UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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Space Exploration Technologies Corp.
Petitioner

v.

Blue Origin LLC
Patent Owner

U.S. Patent No. 8,678,321
Filing Date: June 14, 2010
Issue Date: March 25, 2014

Title: SEA LANDING OF SPACE LAUNCH VEHICLES AND ASSOCIATED SYSTEMS AND METHODS

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Inter Partes Review No. ______

Table of Contents

Table of Contents

EXHIBITS

Ex. No.	Title of Document
1001	U.S. Patent No. 8,678,321 to Jeffrey P. Bezos et al.
1002	Prosecution History of U.S. Patent No. 8,678,321 to Jeffrey P. Bezos et al.
1003	Yoshiyuki Ishijima et al., *Re-entry and Terminal Guidance for Vertical-Landing TSTO (Two-Stage to Orbit)*, A Collection of Technical Papers Part 1, AIAA Guidance, Navigation and Control Conference and Exhibit, A98-37001 ("Ishijima")
1004	U.S. Patent No. 5,873,549 to Jeffery G. Lane et al. ("Lane")
1005	U.S. Patent No. 5,927,653 to George E. Mueller et al. ("Mueller '653")
1006	U.S. Patent No. 6,024,006 to Bjørn Kindem et al. ("Kindem")
1007	Jack Waters, et al., *Test Results of an F/A-18 Automatic Carrier Landing Using Shipboard Relative GPS*, Proceeding of the ION 57th Annual Meeting and the CIGTF 20th Biennial Guidance Test Symposium (2001) ("Waters")
1008	U.S. Patent No. 6,450,452 to Robert B. Spencer et al. ("Spencer")
1009	LUCY ROGERS, IT'S ONLY ROCKET SCIENCE: AN INTRODUCTION IN PLAIN ENGLISH (2008).
1010	U.S. Patent No. 8,047,472 to Vance D. Brand et al. ("Brand")
1011	STEVEN J. ISAKOWITZ, JOSEPH P. HOPKINS & JOSHUA B. HOPKINS, INTERNATIONAL REFERENCE GUIDE TO SPACE LAUNCH SYSTEMS (4th ed. 2004).
1012	MARSHALL H. KAPLAN, SPACE SHUTTLE: AMERICA'S WINGS TO THE FUTURE (2nd ed. 1978).
1013	NASA, http://www.nasa.gov/mission_pages/shuttle (last visited Aug. 13, 2014).

Ex. No.	Title of Document
1014	Ed Memi, *A Step To The Moon: DC-X Experimental Lander Set Up Boeing For Future NASA Work*. BOEING FRONTIERS, 8-9. http://www.boeing.com/news/frontiers/archive/2008/aug/i_history.pdf (last visited Aug. 13, 2014).
1015	William Gaubatz, et al., *DC-X Results and the Next Step*, American Institute of Aeronautics and Astronautics, AIAA-94-4674 (1994).
1016	Declaration of Marshal H. Kaplan, Ph.D. dated August 25, 2014

Space Exploration Technologies Corp. ("Petitioner" or "SpaceX") hereby petitions for *inter partes* review under 35 U.S.C. §§ 311-319 and 37 C.F.R. § 42 of claims 1-13 of U.S. Patent No. 8,678,321 [Ex. 1001] ("the '321 patent").

I. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(A)(1)

A. Real Party-ln-lnterest under 37 C.F.R. § 42.8(b)(1)

Petitioner SpaceX is the real party-in-interest for the instant petition.

B. Related Matters under 37 C.F.R. § 42.8(b)(2)

Petitioner notes that it is concurrently filing a separate petition for *inter partes* review of claims 14-15 of U.S. Patent No. 8,678,321.

C. Lead and Back-Up Counsel under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

LEAD COUNSEL	BACK-UP COUNSEL
Heidi L. Keefe (Reg. No. 40,673) Cooley LLP, ATTN: Patent Group 1299 Pennsylvania Ave., NW, Suite 700 Washington, DC 20004 Tel: (650) 843-5001 Fax: (650) 849-7400 hkeefe@cooley.com zpatdcdocketing@cooley.com	C Scott Talbot (Reg. No. 34,262) Cooley LLP, ATTN: Patent Group 1299 Pennsylvania Ave., NW, Suite 700 Washington, DC 20004 Tel: (703) 456-8072 Fax: (202) 842-7899 stalbot@cooley.com zpatdcdocketing@cooley.com

D. Service Information

As identified in the attached Certificate of Service, a copy of the present petition, in its entirety, including all Exhibits and a power of attorney, is being served by EXPRESS MAIL® to the address of the attorney or agent of record for the owner of record of the '321 patent, Blue Origin LLC. SpaceX may be served at the lead counsel address provided in Section I.C. SpaceX consents to electronic service by e-mail at the e-mail addresses provided above, which include both individual e-mail addresses and a general docketing e-mail address.

E. Power of Attorney

Filed herewith in accordance with 37 C.F.R. § 42.10(b).

II. PAYMENT OF FEES - 37 C.F.R. § 42.103

This petition requests review of 13 claims of the '321 patent and is accompanied by a payment of $23,000 for 13 claims. *See* 37 C.F.R. § 42.15. This Petition therefore meets the fee requirements under 35 U.S.C. § 312(a)(1).

III. REQUIREMENTS FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. § 42.104

A. Grounds for Standing under 37 C.F.R. § 42.104(a)

Petitioner certifies that the '321 patent is eligible for *inter partes* review and that Petitioner is not barred or otherwise estopped from requesting *inter partes* review challenging the identified claims on the grounds identified herein.

B. Identification of Challenge under 37 C.F.R. § 42.104(b) and Statement of Precise Relief Requested

Petitioner respectfully requests that the Board initiate *inter partes* review of claims 1-13 of the '321 patent, and find them unpatentable based on the grounds set forth herein. The prior art references upon which the invalidity challenge in this Petition is based are listed below:

Ex. No.	Prior Art Document
1003	Yoshiyuki Ishijima et al., *Re-entry and Terminal Guidance for Vertical-Landing TSTO (Two-Stage to Orbit)*, A Collection of Technical Papers Part 1, AIAA Guidance, Navigation and Control Conference and Exhibit, A98-37001 ("Ishijima")
1004	U.S. Patent No. 5,873,549 to Jeffery G. Lane et al. ("Lane")
1005	U.S. Patent No. 5,927,653 to George E. Mueller et al. ("Mueller '653")
1006	U.S. Patent No. 6,024,006 to Bjørn Kindem et al. ("Kindem")
1007	Jack Waters, et al., *Test Results of an F/A-18 Automatic Carrier Landing Using Shipboard Relative GPS*, Proceeding of the ION 57th Annual Meeting and the CIGTF 20th Biennial Guidance Test Symposium (2001) ("Waters")
1008	U.S. Patent No. 6,450,452 to Robert B. Spencer et al. ("Spencer")

This Petition cites additional prior art materials for purposes of providing a technology background and describing the state of the art at the time of the alleged invention. These materials are also cited and discussed in the accompanying Declaration of Marshall H. Kaplan dated August 25, 2014 [Ex. 1016] ("Kaplan

Decl."), an expert with more than four decades of experience in spacecraft and launch vehicles. The specific grounds for IPR are identified in the following table:

Ground No.	**Claim(s) Affected**	**Proposed Ground for *Inter Partes* Review**
1	1-3	Anticipated by Ishijima under 35 U.S.C. § 102(b)
2	8, 9, 12, 13	Obvious over Ishijima in view of Lane under § 103(a)
3	4, 5	Obvious over Ishijima in view of Mueller '653 under § 103(a)
4	6	Obvious over Ishijima in view of Kindem under § 103(a)
5	7	Obvious over Ishijima in view of Spencer, further in view of Waters under § 103(a)
6	11	Obvious over Ishijima in view of Lane, further in view of Waters under § 103(a)
7	10	Obvious over Ishijima in view of Lane, further in view of Mueller '653 under § 103(a)

As reflected in the chart above, this Petition relies on the base reference of Ishijima for anticipation of claims 1-3, and adds additional references as appropriate for limitations added by other claims challenged in this Petition. Each of the references relied upon above qualifies as prior art to the '321 patent under at least 35 U.S.C. § 102(b) (pre-AIA). A specific explanation of each of the grounds listed above is set forth in Part VII below.

