adjacent to a vehicle in motion. The laminar flow surfaces **14**L are shown in plural representative locations on the body **3** including the forward projection of the body containing the flight deck or cockpit **31**C, on the wing

61, on the vertical stabilizer **88**V and horizontal stabilizer **88**H, and on the stabilizer endplate **88**E, without limitation. The laminar flow surfaces **14**L may be enabled and implemented utilizing a variety of methods known from the prior art of aerodynamics, and include areas of at least one of natural laminar flow, active laminar flow and hybrid laminar flow technologies and designs, and optionally including boundary layer control with at least one of surface loft tailoring, pressure gradients tailoring, suction, blowing, and a tailored skin single duct concept. The PASRACS **1** will also naturally feature a measure of skin friction drag (parasite drag) reduction from the reduced airflow speeds in the ram air cushion **20** that occur concurrently with the increased pressure in the ram air cushion **20** that contributes an aerodynamic lift force **25**. This drag reduction from reduced airflow speed is inherent as skin friction drag scales with the local airspeed, squared.

[0279] FIG. **9**A also illustrates the use of a riblet surface **14**R as an aerodynamic feature that acts to reduce skin friction aerodynamic drag, also called parasite drag, using principles known from the art of aerodynamic devices and their action on airflow adjacent to a vehicle in motion. The riblets may utilize ridges on one or more of on an applique applied to a surface of ship structure **2** or cut or fabricated microgrooves in the surface of the ship structure **2**. The riblet surfaces **14**R are shown in plural representative locations on the body **3**, on the wing **61**, and on the vertical stabilizer **88**V, without limitation.

[0280] FIG. **9**A also illustrates the use of vortex generators **14**V as an aerodynamic feature that acts to reduce at least one of aerodynamic flow separation and skin friction aerodynamic drag, also called parasite drag, using principles known from the art of aerodynamic devices and their action on airflow adjacent to a vehicle in motion. Vortex generators **14**V are shown on the vertical stabilizer **88**V forward for the rudders **90**R, as one example and without limitation on numerous areas of potential beneficial application on the external surfaces of a PASRACS **1**, as known from the prior art of the use of vortex generators to enhance flow attachment, reduce flow separation, drag reduction, and/or control surface effectiveness enhancement for control surfaces downstream of the vortex generators.

[0281] FIG. **9**A also shows a plurality of hydrodynamic features known from the art of hydrodynamics of marine vehicles, hydrofoil vehicles with surface penetrating or fully submerged hydrofoils, amphibious vehicles, hovercraft, seaplanes and flying boats. Some hydrodynamic features can contribute to hydrodynamic lift force **36** acting to help lift the PASRACS **1** relative to the water surface **18**. Specific features that are shown can leverage technologies and designs, without limitation, from the prior art. A first feature is the use of hulls **54** with water contacting surface lofts designed to minimize hydrodynamic drag at different phases of operation while moving on the water, such as floating operations, hump operations, planing operations, planing on a step operations, transition mode operations, ram air cushion operations with edge contacts of waves, and ram air cushion operations with no water contact. The hulls **54** may utilize one or more of curved surfaces, varying forward (bow) lofts, varying aft (stern) closure lofts, varying deadrise lofts, a keel edge, a hydrodynamic planing surface **36**P, a step **36**T, a chine, a strake and a spray rail. The bottom ends of the keel ventral stabilizer **88**K and the body side flaps **90**S will also preferably include lofting beneficially appropriate for them to contribute as hydrodynamic features (in addition to their aerodynamic primary purposes) as and when they contact the water surface **18**. A hydrodynamic lift member **36**M and a hydroski **36**S can also be provided in a suite of hydrodynamic features designed to improve vehicle hydrodynamic attributes in waterborne and transition operations that include taxi and takeoff and landing on a water surface **18**. FIG. **9**A also shows a combined hydrofoil and hydroski **36**HS as an additional optional hydrodynamic feature not shown earlier in FIG. **1**A. The combined hydrofoil and ski **36**HS has a hydrofoil mounted near the aft end of a hydroski, with the combined unit mounted to a hull **54** through a actuator controlled deployment mechanism with a suspension included, such as a shock absorber or active control shock strut. The hydrofoil can serve as a surface penetrating hydrofoil for part of the transition mode **37**, if it has dihedral (as illustrated) that allows part of the hydrofoil to be below the waterline and part above the waterline. Fully submerged hydrofoil elements, subcavitating hydrofoil elements and/or supercavitating hydrofoil elements can optionally be used. This system can provide reduced ride quality adverse impacts and reduced loads for a landing derotation maneuver (known as ‘slapdown loads’ for a nose landing gear in airplane prior art) as well as enhancing ride quality when the PASRACS **1** might encounter a tall wave or a ‘rogue wave in the water surface **18**. Vehicle hydrodynamic attributes that can be optimized singly or in combination with specific optimization functions or relationships or objective functions, include drag reduction for all types of waterborne drag (including skin friction drag, wave drag, hydrodynamic lift induced drag, pressure drag, excrescence drag, and water surface wave and current related drag), hydrodynamic lift to help lift the PASRACS **1** up relative to the water surface **18**, contributing to vehicle control and navigation, and ride quality improvement to reduce vertical and lateral g forces on people on board when the PASRACS **1** is maneuvering and/or encountering disruptive forces from current and/or wave and/or floating object impacts. At speeds sufficiently low for operation of a subcavitating hydrofoil in subcavitating mode, increased hydrodynamic lift to drag ratio can be achieved by optimized design of the subcavitating hydrofoil including span, aspect ratio, lifting foil cambered section design, planform, taper, twist, dihedral and other known design parameters for hydrofoil design. It is important to note that controllable aerodynamic surfaces and controllable hydrodynamic surface can be used synergistically and in conjunction, with control algorithms or control laws in the vehicle motion control system (similar to a flight control system and flight navigation system in aircraft), enabling optimized performance and maneuvering for taxi, takeoff, landing, coordinated turns with appropriate vehicle bank angle, obstacle-avoidance maneuvers, passenger comfort and safety and other purposes. These will be discussed further with reference to FIG. **10** below on alternate preferred systems and controls architectures and features that can be applied on a partially aerostatically supported ram air cushion ship **1**.

[0282] FIG. **9**B shows a bottom plan view of a preferred embodiment of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, similar to the bottom plan view earlier shown and described in detail with reference to FIG. **1**B. FIG. **9**B shows some preferred aerodynamic and hydrodynamic features that can be applied on a partially aerostatically supported ram air cushion ship **1**. As in FIG. **9**A, representative surface areas of application of a laminar flow surface **14**L and a riblet surface **14**R are shown, without limitation. FIG. **9**B also illustrates the use of base suction flow orifices **14**B at representative locations at the trailing edge **84** and on the underside of the body **3** of the PASRACS **1** behind the body flaps **90**B. When the PASRACS has a positive airspeed **24** and the body flaps **90**B are deflected trailing edge down to set the aerodynamic Kutta condition at the trailing edge of the ram air cushion **20**, these locations for the base suction flow orifices **14**B are at sub-ambient pressure for aerodynamic flow reasons well understood in the art. These base suction flow orifices **14**B can be connected by tubing to laminar flow surfaces **14**L fitted with micropore holes to enable suction hybrid laminar flow facilitation without needing electrically powered suction fans. These base suction flow orifices **14**B can thus serve as enablers for non-powered hybrid laminar flow areas and/or body flow relaminarization for the PASRACS **1**. The base suction flow orifices **14**B behind the deployed body flaps **90**B can also act as base drag reduction enablers, to reduce the base drag caused by deflection of the body flaps **90**B acting aerodynamically at least in part as split flaps. FIG. **9**B also illustrates additional optional aerodynamic features, including and adjustable fairing **14**F, that can be deployed and adjusted to provide smooth aerodynamic fairing surface lofts and reduce excrescence drag at interfaces such as the illustrated interface between the bottom of the body of the PASRACS **1** and an emergency evacuation barge **47**E, for example and without limitation. FIG. **9**B also illustrates representative use of plasma flow actuators **14**P for one or more of aerodynamic flow control and/or active noise control. Exemplary locations are shown around a propulsor nacelle **28**N, while many other locations of application on the surfaces of a PASRACS **1** are possible. FIG. **9**B also illustrates exemplary applications of a morphing control surface **90**M at representative locations at the leading edge of the keel ventral stabilizer **88**K and at the strake leading edges of the wing **61** at side of body interfaces, for aerodynamic flow control purposes. Morphing control surfaces **90**M may utilize a variety of actuation systems known from prior art including mechanical actuation systems and shape memory alloy actuation systems. Morphing control surfaces **90**M can also be beneficially used to morph surface lofts of portions of the aerodynamic surfaces of the PASRACS **1** to improve transonic area-ruling of the PASRACS **1** vehicle and thus reduce its compressibility drag when flying at higher speeds between normal cruise speed and maximum cruise speed. FIG. **9**B also illustrates the use of ice protection subsystems **88**P, that may comprise anti-ice subsystems and/or de-ice subsystems and/or scraper subsystems and/or washer subsystems that inhibit growth of ice on the external surfaces of the PASRACS **1** and/or act to remove ice on the external surfaces of the PASRACS **1**. External icing is a known hazard to heavier-than-air aircraft and airships and even to wind turbine blades are well known in the prior art, and a variety of anti-icing and de-icing have been successfully applied in the prior art, including weeping fluids such as glycol, electrical heating, vibration and scraping and/or washing. FIG. **9**B illustrates representative applications of ice protection subsystems in forward facing regions near the flight deck/cockpit **31**C and body **3** and wing **61** and wing tip fence **61**T and horizontal stabilizer **88**H and stabilizer endplate **88**E and vertical stabilizer **88**V, for example and without limitation. It should be understood that ice protection requirements and objectives for different parts of the surfaces of a PASRACS **1** will depend strongly on the specific geometry and flow physics and operation envelopes applicable to each particular design, with tailored application of ice protection subsystems to be made in specific manners as needed and appropriate to each particular design of a PASRACS **1**.

[0283] FIG. **9**B also shows representative hydrodynamic features in a manner similar to FIG. **9**A, including use of a hull **54**, a hydrodynamic planing surface **36**P, a step **36**T, plural hydroskis **36**S and a combined hydrofoil and ski **36**HS. Differential deployment of the plural hydroskis **36**S can be used to adjust pitch trim, heave trim and roll trim while the PASRACS **1** is moving on a water surface, as well as for passive and/or active ride quality control and enhancement. As in FIG. **9**A, the bottom ends of the keel ventral stabilizer **88**K and the body side flaps **90**S will also preferably include lofting beneficially appropriate for them to contribute as hydrodynamic features (in addition to their aerodynamic primary purposes) as and when they contact the water surface.

[0284] FIGS. **10**A through **10**E show block diagrams of some alternate preferred systems and controls architectures and features that can be applied on a partially aerostatically supported ram air cushion ship **1**, including the preferred embodiment earlier described in detail with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. Each system or subsystem can incorporate a computer or processor, hardware and software, programmable and modular components, diagnostic and health management, and redundancy and redundancy management as known from the prior art of system and subsystem design, fabrication and operation.

[0285] FIG. **10**A illustrates a system architecture block diagram of a motion control system comprising a vehicle control and automatic control system **29** for a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. The vehicle control and navigation system **29** can be configured to enable said PASRACS **1** to move and maneuver on a travel path **24**T (such as that shown earlier in FIG. **1**B) in accordance to commands **30** received from at least one of a crew input device **31** and an autoflight command system **32**, as well as to enable other things as will be described below. The vehicle control and navigation system **29** is shown with system redundancy **1**R with a redundancy level of 5 illustrated. Note that the level of redundancy of the illustrated vehicle control and navigation system **29** and the level of redundancy of the other boxes shown in FIG. **10**A are all shown as representative and are not to be construed as limiting the invention to specific values of system redundancy for any illustrated item. It will be understood that the art and science of redundancy and redundancy management to improve fault tolerance and the ability of a vehicle and its systems to operate normally or with some limitations, following one or more failures of various kinds, is based on well-established precedents in the design of prior art vehicles such as airliners, for example. The vehicle control and navigation system **29** receives inputs from at least one crew input device **31** and at least one sensor **22**, and sends output to at least one effector **60**, as illustrated. The crew input device **31** can be any of numerous crew input devices known from the art of transport vehicles, including without limitation: a control column (as for example for a pitch control command in an aircraft), a control wheel (as for example a roll control command in an aircraft), a sidestick controller (as for example for pitch and roll control commands in an aircraft), a stick controller (as for example for pitch and roll control commands in an aircraft), rudder pedals or a tiller or a steering wheel (as for example for directional or yaw control commands in a vehicle), a throttle (as for example for a thrust control command in an aircraft), a brake command or reverse thrust control input device as for example to command braking or regenerative braking or reverse thrust in a vehicle), a heave or direct lift or vertical motion input device (such as a collective pitch control input device on a helicopter), a side force or sideways motion command input device with associated side force limiter, a control knob, a switch, a control lever, a hand-operated input device, a finger operated input device, a foot operated input device, a touchscreen device for crew input, a voice actuated input subsystem, and a thought actuated input subsystem. Note that for each architectural block shown in this architectural diagram, the types and numbers of each block may vary over a wide range and should not be construed to be limited to the notional representation of **5** architectural blocks (of each type) shown behind one another for illustrative purposes. For example, a PASRACS **1** may have two pilot input stations corresponding to a pilot station and a copilot or first officer station in a manner similar to that found in two-pilot airliners, each with a pitch input device, roll input device, and yaw input device, and with each device potentially having multiple redundant input sensor devices such as a linear variable differential transformer (LVDT) or rotary variable differential transformer (RVDT), for example and without limitation. The use of redundancy and redundancy management to ensure high levels of fault tolerance and continued operation following faults or failures, is well known in the art and can be applied for PASRACS **1** vehicles in a manner similar to prior art on other vehicles such as airplanes, helicopters, airships, spacecraft, ships and marine craft, automobiles and other road vehicles, and rail or tracked vehicles. The design and application of the vehicle control and automatic control system **29** and of the other systems shown in FIG. **10**A can incorporate redundancy and redundancy management in sensors, actuators, analog control devices, digital control devices, electronic devices, computational devices, avionics, software, microprocessors, processors and hardware devices, as known in the prior art. The vehicle control and automatic control system **29** will enable both manual control of the motion, configuration and operation of a PASRACS **1** as commanded by the flight crew through crew input devices **31** and automatic control of the motion, configuration and operation the PASRACS **1**. The automatic control portion of the vehicle control and automatic control system **29** can include automatic emulations of piloted controls for many routine and some nonroutine operations of the PASRACS **1**, as known from the prior art of autopilot, autoflight, and automatic control systems for transport vehicles. For example and without limitation, automatic control examples may include cruise segment navigation with inputs from the communication and navigation system **172** that includes flight management functionality. Autoland functionality for smooth and safe landings of the PASRACS **1** on a water surface **18** as described earlier in the context of FIGS. **1** and **2**, auto takeoff, and obstacle or hazard avoidance such as applying direct lift control to increase flight height in ground effect to effectively “jump” over a floating obstacle or hazard such as a fish, marine mammal, log, swimmer, kayaker, canoe, boat, ship or other marine vehicle. The vehicle control and automatic control system **29** will preferably include a weight, balance and trim control subsystem **29**T, that will be described further with reference to FIG. **10**B following, and a stability management and vehicle protection subsystem **29**S, that will be described further with reference to FIG. **10**C following. The weight, balance and trim control subsystem **29**T is intended to enable safe and efficient operation of the PASRACS **1** even in the presence of a variety of loading conditions that can also change over the course of a vehicle trip. As shown in FIG. **10**A, outputs from the vehicle control and automatic control system **29** include outputs sent to plural effectors **60**. These plural effectors **60** can comprise one or more effectors selected from a wide variety of effectors known from the prior art, including actuators, linear actuators, rotary actuators, complex motion effectors combining at least one of an actuator and motor and at least one of a linkage and a gear and a drivetrain, electrical actuators, hydraulic actuators, electrohydraulic actuators, electromechanical actuators, pneumatic actuators, servoactuators, solenoids, thermal actuators, shape memory actuators, magnetic actuators, piezoelectric actuators, fluidic actuators, carriers, robotic effectors, robotic arms, grippers, lifters, robots, soft actuators, synthetic muscles, motors, stepper motors, gearmotors, pumps, valve actuators, fans, and screw jacks. For the PASRACS **1** configuration described in detail with reference to FIGS. **1**A through **1**G and **2**A through **2**F, the effectors **60** shown in FIG. **10**A can act on a plurality of members including but not limited to: a controllable aerodynamic surface **90**, an elevator **90**E, an aileron **90**A, a rudder **90**R, a flap **90**F, a body flap **90**B, a side flap **90**S, an aerodynamic lift subsystem **19**, a wing **61**, a horizontal stabilizer **88**H, a stabilizer endplate **88**E, a vertical stabilizer **88**V, a keel ventral stabilizer **88**K, a control device connected to a laminar flow surface **14**L, a hydrodynamic lift member **36**M configured to generate a hydrodynamic lift force **36**, a hydroski **36**S, a controllable device acting on at least one of weight **33** and on ballast in a ballast volume **33**B, a controllable member of a propulsion system **26** such as a blade pitch control device, a thrust control device, a reverse thrust control device, a vectored thrust control device, and a fluid dynamic propulsor **55**, a controllable device acting on energy **27**, a controllable device acting on at least one of lifting gas **9** and a lifting gas enclosure **8** and a ballonet **91**, a control device acting on a hydrostatic floatation system **15**, a control device acting on a ram air cushion **20**, a control device acting on ship structure **2**, a control device acting on a hull **54**, a control device acting on or for the benefit of any person or item of payload **7** (e.g. elevator **143**E and freight elevator **143**F), and a control device acting on a payload transfer transport module **47**, all without limitation.

[0286] FIG. **10**A shows that the above described vehicle control and automatic control system **29**, is connected by a data transmission member **168** to multiple systems, comprising an energy management system **170**, a safety & security system **171**, a communication & navigation system **172**, a monitoring & alert system **173**, a maintenance & repair system **174**, a payload services system **175**, a crew services system **176**, an environmental control system **177**, an onboard inventory system **178**, and external interfaces system **179**, an integration & optimization system **180** and a terminal operations system **181**, each and all without limitation. Note that design, operation and functioning of different systems can vary and that different systems could have varying boundaries and potential areas of overlap or joint responsibility, with appropriate coordination and prioritization amongst the systems. The data transmission member **168** could be at least one of: a parallel or serial databus, a bidirectional or unidirectional or multidirectional databus, an electrical databus or optical databus, a fly-by-wire link, a fly-by-light link, a direct optical link, a vehicle databus, an avionics databus, an Ethernet bus, an ARINC databus, a CAN bus, a LIN bus, a FlexRay databus, a Mil-Std databus, a critical databus, an essential databus, and a nonessential databus, for example and without limitation.

[0287] The energy management system **170** will be explained in further detail later with reference to FIGS. **12**A through **12**E that show block diagrams of some alternate preferred fuels, propulsion and energy architectures and features that can be applied on a partially aerostatically supported ram air cushion ship **1**.

[0288] The safety and security system **171** can comprise at least one of: lockable/secure door systems, detection of a safety threat, response to a safety threat, detection of a security threat, response to a security threat, systems redundancy and separation for survival of threats including a bomb blast threat, emergency management, fire protection, hazard protection, lightning protection, electromagnetic effects (EME) protection, electromagnetic pulse (EMP) protection, ice and rain protection, sand and ash protection, pollution and chemical hazards protection, meteorological hazard protection, vehicle protection, human occupant protection, injury prevention or inhibition, death prevention or inhibition, animal protection (including collision probability reduction with optical/electromagnetic/sonic warning systems to scare off or otherwise reduce collision risk with birds, marine mammals, fish, and other animals), plant protection, pervasive cameras plus mirrors and life form monitoring sensors and other monitoring subsystems, digital tags and/or trackable wristbands for all people on board, safety monitoring, security monitoring, expert system for safety, expert system for security, antiterrorist expert system and remote monitoring and robotic remediation system, artificial intelligence (AI) for safety, AI for security, safety crew, first responders, emergency responders, security crew, police crew, firefighters, bomb and explosives squad, detention management crew, safety robots and security robots, without limitation. Fire protection systems can include robotic firefighting vehicles, fire trucks, crew trained in firefighting, fire containment deployable partitions, halon and water misting and spray and other fire suppression systems, fire hydrants, fire extinguishers, kitchen fire detection and suppression subsystem, cargo fire and smoke detection and suppression subsystem, use of potable water, use of sea water, and use of fire suppression foam, without limitation.

[0289] The communication and navigation system **172** can comprise at least one of: an autoflight command system **32**, a radio, an electromagnetic communication device, a transmitter, a receiver, a wireless communication subsystem, a wired communication system, an optical fiber communication system, a laser communication system, a transponder, a traffic collision avoidance system (TCAS), a landing guidance system, an instrument landing system (ILS) or microwave landing system (MLS) or GPS landing system (GLS), a takeoff guidance system, a ground track guidance system, an en-route guidance system, a marine navigation system using sonar, a map and compass navigation system, a dead reckoning system, an inertial navigation system, a celestial navigation system, a satellite navigation system, an electronic route guidance system, a 4-D path (x,y,z.t) guidance system, a personal navigation assistant (PNA), a global positioning system (GPS) and a differential GPS.

[0290] The monitoring and alert system **173** can comprise at least one of: a sensor, instrumentation, a display, a warning, a caution, an advisory, a doppler radar, radar, a radio altimeter (RADALT), a wave sensor, an obstacle sensor, a video sensor with some sensed frequency range, a pattern recognition subsystem, a weather sensor or weather sensors for monitoring and alerting for many conditions (including but not limited to temperature, humidity, winds and gusts, Beaufort wind force scale, Beaufort sea state scale, Douglas sea and swell scale, windshear, reduced visibility, fog, low cloud ceiling, thunderstorms, lightning, turbulence, clear air turbulence, wave conditions, spray conditions, sand in the air, ash in the air, cyclone, typhoon, hurricane, Saffir-Simpson hurricane wind speed scale, tornado, tsunami, Tsunami Intensity Scale, freezing conditions, sleet, hail, and icing), a lookahead sensor, a health monitoring subsystem, a condition monitoring subsystem, a structures monitoring subsystem, a systems monitoring subsystem, an aerodynamic monitoring subsystem, a hydrodynamic monitoring subsystem, a surface condition monitoring subsystem (for skin, riblets, applique, EME layer, paint, etc), a video monitoring subsystem, a contamination monitoring subsystem, a biofouling monitoring subsystem, a visual alert subsystem, a display, a an aural alert subsystem, a speaker, a synthetized voice alert subsystem, a passenger monitoring subsystem, and a passenger alert subsystem. The passenger alert system may include visual and/or aural alerts for situations that may require passenger awareness, such as a brace warning or stay seated or stay belted warning for situations such as encountering severe turbulence or severe waves or the flight crew performing an emergency collision avoidance maneuver.

[0291] The maintenance and repair system **174** can comprise at least one of: a maintenance crew member, a repair crew member, a maintenance sensor, a maintenance computer, a maintenance management crew interface, a maintenance effector, a maintenance robot, a corrosion remediation subsystem, a repair diagnostic subsystem, a repair parts management subsystem, a repair effector, and a repair robot.

[0292] A payload services system **175** can comprise at least one of: a passenger service subsystem, a passenger concierge subsystem, an Internet of Things (IoT) subsystem, a passenger money management subsystem, a passenger health subsystem, a passenger wellness subsystem, a passenger comfort subsystem, a passenger entertainment subsystem, a passenger amenity subsystem, an operable passenger feature, a live animal carriage service subsystem, a baggage subsystem, a container subsystem, a cargo subsystem, and an oversize cargo subsystem.

[0293] A crew services system **176** can comprise at least one of: a flight crew service subsystem, a cabin crew service subsystem, an operational crew service subsystem, a freight crew service subsystem, a maintenance crew service subsystem, a repair crew service subsystem, a food & beverage crew service subsystem, a custodial crew service subsystem, a crew health & wellness subsystem, a crew eating subsystem, a crew accommodation subsystem, a crew amenities subsystem, a crew entertainment subsystem and a crew training subsystem.

[0294] An environmental control system **177** can comprise at least one of: a heating subsystem, a cooling subsystem, a heat pump subsystem, a skin heat exchanger subsystem, a ventilation subsystem, a fresh air subsystem, a controllable flow inflow scoop, a controllable flow outflow valve, a recirculated air subsystem, a filtration subsystem, a HEPA filter subsystem, a UV purification subsystem, a humidity management subsystem, an air quality enhancement subsystem, a water purification subsystem, a water quality enhancement subsystem, a lighting subsystem, an interior noise management subsystem, a thermal insulation subsystem, a noise insulation subsystem, and an active noise control subsystem.

[0295] An onboard inventory system **178** can comprise at least one of: a supply management system, an inventory management system, a vehicle configuration specification file system, a sensor, a computer, a database, a crew interface, a passenger interface, a loading on and loading off command system, an inventory handling robot, a loading on and loading off items handling system, a storage system, a retrieval system, an internal movements management system, an ordering system, a just-in-time (JIT) inventory system, and a kanban system.

[0296] An external interfaces system **179** can include at least one of: a mating system for a payload transfer transport module **47**, an unmating system for a payload transfer transport module **47**, an outward command and control subsystem, an inward command and control subsystem, a remote pilot subsystem, a remote medical subsystem, a medevac subsystem and an external security interface subsystem.