C. Threshold for *Inter Partes* Review 37 C.F.R. § 42.108(c)

The Board should institute *inter partes* review of claims 1-13 because this Petition establishes a reasonable likelihood of prevailing with respect to each challenged claim. *See* 35 U.S.C. § 314(a). Each limitation of each claim challenged herein is disclosed and/or suggested by the prior art, as explained below.

IV. TECHNOLOGY BACKGROUND RELEVANT TO THE '321 PATENT

The '321 patent, entitled "Sea Landing of Space Launch Vehicles and Associated Systems and Methods," generally relates to a system for landing and recovering portions of a space launch vehicle on a platform at sea or in a body of water. ('321 patent, Abstract.) The accompanying declaration of Dr. Kaplan describes the state of the art at the time of the alleged invention. (*See* Kaplan Decl. ¶¶ 15-44.) This section provides an overview of that description.

A. "Rocket Science"

History changed on October 4, 1957 when the Soviet Union launched *Sputnik 1*, the first man-made satellite ever placed into orbit. This event sparked a "space race" between the United States and the Soviet Union, which culminated in the United States landing on the moon in 1969. (Lucy Rogers, *It's ONLY Rocket Science: An Introduction in Plain English* (2008) [Ex. 1009], at 1.) The ensuing years witnessed an extraordinary number of scientific and technological breakthroughs for launching objects into space and bringing them back.

These breakthroughs captured the public imagination and created a new vernacular, with terms like "rocket science," referring to fields generally reserved for only the most intelligent. (*Id.*) But by 2009, the earliest possibly priority date listed on the face of the patent, the basic concepts of "rocket science" were well-known and widely understood. The "rocket science" claimed in the '321 patent was, at best, "old hat" by 2009. (Kaplan Decl. ¶ 19.)

B. Launch Vehicles

To understand the process for launching objects into space, one should be familiar with the concept of a "launch vehicle," which is a device used to launch one or more other objects – known as the "payload" – into space. (*Id*. ¶ 20.) Examples of "payloads" include satellites, space probes, telescopes, equipment for research and experimentation, and manned or unmanned spacecraft (small vehicle, usually a capsule, that maneuvers in space). The launch vehicle typically includes one or more rocket engines that propel the launch vehicle and carry the payload into space. (*See* Ex. 1009 at 30.) As explained in the Background of the '321 patent, "[r]ocket powered launch vehicles have been used for many years to carry human and non-human payloads into space." ('321 patent at 1:49-50.)

C. Multistage Rockets

Most launch vehicles utilize a rocket assembly with multiple different "stages," commonly referred to as a "multistage rocket." The concept has been used since the 1500s, when Johann Schmidlap, a German fireworks manufacturer, designed a "step rocket" to propel his fireworks to higher altitudes by strapping a smaller rocket atop a larger one. The larger rocket ignited first and carried the fireworks into the air. When the large rocket exhausted its fuel, the smaller rocket detached and ignited, carrying the fireworks to even higher altitudes using the smaller rocket's own fuel. (Ex. 1009 at 27.)

Modern "multi-stage" rockets use precisely the same approach for the same simple reason as Schmidlap's "step rocket": by shedding the mass of the used-up "booster" stage(s) along the way, the rocket is able to carry heavier payloads farther. To date, all successful orbital launch vehicles have employed multiple rocket stages because "[t]he weight of the rocket, including the engines, fuel and payload, is too large for current propulsion systems to get into orbit in one stage." (*Id.*) Each rocket stage typically "contains its own propellant, engines, instrumentation and airframe, so that it can function independently." (*Id.*) The first stage is responsible for lifting the payload and all other stages off the surface of the Earth. (*Id.* at 27-28.) "Usually, the first stage burns for only a couple of minutes. After it has used all of its propellant, the empty propellant tank, engine, instrumentation and airframe are just dead weight and are jettisoned and usually return to Earth." (*Id.* at 28.) The next stage then ignites and carries the payload and any remaining stage(s) even higher. As of 2008, rockets with up to five stages had been developed and launched. (*Id.*)

D. Reusable Spacecraft and "Reusable Launch Vehicles" (RLVs)

Traveling to space has always been an expensive proposition, and there has long been an interest in developing launch vehicles that can be partially or completely reused. (*See* Kaplan Decl. ¶ 23.) By the 1970s, the expense of relying on expendable launch vehicles to reach space led to the Space Shuttle program. (*Id.*) Even with the partially reusable Space Shuttle, the cost to reach space remained staggeringly expensive. (Kaplan Decl. ¶ 24.)

By the late-1970s, industry recognized that the need for reusability also extended to booster stages. As explained in U.S. Patent No. 5,927,653 to George E. Mueller et al. ("Mueller '653") [Ex. 1005], filed in 1996, "[o]ne of the most significant problems facing industry with respect to satellite deployment is the extremely high cost to transport the satellite to a desired orbit." (Ex. 1005 at 1:29-31.) Mueller '653 reported that launching an unmanned satellite into orbit in 1996 could cost from $40 million to $200 million, depending on the type of rocket required. (*Id.* at 1:31-35.) Mueller and others recognized that substantial cost savings could be realized by reusing booster stages. (Kaplan Decl. ¶ 25.) Mueller

‘653 therefore disclosed “a reliable, *reusable* and cost-effective system for deployment of payloads to low Earth orbit.” (Ex. 1005 at 2:23-26 (emphasis added).)

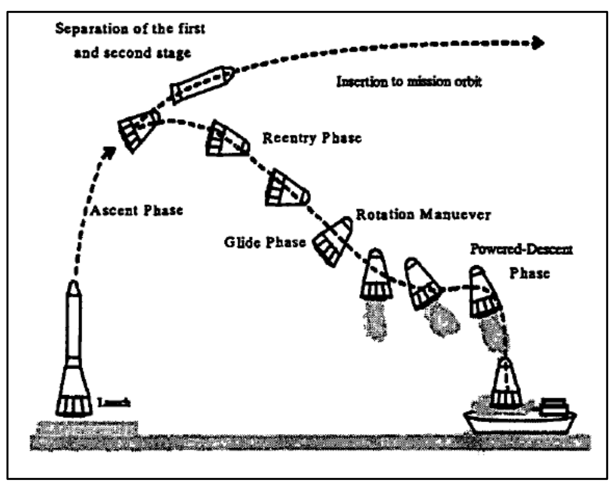
These concerns were echoed in U.S. Patent No. 5,873,549 to Jeffrey G. Lane et al. (“Lane”) [Ex. 1004], also filed in 1996. Lane describes a reusable single stage to orbit (“SSTO”) launch vehicle. SSTO vehicles “are designed to perform their intended operation and return to earth without jettisoning any portions of the vehicle.” (Ex. 1004 at 1:12-16.) Lane and Mueller ‘653 confirm that by at least 1996, industry had recognized and responded to the need for reusable launch vehicles, which provide cost savings over prior techniques that rely on single-use rockets. (Kaplan Decl. ¶¶ 25-26.)

E. Sea Landing of Reusable Launch Vehicles

The industry also recognized a need for reusable launch vehicles that could land *at sea*. The advantages of landing a reusable launch vehicle at sea have also long been obvious and straightforward to persons of ordinary skill in the art. Landing a launch vehicle or launch vehicle component at sea reduces the risk of accidental loss of life or property in the event of a vehicle malfunction or crash. (Kaplan Decl. ¶ 34.) It also simplifies down-range landing of boosters, which are typically launched from coastal launch sites, by eliminating the need for the boosters to substantially change their trajectory to reach a particular location on land, thereby minimizing their expenditure of propellant. (*See* Kaplan Decl. ¶ 32.)

For example, throughout the prosecution of the '321 patent, the claims were rejected over U.S. Patent No. 8,047,472 to Vance D. Brand et al. ("Brand") [Ex. 1010], which disclosed a "reusable launch system" in which the lower stage "descends to touchdown on a barge in the ocean" (*id.* at 5:41-42).

A similar technique was described in a 1998 publication by Yoshiyuki Ishijima et al., "Re-entry and Terminal Guidance for Vertical-Landing TSTO (Two-Stage to Orbit)," AAIA Pub. No. 98-4120 ("Ishijima") [Ex. 1003]. Ishijima explains that "the research about Reusable Launch Vehicles (RLV) is becoming more active, because they have the potential to reduce the cost of space transportation." (Ex. 1003 at 192.) Ishijima discloses a TSTO system in which the first stage "is recovered and transferred to the launch site on a large tanker or pontoon," as shown in Figure 1 of Ishijima shown at the right. (*Id.* at 192, 193 (Fig. 1).) Ishijima explains that "[i]n order to land in a limited area such as a tanker on the sea, the re-entry and



Ex. 1003 Figure 1

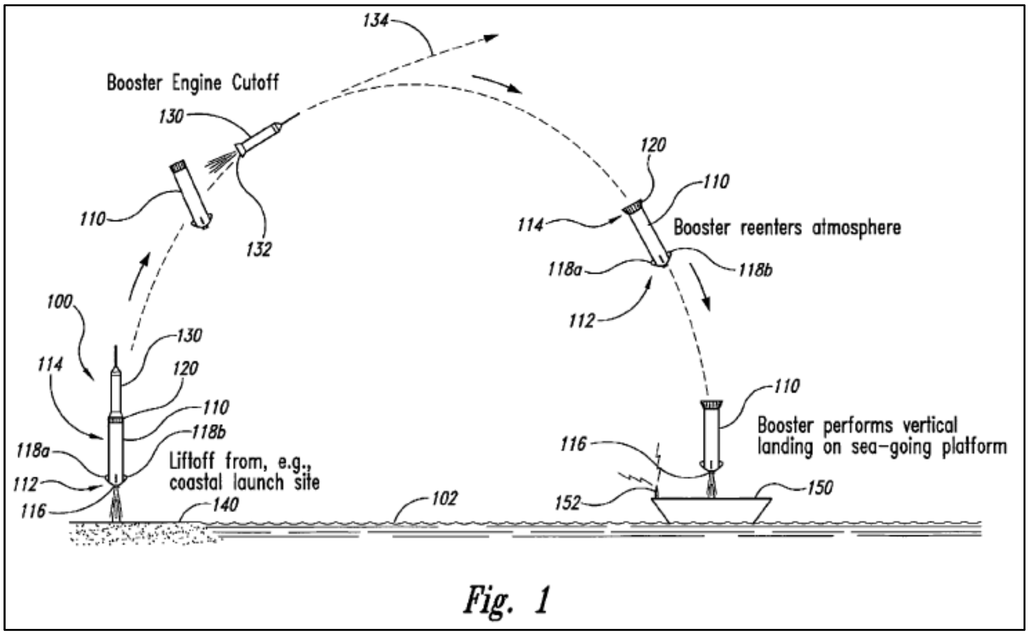
terminal guidance should be accurate and robust." (*Id.* at 192.)

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

A. The Specification of the '321 Patent

The reusable launch vehicle techniques described in Section IV above were known to persons of ordinary skill in the art by at least the late 1990s, but this fact went largely unnoticed by the patent owner during the original prosecution of the '321 patent. The Background portion of the '321 patent pays lip service to the existence of prior art reusable launch vehicles (RLVs), but does not describe them in any detail. ('321 patent at 1:60-62.) Nor does the specification identify any specific drawback of existing RLVs that the alleged invention seeks to address. (*Id.*)

The '321 patent instead attempts to lay claim over the technique described by Ishijima in 1998 of landing a reusable space launch vehicle on a "sea-going platform," such as a "free-floating, ocean-going barge" or other vessel. ('321 patent at 5:14-20.) The basic technique disclosed in the specification of the '321 patent is shown in Fig. 1 of the patent:



'321 patent, Fig. 1

Fig. 1, above, shows "a flight profile of a reusable launch vehicle that performs a vertical powered landing on a sea-going platform in accordance with an embodiment of the disclosure." (*Id*. at 3:10-13.) The left side of Fig. 1 shows a launch vehicle (100) situated on a "coastal or other land-based launch site 140." ('321 patent at 3:13-15, 3:42-43.) The launch vehicle (100) includes "a first or booster stage" (110) and "a second or upper stage" (130). (*Id*. at 3:13-15.) The right side of Fig. 1 shows a "sea-going platform" (150) that may be located "a hundred or more miles downrange from the coastal launch site 140." (*Id*. at 4:13-15.)

The specification explains that the launch vehicle (100) "takes off from a coastal or other land-based launch site 140 and then turns out over an ocean 102."

(*Id*. at 3:42-44.) After the booster stage (110) shuts off at high altitude, it "separates from the upper stage 130 and continues along a ballistic trajectory." (*Id*. at 3:64-66.) The booster stage (110) then reorients itself into a "tail first" position and then moves toward the sea-going platform (150). (*Id*. at 4:3-6.)

In order to land the booster stage (110) on the sea-going platform (150), the booster stage "restarts the booster engines 116 to slow its descent." (*Id*. at 4:51-55.) "The booster stage 110 then performs a vertical, powered landing on the platform 150 at low speed." (*Id*. at 4:55-57.)

The specification does not provide any detailed description of how to land the booster stage (110) at sea. In fact, the specification admits that details associated with "launching and landing space launch vehicles" are "well-known," and therefore not set forth in the specification "to avoid unnecessarily obscuring the various embodiments of the disclosure." (*Id*. at 2:32-37.)

B. Summary of the Relevant Prosecution History

Throughout prosecution, the claims were repeatedly rejected over the Brand patent, which, as noted previously, disclosed a reusable launch system in which the lower stage lands on a barge in the ocean. (*See* Ex. 1010 at 5:41-42.)

The patent owner did not dispute that Brand disclosed the use of a reusable launch vehicle that could land on a sea-going platform. It instead argued that Brand discloses an "air-breathing" booster and not a rocket. (Ex. 1002 at 191-94.)

The difference between an air-breathing engine and a rocket would have been plainly obvious to one of ordinary skill in the art considering not only that Brand disclosed both types of engines, but also that the '321 patent itself describes an embodiment in which jet engines are attached to the booster to perform vertical landing maneuvers. ('321 patent at 5:1-13.) The Examiner, however, subsequently allowed the claims, reasoning that Brand did not teach "vertically landing the space launch vehicle . . . while providing thrust from at least one or more rocket engines . . . [because] Brand specifically teaches away from the use of rocket engines in the booster stage." (Ex. 1002 at 12-13.) The '321 patent subsequently issued on March 25, 2014.