[0297] A terminal operations system **181** can include at least one of: a harbor pilot subsystem, a terminal area control subsystem, a multientity deconflicting subsystem, a taxi guidance subsystem, a terminal collision prevention subsystem, an inbound track vector subsystem and an outbound track vector subsystem. Further detail on terminal operations will be presented subsequently with reference to FIGS. **14**A through **14**F that illustrate some alternate preferred methods of operation that can be applied for normal and nonnormal operations of a partially aerostatically supported air cushion ship **1**.

[0298] Finally, an integration & optimization subsystem **180** can include at least one of: connection and integration of plural systems and/or subsystems, and optimization of plural systems and/or subsystems wherein “optimization” can be relative to a wide variety of objective functions or measures of merit, and can include built-in prioritization and deconfliction as appropriate.

[0299] FIG. **10**B illustrates a weight, balance and trim control subsystem **29**T that is part of the vehicle control and automatic control system **29** earlier described with reference to FIG. **10**A.

[0300] As illustrated in FIG. **10**B, a suite of sensors **22** can comprise a variety of sensor types along with processing and integration of sensor outputs. The types of sensors can include, without limitation, air data **22**A (e.g., static pressure, dynamic pressure, impact pressure, pitot tube pressure, airspeed, altitude, wind data, windshear data, turbulence data, air temperature data, humidity data, particulates data); water data **22**W (e.g., water static pressure, water dynamic pressure, water speed, water current, water depth, wave height, wave spacing, wave speed, wave direction, water temperature, water salinity, water purity, water particulates, ice particulates, ice masses, ice layer); inertial data **22**N (e.g., accelerometers in all axes, gyros in all axes,); electromagnetic data **22**E (e.g., cameras, **1**R cameras, UV cameras, custom frequency cameras, optical sensor data, camera pattern recognition data, radar, astronomical sensor data, EME data); satellite data **22**S (e.g., GPS data, differential GPS data, navigation satellite data,); acoustic data **22**C (e.g., noise data, noise cancellation data, noise damping data, frequency data, spectral data, sonar, pattern data and processed data); operational data **22**P (vehicle internal position sensors, motion sensors, discrete data, mode identification data, non-normal identification data); and data processing & integration **22**D that allows and performs fusion of multiple data sources along with integration and synthesis of desired synthesized and forecast data. The sensors **22** provides data and information to the weight, balance and trim control subsystem **29**T that is part of the vehicle control and automatic control system **29**, and also to other systems connected to the data transmission member **168**, as illustrated in FIG. **10**B.

[0301] Using inputs from the crew input devices **31** and the sensors **22**, the weight balance and trim control subsystem **29**T accomplishes estimation and control functions using plural incorporated subsystems, these being a vehicle mass & weight estimator **29**W (that can use one or more of a bottoms-up buildup starting with manufacturer's empty weight; a trim estimation using a summation of estimates for aerostatic lift+aerodynamic lift+hydrostatic lift+hydrodynamic lift; an inertial method estimation from measured delta acceleration having a defined mathematical relation such as measured force such as thrust or lift divided by mass, or increment variants thereof; build-ups and integration from an array of strain gages and/or load sensors and/or water displacement sensors and/or air displacement sensors and/or air pressure sensors and/or water pressure sensors and/or weighbridges and/or suspension cable tension sensors on cables supporting payload transfer transport modules or other suspended modules; state space estimator algorithms and back-solve methods based on modeled vehicle response functions to control surface deployments; and hybrid methods combining multiple sub-methods); a vehicle moments of inertia estimator **29**M (that can use one or more of a bottoms-up buildup method; an inertial method estimation from measured delta angular acceleration having a defined mathematical relation such as measured moment divided by a moment of inertia; state space estimator algorithms and back-solve methods based on modeled vehicle response functions to control surface deployments; and hybrid methods combining multiple sub-methods); a vehicle balance estimator & controller **29**B; a kinematics estimator & controller **29**K (that can use: inputs from one or more of linear variable differential transformers or LVDTs, rotary variable differential transformers or RVDTs, video sensors and other sensors, and crew input device(s) **31**; control laws; and command outputs to effectors **60**); a dynamics estimator & controller **29**D (that can use: inputs from one or more of linear variable differential transformers or LVDTs, rotary variable differential transformers or RVDTs, force sensors, load sensors, video sensors and other sensors, and crew input device(s) **31**; control laws; and command outputs to effectors **60**); a longitudinal trim system **87** (that can define a target longitudinal trim condition using inputs from crew input device(s) **31** and sensor(s) **22**; that can estimate actual longitudinal trim condition using inputs from sensor(s) **22** and longitudinal trim computations; that can implement control laws to drive actual longitudinal trim condition towards matching the target longitudinal trim condition in a desired manner; and that can issue command outputs to effectors **60** that can affect longitudinal trim); a lateral trim system **93** (that can define a target lateral trim condition and target directional trim condition using inputs from crew input device(s) **31** and sensor(s) **22**; that can estimate actual lateral trim condition and directional trim condition using inputs from sensor(s) **22** and lateral/directional trim computations; that can implement control laws to drive actual lateral trim condition towards matching the target lateral trim condition and actual directional trim condition towards matching the target directional trim condition both in a combined desired manner; and that can issue command outputs to effectors **60** that can affect lateral trim and directional trim); and an objective functions estimator & controller **29**F (that can define objective functions based on inputs from crew input device(s) **31** and sensor(s) **22**; that can estimate deviations from the objective functions; that can implement control laws that work to minimize deviations in a desired manner; and that can issue command and optimization outputs to effectors **60** directly and/or indirectly through outputs to other control systems, control subsystems and controllers). The vehicle balance estimator & controller **29**B comprises plural incorporated subsystems, these being an aerostatic estimator & controller **10**E (that uses: inputs from crew input device(s) **31** and sensor(s) **22**; estimator to estimate actual aerostatic lift force and moments from each aerostatic lift member that comprises an encompassed lifting volume **9**E with associated effects of lifting gas, ambient conditions and ballonet **91** as applicable; control laws to generate aerostatic lift commands and generate resultant outputs to effector(s) **60** acting on each aerostatic lift member as well as on ballonets and on interconnect pipes or tubing with valves and pumps); an aerodynamic estimator & controller **25**E (that uses: inputs from crew input device(s) **31** and sensor(s) **22**; estimator to estimate actual aerodynamic forces and moments from each aerodynamic member that interfaces with the atmosphere **14** at ambient conditions as applicable; control laws to generate aerodynamic commands and generate resultant outputs to effector(s) **60** acting on each aerodynamic member); a hydrostatic estimator & controller **17**E (that uses: inputs from crew input device(s) **31** and sensor(s) **22**; estimator to estimate actual hydrostatic lift force and moments from each hydrostatic lift member that such as a hull **54** with associated effects of displacement and water properties and ambient conditions as applicable; control laws to generate hydrostatic lift commands and generate resultant outputs to effector(s) **60** as applicable acting on each hydrostatic lift member); a hydrodynamic estimator & controller **36**E (that uses: inputs from crew input device(s) **31** and sensor(s) **22**; estimator to estimate actual hydrodynamic forces and moments from each hydrodynamic member that interfaces with water near a water surface **18** at water properties and ambient conditions as applicable; control laws to generate hydrodynamic commands and generate resultant outputs to effector(s) **60** acting on each hydrodynamic member such as at least one of a hull **54** and a hydrodynamic planing surface **36**P and hydrodynamic lift member **36**M and hydroski **36**S and hydrofoil **36**H a step **36**T, without limitation); and a CG estimator & controller **29**C (that can define a target center-of-gravity or CG location or envelope of CG locations using inputs from crew input device(s) **31** and sensor(s) **22**; that can estimate actual CG location using inputs from sensor(s) **22** and the aerostatic estimator & controller **10**E and the aerodynamic estimator & controller **25**E and the hydrostatic estimator and controller **17**E and the hydrodynamic estimator and controller **36**E and the longitudinal trim system **87** and the lateral trim system **93**; and that can implement control laws to drive the actual CG location towards matching the target CG location or to drive the actual CG location to fall within said envelope of CG locations in a desired manner; and that can issue command outputs to effectors **60** that can affect CG location either directly or indirectly through a cargo handling system **43**S, potable water system **92**C, waste system **92**G, ballast system **33**B, fuel system **82**, and fuel transfer system **82**S, as illustrated and without limitation).

[0302] The outputs from the weight balance and trim control subsystem **29**T along with other outputs from the vehicle control and automatic control system **29**, comprise plural outputs to plural effectors **60**, as illustrated in FIG. **10**B. Examples of effectors **60** can be a variety of effector and actuator types, including those creating one or more of desired linear and rotary NS complex motions powered by one or more of electrical power and a mechanical linkage and a cable and a pushrod and hydraulic power and pneumatic power and a servo and a fluid dynamic control tab such as an aerodynamic control tab or hydrodynamic control tab. Effectors **60** can serve to position or move a variety of items described and shown earlier in FIGS. **1**A through **1**G and **2**A through **2**F, said items including but not limited to: a controllable aerodynamic surface **90**, an elevator **90**E, an aileron **90**A, a rudder **90**R, a flap **90**F, a body flap **90**B, a side flap **90**S, an aerodynamic lift subsystem **19**, a wing **61**, a horizontal stabilizer **88**H, a stabilizer endplate **88**E, a vertical stabilizer

88V, a keel ventral stabilizer **88**K, a control device connected to a laminar flow surface **14**L, a hydrodynamic lift member **36**M configured to generate a hydrodynamic lift force **36**, a hydroski **36**S, a controllable device acting on at least one of weight **33** and on ballast in a ballast volume **33**B, a controllable member of a propulsion system **26** such as a blade pitch control device, a thrust control device, a reverse thrust control device, a vectored thrust control device, and a fluid dynamic propulsor **55**, a controllable device acting on energy **27**, a controllable device acting on at least one of lifting gas **9** and a lifting gas enclosure **8** and a ballonet **91**, a control device acting on a hydrostatic floatation system **15**, a control device acting on a ram air cushion **20**, a control device acting on ship structure **2**, a control device acting on a hull **54**, a control device acting on or for the benefit of any person or item of payload **7** (e.g. elevator **143**E and freight elevator **143**F), and a control device acting on a payload transfer transport module **47**, all without limitation.

[0303] FIG. **10**C illustrates further details of a stability management and vehicle protection subsystem **29**S. The stability management and vehicle protection subsystem **29**S is, like the weight balance and trim control subsystem **29**T, a part of the vehicle control and automatic control system **29**, as described earlier with reference to FIG. **10**B. FIG. **10**C shows that the stability management and vehicle protection subsystem **29**S includes a stability subsystem **29**SS, a protection subsystem **29**SP and a redundancy management subsystem **29**SR. The stability subsystem **29**SS comprises a longitudinal subsystem **29**S**1**, a lateral/directional subsystem **29**S**2**, an interactions subsystem **29**S**3** and an optimization subsystem **29**S**4**. The protection subsystem **29**SP comprises an accident avoidance subsystem **29**S**5**, a terrorist defeating subsystem **29**S**6**, an envelope protection subsystem **29**S**7**, and environmental protection subsystem **29**S**8** and an accident survival subsystem **29**S**9**, and may optionally further include additional protection subsystem(s) to contribute to protection of passengers, crew and other life forms for a variety of normal and nonnormal operations and scenarios. As shown in FIG. **10**C, the stability management and vehicle protection subsystem **29**S is connected to data transmission member **168** such as one or more databuses, and outputs from the stability management and vehicle protection subsystem **29**S flow to plural other systems and also flow to effectors **60**. The stability subsystem **29**SS can provide one or more of stability augmentation, artificial stability, and natural stability attributes modification, for all operation modes including flight, flight in ground effect, flight with intermittent or partial water surface contact, takeoff, landing and on-water operation. The longitudinal subsystem **29**S**1** contributes to stability attributes and dynamic behavior of the PASRACS **1** in pitch, heave and fore-and-aft motion. The lateral/directional subsystem **29**S**2** contributes to stability attributes and dynamic behavior of the PASRACS **1** in roll, yaw and side-to-side motion. Note that dynamic behavior encompasses both rigid-body dynamics and dynamics of a wide variety of flexible modes such as structural dynamic modes and dynamic modes involving control surfaces in contact with the air and/or the water under the vehicle, including dynamic effects from maneuvering, controls and external variations such as winds, gusts, windshear, precipitation (e.g., rain, hail, sleet), waves, current, tides and impacts from particles (e.g., dust, ash, sand, spray, debris, bird droppings, birds). The interactions subsystem **29**S**3** manages coupling and interactions between the longitudinal subsystem **29**S**1**, the lateral/directional subsystem **29**S**2**, and other subsystems as illustrated in FIG. **10**C. Examples of effects that can be managed by the interactions subsystem **29**S**3** include Coriolis force effects and pitch-roll coupling & pitch-yaw coupling arising from gyroscopic effects, without limitation. The optimization subsystem **29**S**4** can operate to optimize one or more objective function by modifying, varying or overriding outputs to effectors **60** or other systems shown. As one example, maintaining stability while performing a commanded maneuver may be accomplished with multiple alternate command sets to propulsors and control surfaces, and the optimization subsystem **29**S**4** may select a “most preferred” command set that optimizes an objective function that may be characterized by a parameter such as (i) minimizing vehicle drag, (ii) minimizing parasite power needed for commanded movements of the control surfaces, (iii) a linear combination of (i) and (ii), or (iv) a linear combination of (i), (ii) and other specified optimization parameters or variables.

[0304] The redundancy management subsystem **29**SR is intended to furnish redundancy management for redundant (plural and/or alternative) components and subsystems such as power wires, data wires or optical fibers, databuses, sensors, transducers and actuators is well-known in the prior art of high-reliability, fault-tolerant and fail-operational architectures and designs for commercial airliners and other advanced vehicles and technological systems. Redundancy management is for critical, essential and nonessential systems, subsystems and components is also well-known from the prior art, and includes signal selection and failure detection (SSFD) such as median-selection or equalized median-selection with failure detection thresholds, algorithmic or deterministic redundancy management, expert system and artificial intelligence aided redundancy management, and flight crew overridable redundancy management such as deliberate selection of simple deterministic highly reliable analog links such as direct electrical or optical links to control surfaces following the occurrence of complex or undiagnosable failure scenarios.

[0305] The accident avoidance subsystem **29**S**5** is configured to enable the PASRACS **1** to conduct normal and nonnormal operations whilst avoiding any accident, where examples of an accident include a collision with a living being (e.g. a birdstrike hitting or being hit by a bird in flight or fish/marine mammal/swimmer strike hitting or being hit by a living being in the water or hitting a tree on land), a collision with an object (e.g., hitting or being hit by another vehicle such as another aircraft or watercraft, hitting or being hit by debris in the air or water such as a floating log, hitting a fixed object such as a floating pier or drilling rig or offshore wind turbine or onshore building), flight into terrain such as controlled flight into terrain, a landing-related accident, a takeoff related accident, a terminal operations accident, a loading accident and an unloading accident. The accident avoidance subsystem **29**S**5** will preferably include functionality from prior art aircraft accident avoidance subsystems including one or more examples without limitation such as an Air Traffic Control (ATC) system, Automatic Terminal Information Service (ATIS), a Traffic Collision Avoidance System (TCAS) system or Airborne Collision Avoidance System (ACAS), Automatic Dependent Surveillance-Broadcast (ADS-B), a warning or avoidance system for Controlled Flight Into Terrain (CFIT) such as a Ground Proximity Warning System (GPWS) or Terrain Awareness Warning System (TAWS), Short Term Conflict Alert (STCA), navigation lights with right-of-way rules, and a tiered warning and caution and advisory system to alert flight crew of different categories of actual or impending danger or threat. The accident avoidance subsystem **29**S**5** will preferably also include functionality from marine accident avoidance subsystems including one or more examples without limitation such as shipping lane definition and marking, radio and sonar, dive detection sonar, doppler radar, swimmer detection system, an infrared swimmer detection system, a computer vision system, a sensing and neural network system for marine mammal detection, warning siren/fog horn, Machine Vision for Safety at Sea (SEA.AI or OSCAR), and International Regulations for Preventing Collisions at Sea (COLREGs) with associated collision avoidance decision support schemes, an improved artificial potential field (IAPF) method and nonlinear model predictive control (NMPC) algorithm. The accident avoidance system **29**S**5** may also optionally incorporate elements from prior art land vehicle accident avoidance systems, including without limitation one or more selected from forward looking sensors, radar, LIDAR, ultrasonic sensors, cameras with image recognition, a night vision system, a blind spot monitoring system, a pedestrian/bicyclist/person detection system, a forward collision warning (FCW) system, a cross traffic warning system, a pre collision system (PCS), an automatic emergency braking system (AEBS), a lane-holding system, an emergency steering function (ESF) and an autonomous driving system.

[0306] The terrorist defeating subsystem **29**S**6** will preferably include features and technologies from the prior art of detecting, detaining and/or defeating a terrorist or “bad actor” person or persons or entity that may comprise, without limitation, one or more of a politically motivated terrorist, a religiously motivated terrorist, a jihadist, a suicidal person, a mentally unhinged person, a maniac, an angry armed person, a vengeful armed person, a depressed armed person, an impaired armed person, a villain, an anarchist, a criminal, a vandal, and a person who wishes to cause harm or hurt or death. The terrorist defeating subsystem **29**S**6** can include features and technologies from the prior art such as screening sensors, technologies and methods, Transportation Security Administration (TSA) sensors, technologies and methods, enforcement of policies prohibiting carriage of arms or weapons or dangerous goods, on board security personnel and robots with nonlethal (e.g. TASER) and lethal (e.g., firearm) armaments, continuous tracking or each person on board using retina scans and person identifiers and pervasive detection sensors and video cameras, detention and expulsion devices and methods (e.g., zipties, handcuffs, conefinement cells and jettisonable lifeboats to eject captured terrorists from the PASRACS **1**) and advanced methods such as NATO's DEXTER (Detection of EXplosives and firearms to counter TERrorism) leveraging advancements on sensors, detection and artificial intelligence.

[0307] The envelope protection subsystem **29**S**7** will preferably include features and technologies from the prior art of aircraft or vehicle envelope protection systems and envelope limiting systems, which may include at least one of: a normal load limiting system that limits normal load factor for maneuver and/or gust loads, a normal load protection system that inhibits crew command of normal load factor outside normal limits without an overriding force level or an override control or switch, a load limiting system that limits an other load factor for maneuver and/or gust loads, a load protection system that inhibits crew command of an other load factor outside normal limits without an overriding force level or an override control or switch, a water contact load limiting system, a water contact load protection system, an angle of attack limiting system, an angle of attack protection system, a stall protection system, a stall prevention system, a stall recovery system, a sideslip limiting system, a sideslip protection system, a pitch rate limiting system, a pitch rate protection system, a pitch-roll diagram limiting envelope for normal operations, a heave limiting system, a heave protection system, an airspeed limiting system, an airspeed protection system, a water speed limiting system, a water speed protection system, a roll rate limiting system, a roll rate protection system, a roll angle protection system, a yaw rate limiting system, a yaw rate protection system, a ride quality envelope limiting system, a ride quality envelope protection system (e.g. that inhibits vertical acceleration magnitude and spectral density and lateral acceleration magnitude and spectral density within specified boundaries, such as the International Standards Organization or ISO ride quality criteria boundaries), a ride quality enhancement system, a wing load alleviation system, a tail load alleviation system, a water alighting load alleviation system, a control surface load limiting system, a control surface load alleviation system, a structural modes limiting system, a structural modes modification system, and a component failure avoidance system using component retraction or reconfiguration. A ride quality enhancement system may also incorporate a roll damper, yaw damper, turn coordinator, pitch damper, heave damper, longitudinal acceleration damper, jerk limiter (where jerk is a time derivative of acceleration), dutch roll damper, coupled motions damper, and modal suppression damper as elements of its portfolio of subsystems.

[0308] The environmental protection subsystem **29**S**8** will preferably include features and technologies from the prior art of aircraft or vehicle environmental protection systems, including at least one of: windshield wipers, windshield water protection, windshield defogger, deicing feature, anti-icing feature, surface protection for rain, surface protection for sleet, surface protection for hail, surface protection for water impact, surface protection for ash (e.g. from an erupting volcano), surface protection from sand (e.g. from a sandstorm or sirocco), lighting strike protection that may include conductive mesh or other Faraday Cage members around human occupied volumes, electromagnetic effects (EME) protection, electromagnetic pulse (EMP) protection, birdstrike protection, fish and marine mammal strike protection, airborne debris protection, waterborne debris protection, and corrosion protection.

[0309] The accident survival subsystem **29**S**9** will preferably include features and technologies from the prior art of aircraft or vehicle accident survival systems and inventions, including at least one of: impact absorption subsystems (e.g., crushable structures, bumpers, shock struts, hydraulic members, pneumatic members, spring members, damper members, cowcatcher type members), shatterproof transparencies, crash load limiting members supporting seats and furnishings used by people on board, belts such as seatbelts and bed belts, handholds, railings, straps, airbags and personal protection items such as lifejackets, helmets or other protective gear, smoke detection system such as a photoelectric smoke detector, gas leak detection systems, fire detection and fire suppression systems, fire door systems, sprinklers, escape slides, escape chutes, slide-rafts, liferafts, lifeboats, life rings, floating cushions, detachable boarding barges or payload transfer transport modules (with onboard equipment that can include but is not limited to heating ventilation and air conditioning/HVAC as well as life support equipment and signalling and communication equipment and first aid and medical equipment and disabled personnel support equipment), flares, batteries, radios, satellite communication, locator beacons, telemetry, accident data recorder, crash data recorder, voyage data recorder, flight data recorder, event data recorder, video data recorder, life detection devices, medics, emergency responder trained crew, robotic rescue devices also known as rescue robots, and remote monitoring and action crew that can perform appropriate search and rescue operations from a remote or offboard location by commanding onboard robots that may include humanoid robots.

[0310] FIG. **10**D illustrates further subsystems in a payload services system **175**. The payload services system **175** will preferably include a plurality of systems selected from: a cargo management system **43**M, a passenger amenities & activities system **175**A, an individual comfort & services system **175**C, an eating & drinking services system **175**E, an onboard financial system **175**F, a medical, health & sanitation services system **175**H, an onboard transport & mobility services system **175**M, a payload services inventory management system **175**N, a regulatory compliance services system **175**R. An adjacent crew services system **176** provides many or all of the features of the payload services system **175**, with added functionality tailored to the needs of different categories of crew such as flight crew, cabin crew, maintenance crew, repair crew etc. It should also here be noted that more details of payloads will be presented subsequently with reference to FIGS. **13**A through **13**E that illustrate some alternate preferred payloads architectures and features that can be applied on a partially aerostatically supported air cushion ship **1**.

[0311] The cargo management system **43**M shown in FIG. **10**D orchestrates and performs all management functions related to cargo **43**, that as described earlier with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F, can include one or more of: a cargo container or unit load device (ULD) **43**A, a refrigerated container **43**R, oversize cargo **43**XL, baggage **44**, and living cargo. The cargo management system **43**M can comprise more than one of: a cargo handling system **43**S (which can include one or more of ball mats, roller trays, powered rollers, crane systems, ramps, elevators, fittings, locks, stops, and cargo handling robotic members), a cargo transfer floor opening **43**F, a cargo transport corridor area **43**T, stowage volumes **44**S, a live animal carriage subsystem **43**L for carrying pets, animals, land and marine mammals, birds, and fish, each in controlled safe and health-fostering and physically and psychologically comfortable environments suitable to each animal type, and a plant carriage subsystem **43**P for carrying all kinds of plants including trees and bushes and houseplants and ornamental plants and food-yielding plants, each in controlled safe and health-fostering and physically appropriate environments suitable to each plant type.

[0312] The passenger amenities & activities system **175**A can include amenities & activities in more than one of: arts, music, a stage feature, a screen feature, an entertainment feature, sports, recreation, gaming, events, meetings, conferences, other amenities and other activities. Special amenities may be provided free or at a charge for special categories of people such as infants, toddlers, children, obese persons, elderly persons, handicapped persons, Persons of Reduced Mobility (PRM), blind or limited vision persons, deaf or limited hearing persons, and other categories of persons whether they be passengers or crew. Similarly, special amenities may be provided for animals and plants and other living beings on board. Several of the amenities can be provided by features already described with reference to FIGS. **2**A through **2**F. The individual comfort & services system **175**C can include more than one of: a personal digital assistant or PDA, apps, a language translator, wayfinding, onboard communications, a financial onboard credit/debit card, a crew assist connection, concierge services, and personal & private cabin items including comfort, temperature, humidity, lighting & mood lighting, pillows and bedlinen and blankets/quilts and sleep facilitating provisions, ADA provisions, and personal air customization including oxygen enrichment. The eating & drinking services system **175**E can include on-demand food and drinking services, robotic delivery, food carts, beverage carts, food and beverage trucks, crew food and beverage vendors, vending machines, grocery stores, cabin refrigerators and microwaves, self-service bars and kitchenettes, cafes, restaurants, bistros, food courts, and specialized cuisine and beverage venues, without limitation. The onboard financial system **175**F can comprise one or more of: onboard electronic currency, loading and replenishing financial onboard credit/debit cards, buying and selling, retail, payment for amenities, destination shopping, deposit and withdrawal, interest and dividend, wire transfer and duty free zones, without limitation. The medical, health & sanitation services system **175**H can comprise more than one of: a clinic, a preventative medicine site, a salon, a gym area, a yoga area, a walk area, an oxygen bar, a massage chair, a bathroom, a shower, a jetted hot tub, a sauna, antibacterial and antiviral provisions, a morgue, and other medical, health & sanitation features without limitation. The onboard transport & mobility services system **175**M can include onboard aisles, paths, moving sidewalks, stairways, escalators, elevators, roads, vehicle ramps, spiral ramps, vehicle elevators, self-propelled chairs, electric personal vehicles such as ebikes or self-balancing scooters, onboard vehicles for carrying people, vehicle trains, rickshaws, cycle rickshaws, motorized rickshaws, robotic rickshaws, robotic people carrying mobile pods, mobile cabins, electric microbuses, tracked vehicles, automated guideway transit (AGT) vehicles, and vehicles with vision systems and collision avoidance, for example and without limitation. The payload services inventory management system **175**N can include at least one of: supplies management, food management, potable water management, beverage management, store inventory management for a wide variety of stores, inventory cleaning/maintenance/repair/recycling for different categories of inventory, rentable items inventory management, and inventory management related to all the other items shown in FIG. **10**D. Note that the potable water management system may be integrated with a more general onboard water management system that manages potable water as well as nonpotable water such as gray water and sewage on board, with water use minimization features and water reuse features such as optional recycling of gray water for toilet or urinal flushing purposes. Water purification, desalination and distillation subsystems can be optionally provided. Low flow showers and toilets can help minimize water weight needed to be carried on board. Potable water can be sourced both by incoming potable water coming in from shore sources, and onboard creation of potable water from salt water sourced from the ocean or sea water below the vehicle when it is in a mode floating on a water surface **18**. Potable water can also be sourced on board a PASRACS **1** from a water condenser system from an engine and/or APU and/or fuel cell, as well as collection of water from hydrogen combustion with air to create water as an output product. The payload services inventory management system **175**N shown in FIG. **10**D should be closely connected and functionally integrated with the onboard inventory system **178** shown earlier in FIG. **10**A, wherein the latter has coverage over all types of inventory related to the PASRACS **1**, and not just for payload related inventory. The regulatory compliance services system **175**R can comprise more than one of: passenger-assist crew, Transportation Security Administration (TSA) or similar administrative personnel and equipment, customs, immigration, police/security personnel and equipment, impaired persons management, external markings and lighting, and other regulatory compliance subsystems without limitation. The regulatory compliance services system **175**R can also monitor and help foster compliance with a plurality selected from the following regulatory and standards items: [0313] 1) meeting all applicable regulatory standards [0314] 2) meeting electrical & mechanical & civil engineering standards [0315] 3) meeting environmental standards [0316] 4) meeting operational risk standards for risk of hazards to people, birds, marine animals, and vehicles including marine and air vehicles [0317] 5) having appropriate placards and warnings and instruction manuals for all categories of personnel [0318] 6) having installation and repair processes that minimize risks to personnel or equipment [0319] 7) being operational with constraints with wave heights through Douglas sea scale TBD [0320] 8) fostering survival in flight mode over either tsunami waves or ultra-high or rogue waves up to TBD meters high [0321] 9) enabling operation with specified constraints in adverse weather conditions including heavy rain, snow, and severe hail such as TORRO hail scale TBD (up to and including TBD mm ice balls) [0322] 10) Including design for long life, design for robustness, design for reliability, and design for serviceability, maintainability & repairability standards

[0323] FIG. **10**E illustrates further details of an environmental control system **177** for a PASRACS **1**. As illustrated, the environmental control system **177** comprises at least one of: a ventilation subsystem **177**V that may include at least one of a fresh air subsystem, a controllable inflow subsystem such as an inflow scoop, a controllable flow outflow subsystem such as an outflow valve, and a recirculation subsystem; a thermal management subsystem **177**T that may include at least one of a heating subsystem, a cooling subsystem, an air conditioning subsystem with a refrigerant, a heat pump subsystem, a heat exchanger subsystem, a thermal insulation subsystem, a hot fluid storage & distribution subsystem, a cold fluid storage & distribution subsystem, a heat provision system for hot food preparation and a cold provision system for food and medicine refrigeration and/or freezing; a filtration subsystem **177**F for at least one of air and water that may include at least one of a filter screen and a HEPA filter and an electrostatic filter; a purification subsystem **177**P for at least one of air and water that may include at least one of a UV purification element, a UV excimer lamp, a 222 nm excimer member that can provide disinfection for COVID while greatly reducing human exporsure risk, a UV wand, and a cleaning robot with at least one of wipe cleaning capability, wet-wiping capability, UV purification cleaning capability, antimicrobial administration capability, disinfectant administration capability, fogging capability, chemical cleaning capability, vacuuming capability, dusting capability, and cover-changing capability for fabric coverings and pillow cases and bedlinen; a humidity management subsystem **177**H that can include at least one of a humidifier and a mister and a fountain and a waterfall and a dehumidifier; an air quality enhancement subsystem **177**A that can include at least one of an oxygen supplementation subsystem, a deodorizer subsystem, a desirable scent adding subsystem, an ionizer subsystem, a desirable gas adding subsystem, a desirable droplets adding subsystem and a desirable particles adding subsystem; a water quality enhancement subsystem **177**W that can include at least one of a filtration subsystem, a purification subsystem, an impurity removal subsystem, a water softener subsystem, a chlorination subsystem, and a desirable additives integration subsystem; a lighting subsystem **177**L that includes at least one of interior lighting, emergency evacuation lighting, cabin lighting, cockpit or flight deck lighting, instrumentation lighting, display lighting, mood lighting, “starry sky” night lighting, biorhythm/circadian rhythm lighting, personal area lighting, reading light, warming light, disco lighting, venue lighting, theatre lighting, movie lighting, advertising lighting, maintenance lighting, repair lighting, portable lighting, lighting mobile robots, exterior lighting, lighting for night operations, lighting for reduced visibility operations, logo lighting, marker lighting, navigation lighting, warning lighting, landing light, and terminal area operations lighting; and a noise management subsystem **177**N that can include features, technologies and components for at least one of interior noise management, community noise management, overflight noise management, terminal operations noise management, a noise insulation subsystem, a white noise subsystem, a transient noise minimization subsystem, a sleeptime reduced noise subsystem, a personal noise control subsystem, a noise cancelling headset with a personal sound system, a virtual reality headset, and an active noise control subsystem.

[0324] FIGS. **11**A through **11**G illustrate some alternate preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, including but not limited to the preferred embodiment of a PASRACS **1** described earlier with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F.

[0325] FIG. **11**A shows a graph in a log-log scale format to illustrate the foundational and important effects of “square-cube” laws on sizing and scaling effects applicable to vehicles in general, and especially so to vehicles that include aerostatic lift, such as dirigibles or partially aerostatically supported air cushion ships. Square-cube laws are one of the very early discoveries of modern science and engineering, and were first published by Galileo Galilei in **1683**. The simplest form of the square-cube law captures the mathematic and scientific principle that the law states that as an object increases in size without changing shape or configuration, its volume increases faster than its surface area, where the area ‘squares’ while volume ‘cubes’ relative to a linear dimension or linear scale. In the vehicle design arena parameters such a vehicle volume, lifting gas volume, and other volume metrics behave according to the Cube Law, while parameters such as vehicle wetted area, body wetted area, wing planform area, and weights that scale with areas behave substantially according to the Square Law. In FIG. **11**A the horizontal axis or abscissa is a linear scale corresponding to body width of a vehicle incorporating aerostatic lift, in feet. To anchor the square and cube trend lines, data is included for a known reference vehicle that was actually built and flown, the dirigible LZ130 Graf Zeppelin II (Ref. 7). The body width of the LZ130 was 135.1 ft., as shown by the column of data points at abscissa value 135.1. The nominal partially aerostatically supported air cushion ship data shown in FIG. **11**A is for the preferred embodiment nominal PASRACS **1** described earlier with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. This preferred embodiment PASRACS **1** has a body width of 730 ft., as shown by the column of data points at abscissa value **730**. It should be noted that PASRACS of different sized and configurations can have significantly varying body widths, as well as significantly varying alternate metrics of linear scale such as body length, overall length, wingspan or average chord, and so the specific data shown should not be construed as limiting the invention as described and claimed. Square symbols are used to indicate lifting gas volume, with the anchor value for the LZ130 being 7.062.000 cubic feet or cu.ft., as shown. By the square-cube law, lifting gas volume should increase by the cube of the linear scale, as shown by the Cube Law Relationship trend line **182**C that is shown in FIG. **11**A. The PASRACS **1** has a lifting gas volume of 250.000.000 cu.ft, as shown, which is below the Cube Law Relationship trend line **182**C by an aerostatic lift volume decrement **183**, as shown. This aerostatic lift volume decrement occurs for multiple configuration, technology and requirements reasons, with three key reasons being that: (1) the body length/width or fineness ratio is smaller for the PASRACS **1**. (2) a larger fraction of the vehicle overall volume is used for payload on the PASRACS, correspondingly reducing lifting gas volume as a percentage of overall vehicle volume, and most importantly. (3) the PASRACS **1** gets only 17.5 million lb, of aerostatic lift out of 45 million lb, needed to balance a maximum takeoff weight condition of 45 million lb., with the remaining 27.5 million lb, coming from aerodynamic lift in ground effect. Thus for this hybrid lift vehicle at the MTOW condition at a vehicle takeoff condition (when airspeed has increased sufficiently such that aerodynamic and aerostatic lift together match 100% of weight and when hydrodynamic lift drops to zero), only 39% of the lift is aerostatic while 61% is aerodynamic. These three key reasons plus other second order effect differences can thus fully explain and justify the illustrated aerostatic lift volume decrement **183** from the Cube Law Relationship trend line **182**C. While the Cube Law Relationship has been illustrated in FIG. **11**A for lifting gas volume, the Cube Law Relationship also applies to overall vehicle volume and to aerostatic lift and hydrostatic lift. Variations from the Cube Law Relationship can occur for configuration, technology and requirements reasons as well as second order effects such as use of helium rather than hydrogen for some or all of the lifting gas sub-volumes and compartments or gas bags or gas cells, as noted and described earlier herein. The Square Law Relationship applies to parameters that scale exactly or approximately with area rather than volume, and include for example and without limitation, vehicle wetted area, vehicle planform area, wing planform area, body wetted area, tail areas, aerodynamic forces, hydrodynamic forces (when in motion with water contact, before takeoff or after landing), and weights of various categories that approximately follow the Square Law Relationship. Two of the most important vehicle-related weights that approximately follow the Square Law relationship are Maximum Takeoff Weight (MTOW) which is shown with triangle symbols, and Operational Empty Weight (OEW) **33**E which is shown with inverted triangle symbols in FIG. **11**A. Note that MTOW corresponds to the heaviest takeoff condition when payload weight **33**P and non-lifting-gas fuel weight **33**F are added to the OEW **33**E. The OEW of the LZ130 dirigible is approximately 370.000 lb, as illustrated, and a Square Law Relationship trend line **182**S is fitted through this point. The estimated OEW of the aforementioned nominal PASRACS **1** is 16.000.000 lb, a value above this trend line by an Empty Weight increment **184** as illustrated. This Empty Weight increment is readily understandable and can be justified by the facts that the PASRACS **1** has: (1) higher cruise and maximum speeds than the LZ130. (2) must include elements that provide hydrostatic, hydrodynamic and aerodynamic lift, and (3) must meet more stringent modern safety and certification requirements, even despite some offsetting OEW reductions attributed to lighter weight modern materials and structures. The estimated MTOW of the nominal PASRACS **1** is 45.000.000 lb., and an upper Square Law Relationship line **182**S is fitted through this point. The MTOW of the LZ130 is around 476.000 lb, as shown, and corresponds to maximum aerostatic lift, not accounting for second order ballast and ballonet effects and weight and aerostatic lift as known in the prior art of airships and dirigibles. The MTOW of the LZ130 is below the upper Square Law Relationship line **182**S by an MTOW decrement **185**, as shown in FIG. **11**A. This MTOW decrement for the LZ130 is readily understandable and can be justified by the facts that the dirigible has (1) lower design speeds and loads requirements. (2) lower stringency on safety and certification requirements and (3) no requirement or capability for running takeoffs from water using a combination of lift encompassing hydrostatic lift, hydrodynamic lift and aerodynamic lift in addition to aerostatic lift that both the LZ130 and PASRACS **1** have in common.

[0326] There are important and foundational ramifications of the Square Cube law trends in FIG. **11**A with regard to how and why vehicles which use aerostatic lift for some or all of the lift needed to balance weight, optimize for several measures of merit at larger values of linear scale. Fundamentally, because the Cube Law Relationship trend line **182**C is steeper than the Square Law Relationship trend line **182**S, as vehicle scale increases the volume of lifting gas and the amount of aerostatic lift increase faster than the vehicle area and weight metrics increase. Thus a partially aerostatically supported air cushion ship can offer nonobvious but highly significant overall optimization opportunities relative to a fully aerostatically supported vehicle when scale is increased substantially, as shown in the comparison between the LZ130 fully aerostatically supported vehicle and the nominal PASRACS **1** in FIG. **11**A. With a linear scale increase using body width of 5.4:1 as shown, the corresponding cube law lifting gas volume increase would be 157.8:1. However, with the PASRACS **1** utilizing ground-effect aerodynamic lift for 61% of needed total lift to balance vehicle weight at a vehicle takeoff condition when airspeed has increased sufficiently that hydrostatic and hydrodynamic lift can drop to zero, an aerostatic lift volume increase well under the cube law trend line is sufficient (shown in FIG. **11**A at lifting gas volume ratio of about 35.4:1 for the nominal PASRACS **1** relative to the LZ130 reference vehicle with 100% aerostatic lift). The need for aerostatic lifting volume below the cube trend line implies that the PASRACS can be sized with less required wetted area increase and still have a greater percentage of internal volume available for payload, which in turn implies a larger number of passengers and amount of cargo that can be beneficially and profitably carried, as well as enhanced comfort and amenities for passengers that are enabled by large volume allocations per passenger for different fare classes of carriage. The empty weight fraction or ratio of OEW to MTOW for the

PASRACS can also be lowered, as shown in FIG. **11**A from 78% for the LZ130 to 36% for the nominal PASRACS **1**. The PASRACS **1** uses a hybrid combination of lift sources to optimize lift at different speeds in a takeoff maneuver, starting with hydrostatic+aerostatic at zero speed, then hydrostatic+hydrodynamic+aerostatic, then hydrostatic+hydrodynamic+aerostatic+ram air cushion aerodynamic, then after lifting off from the water just aerostatic+aerodynamic.

[0327] The inventive use of hybrid lift sources minimizes required thrust from the propulsion system for the takeoff and transition to cruise flight in ground-effect, and enables the overall vehicle design size and weight and drag to cycle down from what they would have been if all the lift were aerostatic, according to principles of vehicle sizing and cycled design. It should be noted that advanced lightweight but strong materials and structures and technologies can also contribute to reduced sizing thrust and weight and cycled vehicle benefits. There are huge advantages that accrue from the Square Cube law effects and design cycling and optimization and reduced empty weight fraction. These huge advantages include advantages in terms of key vehicle measures of merit such as energy use per passenger-mile, fuel burn per passenger-mile, cash related aircraft operating cost (CAROC) per passenger-mile, and other measures of merit for transport vehicles that are denominated by passengers or payload—as the ratio of passengers from the LZ130 airship to the representative PASRACS **1** is nominally 694:1 (50,000 passengers on nominal PASRACS **1** relative to 72 passengers on the LZ130), which is well above even the Cube Law relationship! While the fundamental science-based benefit mechanisms described immediately above are incontrovertible, it is readily acknowledged that pairwise comparisons between different vehicles will be also affected by a variety of other factors including but not limited to: safety & certification; requirements & objectives for market, mission, vehicle & systems; technologies employed; and vehicle configuration & architecture details.

[0328] FIG. **11**A in combination with the earlier described FIGS. **1**A through **1**G and FIGS. **2**A through **2**F, thus illustrate a preferred embodiment of a partially aerostatically supported ram air cushion ship **1**, comprising in combination: a ship structure **2** incorporating a body **3** with a payload volume **4** with plural decks **5** at plural levels **6** for carrying payload **7**; said ship structure **2** connected to a lifting gas enclosure **8** configured to contain a lifting gas **9** providing an aerostatic lift force **10** acting on said ship **1**, said lifting gas **9** comprising at least one of helium **11**, hydrogen **12** and a low-density lifting gas **13** with density lower than that of an atmosphere **14** immediately outside said ship **1**; a hydrostatic floatation subsystem **15** comprising a water displacing structure **16** connected to said ship structure **2**, said water displacing structure **16** configured to provide a hydrostatic lift force **17** acting on said ship **1** in a period of time when said water displacing structure **16** is displacing a water volume below a water surface **18** below said atmosphere **14**; an aerodynamic lift subsystem **19** comprising a ram air cushion **20** when said ship **1** has positive airspeed **24**, said ram air cushion **20** below a lower surface **1**L of the ship **1** and above an Earth surface **21**, wherein said aerodynamic lift subsystem **19** comprising said ram air cushion **20** is configured to contribute an aerodynamic lift force **25** acting on said ship **1** when said ship **1** has said positive airspeed **24**; a propulsion system **26** capable of using energy **27** to generate a thrust force **28** acting on said ship **1**; and a vehicle control and navigation system **29** configured to enable said ship **1** to move and maneuver on a travel path **24**T; wherein weight **33** of said partially aerostatically supported ram air cushion ship **1** comprises operational empty weight **33**E plus non-lifting-gas fuel weight plus payload weight **33**P; wherein the ratio of operational empty weight **33**E to weight **33** decreases with increased linear scale of the partially aerostatically supported ram air cushion ship **1** consequent to square-cube law effects, enabling an increase in the ratio of payload weight **33**P to weight **33**; wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said hydrostatic lift force **17**, when said ship **1** is in a substantially stationary mode **34** on said water surface **18**; and wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25**, when said partially aerostatically supported ram air cushion ship **1** is in a flight in ground-effect mode **35** [not shown] with said positive airspeed **24**; and wherein the weight **33** of said partially aerostatically supported ram air cushion ship **1** is substantially balanced by a combination of said aerostatic lift force **10** and said aerodynamic lift force **25** and at least one of said hydrostatic lift force **17** and a hydrodynamic lift force **36**, when said partially aerostatically supported ram air cushion ship **1** is in a transition mode **37** comprising a takeoff transition mode **37**T or a landing transition mode **37**L.

[0329] FIG. **11**B illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, utilizing the representative transverse cross-sectional view of a PASRACS **1** that was shown in FIG. **1**E and corresponding to the longitudinal location C-C of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A. The PASRACS **1** includes ship structure **2** in various parts of the vehicle including the body **3** and the wing **61**. The body **3** includes a body top surface **3**T, side surfaces such as the body right side surface **3**R, and a body lower surface **3**LS. The wing **61** includes a wing tip fence **61**T and a wing side of body joint **61**SB as shown. Ship structure **2** also serves to support and carry payload such as passengers, bags and cargo in a payload volume **4**; and also serves to enclose and carry lifting gas **9** in lifting gas enclosures such as the illustrated helium enclosures **11**E and hydrogen enclosures **12**E. It should be understood that ship structure **2** can utilize a wide variety of materials and material systems including metals, metallic alloys, aluminum alloys, steels, fiber-metal laminates, composite materials, thermoplastic materials, thermoset materials, fiberglass, carbon composite materials, isotropic composites also known as “black aluminum,” tailored composites, ceramic materials, plastic materials, synthetic materials, natural materials, wood, rubber, and other materials as well as structural members and assemblies known from the prior art including fastener members, elongated or near-linear structures such as rods, tubes, and extrusions, near-planar members such as panel members, three-dimensional structures such as topologically-optimized structures and additively manufactured structures and cast structures, laid-up and autoclave cured structures, woven structures, braided structures, redundant structures, fault-tolerant structures, fail-safe structures, fatigue life limited structures, damage-tolerant structures, and self-healing structures.

[0330] Ship structure **2** includes skin structure **2**K which are used on surfaces of the PASRACS **1** that contact the atmosphere **14** around the vehicle, as well as portions that are designed to contact a water surface **18** beneath the vehicle, such as in a hydrodynamic planing surface **36**P. Skin structure **2**K can include elements and features found in prior art skin structures for aircraft, marine vehicles and land vehicles, including but not limited to: metallic structural elements, composite structural elements, supporting frame elements, rib elements, longeron elements, stringer elements, isogrid elements, orthogrid elements, sandwich elements, impact resistant elements such as a hail-proof surface for a specified category of hail risk, corrosion resisting elements or treatments, coatings, drag reducing elements such as riblets or sharkskin surface, electrically conductive elements such as a conductive grid designed for EME and lightning strike, see-through elements such as a transparency (including one or more from a window, glass window, acrylic window, polycarbonate window, craze-resistant window, dimmable window, electrochromic window and structural composite window), a surface-integrated solar panel, and a decorative element such as one or more of paint and applique film and a video display surface such as an LCD surface.

[0331] Ship structure **2** includes multiple applications of near-planar structure **2**P, with several illustrated in FIG. **11**B. Specifically, near-planar structure **2**P is shown in floor structure for supporting payload such as passengers and cargo, fuselage perimeter structure for the fuselage **3**, wing upper panel and lower panel structure for the wing **61**, and side structure panels for downward-extending configuration members supporting hydrodynamic planing surfaces **36**P, such as the illustrated wing tip fence **61***t*. Near-planar structure **2**P can include elements and features found in prior art near-planar structures for aircraft, marine vehicles and land vehicles, including but not limited to: structural sheet, rigidized panels with a sheet and attached stiffener members such as stringer or longeron members, integral grid panels such as isogrid or orthogrid panels, topology-optimized panels, additive manufacturing panels, sandwich panels, metallic panels, composite panels, near-planar truss structure, framed membrane panels, structural panels with integrated systems or systems raceways, structural panels with integrated structural health monitoring, and other near-planar structural members.

[0332] Ship structure **2** includes multiple applications of skin structure **2**K, with several illustrated in FIG. **11**B. Specifically, skin structure **2**K is shown on external surfaces of the PASRACS **1** including the body **3** and wing **61** without limitation. Skin structure **2**K can include elements and features found in prior art skin structures for aircraft, marine vehicles and land vehicles, including but not limited to: support by underlying structure **2** that can include near-planar structure **2**P as well as members such as a frame **2**F or a spar **2**S, insulation such as at least one of noise insulation and thermal insulation and multipurpose insulation, a smooth external surface for low skin-friction fluid dynamic drag such as air drag or water drag, surface protection layer to inhibit scratching or scoring from airborne sand or volcanic ash or particulates, drag-reducing surface such as riblet or sharkskin surface with drag-reducing small-scale surface contouring, surface applique for at least one of drag reduction and externally viewable colorized images, corrosion inhibiting surface treatment such as anodizing or primer application or inhibitor application, decorative paint, impact and penetration resistant layer for defense against external impacts from hail or debris, birdstrike resistant layer, and electrically conductive surface or mesh or wires for protection from at least one of lightning and electromagnetic environment (EME) effects and electromagnetic pulse (EMP) effects without limitation.

[0333] The ship structure **2** used in the body **3** also includes a frame **2**F that provides structural rigidity and strength to carry external and internal loads, around some or all of the perimeter of the body **3**; concave structure **2**V for containing pressure such as in at least one of a lifting gas compartment (such as the illustrated helium enclosure **11**E and hydrogen enclosure **12**E that hold lifting gas **9**), a pressurized cabin volume and a liquid containing volume for liquid such as water or liquid fuel without limitation; a structural column **2**C that can carry loads including weight-related loads and wherein the structural column **2**C can optionally embody a hollow cross-sectional shape and also serve as a pipe or duct; a fire-resistant partition **2**FP that is a structural member that prevents or inhibits spread of a fire; and a tension member **2**W such as a cable or rope or wire without limitation, illustrated in FIG. **11**B as supporting a payload transfer transport module **47** hanging beneath the body **3** with the upper end connected to a hardpoint **2**H that is part of the ship structure **2** in the body **3**.

[0334] The ship structure **2** used in a wing **61** of a PASRACS **1** includes the aforementioned near-planar structure **2**P and skin structure **2**K, as well as at least one structural spar **2**S configured to carry loads spanwise on said wing **61**, redundant structure **2**R with multiple load paths (such as wing bending loads through wing upper and lower panels as well as wing cargo compartment top and bottom surfaces, as shown), and in the illustrated embodiment also a truss structure **2**T at the side-of-body joint **61**SB where the wing **61** meets the body **3**, with truss members providing load paths and stable and strong structural connection between wing structure members including said structural spar **2**S and body structure members including said frame **2**F. While truss structure **2**T has been shown at the side-of-body joint **61**SB for the illustrated preferred embodiment of a PASRACS **1**, it should be understood that many other beneficial applications of truss structure **2**T in other parts of the PASRACS **1** including the wing **61** and body **2** without limitation, are possible within the spirit and scope of the invention. At the outer ends of the wing **61**, the structural spar **2**S connects with a wing tip fence **61**T that provides spanwise constraint to the outer ends of the ram air cushion **20** and preferably also has a lower hydrodynamic planing surface **36**P that can contact the water surface **18** under circumstances of high waves and/or bank angle, for example and without limitation.