C. The Claims of the '321 Patent

The three independent claims addressed in this Petition, claims 1, 8, and 13, purport to recite methods for landing a space launch vehicle tail-first on a floating platform. All claims recite substantially the same steps of launching a space vehicle, reorienting it to a tail-first position after launch, and then landing on a floating platform. Representative claim 1 recites in full:

1. A method for operating a space launch vehicle, the method comprising:

[a] launching the space vehicle from earth in a nose-first orientation, wherein launching the space launch vehicle includes igniting one or more rocket engines on the space launch vehicle;

[b] reorienting the space launch vehicle to a tail-first orientation after launch;

[c] positioning a landing structure in a body of water; and

[d] vertically landing the space launch vehicle on the landing structure in the body of water in the tail-first orientation while providing thrust from at least one of the one or more rocket engines.

('321 patent at 8:59-9:4 (Claim 1) (bracketed notations (e.g., "[a]," "[b]," etc.) added to facilitate easier identification of the specific claim limitations in this Petition).)

The other independent method claims addressed in this Petition, *i.e.* claims 8 and 13, merely add detail about how the rocket is powered; they add nothing of patentable significance, as shown in Part VII below. All of the other claims addressed in this Petition are dependent claims that add nothing of patentable significance.

VI. CLAIM CONSTRUCTION UNDER 37 C.F.R. § 42.104(B)(3)

A claim subject to *inter partes* review must be given its "broadest reasonable construction in light of the specification of the patent in which it appears." 37 C.F.R. § 42.100(b). As the Federal Circuit has recognized, the "broadest reasonable construction" standard is different from the manner in which the scope of a claim is determined in litigation.[1] (*See In re Swanson*, 540 F.3d 1368, 1377-78 (Fed. Cir. 2008).) Petitioner accordingly requests that the Board adopt the broadest reasonable construction of each challenged claim. For claim terms not addressed below, Petitioner has applied the plain and ordinary meaning of those terms.

A. "Space Launch Vehicle"

The term "space launch vehicle" is recited in independent claim 1 as the vehicle that is launched and then landed. The specification uses this term to refer to a device used to carry a payload into space. ('321 patent at 1:49-50 ("Rocket powered launch vehicles have been used for many years to carry human and non-human payloads into space.").) This is consistent with the understood meaning of "launch vehicle" to persons of ordinary skill in the art. (Kaplan Decl. ¶ 56; *see also* Ex. 1009 at 30 ("The launch vehicle is the rocket, including all of the stages, that is used to launch a payload into space.").) Petitioner accordingly requests that

[1] Petitioner's proposed constructions in Section VI are based on the broadest reasonable construction in light of the specification. *See* 37 C.F.R. § 42.100(b); M.P.E.P. § 2111. Petitioner does not concede that those constructions would be appropriate in litigation or any other proceeding that applies a different standard governing claim construction. *See In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989).

the Board find that the broadest reasonable construction of “space launch vehicle” is “a device used to carry a payload into space.”

B. “Nose-First Orientation” and “Tail-First Orientation”

The terms “nose-first orientation” and “tail-first orientation” appear in each independent claim to describe the positioning of the “space launch vehicle” or “booster stage” at different phases of operation.

The specification explains that “the booster stage 110 [Fig. 1] can reenter the atmosphere nose-first, and then reorient to a tail-first orientation just prior to landing.” (‘321 patent at 4:6-8.) The specification further explains that a “tail-first orientation” exists when “the aft end [of the booster stage] is pointing in the direction of motion.” (*Id*. at 4:4-5.) The specification acknowledges that this is not a constant state because the booster may rotate off-axis, requiring efforts to stabilize the booster in a tail-first orientation. (*Id*. at 4:32-37.) The specification also notes that adjustments to the glide path are needed to adjust for movement of the landing platform in the water, further indicating that the booster may not always proceed precisely in the direction of motion. (*See, e.g.*, *id*. at 7:1-23.)

Accordingly, Petitioner respectfully submits that the broadest reasonable construction of “tail-first orientation” is “a position in which the vehicle tail is pointed substantially in the direction of motion.” (Kaplan Decl. ¶ 61.) The related term "nose-first orientation" should similarly be construed as "a position in which the vehicle nose is pointed substantially in the direction of motion." (*Id*.)

C. "Positional Information"

Claims 7 and 11 each recite receipt of "positional information" from "[a] landing platform." The term "positional information" does not appear in the specification, though the related term, "positional data," appears once. ('321 patent at 4:18 (indicating booster stage glide path may be adjusted based on positional data).) The specification explains that "the sea-going platform 150 can include a broadcast station 152 for communicating its position to the launch vehicle 100 in real time" (*Id*. at 3:44-47), but does not provide any details about this communication. Accordingly, under the broadest reasonable construction, "positional information" should be construed as "a signal comprising data representative of location." (Kaplan Decl. ¶ 63.)

D. Deploying [Flared] Control Surface[s]

The term "deploying" appears in independent claim 13 and dependent claim 9 in conjunction with the terms "flared control surfaces" and "control surfaces," respectively. During the prosecution of the '321 patent, the patent owner stated that "the plain meaning of 'deploying' is 'to position, or to bring in to action,'" and that "the plain meaning of a 'flared' control surface means a control surface that is 'expand[ed] or open[ed] outward in shape.'" (Ex. 1002 at 196). Although the

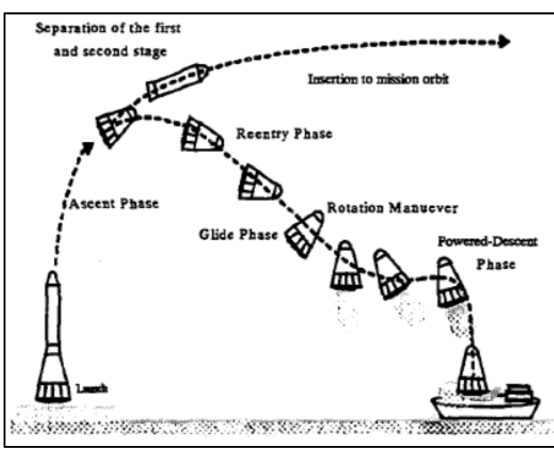
Board is not necessarily bound by the patent owner's assertions during the original prosecution, these definitions are consistent with the broadest reasonable constructions of "deploying" and "flared control surface[s]," and should therefore be construed accordingly. (Kaplan Decl. ¶ 64.)

VII. CLAIMS 1-13 OF THE '321 PATENT ARE UNPATENTABLE

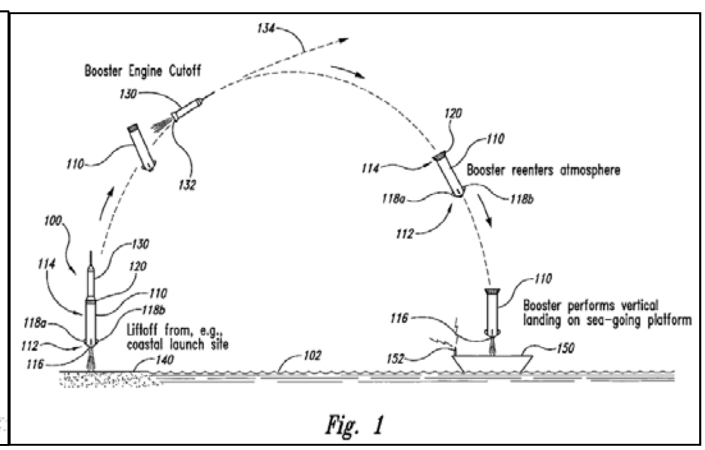
A. Ground 1: Claims 1-3 Are Anticipated by Ishijima

Each limitation of claims 1, 2, and 3 is disclosed by Ishijima. Ishijima qualifies as prior art to the '321 patent under at least 35 U.S.C. § 102(b) (pre-AIA) because it was published in 1998, more than a decade before the earliest application filing date for the '321 patent.