[0335] FIG. **11**C illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, utilizing the representative transverse cross-sectional view of a PASRACS **1** that was shown in FIG. **1**C and corresponding to the longitudinal location A-A of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A, with scaling up applied for clarity. The PASRACS **1** includes ship structure **2** in various parts of the vehicle including the body **3**, which in turn includes a flight deck or cockpit **31**C that is at a forward end of a cabin **38** and separated from passenger accessible areas by a lockable door located behind the section of this view. The flight deck **31**C accommodates at least one person **39** that is a seated person **37**S and a member of the crew **41**, more specifically flight crew. The flight deck **31**C also includes at least one crew input device **31** and the body **3** also includes a vehicle control and automatic control system **29**. The ship structure **2** includes a frame **2**F, near-planar structure **2**P, and floor structure **2**FL. The window **149** can be a structural window, and can be openable for crew emergency evacuation purposes, in which case the window **149** comprises movable structure **2**M. FIG. **11**C also illustrates that the ship structure **2** includes leading-edge structure **2**LE such as on the leading edge of the crown of the body segment housing the flight deck **31**C, which will preferably be designed to survive impacts by birdstrike or hail as known from the art of airplane cockpit structure design; and further includes energy absorbing structure **2**EA that can include engineered crushable structure, shown in one representative application location in the bottom region of the body **3**, so as to be able to absorb impact energy from impact with an Earth surface **21** such as a water surface or ground surface. The PASRACS **1** will preferably be designed to meet all crashworthiness requirements for personnel and goods on board.

[0336] FIG. **11**D illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, utilizing the representative transverse cross-sectional view of a PASRACS **1** that was shown in FIG. **1**D and corresponding to the longitudinal location B-B of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A. In addition to structural architectures and features already described with respect to FIG. **11**B, FIG. **11**D shows a hull that is a forward hull **54**F, that includes a hydrodynamic planing surface **36**P. The illustrated hull, the forward hull **54**H, is shown to include ship structure **2** that is enclosed floatation structure **2**EF, such as watertight compartments known from the prior art of ship and marine vehicle hulls. The bottom region of the illustrated hull that is the forward hull **54**F also includes impact contacting structure **2**EC for normal operation impacts on an Earth surface **21** that is a water surface **18**, and for nonnormal operation may also impact a solid surface such as an Earth surface **21** that comprises a floating ice surface or a ground surface. The sides of the illustrated forward hull **54**F include near-planar structure **2**P, as shown. FIG. **11**D also illustrates some structural features representative of ship structure **2** that connects the body **3** to parts of the propulsion system **26** such as a nacelle **28**N and thruster **28**T. More specifically, the connecting structural features include a propulsor strut **28**S, that includes multiple load paths and so acts as redundant structure **2**R that can survive some faults and failures; and in the illustrated preferred embodiment also serves as breakaway structure **2**B designed to break away at defined load conditions such as a crash condition to cite one example, without limitation. The use of breakaway structure in propulsor struts has precedence in underwing jet engine struts on commercial airliners, to allow the propulsor to break away cleanly in a crash condition without damage propagation to the main parts of vehicle structure such as wing and body structure.

[0337] FIG. **11**E illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, utilizing the representative transverse cross-sectional view of a PASRACS **1** that was shown in FIG. **1**G and corresponding to the longitudinal location E-E of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A. The PASRACS **1** includes ship structure **2** in various parts of the vehicle including the body **3**. The ship structure **2** includes a frame **2**F and floor structure **2**FL in the body

3, a spar **2**S in the horizontal stabilizer **88**H that also traverses into the body **3** and connects to the frame **2**F at a tail-body joint similar to a wing-body joint, and multiple locations of applications of near-planar structure **2**P and skin structure **2**K. The tail boom **88**B is shown to incorporate tubular structure **2**TU which is partial tubular structure as shown, and utilizing longerons **2**L as shown to carry longitudinal loads between the body **3** and the vertical tails located aft. The stabilizer endplates **88**E serve as movable structure **2**M that are rotatably movable thereby changing the angle of the hydrodynamic planing surface **36**P at the bottom ends of the stabilizer endplates **88**E. The rotation can be effected by a rotary actuator or a linear actuator or jackscrew with appropriate linkages and gears as known from the prior art of mechanical drive systems that also include safety stops. The side flaps **90**S at the bottom sides of the body **3** are also movable structure **2**M and can deploy downward to reduce the spanwise leakage flow from the ram air cushion **20**. The bottom edges of the side flaps **90**S may optionally be serrated with hydroski bottom ends with trailing edge of a segment lower than the corresponding leading edge. Downward movement of the side flaps **90**S can be enabled by a variety of motor, actuator, drivetrain and/or track members. Energy absorbing structure **2**EA will preferably be provided above the hydrodynamic planing surfaces **36**P at the bottom ends of the keel **88**K and stabilizer endplates **88**E as well as the bottom ends of the side flaps **90**S, all of which can contact the water surface **18** with resulting high loads for certain circumstances such as the PASRACS **1** flying in ground effect at a high cruise speed and suddenly encountering a very tall "rogue wave." and all of which can also contact an Earth surface that is a ground surface in emergency landing scenarios for a land overflight portion of a journey of a PASRACS **1**.

[0338] FIG. **11**F illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1**, utilizing the representative left side view of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A, with scaling down. The PASRACS **1** includes ship structure **2** in various parts of the vehicle including the body **3** and the wing **61** and the propulsion system **26** and the horizontal tail **88**H and vertical tail **88**V, without limitation. The ship structure **2** includes planar structure **2**P and skin structure **2**K in plural locations shown without limitation; at least one frame **2**F and grid structure **2**G supporting skin **2**K as an integral part of a lifting gas enclosure **8** separating lifting gas **9** from the atmosphere **14**, in a manner similar to the grid structure of rigid airships of the past and optionally utilizing assembled grid, integral grid, orthogrid, isogrid, hexagonal grid, or topology-optimized grid along with associated structural architectures; leading edge structure **2**LE at the front of the body **3** and wing **61**; impact contacting structure **2**EC in the front of a hull **54** that can be designed to withstand impacts from floating debris or logs etc.; energy absorbing structure **2**EA in lower portions of the PASRACS **1** such as the illustrated hull **54** and payload transfer transport module **47**; enclosed floatation structure **2**EF in lower parts of the PASRACS **1** that may provide hydrostatic lift in normal or nonnormal operations, such as the hull **54** and wing tip fence **61**T (serving as a tip float) and payload transfer transport module **47**, wherein said enclosed floatation structure **2**EF can have enclosed structural chambers and/or be filled with floatation material such as closed-cell floatation foam; a shock absorber **2**ES as a type of energy absorbing structure, shown in a representative application in conjunction with an effector **60** that is configured to extend/deploy or retract/stow a hydroski **36**S, with the upper end of the effector **60** attached to a hull **54** at a hardpoint **2**H; column structure **2**C shown with the interfloor traversal column **143**; floor structure **2**FL shown for floors in payload volume **4** suitable for accommodating passengers and cargo including cargo containers **43**A as shown; ceiling structure **2**CE shown above the payload volume **4** and preferably also serving as a fire-resistant partition **2**FP; redundant structure **2**R shown in the propulsor strut **28**S; and concave structure **2**V shown concurrent with the lifting gas enclosure **8** holding lifting gas **9**.

[0339] FIG. **11**G illustrates some preferred structures architectures and features that can be applied on a partially aerostatically supported air cushion ship or PASRACS **1** in the region of the wing **61** and adjacent lower portions of the body **3**, utilizing the representative left side view of the partially aerostatically supported ram air cushion ship as notated on FIG. **1**A, with scaling up. The PASRACS **1** is in a transition mode flying in ground-effect but still having some hydrodynamic lift from hydroskis **36**S in contact with an Earth surface **21** that is a water surface **18**. The ship structure **2** includes planar structure **2**P and skin structure **2**K in plural locations with examples shown without limitation; leading edge structure **2**LE at the front of the wing **61** and hull **54**; structural spars **2**S at the front and back sides of a wingbox in the wing **61**, wherein the spars can utilize a variety of cross-sections and configurations and materials known from the art of aircraft spars, and can also optionally be truss spars; impact contacting structure **2**EC in the front of a portion of a payload transfer transport module **47** that can be designed to withstand impacts from floating debris or logs etc.; enclosed floatation structure **2**EF in lower parts of the PASRACS **1** that may provide hydrostatic lift in normal or nonnormal operations, wherein said enclosed floatation structure **2**EF can have enclosed structural chambers and/or be filled with floatation material such as closed-cell floatation foam; floor structure **2**FL shown for floors in payload volume **4** suitable for accommodating passengers and cargo; redundant structure **2**R shown in a propulsor strut **28**S supporting a propulsor nacelle **28**N and thruster **28**T; movable structure **2**M associated with the flap **90**F at the trailing edge of the wing **61** and also associated with the deployable hydroskis **36**S; and concave structure **2**V shown concurrent with a fluid containment structure **2**FC in the illustrated payload transfer transport module **47**.

[0340] FIGS. **12**A through **12**F show some alternate preferred propulsion, fuels and energy architectures and features that can be applied on a partially aerostatically supported ram air cushion ship or PASRACS **1**.

[0341] FIG. **12**A shows a diagram of vehicle drag vs, vehicle speed, that is of key importance to propulsion sizing for a vehicle such as the PASRACS **1** described in detail earlier with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F. The diagram is shown with representative quantitative estimates for vehicle drag as measured with drag force **141** in pounds or lb., for the preferred embodiment PASRACS **1** described in detail earlier with reference to FIGS. **1**A through **1**G and FIGS. **2**A through **2**F; but the illustrated drag curves should be construed as illustrating key qualitative aspects of drag components and how they add up at different phases and velocities of operation for a variety of PASRACS **1** vehicle sizes and configurations as included in the invention and its various embodiments as described and claimed herein. The curve of nominal vehicle drag starts at zero drag with zero vehicle velocity, which will be exactly correct in conditions of zero wind and zero water current and zero waves. As the vehicle starts to accelerate to forward motion with increased vehicle velocity, the initial rise in drag force **141** has viscous friction water drag **141**A as its largest single component. As Froude number increases but still has a value less than one, the drag force **141** next has wave making drag **141**B as its largest single component, as shown and as known from the science of hydrodynamics of hulls moving in water and the well-understood phenomenon of a “drag hump” in this phase of operation. The wave making drag, as known from the science of hydrodynamics, is associated with hydrostatic lift or buoyancy on hulls moving forward while displacing water, with the amount of hydrostatic lift or water displacement lift needed being reduced to some extent by the aerostatic lift provided by lifting gas in the PASRACS **1**. Note that Froude number is ratio of velocity over square root of the product of length times gravitational acceleration. Thus, for example for a PASRACS **1** going at 100 ft./sec, a hull with a length around 200 ft, would have a Froude number of (100)/∞[(200)*(32.2)]=1.25. As the PASRACS **1** accelerates to still higher vehicle velocity, it is supported by a combination of hydrodynamic lift from planing surfaces of hulls as well as hydroskis and lifting hydrofoils as applicable, plus some starting aerodynamic lift from a ram air cushion beneath the vehicle. Overall drag at speeds or velocities just above the hump drag velocity, tends to drop to some extent as shown, and in this phase of operation the single largest component of drag force **141** is high-speed water drag **141**C from water friction plus hydrodynamic lift induced drag acting on hydroski, planing surface and hydrofoil interactions with water flowing past these components at high speed while being deflected at an angle downwards at high speed to create hydrodynamic lift. A small amount of aerodynamic skin friction drag is also present in this phase of operation. As velocity continues to increase in a takeoff phase of operation, the PASRACS **1** slowly rises up with a combination of hydrodynamic planing surface and hydroski and hydrofoil lift and ram air cushion lift, supplementing the steady aerostatic lift from lifting gas in the vehicle. In this phase, shown at a velocity corresponding to **141**D for total drag in FIG. **12**A, the largest component of drag is a combination of high speed water plus aerodynamic induced drag. The aerodynamic induced drag vs, velocity is shown by the representative curve in a dashed line designated **141**E in FIG. **12**A. Aerodynamic induced drag from spanwise leakage flow rises rapidly as the vehicle rises from zero air cushion edge gap to a nominal edge gap height for wave clearance, then the aerodynamic induced drag drops steadily as velocity increases at constant edge gap. The height of the induced drag peak will be larger if a higher edge gap is necessitated by taller waves or other operational considerations. The illustrated drop in induced drag with velocity or speed is well understood from the science of aerodynamics of lifting wings and bodies in flight. Aerodynamic skin friction drag **141**F scales as velocity squared where velocity is airspeed, as shown. The total drag at a nominal cruise velocity of 250 miles per hour (366.6 feet per second) in a flight in ground effect mode of operation is shown at **141**G, and is clearly dominated by aerodynamic skin friction drag. Note that the propulsion system is configured with sizing of propulsion subsystems (such as engines/motors, propellers/fans/other thrusters, ducts, struts, structures, systems, etc) such that the resulting design curve for maximum available thrust force **28**M has a value exceeding the total drag **141**G at cruise speed, as shown.

[0342] FIG. **12**B shows a block diagram of an energy management system **170**, similar to that first presented with reference to FIG. **10**A. The energy management system **170** is shown with system redundancy **1**R with a 3-level redundancy shown as representative but not to be construed as limiting the invention (note that in FIG. **10**A the energy management system **170** was shown with a 5-level redundancy of system redundancy **1**R, also representative and not to be construed as limiting the invention). The level of redundancy of the illustrated vehicle control and navigation system **29** and also the levels of redundancy of the other boxes shown in FIG. **12**B shown with or without redundancy, are all representative and are not to be construed as limiting the invention to specific values of system redundancy (or lack of any redundancy, i.e. a nominal “1-level” redundancy) for any illustrated item. It will be understood that the art and science of redundancy and redundancy management to improve fault tolerance and the ability of a vehicle and its systems to operate normally or with some limitations, following one or more failures of various kinds, is based on well-established precedents in the design of prior art vehicles such as airliners, for example.

[0343] The energy management system **170** shown in FIG. **12**B includes a propulsion system **26**, an external energy sourcing system **27**X, an energy storage system **27**S, a power management and transmission system **170**P and a heat energy system **27**H. In a manner consistent to the systems architecture shown earlier in FIG. **10**A. FIG. **12**B also shows that the energy management system **170** has connections with one or more each of a crew input device **31**, sensor **22**, effector **60**, and plural vehicle systems **1**S. Note that the plural vehicle systems notated by **1**S in FIG. **12**B, should be construed to include all the systems earlier shown in FIG. **10**A, including a vehicle control and automatic control system **29**, a safety & security system **171**, a communication & navigation system **172**, a monitoring & alerting system **173**, a maintenance & repair system **174** that includes a well-equipped maintenance and repair shop on board as well as trained personnel and robots, a payload services system **175**, a crew services system **176**, an environmental control system **177**, an onboard inventory system **178**, an external interfaces system **179**, an integration & optimization system **180**, a terminal operations system **181**, as well as various subsystems. FIG. **12**B shows plural connections including data transmission member **168** connections such as databus connections, as well as power transmission member **169** connections such as electrical wire/cable connections but that can also optionally comprise hydraulic connections and/or pneumatic connections. Power transmission members **169** may be run in conduits and/or raceways and/or in a secure passageway accessible for service personnel to enter to perform diagnosis, maintenance, repair and replacement of selected power transmission members **169** as and when needed.

[0344] The external energy sourcing system **27**X illustrated in FIG. **12**B can comprise at least one of (i) solar energy capture elements at or near the skin structure **2**K of a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, such as skin integrated photovoltaic members, window integrated photovoltaic members, and window facing solar panels; (ii) solar thermal energy harvesting members; (iii) wind energy harvesting members; (iv) water current energy harvesting members; (v) wave energy harvesting members including “heaving oscillators” as one example; (vi) a skin heat exchanger for getting heat into the vehicle from the surrounding fluid environment (i.e., air and/or water) when desired and for dumping waste heat from the vehicle into the surrounding fluid environment (i.e., air and/or water) when desired; and (vii) means for connecting to an external energy source such as “ground power” and/or fuel and/or hydrogen at a travel origin/destination with a detachable connection to a land supported entity such as pier and/or a water supported entity such as another floating vessel adjacent to the PASRACS **1** where both are floating on a water surface. The external energy sourcing system **27**X can also convert some of the sourced energy to chemical energy in hydrogen by use of an onboard electrolyzer, that can also generate supplemental oxygen on board for medical or therapeutic or other uses on board the vehicle.

[0345] The energy storage subsystem **27**S shown in FIG. **12**B is configured to store energy in at least one of (i) a battery **27**B capable of storing electrical energy; (ii) a kinetic/potential energy storage subsystem **27**KP that can utilize one or more of a flywheel, compressed gas storage, lifted weight gravitational energy storage, and lifted fluid gravitational energy storage by lifting at least one of water, waste, and liquid fuel to a higher elevation tank; (iii) a hydrogen compartment **12**C for storing hydrogen containing chemical energy, with either or both of cryogenic liquid hydrogen storage or/and gaseous hydrogen storage as in a lifting gas compartment; and (iv) a fuel tank **82**B for storing a fuel containing chemical energy wherein the fuel can be one or more of a biofuel, a fossil fuel, a petroleum based fuel, jet fuel, kerosine, gasoline, diesel fuel, bunker fuel, natural gas, methane, propane, butane, hydrogen, and other fuel.

[0346] The power management and transmission subsystem **170**P shown in FIG. **12**B serves to manage and transmit power through power transmission member **169** connections such as electrical wire/cable connections but that can also optionally comprise hydraulic connections and/or pneumatic connections. The power management and transmission subsystem **170**P can include one or more of: (i) a computer for power management control and optimization as well as interfacing with crew and operators, (ii) an electrical substation; (iii) an electric power management system; (iv) a transformer; (v) a rectifier; (vi) a voltage converter; (vii) switches; (viii) relays; (ix) circuit breakers; (x) an inverter; (xi) a charge controller; (xii) a capacitor; (xiii) a circuit switcher; (xiv) a load management and load shedding subsystem; (xv) a control room; and (xvi) a wireless power transmission subsystem. The power management and transmission subsystem **170**P will be configured to enable all the various power needs of power users on the PASRACS **1** to be served with appropriate power to meet the power needs while minimizing losses and maximizing efficiencies and cost effectiveness metrics. Electrical outlets and fittings and connectors and adaptors can be provided to service electrical needs of a wide variety of passenger and crew equipment, ranging from PDAs to smartphones to tablets to laptop computers to other computers to audio equipment to video equipment to other electronic equipment to other nonelectronic equipment. Surge protection can be provided where needed. Power conversion subsystems can help deliver power AC or DC, different voltages, different phases, etc and with plugpoints for different types of plugs and USB and other connector interfaces in a modular and upgradable electrical systems architecture.

[0347] The propulsion system **26** shown in FIG. **12**B includes a fuel transfer system **82**S that can transfer fuel **82**A (in liquid, gaseous, mixed phase and/or slurry forms) from the fuel tank **82**B and/or the hydrogen compartment **12**C, to an energy conversion device **26**E. For the PASRACS **1** embodiment described in FIGS. **1**A through **2**F, the fuel transfer system **82**S can include piping to transfer fuel from a liquid hydrogen tank **47**H in a payload transfer transport module **47** up to either or both a liquid hydrogen tank **12**L on board the PASRACS **1** or transitioning by heating and boil-off into a lifting gas enclosure **8** that is a hydrogen enclosure **12**E and contains gaseous hydrogen **12** that serves both as a lifting gas and as a fuel that can be pumped via another pipe in the fuel transfer system **82**S to the propulsion system and energy conversion devices **26**E such as a gas turbine in a turboprop propulsor, for example and without limitation. Inlets for air can provide air from the atmosphere **14** to be used to provide oxygen to a combustor or fuel cell, and the inlets can be fitted with one or more of a birdstrike diverter, a sand separator and an ash separator as options that may be needed depending on environmental conditions that the PASRACS **1** may be anticipated to encounter. Ballonet devices can be used with the hydrogen enclosures **12**E to allow hydrogen volume to reduce as some of the gaseous hydrogen is piped out to be used as fuel. The energy conversion device **26**E can comprise one or more of a gas turbine **26**G; a combustion engine **26**C such as an internal combustion engine, external combustion engine, piston engine, wankel engine, spark-ignition engine, compression-ignition or diesel engine, and a thermodynamic cycle engine; a fuel cell **26**F; an auxiliary power unit or APU **26**A; and a motor **26**M such as any number of types and configurations of electric motors, hydraulic motors and air motors without limitation.

[0348] The energy conversion device **26**E outputs drive energy **26**D that can be transmitted by a drivetrain **26**DD to a fluid dynamic propulsor **55**, as illustrated. The drivetrain **26**DD may comprise one or more rotating shafts as well as optional gearing and clutch and control and friction-reducing and lubrication and cooling mechanisms as known from the prior art of drivetrains for transport vehicles such as aircraft and land vehicles.

[0349] The fluid-dynamic propulsor **55** shown in FIG. **12**B comprises one or more of: (i) an air propulsor **55**A that in turn can include one or more of rotating aerodynamic blades, variable pitch blades for performance optimization and reverse thrust, propeller assembly, turboprop assembly, propfan assembly, unducted fan assembly with swept tip blades, ducted fan, augmentor fan assembly, and jet; (ii) a water propulsor **55**W that in turn can include one or more of a water propeller, a waterjet, and an azipod thruster; (iii) a propeller **55**P; (iv) a fan **55**F that may be a ducted fan or unducted fan; (v) a retractable propulsor **55**R that can be retracted to reduce vehicle drag for flight phases when it is not needed; and a propulsion system with regenerative braking **26**R. As illustrated, the fluid-dynamic propulsor **55** outputs an energized flow **55**E and generates a thrust force **28** acting on the PASRACS **1**.

[0350] A hybrid architecture that combines some combination of different energy conversion devices **26**E and fluid dynamic propulsors **55** can be highly beneficial in meeting propulsion thrust needs for different phases of operation as well as vehicle internal energy needs, in a highly efficient and economical and environmentally friendly way. As one example, the PASRACS **1** earlier described with reference to FIGS. **1**A through **2**F can use some propulsor units driving air propulsors such as propellers or fans, with gas turbines that burn hydrogen as well as biofuels; plus more than one APU that use either combustion or fuel cell methods to convert hydrogen chemical energy to electrical energy for vehicle internal use as well as propulsive use; some propulsor units using electric motors driving water propulsors such as optionally retractable azipod thrusters that enable precise thrust and maneuvering control on a water surface; and some propulsor units driving air propulsors such as propellers or fans with motors that are electric motor generators, and enable regenerative braking and recapture of vehicle kinetic energy back into electric energy by putting the blade pitch of the air propulsors into a energy harvesting mode when the vehicle is decelerating and landing, and the air propulsors work effectively as wind turbines and the motors that drive them act as generators in this mode. This therefore represents an example of the illustrated propulsion system with regenerative braking **26**R that is illustrated in FIG. **12**B.

[0351] The heat energy system **27**H illustrated in FIG. **12**B is a system that spans different areas of the energy management system **170**, the propulsion system **26**, and also is closely connected to and integrated with heating and refrigeration elements of vehicle systems on the PASRACS **1**, such as the environmental control system **177** and thermal management system **177**T described earlier in the context of FIG. **10**E. The heat energy system **27**H can also provide useable heat energy to galleys and cooking facilities, hot water for showers, onboard water purification systems that utilize one or more of thermal desalination, distillation, condensation, and rainwater collection. The heat energy system **27**H can also contribute to refrigeration, cabin air conditioning, equipment cooling, refrigerated container cooling and other cooling applications on board. The heat energy system **27**H can leverage and utilize a great many heating, cooling and thermal management technologies and features that are well known in the prior art of heating, cooling and thermal management in vehicles and buildings.

[0352] FIG. **12**B in conjunction with FIGS. **1**A-G, further illustrate a partially aerostatically supported ram air cushion ship **1**, wherein said lifting gas **9** includes hydrogen **12** in a hydrogen gas compartment **12**C, and further comprising a fuel system **82** with a fuel transfer pipe **82**T configured to transfer some of said hydrogen **12** from said hydrogen gas compartment **12**C to said propulsion system **26**, and wherein said propulsion system **26** is configured to use some of said hydrogen **12** serving as a source of at least one of chemical energy **27**C and electrochemical energy **27**EC feeding as energy **27** into said propulsion system **26** that is usefully converted by said propulsion system **26** to propulsive energy **27**P by operating at least one of a gas turbine **26**G, a combustion engine **26**C, a thermodynamic cycle engine **26**T and a fuel cell **26**F.

[0353] FIG. **12**B in conjunction with FIGS. **1**A-G, also show a partially aerostatically supported ram air cushion ship **1**, wherein the total volume of lifting gas on board the partially aerostatically supported ram air cushion ship, exceeds 50,000 cubic meters. FIG. **12**B in conjunction with FIGS. **1**A-G, also show a partially aerostatically supported ram air cushion ship **1**, wherein said chemical energy is at least one of energy from liquid hydrogen, energy from boiling hydrogen, energy from gaseous hydrogen, and electrochemical energy.

[0354] FIG. **12**C shows a side sectional view of a preferred propulsion system **26** that can be applied on a partially aerostatically supported ram air cushion ship or PASRACS **1** such as the embodiment earlier described with reference to FIGS. **1**A through **2**F. The propulsion system **26** here comprises a gas turbine **26**G in a propulsor nacelle **28**N that is supported under a wing **61** by means of a structure comprising a propulsor strut **28**S. The gas turbine **26**G includes a compressor **26**CM that receives air from a propulsor intake **26**N and compresses the air, which then flows to a combustor **26**B where it is combined with fuel (which may optionally be hydrogen or a hydrocarbon fuel such as a biofuel such as biodiesel or biomethane or biogas, without limitation) and ignited to create a combustion chemical reaction in said combustor **26**B, and the high pressure, high temperature outflow from the combustor **26**B then flows through and drives a turbine **26**TU that can have multiple stages, and the power extracted from the pressurized flow by the turbine **26**TU can then be sent via at least one shaft **26**S to provide power to said compressor **26**SM, as well as power through an optional gearbox **26**GB to a fluid dynamic propulsor **55** that here comprises a propeller **55**P with plural rotating shaped aerodynamic propulsor blades **55**B. The propeller **55**P is fitted with a central drag reducing aerodynamic fairing in front of it that serves as a spinner **55**S. The pitch of the propulsor blades **55**B can be changed by blade angle control **55**C at the root of each blade, wherein the blade angle control can be energized by hydraulic energy or electrical energy or pneumatic energy in different variant embodiments. Power produced by the gas turbine **26**G is used in major part to generate thrust through both jet thrust from energized flow **55**E as shown and thrust from the fluid dynamic propulsor **55**, while a portion of power produced by the gas turbine **26**G can also be output to a pressurized air extraction subsystem **26**P (sometimes also called a bleed subsystem) and a portion of the power produced by the gas turbine **26**G can also be output to a propulsor electrical generator **26**G to provide some electrical power into a vehicle electric system or electric grid on board the PASRACS **1**. While the illustrated gas turbine **26**G is shown installed in a nacelle connected to a wing **61**, it should be understood that gas turbine(s) **26**G can also be connected to and supported by other parts of the PASRACS **1**, including but not limited to the body **3**.

[0355] FIG. **12**D shows a side view of a preferred propulsion system **26** that can be applied on a partially aerostatically supported ram air cushion ship or PASRACS **1** such as the embodiment earlier described with reference to FIGS. **1**A through **2**F. The propulsion system **26** here comprises a motor **26**M in a propulsor nacelle **28**N that is supported from the body **3** of the PASRACS **1** by means of ship structure **2** comprising a propulsor strut that is not visible in this view. The propulsion system **26** is shown in the forward part of a PASRACS **1** that here also includes a hull **54** that is a forward hull **54**F, a flight deck **31**C, a flight deck window **31**W, a crew interface device **31**F that is a crew input device **31** such as the illustrated slider wheel for pitch and roll command inputs from a pilot, and a vehicle control and automatic control system **29**. Note that crew interface devices **31**F can include a wide variety of devices and systems and subsystems known from the art of vehicles and their interfaces with crew, such as knobs, switches, levers, sliders, controllers, control columns, control wheels, control sticks, side sticks, displays, heads-up display, instruments, data displays, camera view display, virtual reality (VR) display, augmented vision display, synthetic vision display, tactile interface devices, visual interface devices, aural interface devices, advisory & caution & warning devices, eye-tracking and facial understanding devices and other interface devices, systems and subsystems. Note that multipurpose or multimode or multiuse controllers may be provided, that serve different control functions in different modes of operation of the PASRACS **1**, such as a water taxi mode vs a flight in ground effect mode for example. The motor **26**M can be a motor powered by electricity, of any of a great many types of electric motors known from the art and technology of electric motors. For example and without limitation, the motor **26**M can be a DC motor, an AC motor, a synchronous motor, an asynchronous motor, a motor with a permanent magnet such as a PMDC motor, a motor with an electromagnet, a motor with an armature, a compound wound motor, an induction motor such as an asynchronous induction motor, a motor with brushes, a brushless motor, a separately excited motor or electrically excited synchronous motor, a motor with integrated cooling, a stepper motor, a direct drive motor, a gear motor, an electrostatic motor, a piezoelectric motor, a reluctance motor, a universal motor, and an ultra-light weight integrated electric motor and power electronics package. Electricity for the motor **26**M can come via power wiring (not shown) from an auxiliary power unit (APU) **26**A, a fuel cell **26**F, and/or a battery **27**B. The APU can optionally be a fuel cell APU that uses hydrogen fuel, and can optionally also charge the battery **27**B. The motor **26**M drives a fluid dynamic propulsor **55** that is a thruster **28**T that here includes a fan **55**F that is in a ring-fan configuration with plural propulsor blades **55**B and a propulsor duct **28**D that is a short chord spinning duct supported by the tips of the fan blades in this particular preferred embodiment. The fluid dynamic propulsor **55** is also fitted with blade angle control **55**C and a spinner **55**S, as shown. While the particular ducted fan shown is a ring-fan with a spinning duct, it should be understood that variant embodiments with ducted fans can use a wide variety of ducted fan configurations with fixed or spinning ducts, with varying bypass ratios and varying duct geometries and chords. Ducted fans, turbofans, geared turbofans, and augmentor fans are all possible for variant embodiments of propulsors. While no gearing is shown in FIG. **12**D, it should be understood that varying embodiments can use either direct drive or drive through a gear, a gearbox or a geartrain to enable optimized rotation speeds of RPM for the fan **55**F as well as for the motor **26**M, with optimization for energy use, efficiency, cost and/or other objective functions as known in the art.

[0356] FIG. **12**E shows a side view of a preferred propulsion system **26** that can be applied on a partially aerostatically supported ram air cushion ship or PASRACS **1** such as the embodiment earlier described with reference to FIGS. **1**A through **2**F. The propulsion system **26** here comprises a fluid dynamic propulsor **55** that is a jet propulsor **55**J such as a turbojet or turbofan for example, that is also a retractable propulsor **55**R as shown in the secondary or retracted configuration. A deployment and retraction system can utilize a variety of known actuation types including hydraulic and electrical actuation for deployment and retraction of the propulsor module that includes the jet propulsor **55**J in a nacelle **28**N on a movable propulsor strut **28**S connecting to the PASRACS **1** and ship structure **2** in the body **3**; as well as deployment and retraction of propulsor well cover doors (not shown, but similar to wheel well doors in prior art aircraft). When deployed, the jet propulsor **55**J can act also as a vectored thrust propulsor **28**V, by producing an energized flow **55**E that can flow both backward and downward to generate thrust and contribute a lift increment, with this energized flow **55**E also helping to pressurize a power augmented ram air cushion **20**P as shown, with direct effect through the jet efflux and an optional secondary effect where hot jet exhaust converts some water from a water surface below into steam and adds further to the pressurization of the power augmented ram air cushion **20**P. The propulsion system **26** is shown in the forward part of a PASRACS **1** behind the flight deck **31**C and beneath a lifting portion of the body **3** that is not far from the body centerline.

[0357] FIG. **12**F shows a bottom view of hulls **54** of a PASRACS vehicle **1**, with two hulls illustrated but not to be construed as limiting. Keels **20**K are shown at the front ends of the hulls. FIG. **12**F shows a portion of the vehicle propulsion system that utilizes propulsor subsystems that operate on water. More specifically FIG. **12**F shows controllable water thrusters **28**W such as azipod thrusters that can provide azimuth controllable vectored thrust using one or both of a waterjet **28**WJ and a water propeller **28**WP, as shown. Other classes of water propulsors can also be used. Hull doors **54**HD are shown that allow the water thrusters **28**W to be deployed downward as shown, or retracted upward into the hulls **54** after which the hull doors **54**HD can be closed to a configuration with reduced drag, such as for a flight mode. The design and operation of the hull doors **54**HD can use design and operation precedents for wheel well doors in the hulls of prior art amphibious aircraft.

[0358] While FIGS. **12**A through **12**F show inventive features of some preferred embodiments of the invention as pertaining to propulsion systems and interfaces, it should be understood that many variations and combinations are possible within the spirit and scope of the invention as claimed. Using propulsion architectures that combine propulsors of different classes in different numbers, integrated and optimized solutions can be crafted with high fault tolerance through redundancy and redundancy management, and optimized applications of different elements in a manner that can reduce energy consumption, increase efficiency, reduce operating cost, and maximize specified objective functions.

[0359] FIGS. **13**A through **13**C illustrate some alternate preferred payloads architectures and features that can be applied on a partially aerostatically supported air cushion ship, complementing the inventive material on a Payload Services System **175** earlier presented with reference to FIG. **10**D, which Payload Services System **175** is also connected to many other systems on the PASRACS **1** through a data transmission member **168** such as a databus or system of plural databuses, such as nonessential, essential and critical databuses known in the prior art of commercial airliners. The payload services system **175** should preferably provide collective and individualized services to passengers, with services including reservations, orders, crowd and queue management, customized items delivery using robots, and other assorted services.

[0360] FIG. **13**A illustrates some preferred payloads architectures and features in a preferred embodiment of the invention corresponding to that described earlier in the context of FIG. **1**A.

[0361] FIG. **13**A shows payload volume **4** that includes decks **5** at levels **6**, with the decks **5** including a people deck **5**P, flexible use deck **5**F, and cargo deck **5**C. The cargo volume **42** portion of the payload volume **4**, includes space and provisions suitable for carriage and internal movement of cargo **43** including cargo containers **43**A such as Unit Load Devices or ULDs, with specific examples without limitation including a 45 ft (optional high cube) container **43**B and a 53 ft (optional high cube) container **43**C. FIG. **13**A also shows an onboard storage facility **178**S at a bottom region level in the PASRACS **1**, laterally spaced from the forward lower-level volume occupied by the emergency evacuation barges **47**E. The onboard storage facility **178**S can store a wide variety of goods that are tracked in an onboard inventory system **178**, and can include any combination of consumables and nonconsumables and perishable and nonperishable goods, and can optionally include refrigerated and frozen and heated storage as well. While separate areas would typically be provided for pet and live animal carriage as described elsewhere, the onboard storage facility **178**S can also optionally include a designated and segregated volume with HVAC, water, waste management and food facilities for the healthy, happy, and humane transport of pets and/or live animals of any kind. FIG. **13**A also illustrates fluid containment structures **2**FC including potable water tanks **92**B of a potable water system **92**C, shown at locations above the payload decks so that potable water **92**A can flow by gravity feed through a piping system to amenities using water in the payload decks, including kitchens, baths, showers, toilets, sinks, humidifiers and other amenities without limitation. One or more of the potable water tanks **92**B can be for hot water, with a hot water tank **92**H shown above passenger or people decks **5**P in a vertical stabilizer **88**V as one example location, not to be construed as limiting. The hot water tank **92**H in the illustrated vertical stabilizer **88**V location can benefit from heat sourced from waste heat associated with the near-by auxiliary power unit (APU) **26**A. An environmental control system (ECS) **177** is shown at a forward location on the PASRACS **1**, as one preferred location that is not to be construed to be limiting. The ECS provides heating, ventilation and air conditioning as known from the prior art of environmental control systems in vehicles and in buildings, and can include an air intake port/valve, an outflow valve, a heater, a chiller or refrigerator, a heat pump, an internal heat exchanger, a heat transfer subsystem connected to a liquid hydrogen cryogenic cooling and boiloff control subsystem, a skin heat exchanger, a heated air reservoir, a cooled air reservoir, ducting for air including optional separate ducting for heated and cooled air, air outlet tubes feeding personal air outlets such as “gasper” outlets used on airliners and options for temperature controlled air outlets that mix air in desired proportions from heated air and cooled air sources, a recirculated air cleaning subsystem (with at least one of a filter, a HEPA filter, a membrane filter, and an UV radiation sanitizer), a fresh air and recirculated air blending and management system, and a zonal climate control subsystem for different people (passengers, crew) and cargo payload volumes **4** in the PASRACS **1**. Specific cabin areas may be set a higher or lower temperatures, and/or higher or lower humidity levels, and/or higher or lower oxygen levels, for various purposes serving passenger, crew, animals, plants and/or other payload or equipment purposes, within the spirit and scope of the invention. FIG. **13**A also illustrates a waste system **92**G wherein waste from the payload areas can be transported by gravity feed and/or powered feed into at least one waste tank **92**F suitable for collecting liquid waste **92**E as well as solid waste **92**S that can settle in the bottom of the tank in an manner analogous to septic tank precedents. It should be understood that separate tanks or compartments can optionally be provided for liquid waste, solid waste, and garbage (which can also optionally feed through garbage chutes, optionally following garbage volume reduction by trash compactor subsystems on board). Laundry chutes can optionally be provided as well, leading to lower deck laundry facilities such as a laundromat area and/or a self-service laundry area. A payload systems computer **175**PC is shown below the illustrated flight deck/cockpit **31**C. It should be noted that multiple payload systems computers and locations are possible, along with multiple interface locations and types for different categories of crew and passengers (e.g., a flight deck interface, cabin crew interface such as a purser station interface, a passenger touchscreen interface, a control device interface, and a voice recognition interface, without limitation).

[0362] FIG. **13**B shows an expanded plan view of some preferred payloads architectures and features shown in a cabin area of a preferred embodiment earlier described with reference to FIG. **2**D and FIG. **2**C, rotated 90 degrees and scaled up from FIG. **2**D to provide improved clarity. FIG.

13B shows examples of persons **39** such as a passenger **40** and a member of crew **41** using a Personal Digital Assistant (or PDA) **175**D. The PDA **175**D can be a smartphone, remote control for a display, tablet, laptop, or other computer and/or electronic and/or touchscreen and/or voice-actuated and/or thought-activated device that has a human user interface and computational capability as known in the prior art. The PDA **175**D may incorporate data storage and/or expert system and/or artificial intelligence features, ability to interface with RFID tags or smart tags on items such as luggage and other items, as well as ability to communicate through a wireless communications subsystem **168**W such as a wireless mesh router that provides wireless data & internet connectivity, encryption and cybersecurity features, Wi-Fi access to social media and apps (Facebook, LinkedIn, game apps, passengers and crew interpersonal or subgroup communications as examples without limitation), and connectivity with one or more of the payload services system **175**, crew services system **176** and other computer systems connected to a databus type of data transmission member **168**. FIG. **13**B also shows a power connection port **169**P such as a plug outlet and a data connection port **168**P such as a USB interface, that can be accessed and used by persons such as passengers and crew. FIG. **13**B illustrates occupant restraint **39** as an example of a payload protection member **7**P, with both a safety belt **7**P**1** and an inflatable safety member **7**P**2** such as an (stowed & undeployed) airbag shown. FIG. **13**B also shows the provision of hold members **7**P**7** such as handhold/railing/strap items that are illustrated for use by a person to steady themselves while in turbulence or maneuvering conditions. Variant embodiments of PASRACS **1** may provide one or more of: seat belts, bed belts, multi-point harnesses, and airbags. FIG. **13**B also illustrates a tray table **175**T that can be a fold-out tray table or passenger-usable surface of a variety of types known from the prior art of airliners and other passenger transport vehicles. A standing member of the crew **41** is also shown facing and interfacing with a surface mounted interface device **175**S, with a wall mounted device shown as one example. FIG. **13**B also illustrates individual comfort & services system **175**C including personal control lighting **175**L (such as a personal reading light) and controllable air outlet **177**C with separately controllable warm air and cool air outlets shown, as connected to a ventilation subsystem **177**V. FIG. **13**B also illustrates a payload volume such as a private cabin **38**P equipped with a thermal management subsystem **177**T (for heating or cooling of the cabin to a selectable temperature or range of temperatures), a humidity management subsystem that can control humidity with humidifier and/or dehumidifier devices, and a purification subsystem **177**P that can purify one or more of air and water, using technologies such as filtration, HEPA filter, UV purification, ionic purification and chemical purification without limitation. FIG. **13**B also shows a cabin with a lighting subsystem **177**L which optionally serves to provide mood lighting with color control **177**M, that is controllable by a user using a device like a switch or knob or remote control from a remote controller or an app on a smartphone, without limitation. FIG. **13**B also illustrates a noise management subsystem **177**N, that can help control the noise environment experienced by a person **39** on board a PASRACS **1** by one or more of noise insulation, noise attenuation design of structure and systems and amenities, active noise cancellation such as the use of speakers fed with noise cancelling signals in a micro-environment close to the head of a person **39** such as the illustrated reclining/sleeping person. The noise management subsystem may also provide white noise or soothing sounds or sleep facilitating music in variant embodiments of the invention.

[0363] FIG. **13**B also illustrates a kitchenette **175**K that can include more than one selected from a refrigerator, a freezer, a microwave oven, a toaster oven, a toaster, a coffeemaker, a sink with faucet, a water dispenser, a trolley/cart, a robotic self-powered trolley, serving items, cutlery and other items. The kitchenette **175**K is a part of an eating & drinking services system **175**E. A water quality enhancement system **177**W can comprise at least one of a filter, a UV purification device and a chemical purification subsystem.

[0364] FIG. **13**C shows an expanded plan view of some preferred payloads architectures and features shown in a deck level including a cargo deck area, of a preferred embodiment of the invention earlier described with reference to FIG. **2**A. The deck **5** includes a cargo deck **5**C and crew quarters **5**Q, with a connecting door **159** that is preferably secure and access-controlled. A cargo management system **43**M is provided, that includes multiple subsystems and components. The cargo management system **43**M includes one or more cargo cranes **43**E that can be part of an overhead crane system, for example similar to factory overhead cranes systems that can move articles to different locations in two-axes, after lifting them from a supporting surface such as a cargo floor. FIG. **13**C shows representative examples of cargo cranes **43**E that carry a cargo container **43**A that can optionally be a high cube cargo container, a 45 ft (optional high cube) cargo container **43**B, a 53 ft (optional high cube) cargo container **43**C, an open top cargo carrier **43**OT (such as a bin or pallet base for supporting cargo or baggage, with optional net or cover on top), a 20 ft (optional high cube) cargo container **43**W and a 40 ft (optional high cube) cargo container **43**Y. At the start of a travel leg of a PASRACS **1** traveling from an origin, cargo containers can be engaged by combinations of cables, winches, robotic arms, quick-attach and quick-release fittings and other engagement components and assemblies, then picked up from payload transfer transport modules **47** suspended below the PASRACS **1** (below the illustrated deck so not seen in this view), then lifted up through a cargo transfer floor opening **43**F to the illustrated deck by a cargo crane **43**E, then moved in a lifted configuration through cargo transport corridor areas **43**T that are also shown in FIG. **13**C. The cargo containers/cargo carriers can then be deposited at designated locations in the payload volume **4** and cargo deck **5**C as shown, and set down on floor structure **2**FL such as a cargo floor designed to support and react cargo loads for a variety of loading conditions. The cargo containers/cargo carriers can optionally be restrained/locked in place either individually or collectively in some grouping(s). Individual container restraint is shown with cargo restraint devices **43**RD such as locks and stops known in aircraft cargo restraint fittings, shown engaging a 20 ft (optionally high cube) container **43**W. FIG. **13**C also illustrates examples of non-individual container restraint utilizing a cargo restraint device **43**RD that is a cargo barrier **43**CB. Note that a cargo barrier **43**CB can be at least one of a rigid barrier and a barrier with flexibility such as a cargo net and/or energy absorbing barrier. When cargo containers need to be offloaded at a destination the above-described process of transporting a cargo container from a payload transfer transport module **47** is reversed to a process of transporting a container to a payload transfer transport module by a cargo crane **43**E, then winching down the container through said cargo transfer floor opening **43**F. For the case of passenger's and/or crew baggage **44**, some baggage can be transported in a manner similar to the cargo containers, but in open top cargo carriers **43**OT such as cargo bins or wheeled cargo bins or pallet bases, that can also be transported by cargo cranes **43**E.

[0365] An autonomous flatbed carrier **43**FC is shown, that can be used as an option to carry cargo and/or baggage within the PASRACS **1**, and can also access the payload transfer transport module **47** below through a downwardly deployed deployable ramp **43**DR, and can further access a dock or vessel (not shown) outside the PASRACS **1** through another deployable ramp **43**DR shown in the body left side surface **3**L. The autonomous flatbed carrier **43**FC can optionally be an ultra-lowrider flatbed truck with a container loading and manipulation subsystem.

[0366] The deployable ramps **43**DR may be fitted powered roller, roller tray, and/or winch members to facilitate cargo loading and unloading, as known in the art of aircraft cargo handling systems. The latter deployable ramp **43**DR in the body left side surface **3**L may have a ramp structure integrated with a cargo door **43**D or separate from the cargo door **43**D; wherein the cargo door **43**D may be hinged on the bottom, side or top in variant embodiments of the invention. The deployable ramp(s) **43**DR serve as cargo loading device(s) **43**LD, and may also be usable by at least one of a bus **115**B, truck **115**C and trailer **115**D, that are shown in a vehicle parking area **142**T in FIG. **13**C.

[0367] The illustrated cargo cranes **43**E can utilize a variety of lifting, locking and moving mechanisms as known in the art of crane technology. Tracks on which overhead cranes can run are not shown, but it should be understood that methods of ceiling-structure-hung tracks along with branches, curves, and switches are known from the prior art of overhead crane systems such as factory crane systems. Optional features can include one or more of: top corner lifts with spreaders, top corner lifts without spreaders, container lifting jacks, gantry cranes, straddle carriers, reach stackers, side loaders, forklifts and truck cranes.

[0368] In addition to standard size containers or Unit Load Devices, FIG. **13**C shows that the PASRACS **1** can carry a refrigerated container **43**R with fittings that can be connected to provide power and/or cooling fluid to the refrigerated container **43**R from ship's systems, and oversize cargo **43**XL that can either (i) be transported to a holding area (shown) by a cargo crane **43**E or an autonomous flatbed carrier **43**FC, or (ii) be retained on a payload transfer transport module **47** for the duration of its journey.

[0369] FIG. **13**C also illustrates an umbilicals connection subsystem **43**U that allows connection of a variety of umbilicals or connections with secure and quick-connect/quick-disconnect fittings for conveying a plurality selected from: electric power, signals, hydraulic power, pneumatic power, potable water, waste from a waste container **142**W, hydrogen, fuel, lifting gas, and other conveyables, between the PASRACS **1** and a payload transfer transport module **47** connectedly suspended below. The umbilicals connection subsystem **43**U can utilize prior technologies used for aircraft, ships and other vehicles.

[0370] FIG. **13**C also illustrates a ballast subsystem **33**B that can use liquid or solid ballast, as well as integrate a load management and cg control capability that involves moving cargo containers with different weights to different locations in the cargo deck.

[0371] FIG. **13**C also shows a live animal accommodation area **43**LA, that is also accessible by authorized personnel (crew, animal keepers who feed and serve the animals with health and comfort measures etc., and selected passengers such as pet owners as applicable). Live animal carriage should aspire to provide high standards for animal health, welfare, comfort and care. Provisions in the live animal accommodation area **43**LA can include one or more from: a dog area, a cat area, a pet animals area, a pet area with access for pet owners, a passenger plus pet private cabin, a pet walking area, pet sanitation provisions for pet urine and fecal matter collection and sanitary disposition, a veterinary services area with at least one of a human an a robotic veterinary service provider and appropriate facility and equipment, pet telehealth provisions, water provisions for pets, food provision for pets, pet toys, and pet health and wellness services for physical and mental well-being of pets. Provisions for non-pet animals and marine animals and fish and flying animals and birds on board can similarly be provided for all the categories noted in the pet provisions above. Special provisions can also be provided on board a PASRACS **1** for live organ transport and other medical transport special purposes. Animal harming or killing on board should preferably be prohibited for ethical reasons. The live animal accommodation area can also optionally accommodate live plants, or alternatively separate life plant accommodation area(s) can be provided within the spirit and scope of the invention.

[0372] FIG. **13**C also shows openings **47**P for passenger tower portions of payload transfer transport modules **47** to project through the illustrated deck to next upper deck (that was earlier described with reference to FIG. **2**B). The passenger tower portions can also allow for some baggage **44** to go up to the next upper deck, as shown and described earlier with reference to FIG. **2**B.

[0373] FIGS. **14**A through **14**E illustrate some alternate preferred methods of operation that can be applied for normal and nonnormal operations of a partially aerostatically supported air cushion ship **1**, complementing the transport method aspects already described with reference to FIGS. **8**A through **8**E and the vehicle aspects already described, including of the preferred embodiment of a PASRACS **1** described with reference to FIGS. **1**A-**1**G and **2**A-**2**F.

[0374] FIG. **14**A illustrates a preferred method of seamlessly swapping incoming and outgoing payload **189** on a travel leg of a PASRACS **1**, in normal operation.