Ishijima discloses a reusable launch vehicle that utilizes a flight and recovery sequence essentially identical to the one later described and claimed in the '321 patent. This is illustrated by the following comparison showing Figure 1 from Ishijima (on the left) and Figure 1 of the '321 patent (on the right):



Ex. 1003 Figure 1



'321 patent, Fig. 1

Figure 1 of Ishijima above shows a launch vehicle that undergoes various phases including an "Ascent Phase," "Reentry Phase," "Glide Phase," and "Powered-Descent Phase." The booster stage in Ishijima separates following the Ascent Phase, enabling the second stage and payload to continue to orbit while the first stage proceeds to the Reentry Phase and ultimately lands on a sea-going tanker. (Ex. 1003 at 193, Fig. 1.) "After the glide," Ishijima explains, "the vehicle [*i.e.* booster stage] re-ignites the main engines, and changes its attitude from nose-first to tail-first." (*Id.* at 193.)[2] "In the landing phase, the vehicle performs vertical powered-descent while compensating [sic; for] the errors caused in the reentry and glide phases." (*Id.*) Finally, the launch vehicle "lands softly [on the tanker] throttling the thrust." (*Id.*)

Ishijima therefore discloses precisely the same flight and recovery path as the '321 patent. As shown in the analysis that follows, there is no material difference between the operation of Ishijima's booster stage and the launch vehicle claimed in the '321 patent more than a decade later.

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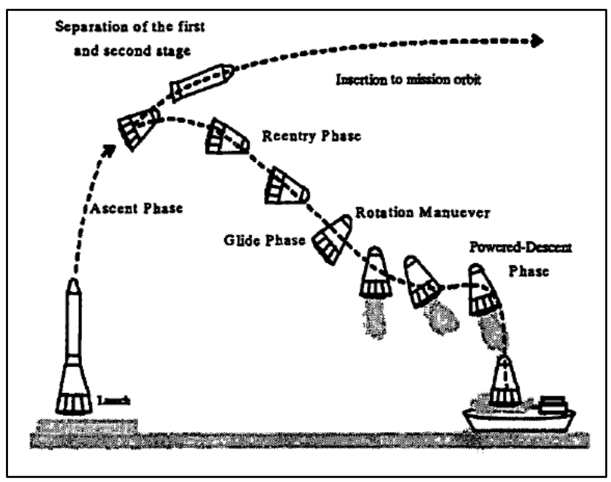
[2] Figure 1 of Ishijima used hashmarks to depict the tail of the booster stage, whereas the artist of the '321 patent used hashmarks to depict the deployable aerodynamic surfaces on the nose of the booster stage. Both figures reflect substantially the same orientation at all significant points on the flight path.

1. Ishijima Anticipates Claim 1

The preamble of claim 1 of the ‘321 patent recites, “[a] method for operating a space launch vehicle.” Ishijima discloses a method of “re-entry and terminal guidance for the first stage of a TSTO [two-stage to orbit vehicle] used to launch a payload into space.” (Ex. 1003 at 192.) Ishijima identifies a TSTO as an example of a “Reusable Launch Vehicle (RLV).” (*Id.*) As shown below, Ishijima discloses each limitation of claim 1.

a. Claim 1[a]



Ex. 1003 Figure 1

The first limitation of claim 1 recites “launching the space launch vehicle from earth in a nose-first orientation, wherein launching the space launch vehicle includes igniting one or more rocket engines on the space launch vehicle.” This is shown in Figure 1 of Ishijima (shown above), which “illustrates the outline of a flight sequence.” (Ex. 1003 at 192.) The bottom-left of Figure 1 identifies the first step of the sequence as “Launch.” (*Id.* at 193, Fig. 1.) Figure 1 also clearly depicts the nose of the launch vehicle at the top, in the direction of the vehicle’s motion. (*Id.*) Ishijima discloses that <u>after</u> separation, the booster stage “changes its attitude from nose-first to tail-first" (*Id.* at 193 (emphasis added)), further confirming that the TSTO launch vehicle was launched in a "nose-first orientation" as recited in claim 1[a].

Ishijima further discloses that the launch vehicle was launched "from earth" as recited in the claim, specifically from the "Tanegashima Space Center," for which Ishijima provides the precise geographical coordinates ((*id.* at 193, Table 1), on the island of Tanegashima, off the southern tip of Kyushu, Japan. (*See* Kaplan Decl. ¶ 91.)

Ishijima discloses that "launching the space launch vehicle includes igniting one or more rocket engines on the space launch vehicle," as recited at the end of claim 1[a]. Ishijima specifically discloses a two-stage to orbit (TSTO), rocket-propelled launch vehicle. (Ex. 1003 at 192 ("There are several kinds of rocket-propelled [reusable launch vehicles], one of them is the single-stage to orbit vehicle (SSTO), an alternative is the two-stage to orbit vehicle (TSTO).").) Moreover, Table 2 of Ishijima describes the mass of "propellant" used at various stages of the flight sequence. (*Id*. at 193, Table 2.) One of ordinary skill in the art would understand that "propellant" is used with rocket engines and therefore the artisan would understand that the launch vehicle in Ishijima includes at least one rocket engine. (Kaplan Decl. ¶ 93.)

Finally, Ishijima discloses the step of "igniting one or more rocket engines on the space launch vehicle," as recited in claim 1[a]. This is shown by Figure 1 shown above, which depicts a vertical launch. (Ex. 1003 at 193, Fig. 1, Table 2 (showing rocket propellant consumed by the booster stage "[f]or Ascent.").) Ishijima further discloses that the launch vehicle, after separation, "re-ignites the main engines," confirming that the engines were in fact previously ignited. (*Id*.) Ishijima therefore teaches igniting one or more rocket engines as recited in claim 1[a].

b. Claim 1[b]

Claim 1[b] next recites "reorienting the space launch vehicle to a tail-first orientation after launch." Ishijima specifically discloses that the launch vehicle "changes its attitude from nose-first to tail-first" (*id.* at 193), and Figure 1 of Ishijima clearly depicts a "Rotation Maneuver" to a tail-first orientation in preparation for landing. (Ex. 1003 at 193, Fig. 1; Kaplan Decl. ¶ 99.) Ishijima therefore teaches this limitation.

c. Claim 1[c]

Claim 1**[c]** recites the step of "positioning a landing structure in a body of water." This is again shown in Figure 1 (see above) of Ishijima that depicts a floating tanker as the landing structure for the booster stage. (Ex. 1003 at 193, Fig. 1.) Ishijima describes Figure 1 by stating that "[i]n order to land in a limited area such as a tanker on the sea, the re-entry and terminal guidance should be accurate and robust." (*Id.* at 192 (emphasis added).) Ishijima also notes that by "changing the first stage landing positions, the TSTO system can transport payloads to various orbits," (*id.*), which reinforces the artisan's understanding that the landing structure can be positioned where desired. (Kaplan Decl. ¶ 104.) Ishijima therefore discloses "positioning a landing structure in a body of water," as recited in claim 1[c].

d. Claim 1[d]

The final limitation of claim 1 recites the step of "vertically landing the space launch vehicle on the landing structure in the body of water in the tail-first orientation while providing thrust from at least one of the one or more rocket engines." Ishijima discloses each aspect of this claim limitation.