[0375] As shown in FIG. **14**A, the first steps of this method **189**, that may be concurrent or at similar timings within a modest window of time, comprise the two steps of: [0376] **190**A—Identifying and notifying next-stop disembarking passengers, and [0377] **190**B—Guiding & moving embarking passengers to embarkation holding area.
[0378] The subsequent steps for this method **189** comprise the following steps in sequence: [0379] **191**—Guiding & moving disembarking passengers from travel seat/cabin to disembarkation holding area [0380] **192**—Cleaning & servicing vacated seat/cabin areas [0381] **193**—Notifying embarking passengers their seat/cabin is ready, and [0382] **194**—Guiding & moving embarking passengers to their travel seat/cabin.
[0383] FIG. **14**B illustrates a transport method **63** that includes a preferred method of operation that can be applied for normal operations of a partially aerostatically supported air cushion ship **1** or PASRACS **1**, wherein the PASRACS **1** from an inbound travel leg arrives at a port region **79**R with a water surface **18**, and in that port region **79**R a transfer vehicle **69** that is a transfer vehicle departing to destination **69**DD, unmates from the PASRACS **1** and then moves to an arrival facility such as an arrival gate at a dock to enable disembarking payload from the PASRACS **1** (passengers and cargo from the inbound travel leg) to disembark to their destination; with the PASRACS **1** then moving appropriately on the water surface **18** to rendezvous with a transfer vehicle **69** that is a transfer vehicle incoming from origin **6910**, which then mates with the PASRACS **1** to enable embarking payload to the PASRACS **1** (passengers and cargo starting on the outbound travel leg) to then board the PASRACS **1** for outbound travel leg from the illustrated port region **79**R. Note that the port region **76**R typically serves one or more particular habited areas (such as one or more of a city, urban agglomeration, county, state, country or other transportation hub or stop) as a destination & origin location. While a single inbound transfer vehicle **76** and single outbound transfer vehicle **76** are shown for illustrative purposes, it should be understood that multiple inbound transfer vehicles **76** and multiple outbound transfer vehicles **76** could be involved in an integrated method of operation, for various circumstances including but not limited to: (i) a circumstance where the number or passengers and/or number of TEUs of cargo that need to be offloaded or loaded, exceed the payload capacity of a single transfer vehicle **76**; and (ii) a circumstance where a single port region **79**R on a water surface **18** serves more than a single landing port/dock, such as one landing port in one country and a second landing port in another bordering country, with separate transfer vehicles serving the different jurisdictions for approximately concurrent operations (as will be shown subsequently for Enez, Turkey+Alexandroupoli, Greece in FIG. **16**A; Aqaba, Jordan+Eilat, Israel+Taba, Egypt also in FIG. **16**A; and Corozal, Belize+Chetumal, Mexico in FIG. **16**C, for example and without limitation). Transfer vehicles **76** that comprise payload transfer transport modules **47** can also optionally be ganged together for combined mating and unmating operational steps, such as the paired payload transport modules **47** shown earlier in FIG. **1**B, for example and without limitation.
[0384] The transport method **63** that includes a preferred method of operation as shown in FIG. **14**B, more specifically involves five sequential steps as shown in the five connected boxes shown, starting in the top left of the Figure and ending in the bottom right. The first box, in the top left of FIG. **14**B, shows a plan view showing a portion of a PASRACS **1** from an inbound travel leg as it has arrived at a port region **79**R with a water surface **18**. The portion of the PASRACS **1** that is visible in this view include a body **3**, a right hull member **54**R and wing **61**. The transfer vehicle **69** that is a transfer vehicle departing to destination **69**DD, starts at this configuration hanging below and mated with the underside of the PASRACS **1**, connected by an unmating apparatus **80**A that serves as a method to contiguously connect **72** the transfer vehicle **69** to the PASRACS **1**. The unmating apparatus **80**A includes a controlled drop down system **139** with a guide track member **136** and a winch **134** and a positioning system **131**, all shown in an up-and-mated configuration for the transfer vehicle **69** in this first box. The transfer vehicle **69** is a payload transfer transport module **47**, and it has already been explained (in FIGS. **8**A and **8**B) how passengers and cargo

transfer from the internal decks of the PASRACS **1** to this payload transfer transport module **47**, ahead of arrival at the port region **79**R, as a first step for enabling disembarking transfer **69**C.
[0385] The second sequential step, shown in the top right box of FIG. **14**B, shows the step of the transfer vehicle **76** (that is also the payload transfer transport module **47** and the transfer vehicle departing to destination **69**DD) in the process of being disconnected from the PASRACS **1** in a smooth and safe manner, wherein the positioning system **131** moves the transfer vehicle **76** laterally away from the right hull **54**R, after the winch **134** and the controlled drop down system **139** have together lowered the transfer vehicle **76** still attached by cables **132**, smoothly down to a position where the transfer vehicle **76** is floating by itself on the water surface **18**. The positioning system **131** can utilize a variable length, variable angle member such as the illustrated dual powered and controlled arms shown, which can be controlled robotically and/or by a crew member operating controls. The use of robotic or crew operated arm or boom controls is known for example from corresponding technology applied to in-flight refueling boom control on prior tanker transport aircraft.
[0386] The third sequential step, shown in the middle right box of FIG. **14**B, shows the PASRACS **1** moving forward (on the water surface **18** in the port region **79**R) from the position where it dropped off the transfer vehicle departing to destination **69**DD, with communication and control between the PASRACS **1** and the departing transfer vehicle to avoid any interference or collision in the process of moving apart. A baseline approach would be for the transfer vehicle departing to destination **69**DD to be in a station keeping mode while the PASRACS **1** moves forward carefully in a water taxi mode with aft side flaps **90**S retracted, on a path that avoids any interference. The PASRACS **1** can then move over the transfer vehicle incoming from origin **69**IO, which in a baseline scenario will also be in a station keeping mode.
[0387] The fourth sequential step, shown in the lower left box of FIG. **14**B, shows the positioning system **131** on the underside of the PASRACS **1**, identifying and tracking and then engaging and coupling with the transfer vehicle mating fittings **69**F on the transfer vehicle **69** that is the transfer vehicle incoming from origin **6910** and that is also a payload transfer transport module **47**. The positioning system **131** and the mating fittings **69**F and attachment fittings **130** are included as working members of the mating apparatus **70**A, which utilizes common components with the earlier described unmating apparatus **80**A. The positioning system **131** also pulls out the cables **132** from the winches **134** on the PASRACS **1**, to establish a cable load path between the PASRACS **1** on the first hand, and the transfer vehicle **69** on the second hand. In the initial engagement position shown in this box, the transfer vehicle **69** is laterally spaced from the right hull member **54**R, to avoid bumping and associated loads and discomfort to incoming passengers on board the transfer vehicle **69**.
[0388] The fifth sequential step, shown in the bottom right box of FIG. **14**B, shows a mated configuration wherein the positioning system **131** has moved the transfer vehicle **69** to a position adjacent to the right hull member **54**R, and a combination of the winches **134** and the controlled lift up system **138** (which is integrated with the earlier cited controlled drop down system **139**) with lifting members on guide track members **136**, lift the transfer vehicle **69** smoothly up to a mated and locked in place configuration on the underside of the PASRACS **1**.
[0389] FIG. **14**B thus illustrates a transport method **63**, wherein said mating apparatus **70**A and said unmating apparatus **80**A each comprise at least one of: (i) a disconnectable attachment fitting **130**D, (ii) a positioning system **131** (shown) for an attachment fitting **130** (shown), (iii) a cable **132** (shown), (iv) a structural beam **133**, (v) a winch **134** (shown), (vi) an actuator **135**, (vii) a guide track member **136** (shown), (viii) a deployable ramp **137**, (ix) a controlled lift up system **138** (shown), (x) a controlled drop down system **139** (shown), and (xi) a controlled guided transport system **140** connected to said vehicle control and navigation system **29**.
[0390] FIG. **14**C illustrates a transport method **63** including a method for managing crew allocations and duty periods **63**C, comprising the steps of: [0391] (i) Modeling the relationship **63**D

between the frequency and pattern of duty periods and rest periods while giving consideration to the cumulative effects of undertaking long duty hours combined with minimum rest periods; [0392] (ii) Modeling duty patterns **63**E which avoid practices that cause a serious disruption of an established sleep/work pattern such as alternating day/night duties; [0393] (iii) Modeling rest periods **63**F of sufficient time to enable crew members to overcome the effects of the previous duties and to be rested by the start of the following duty period; [0394] (iv) Planning crew allocations and duties **63**G in a manner to be completed within an allowable duty period for each crew member **41**M taking into account (a) the time necessary for any applicable prior & subsequent duties and overlapping handoff periods with prior & subsequent on-duty crew **41** and (b) human factors effects related to passage of the PASRACS **1** through plural time zones; [0395] (v) Assigning duty periods **63**P for each crew member **41**M that are planned in a way that enables each said crew member **41**M to remain sufficiently free from fatigue so that they can operate to a satisfactory level of safety under all circumstances for a normal operational scenario **200**, depending on the nature and criticality of their assigned crew role **41**R and depending on the nature of redundant backup provided from at least one of human and automated backup for each assigned crew role; [0396] (vi) Publishing duty rosters **63**DR sufficiently in advance to provide the opportunity for each crew member **41**M to plan adequate rest; and [0397] (vii) Changing scheduled crew allocations and duties **63**GC to mitigate safety risks in the event of a specified level of exceedances **63**X during a specified period of time **63**T, for a non-normal operational scenario **201**.
[0398] Note that a non-normal operational scenario **201** can be an emergency scenario **202** but does not necessarily have to be an emergency scenario **202**.
[0399] FIG. **14**D illustrates a transport method **63** including a method for method for diagnosing and responding to a non-normal operational scenario **63**R (wherein a non-normal operational scenario **201** can possibly also be an emergency scenario **202**), comprising the steps of: [0400] (i) Happening of a non-normal operational scenario **201**A; [0401] (ii) Diagnosing of a non-normal operational scenario **201**B; [0402] (iii) Automated response & annunciation **201**C; [0403] (iv) Crew response & override **201**D; [0404] (v) Modifying, iterating & optimizing response as needed **201**E; [0405] and [0406] (vi) Return to normal operational scenario or target end state **201**F.
[0407] Note that a normal operational scenario is designated **200**, a non-normal operational scenario is designated **200**, an emergency scenario is designated **202**, and a target end state is designated **203**. Note that there are bidirectional arrows though data transmission member(s) such as databuses connecting the method for diagnosing and responding to a non-normal operational scenario **63**R on one hand, and all of the following on the second hand: [0408] Sensor(s) **22**; [0409] Vehicle systems **1**S; [0410] Crew interface(s) **31**F; [0411] and offboard system(s) **195** connecting through a wireless communications subsystem **168**W.
[0412] Note that vehicle systems **1**S should be construed to encompass any and all systems and subsystems on board the PASRACS **1**, as described in the descriptive portion of the specification and the drawings, and further including redundancy and redundancy management that allows continued safe operations following a single failure or in some cases, multiple failures. Note that offboard system(s) **195** should be construed to encompass any and all systems no on board the PASRACS **1**, which may include for example and without limitation meteorological stations or systems, air traffic and surface traffic control and management systems, harbor area management systems, distributed collision avoidance systems, offboard sensors, offboard communications systems, offboard control systems such as remote pilot provisions for special circumstances, government systems, offboard security & safety systems, remote medical or health systems, and offboard advisory or consultation systems. Note that there are also bidirectional arrows between process steps (iii), (iv) and (v) above, to indicate that automated and crew responses can be modified, iterated and optimized in flexible, appropriate and iterative ways depending on the particular nature of the non-normal operational scenario or scenarios.
[0413] In the paragraphs below several examples of a method for diagnosing and responding to a

non-normal operational scenario **63**R, are presented but are not to be construed to be limiting. Best practices from prior art on managing non-normal and emergency scenarios for prior art air, water and land vehicles can be beneficially applied, including deployment of safety systems and personnel, redundancy and redundancy management, failure identification and annunciation systems, smart camera and expert and artificial intelligence systems, standard operating procedures, triage and emergency protocols, layered advisory and caution and warning systems, automated reconfiguration systems, passenger alerting systems, and passenger aid systems.

[0414] A first example of a non-normal operational scenario **200** is when a travel leg of a PASRACS **1** (as for example any of the travel legs on the routes that will be described in FIGS. **16**A-**16**G following) is either delayed or cancelled for a variety of reasons ranging from environmental issues (snowstorm, hailstorm, windstorm, dust storm, volcanic ash, tornado, hurricane, cyclone, typhoon, tsunami, etc.) to technical issues (engine failure, other vehicle component or system/subsystem or computer failure, hull damage, lifting gas leak, etc). The diagnosis of a travel leg delay or stop cancellation can be by either or both of automated systems and crew monitoring and awareness, as well as based on inputs from offboard systems such as meteorological data or forecasts and inputs from traffic control entities such as air traffic control or surface traffic control entities. Candidate automated and/or crew responses to an impending delay or stop cancellation can include increasing cruise speed to maximum cruise speed, changing ground tracks to reduce travelled distance, and accommodating certain levels of delay by rebooking passengers on connecting travel legs on other PASRACS **1** vehicles and/or other transport modes and/or vehicles. A second example of a non-normal operational scenario **200** is an emergency scenario **202** wherein continued safe flight (in ground-effect) and landing at a scheduled destination is at risk and requires an intervention to maintain safety for passengers, crew, other payload and offboard people, animals and living beings. It will be understood that a very wide variety of emergency scenarios **202** are possible, without limitation ranging across: medical emergency, fire, cargo fire or explosion, fuel or hydrogen fire or explosion, chemical hazard, leakage of lifting gas, vehicle shaking or high-g motion (e.g., due to collision avoidance maneuver and/or turbulence/windshear in the air and/or big waves/strong currents in a supporting water surface layer), structure/system/mechanism/part failure on board, propulsor failure, collision of any kind, terrorist action, action by a mentally unbalanced or suicidal person (passenger or crew member), and natural hazard (e.g., volcanic eruption and ash, sandstorm, hail, severe storm, flying debris, birdstrike or marine animal strike, log or floating object strike, hurricane, cyclone, typhoon, tornado, ice storm, atmospheric icing conditions, rogue wave and tsunami, without limitation).

[0415] An emergency scenario **202** can be diagnosed by either or both of automated systems and crew monitoring and awareness, as well as based on inputs from offboard systems. Candidate automated and/or crew responses can include, as one example without limitation, optional diversion followed by safe landing and stop at a safe location, then followed by maintenance/repair operations where appropriate, plus shelter-in-place awaiting a rescue operation and/or evacuation of the PASRACS **1** if staying on board would be hazardous. FIG. **14**E following will include further information about a nominal evacuation scenario. As regards candidate rescue operations, these can include one or more selected from (i) transferring payload from a PASRACS **1** being evacuated to a second nearby rescue PASRACS, using plural trips as needed by payload transfer transport modules **47** and triaging to rescue passengers, crew, animals and cargo in that order; (ii) using a large rescue vehicle that acts in a “tow truck” mode, such as a rescue hybrid airship that can lift an entire nonoperational PASRACS **1** (after offload of some cargo in payload transfer transport modules **47**) in a hybrid vertical takeoff and landing (VTOL) mode and transport it to a safe offload destination; and (iii) having external rescue vehicles that may be aircraft (e.g., helicopters, VTOL aircraft, flying boat or seaplane aircraft, amphibian aircraft) or watercraft that connect with the nonoperational PASRACS **1** and collect people and animals to transport away to safety. While some emergency scenarios **202** may require rescue or evacuation of most or all people on board, other emergency scenarios **202** may require only one or a few persons to be evacuated, such as a medical emergency requiring a "medevac" operation to transport the affected person or persons to a land-side medical facility, if a clinic or medical facility on board the PASRACS **1** cannot provide sufficient care, even with advisory services by telemedicine from offboard medical expert(s).

[0416] In the event of a terrorist and/or hijack threat or action on board, onboard security or police personnel and robots can attempt to address the threat while the crew performs a safe landing and stop, and in a worst case scenario where crew may also be complicit in a terrorist action, an offboard security crew can remotely pilot the vehicle to a forced safe landing and stop, overriding the onboard crew (with safety provisions that no offboard system can perform any piloting action other than a quick safe landing and stop). External security or antiterrorist personnel can then arrive on external vehicles and board the PASRACS **1** through provisioned interfaces such as a door, boarding barge or landing pad, to apprehend & jail the terrorists or otherwise neutralize the threat. In the event of people with firearms or other contraband, prohibited items or weapons on board, and/or other criminal or dangerous activities on board by criminals or inebriated or drug-impaired people, or other criminal activities of various kinds (drug-dealing, gang warfare, religious or political threats or harassment, trafficking or sexual crimes, assault, fights, bullying, etc.) on board, security personnel and automated robots with nonlethal methods (such as tasers, handcuffs & zip-ties) and lethal methods where necessary and warranted, of remedying violations and arresting and jailing or otherwise stopping offenders, can be used as lines of protection for innocent passengers and crew. Security personnel and automated robots can also effectively address lesser human misbehavior issues such as drunk people, people smoking in no-smoking zones, and other rules violations; as well as any animals on board issues for pets or other animals, such as a dog biting a child, for example and without limitation.

[0417] It should be understood that a variety of offboard experts and offboard systems can be leveraged to help in nonnormal situations involving a PASRACS **1**, including but not limited to offboard expert monitoring and control centers, emergency response centers, and offboard specialists and expert systems applicable to one or more of: health, injuries and deaths, infectious disease, epidemics, pandemics, triage, medevac, mental health, telemedicine, security, police, counterterrorism, SWAT teams, fire, smoke, chemicals, environmental hazards, biohazards, natural disasters (including but not limited to hurricane, typhoon, cyclone, tornado, turbulence, rogue wave, tsunami, birdstrike, obstacle strike, earthquake, volcano, ash plume, sandstorm, extreme temperature), war and weapons, damage survival and other nonnormal circumstances; with following remote control of humanoid robots on board, advice to human crew members on board, and ability to orchestrate and execute remote area rescue operations.

[0418] FIG. **14**E shows a plan view of a preferred embodiment of a partially aerostatically supported ram air cushion ship **1** (PASRACS **1**), similar to that shown and described earlier with reference to FIG. **1**B and FIG. **13**C. The PASRACS **1** is shown floating on a water surface **18** supported by four hulls **54** as shown, following a non-normal operational scenario **200** that may be an emergency scenario **202**, with an at least partial evacuation of the vehicle shown in progress. The PASRACS **1** is shown with plural bay areas with external access **1**B, which each have an internal volume within the PASRACS **1** called a "bay" and openable bay doors that may be hinged or sliding or otherwise openable, to allow things, people and vehicles (e.g. a robotic air vehicle or evacuation vehicle, for example and without limitation) to transit from within the PASRACS **1** to outside the PASRACS **1**. Bay areas may also optionally be fitted with deployable turrets with wide angle external viewing. FIG. **14**E shows this preferred embodiment of a PASRACS **1** with transfer vehicles **69** comprising payload transfer transport modules **47** winched down from the underside of the PASRACS **1** than released to move on their own floating on the water surface **18**, to move gradually away from the PASRACS **1**, as shown. The transfer vehicles **69** will preferably be equipped with onboard energy storage and propulsion to enable them to move in a controlled manner on the water surface **18**, with crew control, remote control and/or autonomous control.

Eight full-size payload transfer transport modules **47**, two dedicated emergency evacuation barges **47**E, and six compact payload transfer transport modules **47**C, are all shown detached from the mothership PASRACS **1**. An expanded inset view of one of the six compact payload transfer transport modules **47**C is also shown, to enable a clearer understanding of some inventive features and amenities on said compact payload transfer transport module **47**C. One of the payload transfer transport modules **47** is shown connected to the PASRACS **1** through a deployable ramp **43**DR, to allow people and baggage to transfer to the payload transfer transport module through a cargo door **43**D that serves as a payload door, and said deployable ramp **43**DR in deployed configuration. Other optional evacuation facilitating features are illustrated, including a landing pad **47**L that is shown at the aft end of the PASRACS **1** vehicle and has a substantially flat surface that is exposed by retraction of a portion of the upper skin of the PASRACS **1** aft body **3**A using one or more of a roll up retractable panel, sliding retractable panel, or folding retractable panel. A VTOL aircraft **166**V such as the illustrated tandem rotor helicopter shown on a landing pad **47**L, without limitation, can carry people from the PASRACS **1** to destinations on the shore or on other marine vehicles, for emergency and some normal scenarios. FIG. **14**E also shows a second aircraft **166** flying above the PASRACS **1**, which can be a remotely controlled or autonomous drone aircraft (VTOL or non-VTOL) that is based on the PASRACS **1**, and can conduct operations such as flights starting and ending from a takeoff and landing pad or fitting or openable bay on the PASRACS **1**, with the aircraft **166** capable of performing video and sensor data gathering missions, security missions, rescue missions including targeted drop-off of life preserver devices, flare or chaff dispensing missions for security or safety or anti-missile tasks, and detection of threats that may range from mines to bombs to explosives to terrorists and human and robotic threats of a wide variety. The aircraft **166** may also be fitted with defense purpose weaponry suitable for protecting the PASRACS **1** from external attacks by human and machine "bad guys" on land, on water, under water, and in the air, including one or more of electronic warfare and jamming and gun and laser weapon options as needed and appropriate. A marine vehicle **115**S such as ship that is a rescue ship is also shown just behind the PASRACS **1** with a connection via another deployable ramp **43**D, to enable people and other payload to exit the PASRACS **1** for non-normal and some normal scenarios.

[0419] FIG. **14**E shows a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**, further comprising life-preservation apparatus **100** configured to be employed to facilitate safe evacuation of said passengers **40** and said crew **41** from said ship **1** in the event of an emergency scenario **202** warranting evacuation, said life-preservation apparatus **100** comprising more than one from the set of: said payload transfer transport module **47**, a wearable life preserver **102**, a life raft **103** and an evacuation raft **105**, an evacuation slide **104**, an evacuation slide-raft **104**R, a warmth preserving device **106**, a heating device **107**, a signaling device **108**, a transmitting device **109**, a nourishment container **110**, a potable water container **111**, and a medical supply container **112**. A barge equipped as a lifesaver barge can be provisioned with a plurality of items from: food and water and medical supplies, heating & ventilation & air conditioning, weather protection, a locator beacon, radio and satellite communications, onboard energy storage and power generation, and human comfort and sanitation systems, for example and without limitation.

[0420] FIG. **14**E also shows a transfer vehicle **69** that comprises a barge **114** configured to float on said water surface **18**, and wherein said transfer vehicle **69** is further configured to carry more than one selected among the following: said first plurality **40**A of passengers **40**, said second plurality **40**B of items **67** of at least one of cargo **43** and baggage **44**, vehicles **115**, cars **115**A, buses **115**B, trucks **115**C, trailers **115**D, electric vehicles **115**E, autonomous vehicles **115**F, recreational vehicles **115**G, road vehicles **115**H, rail vehicles **115**J, wheeled vehicles **115**K, motorcycles **115**L, scooters **115**M, bicycles **115**N, three-wheel vehicles **115**P, vehicle trains **115**Q, amphibious vehicles **115**R, marine vehicles **115**S, potable water **92**A, food **116**, beverage **116**B, merchandise **117**, fuel **82**A, lifting gas **9**, cryogenically liquified lifting gas **9**C, liquid waste **92**E and solid waste **92**S.

[0421] The PASRACS **1** and the transfer vehicle **69** will preferably both be fitted with safety and security equipment including one or more of: fire detection, smoke detection, carbon monoxide detection, fire protection, fire containment, hydrogen safety (including upward vent lines and spatial separation of any hydrogen systems from passenger, payload and crew use volumes), toxic fluids and gases protection and containment, electrical safety, temperature safety, physical security, cybersecurity, and other safety and security devices and subsystems without limitation. FIG. **14**E also illustrates an autonomous vehicle **115**F that is also an autonomous flatbed carrier **43**FC.

[0422] FIG. **14**E also shows a transfer vehicle **69** that comprises a wheeled vehicle **115**K configured to carry more than one selected among the following: said first plurality **40**A of passengers **40**, said second plurality **40**B of items **67** of at least one of cargo **43** and baggage **44**, potable water **92**A, food **116**, beverage **116**B, merchandise **117**, fuel **82**A, lifting gas **9**, cryogenically liquified lifting gas **9**C, liquid waste **92**E and solid waste **92**S.

[0423] Following a nonnormal landing and evacuation as shown in FIG. **14**E, the PASRACS **1** vehicle can be at least partially repaired in-situ with repair personnel arriving on another PASRACS **1** or other marine or air vehicle. The repaired PASRACS **1** can then takeoff on its own power and be flown in ground effect to a destination with a repair hangar where a full repair can be completed. For the takeoff under its own power on an ice surface, the use of hydroskis and planing surfaces acting as ski or skate or runner members, and the ability of the front ends of hulls **54** to withstand ice cutting loads, will be useful enablers. If the damaged PASRACS cannot be repaired sufficiently to takeoff under its own power even for a flight in ground effect with a limited flight envelope, a “tow truck” type vehicle such as a powerful towing hovercraft of PASRACS can be used, or a powerful lift vehicle such as a heavy lift VTOL hybrid airship, to lift up the stricken PASRACS after offload of cargo in barges to reduce the weight that needs to be lifted.

[0424] FIGS. **15**A through **15**D illustrate some alternate preferred methods of manufacture, maintenance and repair that can be applied for a partially aerostatically supported air cushion ship **1** or PASRACS **1**.

[0425] FIG. **15**A shows a plan view of a nominal final assembly factory layout for assembly of a PASRACS **1** similar to that described earlier with reference to FIGS. **1**A-G and **2** A-F, as viewing downward from a level just below the ceiling and roof of a building **196** that is a hangar **196**H. The building **196** is of nominally rectangular layout with walls **196**W as shown, with other geometries and layouts of the building **196** possible within the spirit and scope of the invention. Building construction can utilize a variety of materials and a variety of structural members and architectures, including beams, panels, trusses, three-dimensional members, joining members, surface members, weather protection members, decorative members and other members as known in the art and science of building design and construction. The building **196** is located in the vicinity of a shoreline **21**S that separates a water body with a water surface **18** on the one hand, and a ground surface **21**G of an Earth surface **21** on the other hand. A portion of the building **196** is built over the ground surface **21**G, while another portion of the building projects into an area that was formerly water, in a manner similar to a pier of any type known from the prior art, including but not limited to a piling supported pier, a float supported pier, and a pier built on reclaimed land. Landside access to the interior of the building **196** is via a building doorway subsystem **196**D such as a hangar door opening with optional openable hangar doors. Waterside access can be open as shown, or alternatively also be fitted with a building doorway subsystem (not shown). The building has a paved area **196**P that can be a factory floor area with various subareas for different purposes, that partially encloses an area with water surface **18** on which the PASRACS **1** that is being assembled can be floated with hydrostatic support from hulls **54**, in addition to aerostatic support from encompassed lifting volume **9**E in the PASRACS **1**. The partially enclosed water area can optionally be a dry dock area with the addition of a deployable optional dry dock door subsystem **196**DD.