First, Ishijima discloses "vertically landing the space launch vehicle on the landing structure in the body of water in the tail-first orientation," as recited in the first half of claim 1[d]. As noted previously, Ishijima specifically discloses that the launch vehicle "changes its attitude from nose-first to tail-first." (*Id.* at 193.) Ishijima also explains that "[i]n the landing phase, the vehicle performs vertical powered-descent while compensating [sic; for] the errors caused in the reentry and glide phases." (*Id.*) As noted previously, the launch vehicle in Ishijima lands vertically on "a tanker on the sea." (*Id.* at 192; 193, Fig. 1.)

Ishijima also discloses that the vertical landing takes place "while providing thrust from at least one of the one or more rocket engines," as recited in the second half of claim 1[d]. As noted in the preceding paragraph, Ishijima discloses a landing phase that includes a "vertical powered-descent." (*Id.* at 193.) Ishijima explains that the launch vehicle "lands softly throttling the thrust." (*Id.* (emphasis added).) Ishijima therefore discloses that the launch vehicle lands while providing thrust from its rocket engines, as recited in claim 1[d].

2. Ishijima Anticipates Claim 2

Claim 2 depends from claim 1, and recites: "The method of claim 1 wherein launching the space launch vehicle from earth includes launching the space launch vehicle from a launch site on land." As explained in connection with claim 1[a] above, Ishijima discloses launching the launch vehicle from the "Tanegashima Space Center," which is a launch site on land. (Kaplan Decl. ¶ 118.) Accordingly, Ishijima teaches claim 2.

3. Ishijima Anticipates Claim 3

Claim 3 depends from claim 1 and recites: "The method of claim 1 wherein the landing structure is a floating platform in the body of water." As explained in connection with claim 1[c] above, Ishijima discloses a landing structure in the form of a "tanker on the sea," as shown in Figure 1 of Ishijima. (Ex. 1003 at 192; 193,

Fig. 1.) A tanker on the sea, on which a booster is landed, serves as a platform and is floating in a body of water, thus anticipating claim 3.

B. Ground 2: Claims 8, 9, 12, and 13 Are Obvious over Ishijima in view of Lane

Claim 8 is an independent claim similar to claim 1. Ishijima discloses most of the limitations of claim 8 for substantially the same reasons as claim 1 above. Ground 2 combines Ishijima with U.S. Patent No. 5,873,549 to Jeffrey G. Lane ("Lane") [Ex. 1004]. Lane qualifies as prior art to the '321 patent under at least 35 U.S.C. § 102(b) because it issued more than a decade before the earliest application filing date for the '321 patent.

Lane discloses a vertically-landing reusable launch vehicle that includes flap assemblies for rotating and stabilizing the vehicle. (Ex. 1004 at 1:6-10). The launch vehicle in Lane, like the one in Ishijima, reenters the atmosphere in a nose-first orientation and initiates a landing sequence that includes rotating the vehicle from a "nose-forward orientation" to a "rearward or base-first orientation." (*Id*. at 3:35-38.) This reorientation occurs when the engines are off, by selectively positioning flaps on the launch vehicle while the vehicle is traveling along a parabolic flight path. (*Id*. at 3:48-58.) A flight control computer then controls the engines and the vehicle vertically lands. (*Id*. at 4:51-54; 3:36-39.)

Ground 2 relies on Ishijima for the majority of the claim limitations, but cites Lane for certain aspects relating to the timing of reorientation and reignition of the engines. Ishijima and Lane render claims 8, 9, 12, and 13 obvious as explained below. A specific description of the motivation for combining Ishijima and Lane is provided below in connection with the claim limitation in which Lane is cited.

1. Ishijima and Lane Render Claim 8 Obvious

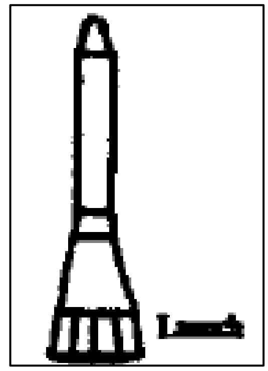
The preamble of claim 8 recites "[a] method for transporting a payload to space." As explained for claim 1 above, Ishijima discloses a two-stage to orbit (TSTO) launch vehicle that "can transport payloads to various orbits." (Ex. 1003 at 192.)

a. Claim 8[a]

The first limitation of claim 8 following the preamble recites the step of "coupling the payload to a booster stage of a rocket, the booster stage having a forward end portion spaced apart from an aft end portion and one or more rocket engines positioned toward the aft end portion." Ishijima discloses this limitation.

Ishijima discloses the claimed step of "coupling the payload to a booster stage of a rocket". Ishijima explains that the TSTO launch vehicle "can transport payloads to various orbits." (Ex. 1003 at 192.) One of ordinary skill in the art would understand that for the launch vehicle to be able to carry a payload into space, the payload must be coupled to the booster stage in some manner, either by direct attachment to the booster or attachment to some other component of the launch vehicle. (Kaplan Decl. ¶¶ 129-130.)

Ishijima also discloses that the booster has "a forward end portion spaced apart from an aft end portion and one or more rocket engines positioned toward the aft end portion," as recited in the claim. Figure 1 of Ishijima (shown in relevant part at the right) plainly discloses such a two-ended booster. Any booster must have "a forward end" spaced apart from "an aft end portion" to even exist in three dimensions. Additionally, as previously addressed for claim 1 above, Ishijima utilizes one or more rocket engines as recited in the claim. (*See* Ex. 1003 at 193.) Figure 1 of Ishijima depicts engine exhaust emanating from the aft end of the booster, clearly indicating the location of the booster's rocket engine(s). (Kaplan Decl. ¶¶ 134-135.)



Ex. 1003 Figure 1

b. Claim 8[b]

Claim 8[b] next recites "positioning a floating platform in a body of water." Ishijima's disclosure of the positioning of a floating platform in water was addressed in connection with claim 1[c] and claim 3, above, incorporated here.

c. Claim 8[c]

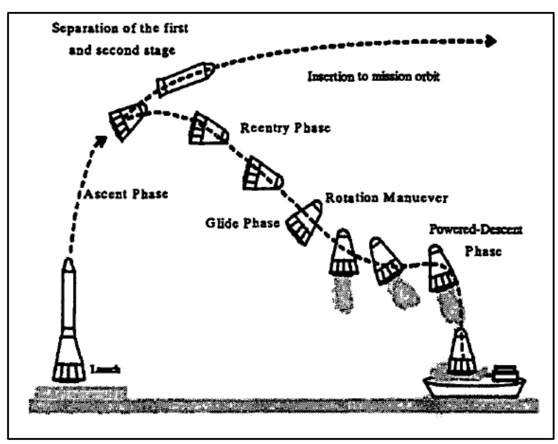
Claim 8[c] requires "igniting at least one of the one or more rocket engines and launching the rocket toward space in a nose-first orientation." This limitation is substantially the same as claim 1[a], above, incorporated here.

d. Claim 8[d]

Claim 8[d] recites "turning off at least one of the ignited one or more rocket engines." Ishijima teaches that the rocket engines are turned off after launch and before the "Glide Phase." In particular, Ishijima explains that "[a]fter the glide, the vehicle <u>re-ignites</u> the main engines" (Ex. 1003 at 193). The engines could not be "re-ignited" after the glide phase unless they were turned off between launch and the glide phase. (Kaplan Decl. ¶ 143.) One of ordinary skill in the art, in fact, would recognize that the "Glide Phase" indicates that the launch vehicle was travelling without propulsion, in other words, with its engines turned off. (*Id*. ¶ 144.)

e. Claim 8[e]

Claim 8[e] next recites "separating the payload from the booster stage." This is shown on the top left of Figure 1 of Ishijima (at right), which shows the second stage and its associated payload separating from the



Ex. 1003 Figure 1

first or booster stage, allowing insertion of the payload into orbit.

f. Claim 8[f]

Claim 8[f] next recites "after separating and turning off, reorienting the booster stage from the nose-first orientation to a tail-first orientation." This limitation is substantially the same as claim 1[b] above, incorporated here. Figure 1 of Ishijima clearly depicts this post-separation and post-engine cutoff reorientation by showing a "Rotation Maneuver" to a tail first orientation in preparation for landing. (Ex. 1003 at 193, Fig. 1; Kaplan Decl. ¶¶ 150-151.) Ishijima specifically discloses that the booster stage "changes its attitude from nose-first to tail-first." (Ex. 1003 at 193.) Ishijima therefore teaches this limitation.

g. Claim 8[g]

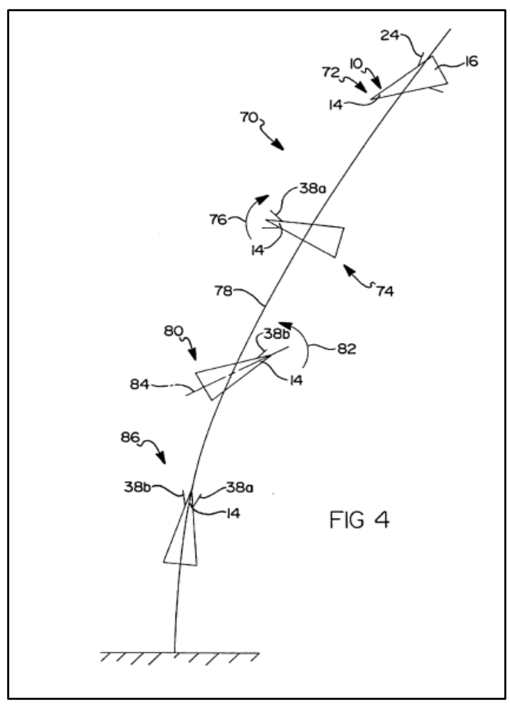
Claim 8[g] next discloses the step of "after reorienting, igniting at least one of the one or more rocket engines to decelerate the booster stage." Figure 1 of Ishijima shows that the booster enters a "Powered-Descent Phase" following the "Glide Phase" and the "Reorientation Maneuver." (Ex. 1003 at 193, Fig. 1.) Ishijima discloses that "[a]fter the glide, the vehicle [*i.e.* booster] re-ignites the main engines, and changes its attitude from nose-first to tail-first." (*Id.* at 193.) "In the landing phase, the vehicle performs vertical powered-descent while compensating [sic; for] the errors caused in the reentry and glide phases." (*Id.*)

Finally, the launch vehicle decelerates and "lands softly throttling the thrust." (*Id.*) Ishijima therefore discloses "igniting at least one of the one or more rocket engines to decelerate the booster stage," as recited in the claim.

While Ishijima does not expressly disclose that the rocket engine is ignited after reorientation, this is clearly disclosed by Lane.

Figure 4 of Lane (below), shows the landing rotation sequence of the launch vehicle (10), in which a descent stage (86), toward the bottom of Figure 4, occurs after the vehicle has reoriented. (Ex. 1004 at 2:13-15.) Lane explains that reignition of the engines begins during this descent stage (86), which takes place <u>after</u> reorientation.

In particular, Lane explains that the launch vehicle's flight control computer "controls the operation of vehicle engines 19 so as to regulate the descent and touchdown velocities of vehicle 10." (*Id.* at 4:51-54.) "As described, the present invention controls the position and orientation of the vehicle 10 during rotation and landing sequence 70 <u>without requiring the consumption of</u>



Ex. 1004 Figure 1

propellant." (*Id*. at 4:55-58 (emphasis added).) Lane therefore discloses that reignition of the engines (19) does not take place until after rotation (reorientation) of the launch vehicle, as recited in claim 8[g].

It would have been obvious to adapt the teachings of Lane to the launch system of Ishijima, with no change in their respective functions, predictably resulting in the Ishijima system in which the booster rocket engines did not reignite until after reorientation as disclosed in Lane. One of ordinary skill in the art would be motivated to achieve the benefit of reducing or minimizing propellant usage, as described in Lane. (Kaplan Decl. ¶ 159.) A reduction in the amount of required propellant would also enable a reduction in the weight of the launch vehicle, increasing its efficiency and the payload that could be delivered to orbit. (*Id*.) Accordingly, one of ordinary skill in the art would be motivated to combine Ishijima's teaching of booster rocket engines used for deceleration with Lane's teaching of delaying engine reignition until after reorientation. (*Id*. ¶ 160.) Thus, Ishijima in view of Lane teaches this limitation.

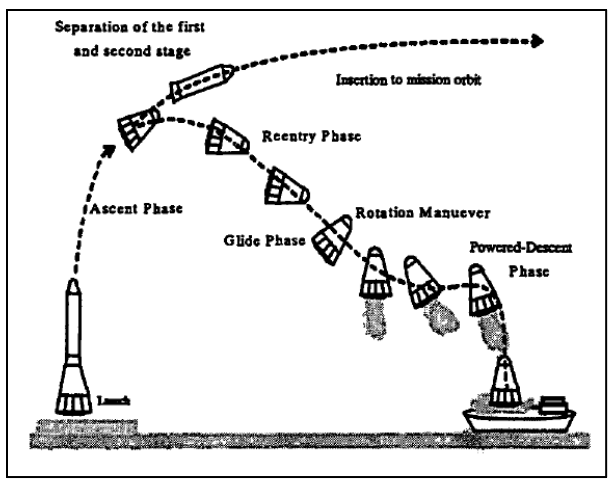
h. Claim 8[h]

Claim 8[h] concludes with: "landing the booster stage on the floating platform in the tail-first orientation, wherein landing the booster stage includes performing a powered, vertical landing of the booster stage on the platform." Again, Ishijima clearly discloses this limitation: "After the glide the vehicle [*i.e.*

booster stage] re-ignites the main engines, and changes its attitude from nose-first to tail-first." (Ex. 1003 at 193.) "In the landing phase, the vehicle performs vertical powered-descent while compensating [sic; for] the errors caused in the reentry and glide phases." (*Id.*) Finally, the booster "lands softly throttling the thrust." (*Id.*) As explained above, the booster in Ishijima lands vertically on "a tanker on the sea." (*Id.* at 192.)

2. Ishijima and Lane Render Claim 9 Obvious

Claim 9 depends from claim 8 and recites "after the booster stage has separated from the payload and followed a ballistic trajectory, deploying an aerodynamic control surface from the booster stage to facilitate reorienting the booster stage from the nose-first orientation to a tail-first orientation."



Ex. 1003 Figure 1

Figure 1 in Ishijima depicts separation of the first (i.e. booster) stage and second stage and indicates that the second stage proceeds to "[i]nsertion to mission orbit." (Ex. 1003 at 193, Fig. 1.) One of ordinary skill in the art would recognize that the payload is attached to the second stage, and thus, that the booster stage in Ishijima separates from the payload. (Kaplan Decl. ¶ 166.) Ishijima also discloses that during at least the

"Reentry Phase" after separation, the booster follows a ballistic trajectory as shown in Figure 1. (Ex. 1003 at 193, Fig. 1.)