[0426] Areas of the building **196** are also shown for a subassembly area **208**S in addition to a primary assembly area **208**, a storage area **196**S, and a building personnel accommodation facility **196**A, that could be multi-story office space without limitation. Machines and tools and vehicles that are used in the fabrication and assembly of the PASRACS **1** can, in this assembly paradigm, include all three of (i) ground supported machines and tools and vehicles that access the construction area for the PASRACS **1** from the paved area **196**P; (ii) water supported machines and tools and vehicles that access the construction area for the PASRACS **1** from areas that have a water surface **18**; and (iii) machines and tools and vehicles that provide services from elevated locations, such as a vertical takeoff and landing or VTOL aircraft **166**V such as an autonomous factory drone, and such as the illustrated hanging platform **206**H, that is suspended from an overhead crane **206** (see FIG. **15**B following) and that can move in two dimensions over the entire manufacturing space and perform a wide variety of factory deliveries and functions at various three dimensional locations with effectors and tools and machines, as known from the art of factory overhead crane systems. Some specific illustrated factory machines and tools and vehicles include a vehicle with a crane **115**U such as a mobile crane without limitation, a vehicle with a boom **115**T such as a bucket lift truck without limitation, and vehicle with a movable platform **115**V such as a piece of ground service equipment such as a lifter-loader without limitation, a robot **204** and a manufacturing/repair machine **205**. A waterside member that is illustrated comprises a barge-supported vehicle with a boom **115**T that is also a vehicle with a crane **115**U and is also a vehicle with a movable platform **115**V, as shown, with a footprint and geometry that allows this to be carried in place of a payload transfer transport module **47** to a different location, if needed, for manufacturing and/or servicing purposes. Another waterside member that is illustrated is a barge **114** that is secured adjacent to the edge of the factory paved area **196**P, to enable seamless delivery to the factory of items including large items that are too large to transport on land infrastructure such as road and rail infrastructure. The barge may be self-powered or towed to site by a tugboat, and may be crewed or uncrewed, in various preferred embodiments.

[0427] It should be understood that many variant embodiments of a manufacturing and assembly system for a PASRACS **1** vehicle are possible, with a variety of factory configurations and layouts, a variety of ground, water and air supported tools and equipment and devices, and a variety of supply chain flow paradigms for delivering components, parts, assemblies, structural members, systems, subsystems, propulsors and energy systems, payloads amenities, and other items to the final assembly. The PASRACS **1** can be assembled in layers from the bottom up, without limitation. Following assembly, the PASRACS **1** can taxi out of the building **196** under its own power or towed by tugboats, floating on the water surface **18** or floating in the air if in a nominal neutral total buoyance configuration with a combination of hydrostatic and aerostatic lift components. If floating on the water, dock bumpers (fixed and/or floating, as will be described with reference to FIG. **15**C following) and/or automatic control systems can prevent any side impacts on the vehicle hulls **54**.

[0428] An approximately rectangular building **196** has been illustrated in FIG. **15**A, but it should be understood that different geometry buildings as well as connecting plural buildings can be utilized for manufacture of subassemblies and assemblies as well as an entire or plural entire PASRACS **1** vehicle(s), building on prior art methods of manufacturing vehicles of various kinds, ranging from automobile or aircraft assembly lines to modular shipbuilding utilizing drydock facilities. While the building **196** has been described with reference to FIG. **15**A above for manufacturing purposes, the same building **196** can also be used for maintenance, repair and overhaul purposes as well, with a PASRACS **1** backing into position either under its own power or towed in by vehicles or winches, without limitation. For this maneuver as well, dock bumpers (floating and/or fixed) and/or automatic control systems can prevent any side impacts on the vehicle hulls **54**.

[0429] FIG. **15**A also illustrates a particular nominal relationship between the building **196** and the shoreline **21**S, but it should be understood that many other relationships are also possible within the spirit and scope of the invention, including a variant with left and right building walls on different land bodies (e.g., left wall on mainland, right wall on island, and central water channel going through the building so that a PASRACS **1** can taxi in one end and out the other end, in a floating mode), and a variant where the entire building is on land (with vehicle exit in an aerostatically supported mode) and a variant where the entire building is on water in a floating mode.

[0430] FIG. **15**B shows a plan view of the same layout shown earlier in FIG. **15**A, but viewed from a height above the roof level of the building **196**, whether the roof of the building is of flat, sloped, or varying contour levels above ground level (AGL) or relative to a defined mean sea level (MSL) such as described by the World Geodetic System WGS**84** geoid. FIG. **15**B shows that the building roof **196**R is supported by the building walls **196**W and extends outward a little beyond the building walls **196**W as illustrated, but without limitation. A portion of the building roof also has an overhang **196**C over the water surface **18**, towards the bottom of the view shown in FIG. **15**B. FIG. **15**B shows representative two overhead cranes **206** that hang on a track system suspended under the structure of the building roof **196**R, such as a roof support truss structure without limitation. The overhead cranes **206** can move in two dimensions throughout the entire fabrication and/or service area, throughout an operational area **206**A for the overhead crane system. Each overhead crane has a hanging platform **206**H beneath it, with variable drop-down levels all the way down to ground level or water level, to enable manufacturing, repair and servicing operations at all locations in a three-dimensional space that includes the interior volume of the building **196** and also a volume under the overhang. The overhead cranes **206** can also pick up materials and parts and assemblies directly from a barge **114**, by traversing to a location under the overhang **196**C that is above the barge **114**. The hanging platforms **206**H can be fitted with equipment and machinery and subsystems for loading and offloading materials and parts and assemblies, as well as performing a variety of actions using extendable and movable manipulator arms and other features known from the arts of robots, robotics, and human operator usable tools, equipment and machinery.

[0431] FIG. **15**C shows a cross-sectional view of the building **196** that is a hangar **196**H, viewed at the cut plane designated as C-C in FIG. **15**A and FIG. **15**B. It can be seen in FIG. **15**C that the building **196** has a nominal architecture and structural design that comprises a foundation **196**F, a floor structure **2**FL, building walls **196**W, a building roof **196**R that also includes an overhang **196**C and selected applications of truss structure **2**T where beneficial for cost-effective construction of strong yet lightweight large-span and clear-span members. It will be understood that a wide variety of materials, structural architectures, members and connectors, can all be used in variant embodiments based on known principles of large building design, architecture and construction. The building floor **2**Fl also includes a central area with a lowered floor above which there is a water surface **18**, as shown, to enable a PASRACS **1** to be floated in and out of the building, with side impact protection provided by dock bumpers **79**B. The PASRACS **1** includes ship structure **2**, a body **3**, a wing **61**, plural levels **6**, and encompassed lifting volume **9**E that can be used for lifting gas. During the initial manufacture of a PASRACS **1**, the payload transfer transport modules **47** and wind tip fences **61**T will preferably not yet be present, and to illustrate this are shown in dashed lines in FIG. **15**C. The particular time in a manufacturing sequence when these are installed can vary, with varying detailed manufacturing and assembly sequence plans.

[0432] When the PASRACS **1** is in a floating on water configuration, it can be held in place by cables **132**, with a representative cable hold-in-place or anchoring system shown. This central area can optionally be a dry dock with a dry dock door and a pumping system to pump out water, as known in the art of dry dock design and construction. On both sides of the building in the illustrated embodiment, there is a water surface **18** above an underwater ground surface **23**U, such as the water surface of an ocean, sea, bay, sound, channel or other natural or man-made water body. Variant embodiments may have water surface(s) **18** on one or more sides of the building **196**, without limitation. The building **196** can be used for one or more of manufacturing, inspection, repair, service, maintenance, overhaul, upgrade and operational purposes, shows representative two overhead cranes **206** that hang on a track system suspended under the structure of the building roof **196**R, such as a roof support truss structure without limitation. An overhead crane **206** can be seen to be able to move in two dimensions throughout the entire fabrication and/or service area, throughout an operational area **206**A for said overhead crane system. The overhead crane has a hanging platform **206**H beneath it, with variable drop-down levels all the way down to ground level or water level, to enable manufacturing, repair and servicing operations at all locations in a three-dimensional space that includes the interior volume of the building **196**. The hanging platform **206**H can be fitted with equipment and machinery and subsystems for loading and offloading materials and parts and assemblies, as well as performing a variety of actions using extendable and movable manipulator arms and other features known from the arts of robots, robotics, and human operator usable tools, equipment and machinery. Other ground supported equipment and machinery and systems can be supported by the illustrated paved area **196**P supported by at least one of the foundation **196**F and the floor structure **2**FL.

[0433] FIG. **15**D shows a plan view of the same PASRACS **1** shown earlier in FIG. **15**A, now floating on a water surface **18** that is preferably in a sheltered water surface area, with said PASRACS **1** in a stationary (at least one of stationkeeping and anchored) mode in a configuration wherein support vehicle(s) **115**X can provide support services comprising at least one of inspection, supply, service, maintenance, repair and other support, with said support vehicle(s) can be manned or remotely controlled or robotic within the spirit and scope of the invention. The support vehicles can also be fitted with a variety of equipment and tools and support devices. More specifically, FIG. **15**D shows an aircraft **166** that can perform non-contact inspection on the PASRACS **1**. VTOL aircraft **166**V can provide non-contact inspection as well as other support activities as noted above. A wheeled vehicle **115**K within the PASRACS **1** can also serve as a support vehicle **115**X and provide the range of support activities noted above. Also shown are waterborne, water supported embodiments of a vehicle with crane **115**U, a vehicle with boom **115**T, a vehicle with movable platform **115**V, a barge **114** connecting to the PASRACS **1** via a boarding bridge **209**, a robot **204** and a manufacturing/repair machine **205**, that can also provide one or more of said range of support activities. Also shown is a submarine **115**W that can provide underwater support activities such as inspection, maintenance, surface coating and repair, wherein the submarine **115**W can be robotic or remotely controlled or manned. FIG. **15**D further illustrates the use of tethered robots **204**T that can utilize surface crawler features and technologies known from other arts such as the art of tethered robotic building window washing machines and systems. These can also be used for a wide variety of support activities and functions, further including surface cleaning, window washing, bug removal, maintenance of riblet surfaces, de-icing and maintenance and repair of skin and support structures and electromagnetic effects (EME) protection layers close to the outer surfaces of the PASRACS **1**. Further variant support functions can be provided by a wide variety of external and internal support vehicles, robots, machines, tools and equipment, within the spirit and scope of the invention.

[0434] FIGS. **16**A through **16**G illustrate representative termini and representative global routes such as round-the-world routes, that could be served with trans-oceanic transportation services provided by partially aerostatically supported air cushion ships (PASRACS). The specific routes shown are trans-oceanic and overwater for the most part, but do include a few land crossings in designated corridors with high ground-effect flight, one from the Red Sea to the Mediterranean Sea in the region of the Suez Canal, one in Central America from the Caribbean Sea to the Pacific Ocean over Costa Rica and Nicaragua including a portion over Lake Nicaragua, and one from the North Sea to Baltic Sea over the Jutland Peninsula. Illustrated round-the-world routes can connect a large number of origin-destination pairs both with single vehicle service, and even a much large number of origin-destination pairs with two vehicle connecting service with a connection at some port of call (origin/destination). It should be understood that other ports of call as well as other routes, round-the-world and otherwise, are all possible within the spirit and scope of the invention as described and claimed. It should also be understood that other geographic paths of travel and other land crossings and/or land corridors are also possible, within the spirit and scope of the invention as described and claimed. Without limitation, some examples of other possible land crossings and/or land corridors that could be operated by PASRACS vehicles comprise: [0435] Crossing from Mediterranean Sea to Black Sea across portions of Turkey [0436] Crossing from the Baltic Sea to the Black Sea across Poland and Ukraine [0437] Crossing from the Atlantic Ocean to Chesapeake Bay across Virginia, Maryland and/or Delaware [0438] Crossing from the Caribbean Sea to the Pacific Ocean across the Isthmus of Panama in Panama [0439] Crossing from the Gulf of Mexico to the Pacific Ocean across the Isthmus of Tehuantepec in Mexico [0440] Crossing from the Gulf of Mexico to the Atlantic Ocean across Florida [0441] Crossing from the Gulf of Mexico to Galveston Bay across the Bolivar Peninsula [0442] Crossing from the Gulf of Mexico to Bay of Chetumal across the Yucatan Peninsula [0443] Crossing from Gulf of Alaska to Bering Sea across Aleutian Peninsula, such as near Cold Bay, Alaska [0444] Crossing from Northumberland Strait to Bay of Fundy across New Brunswick and/or Nova Scotia [0445] Crossing from Bo Hai to Yellow Sea across the Shantung Peninsula in China [0446] Crossing from the East China Sea to Yangtze river/reservoir destinations in China [0447] Crossing from the South China Sea to Mekong river/reservoir destinations in Vietnam, Cambodia, and/or Laos [0448] Crossing the Malay Peninsula across portions of Thailand and/or Malaysia [0449] Crossing from South China Sea to the Gulf of Thailand across the southern end of Vietnam [0450] Crossing from the Bay of Bengal to river/reservoir destinations in Bangladesh, West Bengal and Assam [0451] Crossing from the Gulf of Khambhat to the Gulf of Kutch across Gujarat [0452] Crossing from the Gulf of Mexico to river/reservoir destinations in Louisiana, Mississippi, Arkansas and Tennessee [0453] Crossing from Atlantic Ocean to river/reservoir destinations in Congo and Zaire with possible Angola crossing as well [0454] Crossing from Atlantic Ocean to Amazon river/reservoir destinations in Brazil [0455] Crossing from Mediterranean Sea to Nile River/reservoir destinations across Egypt TABLE-US-00009 FIG. 16A Route 1 Saradhapur Baleshwar Chennai Rameswaram/Munnar Kanyakumari N. Mumbai Pasabandar/Jiwani Musqat Jeddah Aqaba/Eilat/Taba Land: Suez Crossing Enez/Alexandroupoli Fiumicino/Rome Nice Port Guadiana Cherbourg Downton N. Wilhelmshaven Store Revlingen S Reykjavik E Halifax N. Boston New York Dover Galveston Cancun Corozal/Chetumal Land: Costa Rica/Nicaragua (350 mi crossing) Salinas Bay Lazaro Cardenas Los Angeles Wilsonville Grays Harbor Port Williams/Prince Rupert Cold Bay Tokyo Osaka Miyazaki Hsinchu Xiamen Hong Kong/Shenzen Singapore/Batam/Pengerang S. Yangon Chittagong Saradhapur Baleshwar

[0456] The nominal round-the-world Route **1** has 41 stops or destinations, and a total distance of approximately 35,630 miles, or 143% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.43). This is not out of line with typical air travel circuitry of between 1.0 and 1.5. With rapid turn time turnarounds at each destination of 35 minutes, including deboarding, boarding, fueling and servicing operations using lessons learned from “pit stop” optimization techniques, the total round-the-world full traversal on Route **1** is approximately 10,055 minutes, or 25 minutes less than one week (7 days), assuming a nominal block speed of 248 mph, a nominal cruise speed in groundspeed terms of 250 mph, and a maximum cruise speed of 280 mph or 245 knots IAS, with the margin providing safety for a round-the-world trip against prevailing headwinds, such as a westbound round-the-world trip. It should also be noted in the context of FIG. **16**A that origin/destination locations (origin location **64** for upcoming travel/flight leg and destination location **68** for prior travel/flight leg) with plural ports, such as Rameswaram/Munnar, Pasabandar/Jiwani, Aqaba/Eilat/Taba, Enez/Alexandroupoli, Corozal/Chetumal, Hong Kong/Shenzen, and Singapore/Batam/Pengerang, for example and without limitation, can entail the use of separate payload transfer transport modules **47** coming from/going to respectively separate port docks **79**D with separate national customs, immigration and security formalities areas under separate national jurisdictions. In other words, a single stop of a PASRACS **1** can serve multiple locations, through the inventive use of plural payload transfer transport modules **47** being concurrently employed. If one of the origin/destination locations has greater traffic volume, bigger and/or multiple payload transfer transport module(s) **47** can be used to service this greater traffic volume origin/destination location, in a modular and flexible operational paradigm.

TABLE-US-00010 FIG. 16B Route 2 Saradhapur Baleshwar Kanyakumari Goa Dubai Land: Suez Crossing Alexandria Athens Trieste/Koper Reggio/Messina Cagliari Port Guadiana Cherbourg Downton Land: Denmark Ahlbeck/Swinoujscie Klaipeda Copenhagen/Malmo Land: Denmark Aberdeen E Halifax New York Charleston SC Ft. Lauderdale Land: Costa Rica/Nicaragua Salina Cruz Los Angeles Wilsonville Grays Harbor Cold Bay Tomakomai Vladivostok Incheon Tianjin Shanghai Hsinchu W Manila Singapore/Batam/Pengerang Port Blair Saradhapur Baleshwar

[0457] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **2** as shown in FIG. **16**B has 34 stops or destinations, a total distance of approximately 36.745 miles, or 148% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.48), a total round-the-world full traversal time of approximately 10.080 minutes, or one week (7 days).

TABLE-US-00011 FIG. 16C Route 3 Saradhapur Baleshwar Kanyakumari Djibouti/Lawyacado Jeddah Land: Suez Crossing Iskenderun Larnaca Malta Tunis Genoa Cerbere/Portbou Tanger Port Guadiana Cherbourg W. Rotterdam Downton Kinure (Cork) Ponta Delgada, Azores Corriverton/Nieus Nickerie Port of Spain/Macuro San Juan Puerto Plata New York Dover Terra Ceia, FL Corozal/Chetumal Land: Costa Rica/Nicaragua Salinas Bay Los Angeles Wilsonville Grays Harbor Cold Bay Tokyo Osaka Hong Kong/Shenzen Phan Thiet U-Tapao (Bangkok) Saradhapur Baleshwar

[0458] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **3** as shown in FIG. **16**C has 35 stops or destinations, a total distance of approximately 36.535 miles, or 147% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.47), a total round-the-world full traversal time of approximately 10.064 minutes, or 16 minutes less than one week (7 days).

TABLE-US-00012 FIG. 16D Route 4 Saradhapur Kanyakumari Kerguelen (49 20S, 70 13E) Maputo Durban Cape Town Muanda (DRC)/Soyo (Angola) Doula Lagos Accra Abidjan Conakry Dakar Tenerife S Port Guadiana Quiberon Penzance E Halifax N Boston New York Ft. Lauderdale, FL Land: Costa Rica/Nicaragua Salinas Bay Los Angeles Wilsonville Grays Harbor Cold Bay Tokyo Hsinchu Hong Kong/Shenzen Singapore/Batam/Pengerang Saradhapur

[0459] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **4** as shown in FIG. **16**D has 30 stops or destinations, a total distance of approximately 37.295 miles, or 150% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.50), a total round-the-world full traversal time of approximately 10.073 minutes, or 7 minutes less than one week (7 days).

TABLE-US-00013 FIG. 16E Route 5 Saradhapur Kanyakumari Mauritius Antsiranana Dar Es Salaam Mombasa Hurghada, Egypt Land: Suez Crossing Athens Fiumicino/Rome Marseille Port Guadiana N. Boston New York Ft. Lauderdale Land: Costa Rica/Nicaragua Salinas Bay Los Angeles Wilsonville Grays Harbor Honolulu Honaira Cairns Port Moresby Darwin Dili Bali Singapore/Batam/Pengerang Saradhapur

[0460] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **5** as shown in FIG. **16**E has 26 stops or destinations, a total distance of approximately 37.900 miles, or 152% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.52), a total round-the-world full traversal time of approximately 10.079 minutes, or 1 minute less than one week (7 days).

TABLE-US-00014 FIG. 16F Route 6 Saradhapur Chennai Kanyakumari N. Mumbai Port Kutch (@ N Salaya) Land: Suez Crossing Alexandria Athens Fiumicino/Rome Marseille Port Guardiana Ponta Delgada, Azores Recife Rio de Janeiro Sao Fransisco do Sul Magdalena/W. Montevideo Punta Dungeness (Argentina/Chile) [around Cape Horn] Valparaiso Lima San Lorenzo/San Carlos Salinas Bay Mazatlan Los Angeles Wilsonville Grays Harbor Cold Bay Tokyo Shanghai Hong

Kong/Shenzen Singapore/Batam/Pengerang Great Nicobar Saradhapur

[0461] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **6** as shown in FIG. **16**F has 30 stops or destinations, a total distance of approximately 37,195 miles, or 150% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.50), a total round-the-world full traversal time of approximately 10.049 minutes, or 31 minute less than one week (7 days).

TABLE-US-00015 FIG. 16G Route 7 Saradhapur Vishakapatnam Kanyakumari Mangalore Mitsiwa Port Sudan Jeddah Hurghada Land: Suez Crossing Nahariyya/Enn Naqoura Enez/Alexandroupoli Fiumicino/Rome Port Guardiana Cherbourg Downton W. Rotterdam N. Wilhelmshaven Store Revlingen E. Kirkenes/W. Liinahamari (Norway/Russia) (route via North Pole) (adds ~60 mi) 3 stop equivalent extra time for deicing Cold Bay Esquimalt BC Grays Harbor Wilsonville Los Angeles Hawi, Hawaii Honolulu Apia, Samoa Fiji N Auckland Sydney Devonport, Tasmania Torquay, Victoria S. Adelaide Perth Cilagon/Bakau Singapore/Batam/Pengerang Phuket Great Nicobar Saradhapur

[0462] With assumptions similar to that of Route **1** as shown in FIG. **16**A. Route **7** as shown in FIG. **16**G has 37 stops or destinations plus an extra time 105 minute time allowance for Arctic travel de-icing, a total distance of approximately 35.840 miles, or 144% of the nominal Earth (global) circumference of 24,900 miles (i.e., circuitry of 1.44), a total round-the-world full traversal time of approximately 10,078 minutes, or 2 minute less than one week (7 days).

[0463] FIGS. **16**A through **16**G therefore illustrate a novel method for a single large capacity partially aerostatically supported ram air cushion vehicle **1** or PASRACS **1** to provide round-the-world service starting and ending at an origin location within a one week time window, while including quick turn-time stops at a minimum of 25 destination locations excluding the origin location and thus serving at least 325 global location pairs with weekly service, wherein said large capacity enables said PASRACS **1** to accommodate travel volume (of passengers and cargo) on said at least 325 global location pairs and wherein said large capacity also enables lower per-unit-payload energy use and operating cost that arise from and are enabled by square-cube law benefits of large capacity associated with large vehicle size. More generally, if an origin is connected with a minimum of (N-**1**) destinations, FIGS. **16**A through **16**G illustrate a method for a single large capacity partially aerostatically supported ram air cushion vehicle **1** or PASRACS **1** to provide round-the-world service starting and ending at an origin location within a one week time window, while including quick turn-time stops at a minimum of N destination locations excluding the origin location and thus serving at least N*(N-**1**)/2 global location pairs with weekly service, wherein said large capacity enables said PASRACS **1** to accommodate travel volume on said at least N*(N-**1**)/2 global location pairs and wherein said large capacity also enables lower per-unit-payload energy use and operating cost that arise from and are enabled by square-cube law benefits of large capacity associated with large vehicle size. For different preferred embodiments of PASRACS vehicles N may be any number such as 8 or greater with corresponding 28 or greater city pairs connected and served weekly with a single PASRACS vehicle. Quick and efficient turn-time stops are enabled by multiple factors including at least one of: the use of payload transfer transport modules **47**, the use of flight in-ground effect that eliminates prolonged times for climb to and descent from high cruising altitudes, and the use of a propulsion system with regenerative braking. Per-unit-payload metrics can be denominated by number of passengers (pax), by pax-mi or pax-km, by amount of cargo (tonnes or cu.m.) or tonne-mi or tonne-km or cu.m-km, for example and without limitation. Energy use can be measured in kWh or units of fuel consumption, for example and without limitation. Operating cost can be measured as cash aircraft-related operating cost (CAROC) or aircraft-related operating cost (AROC) or total aircraft-related operating cost (TAROC) or total operating cost (TOC), for example and without limitation. The benefit mechanisms of large size PASRACS vehicles arising from square-cube law effects have been already described in detail with reference to FIG. **11**A. The orchestration and management of a global transportation system utilizing PASRACS **1** vehicles can leverage a computerized reservation system that offers a variety of tailored fare structures for different point-to-point and multi-point travel reservations with different classes of travel or suites of included or for-separate-purchase amenities and food and beverage services and classes of service. The computerized reservation system will preferably be connected to a computerized revenue management system, to help maximize win-win solutions for all stakeholders including passengers, shippers, crew, transport entities, tourism entities, nonprofit and for-profit service entities, connecting and interlining with other transport vehicles and modes, other business entities, government entities, and other entities. With a global fleet of PASRACS **1** vehicles in operation, it may be prudent to have a "hot spare" PASRACS **1** vehicle that can substitute for a fleet vehicle that becomes nonoperational—or a "hot spare" that is used solely for charter operations subject to bumping if the vehicle becomes needed as a substitute for a nonoperational scheduled operations vehicle.

[0464] It should be understood that a partially aerostatically supported ram air cushion ship **1** can perform round-the-world routes that are different from the specific example routes described with reference to FIGS. **16**A through **16**G above, within the spirit and scope of the invention. For example and without limitation, a third alternative routing to cross the Americas from east to west would be a "northwest passage" route that connects from an Atlantic Ocean port such as Halifax, Nova Scotia, then runs north through the Labrador Sea and Davis Straight, west through Lancaster Sound and Viscount Melville Sound and the Beaufort Sea, then south through the Bering Strait to a Pacific Ocean port such as Cold Bay, Alaska, to provide shorter circuitry connectivity from North Atlantic ports to Asia-Pacific ports. It should be understood that it is also possible for PASRACS **1** to operate in operational paradigms other than scheduled round-the-World services, including scheduled one-way and scheduled return services, unscheduled services, charter services, and cargo-only services to name some vehicle operational paradigms, without limitation. If a fleet of PASRACS **1** are operating on scheduled services and just one or a few PASRACS **1** are on a different operational paradigm such as unscheduled, charter or cargo-only, in the event of a problem scenario such as a mechanical breakdown, accident or need-for-evacuation-at-sea or other problem or issue with a scheduled PASRACS **1**, a different operational paradigm PASRACS **1** can be commandeered for priority work to rescue passengers and/or replace a scheduled PASRACS **1** to minimize and mitigate the adverse impacts due to the problem scenario, where said adverse impacts may range from injury or death to schedule delay to passenger inconvenience to passenger dissatisfaction to economic losses to punitive regulatory consequences, and others.

[0465] FIG. **17** illustrates inventive aspects of a longitudinal trim system **87** and a lateral trim system **93** applicable to enable balanced trim for a partially aerostatically supported ram air cushion ship **1** or PASRACS **1**. Optimal solutions for longitudinal and lateral trim can leverage different categories of trim systems for different operational phases of the vehicle, ranging without limitation from (i) a combination of aerostatic and hydrostatic trim contributions with the PASRACS **1** stationary on a water surface **18**; to (ii) a combination of aerostatic and aerodynamic and hydrostatic and hydrodynamic trim contributions when the vehicle is moving at modest speeds on the water surface **18**, such as during takeoff and landing operations; to (iii) a combination of aerostatic and aerodynamic trim contributions when the vehicle is flying above and not in physical contact with the water surface **18**. Other scenarios that may be less frequent are also possible, such as takeoff or landing with a strong headwind, wherein a transition between a waterborne mode with hydrostatic and aerostatic lift to an airborne mode with aerodynamic and aerostatic lift may occur with no significant use of hydrodynamic lift, i.e. a circumstance where airspeed is positive but waterspeed is insignificantly small.

[0466] An aerostatic longitudinal pitching moment subsystem **87**B configured to generate an aerostatic pitching moment around said vehicle longitudinal center of gravity **89** (that is the longitudinal location of the center of mass), and an aerostatic lateral rolling moment subsystem **93**B configured to generate an aerostatic rolling moment around said vehicle lateral center of gravity **95** (that is the lateral location of the center of mass), can utilize differential aerostatic lift contributions from an aft encompassed lifting volume **9**EA, a forward encompassed lifting volume **9**EF, a left encompassed lifting volume **9**EL and a right encompassed lifting volume **9**ER; as well as differential ballonet inflations with air between an aft ballonet **91**A, a forward ballonet **91**F, a left ballonet **91**L and a right ballonet **91**R.

[0467] An aerodynamic longitudinal trim subsystem **87**C with aerodynamic members configured to generate an aerodynamic pitching moment around said vehicle longitudinal center of gravity **89** can utilize tailored deflections of one or more of an elevator **90**E, a body flap **90**B, a side flap **90**S, and optionally of a horizontal stabilizer **88**H if said horizontal stabilizer is a trimmable horizontal stabilizer. An aerodynamic lateral trim subsystem **93**C with aerodynamic members configured to generate an aerodynamic rolling moment around said vehicle lateral center of gravity **95** can utilize tailored deflections of one or more of an aileron **90**A, a flaperon **90**FA, and a side flap **90**S.

[0468] A hydrostatic longitudinal pitching moment subsystem **87**D configured to generate a hydrostatic pitching moment around said vehicle longitudinal center of gravity **89**, and a hydrostatic lateral rolling moment subsystem **93**D configured to generate a hydrostatic rolling moment around said vehicle lateral center of gravity **95**, can utilize tailored and differential buoyancy amongst an aft hull member **54**A, a forward hull member **54**F, a left hull member **54**L, a right hull member **54**R, an aft float **54**AF, a forward float **54**AFF, a left float **54**LF, a right float **54**RF, and a keel **88**K. Note that the hulls may include ballast tanks that can accommodate varying amounts of ballast water by pumping, and that the floats may be variable volume and/or inflatable float members and may also optionally be integrated with safety members such as inflatable life rafts or inflatable slide-rafts, without limitation.

[0469] A hydrodynamic longitudinal trim subsystem **87**E with hydrodynamic members **36**M configured to generate a hydrodynamic pitching moment around said vehicle longitudinal center of gravity **89**, and a hydrostatic lateral rolling moment subsystem **93**D configured to generate a hydrostatic rolling moment around said vehicle lateral center of gravity **95**, can utilize one or more of: a hydrodynamic member **36**M (shown), a hydroski **36**S (shown), a combined hydrofoil and hydroski **36**HS (shown), a hydrodynamic planing surface **36**P such as on bottom side of a hull **54**, a variable height hydrodynamic planing surface **36**V (that can also incorporate a suspension as described elsewhere in the specification), a hydrofoil **36**H that may be a subcavitating hydrofoil **36**HA and/or a supercavitating hydrofoil **36**HB, a step **36**T, a hull chine **36**C, and a hull forebody **36**FB.

[0470] The longitudinal trim system **87** and a lateral trim system **93** can also utilize a ballast system **33**B that employs at least one of solid ballast and liquid ballast, wherein liquid ballast can be sea water, potable water, waste water, fuel, liquid hydrogen and other liquid. A ring geometry ballast system **33**B is illustrated in FIG. **17**, with two ballast weights that may be solid or filled with ballast liquid, movable to different azimuthal location to appropriately affect longitudinal trim and lateral trim needed for a eg location for the vehicle weight **33** with a vehicle longitudinal center of gravity **89** and vehicle lateral center of gravity **95** as illustrated. Alternate ballast movement geometries including movability in an envelope region spanning both a longitudinal and lateral dimensional range, are possible within the spirit and scope of the invention. The use of ballast for generating longitudinal and lateral trimming moments can leverage differential filling and fluid movement between an aft tank **4**TA, forward tank **4**TF, left tank **4**TL, and right tank **4**TR, wherein spaced tanks can be provided for one or more of: potable water tanks **92**A, hot water tanks **92**H, waste tanks **92**F, fuel tanks **82**B, liquid hydrogen tanks **12**L and **47**H, and other tanks, within the spirit and scope of the invention.

[0471] FIG. **17** thus illustrates a partially aerostatically supported ram air cushion ship **1**, further comprising: [0472] (a) a longitudinal trim system **87** for trimming out pitching moment **88** around a vehicle longitudinal center of gravity **89** associated with said weight **33** of said partially aerostatically supported ram air cushion ship **1**, said longitudinal trim system **87** connected to said vehicle control and navigation system **29** and configured to utilize at least one of (i) an aerostatic longitudinal pitching moment subsystem **87**B configured to generate an aerostatic pitching moment around said vehicle longitudinal center of gravity **89**; (ii) an aerodynamic longitudinal trim subsystem **87**C with aerodynamic members configured to generate an aerodynamic pitching moment around said vehicle longitudinal center of gravity **89**; (iii) a hydrostatic longitudinal pitching moment subsystem **87**D configured to generate a hydrostatic pitching moment around said vehicle longitudinal center of gravity **89**; (iv) a hydrodynamic longitudinal trim subsystem **87**E with hydrodynamic members **36**M configured to generate a hydrodynamic pitching moment around said vehicle longitudinal center of gravity **89**; and (v) a longitudinal cg management subsystem **87**F configured to longitudinally move said vehicle longitudinal center of gravity **89**; and [0473] (b) a lateral trim system **93** for trimming out rolling moment **88**R around a vehicle lateral center of gravity **95** associated with said weight **33** of said partially aerostatically supported ram air cushion ship **1**, said lateral trim system **93** connected to said vehicle control and navigation system **29** and configured to utilize at least one of (i) an aerostatic lateral rolling moment subsystem **93**B configured to generate an aerostatic rolling moment around said vehicle lateral center of gravity **95**; (ii) an aerodynamic lateral trim subsystem **93**C with aerodynamic members configured to generate an aerodynamic rolling moment around said vehicle lateral center of gravity **95**; (iii) a hydrostatic lateral rolling moment subsystem **93**D configured to generate a hydrostatic rolling moment around said vehicle lateral center of gravity **95**; (iv) a hydrodynamic lateral trim subsystem **93**E with hydrodynamic members configured to generate a hydrodynamic rolling moment around said vehicle lateral center of gravity **95**; and (v) a lateral cg management subsystem **93**F configured to laterally move said vehicle lateral center of gravity **95**.

[0474] The partially aerostatically supported ram air cushion ship **1** or PASRACS **1** as described in the descriptive portion of this specification and drawings and claims, presents a unique new class of large vehicle inventive configurations that can provide global transportation with speed & safety, with extraordinary comfort, luxury and amenities, with extraordinary efficiency, and with essentially zero carbon emissions yielding extraordinary environmental responsibility. PASRACS **1** vehicles and associated transportation systems thus offer extraordinary ability to grow global travel and tourism while fostering international and cross-cultural understanding, peace & prosperity.

[0475] While certain preferred embodiments of the invention have been described in detail above with reference to the accompanying Figures, it should be understood that further variations and combinations and alternate embodiments are possible within the spirit and scope of the invention as described, illustrated and claimed herein.

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Claims

1. A partially aerostatically supported ram air cushion ship, comprising in combination: a ship structure incorporating a body with a payload volume with plural decks at plural levels for carrying payload; said ship structure connected to a lifting gas enclosure configured to contain a lifting gas providing an aerostatic lift force acting on said ship, said lifting gas comprising at least one of helium, hydrogen and a low-density lifting gas with density lower than that of an atmosphere immediately outside said ship; a hydrostatic floatation subsystem comprising a water displacing structure connected to said ship structure, said water displacing structure configured to provide a hydrostatic lift force acting on said ship in a period of time when said water displacing structure is displacing a water volume below a water surface below said atmosphere; an aerodynamic lift subsystem comprising a ram air cushion when said ship has positive airspeed, said ram air cushion below a lower surface of the ship and above an Earth surface, wherein said aerodynamic lift subsystem comprising said ram air cushion is configured to contribute an aerodynamic lift force acting on said ship when said ship has said positive airspeed; a propulsion system capable of using energy to generate a thrust force acting on said ship; and a vehicle control and navigation system configured to enable said ship to move and maneuver on a travel path; wherein weight of said partially aerostatically supported ram air cushion ship is substantially balanced by a combination of said aerostatic lift force and said hydrostatic lift force, when said ship is in a substantially stationary mode on said water surface; and wherein the weight of said partially aerostatically supported ram air cushion ship is substantially balanced by a combination of said aerostatic lift force and said aerodynamic lift force, when said partially aerostatically supported ram air cushion ship is in a flight in ground-effect mode; and wherein the weight of said partially aerostatically supported ram air cushion ship is substantially balanced by a combination of said aerostatic lift force and said aerodynamic lift force and at least one of said hydrostatic lift force and a hydrodynamic lift force, when said partially aerostatically supported ram air cushion ship is in a transition mode comprising a landing transition mode.

2. A partially aerostatically supported ram air cushion ship, comprising in combination: A body configured to accommodate payload, said body encompassing (i) a cabin configured to accommodate persons comprising at least one of passengers and crew and (ii) a cargo volume configured to accommodate at least one of baggage and cargo; and (iii) a lifting gas enclosure configured to contain a lifting gas providing an aerostatic lift force acting on said ship, said lifting gas comprising at least one of helium, hydrogen and a low-density lifting gas with density lower than that of an atmosphere immediately outside said ship; A hydrostatic floatation subsystem comprising a water displacing structure connected to said body, said water displacing structure configured to provide a hydrostatic lift force acting on said ship when said water displacing structure is displacing a water volume below a water surface below said atmosphere; A propulsion system capable of using energy to generate a thrust force acting on said ship; A left catamaran sidewall and a right catamaran sidewall both connected to said body and defining at least one ram air cushion volume that is beneath said body, above an Earth surface and at least in part between said left and right catamaran sidewalls, wherein said ram air cushion volume is configured to decrease in transverse cross-sectional area moving aft from a forward portion of said ram air cushion volume to an aft portion of said ram air cushion volume; An aerodynamic lift subsystem utilizing said ram air cushion volume configured to create a ram air cushion providing aerodynamic lift force acting on said body when said ship has a positive airspeed, propelled by said propulsion system; and at least one payload transfer transport module configured to receive disembarking payload comprising at least a partial subset of said passengers and said baggage and said cargo from at least one of said cabin and said cargo volume, and said payload transfer transport module further configured to separate from said ship and carry said disembarking payload from said ship starting at a transfer time.

3. A transition method for a partially aerostatically supported ram air cushion ship to transition from a substantially static floating mode on a water surface to a water takeoff mode with supplemental fluid dynamic support and then to a flight in ground-effect mode above an Earth surface, comprising the sequential steps of: (i) supporting weight of said partially aerostatically supported ram air cushion ship using a combination of (a) a hull displacing water to provide a

hydrostatic lift force and (b) a lifting gas enclosure containing lighter-than-air lifting gas to provide an aerostatic lift force, in said substantially static floating mode; (ii) powering a fluid dynamic propulsor to apply a thrust force acting on said ship that exceeds drag force acting on said ship, to propel the ship to forward motion with increasing speed in said water takeoff mode; (iii) engaging a supplemental fluid dynamic support system in said water takeoff mode, said supplemental fluid dynamic support system comprising at least one of a hydrodynamic supplemental support subsystem and an aerodynamic supplemental support subsystem, wherein said engaging said supplemental fluid dynamic support system, reduces required hydrostatic support and correspondingly reduces water displacement related drag in said water takeoff mode; and (iv) configuring a ram air cushion under at least one of a wing and a body of said ship to provide a portion of an aerodynamic lift force that complements said aerostatic lift force to fully support weight of said ship in said flight in ground-effect mode wherein said ship flies at a flight speed in ground effect above said Earth surface, said flight speed no less than a minimum flight speed.
4. A transport method for multimodally transporting payload from an origin location, comprising the steps of: (i) enabling a boarding payload to be accommodated in a transfer vehicle at an origin location, wherein said boarding payload comprises at least one of (a) a first plurality of passengers and (b) a second plurality of items of at least one of cargo and baggage; (ii) bringing together said transfer vehicle with a partially aerostatically supported ram air cushion ship, at a mating location; (iii) mating said transfer vehicle to said partially aerostatically supported ram air cushion ship utilizing a mating apparatus configured to contiguously connect said transfer vehicle to said partially aerostatically supported ram air cushion ship; (iv) enabling boarding transfer of at least a portion of said boarding payload from said transfer vehicle to a payload accommodating compartment in said partially aerostatically supported ram air cushion ship, through a boarding transfer path; and (v) transporting said boarding payload in said partially aerostatically supported ram air cushion ship on a travel path as commanded by at least one of crew and a vehicle control and navigation system, said travel path including a takeoff phase and a flight phase with a positive airspeed wherein said partially aerostatically supported ram air cushion ship is supported in part by an aerostatic lift force and in part by an aerodynamic lift force leveraging a ram air cushion between a lower surface of said partially aerostatically supported ram air cushion ship and an Earth surface.
5. The partially aerostatically supported ram air cushion ship of claim 1, wherein said lifting gas includes hydrogen in a hydrogen gas compartment, and further comprising a fuel system with a fuel transfer pipe configured to transfer some of said hydrogen from said hydrogen gas compartment to said propulsion system, and wherein said propulsion system is configured to use some of said hydrogen serving as a source of at least one of chemical energy and electrochemical energy feeding as energy into said propulsion system that is usefully converted by said propulsion system to propulsive energy by operating at least one of a gas turbine, a combustion engine, a thermodynamic cycle engine and a fuel cell.
6. The partially aerostatically supported ram air cushion ship of claim 1, wherein said ship structure is connected to plural lifting gas enclosures comprising at least one helium enclosure in a helium encompassing volume and at least one hydrogen enclosure in a hydrogen encompassing volume, and wherein said helium encompassing volume is configured with a location being below said hydrogen encompassing volume and with said location being above said payload volume, and wherein said hydrogen encompassing volume is configured with an upper location being noncontiguously above said payload volume.
7. The partially aerostatically supported ram air cushion ship of claim 1, wherein said ram air cushion comprises a ram air pressurized region spanning from (i) a left region under a left wing forward of a left trailing edge of the left wing, through (ii) a central region under the body of said partially aerostatically supported ram air cushion ship and forward of an aft left edge and an aft right edge of an aft portion of the body, and to (iii) a right region under a right wing forward of a

right trailing edge of the right wing, when said partially aerostatically supported ram air cushion ship is moving on said travel path with said positive airspeed.

8. The partially aerostatically supported ram air cushion ship of claim 1, wherein said hydrostatic floatation subsystem comprises at least three hull members, comprising a left hull member on a left side of said partially aerostatically supported ram air cushion ship, a right hull member on a right side of said partially aerostatically supported ram air cushion ship, and at least one of an aft hull member in an aft region of said partially aerostatically supported ram air cushion ship and a forward hull member in a forward region of said partially aerostatically supported ram air cushion ship.

9. The partially aerostatically supported ram air cushion ship of claim 1, wherein said propulsion system comprises plural energy conversion devices that are configured to transfer drive energy to drive plural fluid thrusting effectors.

10. The partially aerostatically supported ram air cushion ship of claim 1, wherein said plural decks at plural levels for carrying payload include (i) a people deck with a cabin configured to accommodate persons comprising passengers and crew and (ii) a cargo deck with a cargo compartment configured to accommodate at least one of cargo and baggage.

11. The partially aerostatically supported ram air cushion ship of claim 1, further comprising: (a) a longitudinal trim system for trimming out pitching moment around a vehicle longitudinal center of gravity associated with said weight of said partially aerostatically supported ram air cushion ship, said longitudinal trim system connected to said vehicle control and navigation system and configured to utilize at least one of (i) an aerostatic longitudinal pitching moment subsystem configured to generate an aerostatic pitching moment around said vehicle longitudinal center of gravity; (ii) an aerodynamic longitudinal trim subsystem with aerodynamic members configured to generate an aerodynamic pitching moment around said vehicle longitudinal center of gravity; (iii) a hydrostatic longitudinal pitching moment subsystem configured to generate a hydrostatic pitching moment around said vehicle longitudinal center of gravity; (iv) a hydrodynamic longitudinal trim subsystem with hydrodynamic members configured to generate a hydrodynamic pitching moment around said vehicle longitudinal center of gravity; and (v) a longitudinal cg management subsystem configured to longitudinally move said vehicle longitudinal center of gravity; and (b) a lateral trim system for trimming out rolling moment around a vehicle lateral center of gravity associated with said weight of said partially aerostatically supported ram air cushion ship, said lateral trim system connected to said vehicle control and navigation system and configured to utilize at least one of (i) an aerostatic lateral rolling moment subsystem configured to generate an aerostatic rolling moment around said vehicle lateral center of gravity; (ii) an aerodynamic lateral trim subsystem with aerodynamic members configured to generate an aerodynamic rolling moment around said vehicle lateral center of gravity; (iii) a hydrostatic lateral rolling moment subsystem configured to generate a hydrostatic rolling moment around said vehicle lateral center of gravity; (iv) a hydrodynamic lateral trim subsystem with hydrodynamic members configured to generate a hydrodynamic rolling moment around said vehicle lateral center of gravity; and (v) a lateral cg management subsystem configured to laterally move said vehicle lateral center of gravity.

12. The partially aerostatically supported ram air cushion ship of claim 2, further comprising a keel below said body with a majority of a length dimension of said keel length being located below an aft portion of said body, wherein said keel separates a left ram air cushion portion from a right ram air cushion portion both of which are parts of said ram air cushion volume that is beneath said body, and wherein said keel contributes to at least one of roll stability and yaw stability of said partially aerostatically supported ram air cushion ship at said positive airspeed.

13. The partially aerostatically supported ram air cushion ship of claim 1, configured with a ratio of a total plan-view deck area of all said decks combined, divided by a total wetted area of said partially aerostatically supported ram air cushion ship, that when multiplied by 100%, exceeds 15%.

14. The partially aerostatically supported ram air cushion ship of claim 2, further comprising life-preservation apparatus configured to be employed to facilitate safe evacuation of said passengers and said crew from said ship in the event of an emergency scenario warranting evacuation, said life-preservation apparatus comprising more than one from the set of: said payload transfer transport module, a wearable life preserver, a life raft, an evacuation slide, an evacuation slide-raft, a warmth preserving device, a heating device, a signaling device, a transmitting device, a nourishment container, a potable water container, and a medical supply container.
15. The partially aerostatically supported ram air cushion ship of claim 2, wherein an encompassed lifting volume of said lifting gas is configured to be at least 25% of an encompassed vehicle volume of said partially aerostatically supported ram air cushion ship.
16. The partially aerostatically supported ram air cushion ship of claim 2, wherein a transverse cross-section of said partially aerostatically supported ram air cushion ship, at a longitudinal location corresponding to a forward portion of said ram air cushion volume, is characterized by (i) a left wing, (ii) said left catamaran sidewall, (iii) a central portion of said body, (iv) said right catamaran sidewall, and (v) a right wing; wherein said a central portion of said body comprises a body lower surface above said ram air cushion volume, a body left side surface, a body right side surface and a curved body top surface connecting said body left side surface and body right side surface and wrapped around an upper boundary of said lifting gas enclosure.
17. The partially aerostatically supported ram air cushion ship of claim 2, wherein an aft body of said partially aerostatically supported ram air cushion ship includes a body lower surface and downwardly deployable body flaps at left and right ends of said body lower surface, inwardly tapering surfaces for body left side surface and body right side surface in an aftward direction on said aft body, and a curved body top surface connecting said body left side surface and body right side surface and wrapped around an upper boundary of said lifting gas enclosure.
18. The partially aerostatically supported ram air cushion ship of claim 2, wherein said ram air cushion providing aerodynamic lift force acting on said body, provides span-loaded support for a span-distributed portion of said payload, with said span-loaded support spanning from left to right sides of at least one of said forward portion and said aft portion of said ram air cushion volume.
19. The transition method of claim 3, wherein said aerodynamic supplemental support subsystem comprises a power-augmented ram air cushion, wherein a trailing edge of said power-augmented ram air cushion is a reduced height flow passage above said Earth surface and below a downwardly deflected flap on at least one of a wing and a body of said partially aerostatically supported ram air cushion ship, and wherein said power-augmented ram air cushion is at least partially pressurized by energized flow from said fluid dynamic propulsor.
20. The transition method of claim 3, wherein said hydrodynamic supplemental support subsystem comprises at least one of a subcavitating hydrofoil, a supercavitating hydrofoil, a hydroski and a hydroplane planing surface.
21. The transport method for multimodally transporting payload from an origin location of claim 4, further comprising the steps of: (vi) identifying a disembarking payload for said destination location, which disembarking payload is in on board the partially aerostatically supported ram air cushion ship in said payload accommodating compartment in said flight phase, and wherein said disembarking payload comprises at least one of (a) a third plurality of passengers and (b) a fourth plurality of items of at least one of cargo and baggage; (vii) performing the combined arrival preparation steps within an arrival preparation time window of (a) enabling disembarking transfer of said disembarking payload from said payload accommodating compartment in said partially aerostatically supported ram air cushion ship to said transfer vehicle, through a disembarking transfer path, and (b) landing said partially aerostatically supported ram air cushion ship in a port region encompassing said destination location; (viii) unmating said transfer vehicle from said partially aerostatically supported ram air cushion ship at an unmating location, utilizing an unmating apparatus configured to enable separation of said transfer vehicle from said partially

aerostatically supported ram air cushion ship; and (ix) conveying said disembarking payload being accommodated in said transfer vehicle to said destination location.

22. The transport method of claim 4, wherein said transfer vehicle comprises a barge configured to float on said water surface, and wherein said transfer vehicle is further configured to carry more than one selected among the following: said first plurality of passengers, said second plurality of items of at least one of cargo and baggage, vehicles, cars, buses, trucks, trailers, electric vehicles, autonomous vehicles, recreational vehicles, road vehicles, rail vehicles, wheeled vehicles, motorcycles, scooters, bicycles, three-wheel vehicles, vehicle trains, amphibious vehicles, marine vehicles, potable water, food, beverage, merchandise, fuel, lifting gas, cryogenically liquified lifting gas, liquid waste and solid waste.

23. The transport method of claim 4, wherein said transfer vehicle comprises a wheeled vehicle configured to carry more than one selected among the following: said first plurality of passengers, said second plurality of items of at least one of cargo and baggage, potable water, food, beverage, merchandise, fuel, lifting gas, cryogenically liquified lifting gas, liquid waste and solid waste.

24. The transport method of claim 21, wherein said mating apparatus and said unmating apparatus each comprise at least one of: (i) a disconnectable attachment fitting, (ii) a positioning system for an attachment fitting, (iii) a cable, (iv) a structural beam, (v) a winch, (vi) an actuator, (vii) a guide track member, (viii) a deployable ramp, (ix) a controlled lift up system, (x) a controlled drop down system, and (xi) a controlled guided transport system connected to said vehicle control and navigation system.

25. A partially aerostatically supported ram air cushion ship, comprising in combination: a body configured to accommodate payload, said body encompassing (i) a cabin configured to accommodate persons comprising at least one of passengers and crew and (ii) a cargo volume configured to accommodate at least one of baggage and cargo and (iii) a lifting gas enclosure configured to contain a lifting gas providing an aerostatic lift force acting on said ship; wherein said a central portion of said body is encompassed by a body lower surface spanning above a ram air cushion volume located between said body and an Earth surface, a body left side surface, a body right side surface and a curved body top surface connecting said body left side surface and body right side surface and wrapped around an upper boundary of said lifting gas enclosure; wherein said ram air cushion volume is bounded on upper left and right sides by side flaps in a region beneath an aft body portion of said body; a propulsion system capable of using energy to generate a thrust force acting on said ship; wherein said ram air cushion volume is configured to decrease in transverse cross-sectional area moving aft from below said central portion to below said aft body; an aerodynamic lift subsystem utilizing said ram air cushion volume configured to create a ram air cushion providing aerodynamic lift force acting on said body when said ship has a positive airspeed, propelled by said propulsion system; and an aerostatic lift subsystem utilizing said aerostatic lift force provided by said lifting gas.