Although Ishijima does not disclose the specific structures used for reorientation, Lane discloses "deploying an aerodynamic control surface from the booster stage to facilitate reorienting the booster stage from the nose-first orientation to a tail-first orientation," as recited in the later part of claim 9. Lane discloses aerodynamic control surfaces in the form of flaps that are used to stabilize the launch vehicle. In particular, Lane explains that the flight control system "selectively positions [nose] flaps 38a, 38b, 38c, and 38d to stabilize reusable launch vehicle 10 during rearward flight as well as <u>to modulate the flap positions to perform the rotation maneuver</u> required to land vehicle 10." (Ex. 1004 at 3:42-47 (emphasis added).) This rotation maneuver results in reorientation from nose-first to tail-first orientation. Lane therefore discloses the deployment of aerodynamic control surfaces to facilitate a tail-first orientation as recited in the claim. (Kaplan Decl. ¶¶ 170-171.)

It would have been obvious to one of ordinary skill in the art to adapt the teachings of Lane to the launch system of Ishijima, with no change in their respective functions, predictably resulting in the Ishijima launch system in which the booster deploys an aerodynamic control surface (e.g. flaps) to facilitate reorienting to a tail-first orientation, as disclosed in Lane. In addition to the reasons described for claim 8 above, one of ordinary skill in the art would appreciate that Ishijima and Lane are analogous references because both disclose reusable launch vehicles that must reorient themselves from nose-first to tail-first orientation in preparation for a vertical landing. The use of deployed flaps to facilitate this reorientation was well-known to persons of ordinary skill in the art. (Kaplan Decl. ¶¶ 173-174.)

3. Ishijima and Lane Render Claim 12 Obvious

Claim 12 depends from claim 8 and recites: "The method of claim 8[a] wherein igniting at least one of the one or more rocket engines includes igniting a first rocket engine, [b] wherein turning off at least one of the one or more rocket engines includes turning off the first rocket engine, and [c] wherein, after reorienting, igniting at least one of the one or more rocket engines includes reigniting the first rocket engine." Claim 12 adds nothing of significance to the limitations of claim 8, which were addressed above. As explained for claim 8[c], 8[d], and 8[g] above, Ishijima discloses igniting a first rocket engine, turning it off, and then reigniting it to facilitate descent and landing of the booster.

4. Ishijima and Lane Render Claim 13 Obvious

Independent claim 13 merely combines limitations recited in independent claims 1 and 8, and dependent claim 9. To avoid duplication, cross-references to the pertinent analysis are provided in the table below, and incorporated here.

Claim 13	**Disclosures in Ishijima and Lane**
13. A method for transporting a payload to space, the method comprising:	*See* Claim 1, preamble.
[a] coupling the payload to a booster stage of a rocket, the booster stage having a forward end portion spaced apart from an aft end portion;	*See* Claim 8[a],
[b] positioning a floating platform in a body of water;	*See* Claim 1[c]
[c] igniting one or more rocket engines positioned toward the aft end portion of the booster stage and launching the rocket toward space in a nose-first orientation;	*See* Claims 1[a], 8[a], and 8[c]
[d] turning off the one or more rocket engines;	*See* Claim 8[d],
[e] separating the payload from the booster stage;	*See* Claim 8[e],
[f] after the booster stage has separated from the payload and followed a ballistic trajectory, deploying one or more flared control surfaces from the forward end portion of the booster stage to facilitate reorienting the booster stage from the nose-first orientation to a tail-first orientation; and	*See* Claim 9
[g] landing the booster stage on the floating platform in the tail-first orientation.	*See* Claim 1[d] and 8[b]

C. **Ground 3: Claims 4 and 5 Are Obvious over Ishijima in view of Mueller '653**

Claims 4 and 5 depend from claim 1, which is anticipated by Ishijima for the reasons expressed for Ground 1 above. Dependent claims 4 and 5 add details relating to the reuse of the space launch vehicle. These details are conventional, and do not provide any nonobvious distinction over the teachings of Ishijima.

One of ordinary skill the art would have found claims 4 and 5 obvious over Ishijima in view of U.S. Patent No. 5,927,653 to George E. Mueller et al. ("Mueller '653") [Ex. 1005]. Mueller '653 qualifies as prior art to the '321 patent under at least 35 U.S.C. § 102(b) because it published more than nine years before the earliest application filing date to which the '321 patent could claim priority.

Mueller '653, entitled "Two-Stage Reusable Earth-to-Orbit Aerospace Vehicle and Transport System," discloses a two-space reusable aerospace launch vehicle. (Ex. 1005, Abstract.) The upper and lower stages of the vehicle are joined together at an assembly location, transported to a launch site, assembled into a vertical position, and launched under the power of rocket engines coupled to the lower stage. (*Id.* at 6:9-17, 7:1-3.) The lower stage propels the vehicle to a separation point at which point the lower-stage engines are shut off, the vehicle begins to coast, and the upper stage is separated from the lower stage. (*Id.* at 21:14-20.) After separation, the lower stage rotates to point upwardly, reignites an engine, and lands. (*Id.* at 21:30-38, 53.) As explained below, the combination of Ishijima and Mueller '653 renders claims 4 and 5 obvious.

1. Claim 4 is Obvious over Ishijima in view of Mueller '653

Claim 4 depends from claim 1 and recites: "The method of claim 1, further comprising reusing at least a portion of the space launch vehicle." Ishijima discloses "Reusable Launch Vehicles (RLV)," and explains that they have "the potential to reduce the cost of space transportation." (Ex. 1003 at 192.) Ishijima further discloses that the "first stage is recovered and transferred to the launch site on a large tanker or pontoon." (*Id.*) However, Ishijima does not specifically describe what happens to the launch vehicle after it has landed on the sea-going tanker and transferred to the launch site. One of ordinary skill in the art would understand that the "<u>Reusable</u> Launch Vehicle" described in Ishijima is one in which the booster is intended to be reused. (Kaplan Decl. ¶ 187.) But even if Ishijima itself did not disclose this, Mueller '653 does.

Mueller '653 describes a system for refurbishing and relaunching a launch vehicle after recovery from an earlier launch. (*See, e.g.*, Ex. 1005 at 2:56-63). Mueller '653 explains that after the landing and recovery of the upper and lower stages (14, 16) of the vehicle, a recovery vehicle (400) transports the stages to an "installation and assembly complex" adjacent to the landing area (36). (*Id.* at 24:38-42, 24:59-64, 25:14-17.) The stages are then placed onto a launch transport vehicle (18) that moves the stages into a "reconfiguration and assembly complex 450," where the vehicle is refurbished and readied for its next launch. (*Id.* at 26:7-11 (lower stage 16 placed on transport vehicle), 26:20-27 (upper stage 14 placed on transport vehicle), 26:28-31 (transport vehicle moves vehicle into reconfiguration complex), 26:44-56 (vehicle is refurbished).)

A transport vehicle (18) then moves the refurbished launch vehicle (including the upper and lower stages 14, 16) to a take-off area (20) for its next launch. (*Id.* at 26:57-65). "The aerospace vehicle 10 then fires the lower stage engines 56 and takes off along its ascending trajectory as discussed above." (*Id*. at 27:50-52.) Mueller '653 therefore clearly discloses the step of "reusing at least a portion of the space launch vehicle," as recited in claim 4.

It would have been obvious for one of ordinary skill in the art to adapt the teachings of Mueller '653 to Ishijima, with no change in their respective functions, predictably resulting in the space launch method of Ishijima with the capability to reuse at least a portion of the space launch vehicle after recovery, as described in Mueller '653. One of ordinary skill in the art would understand that reusing portions of the launch vehicle could result in substantial cost savings. Mueller '653 makes this motivation express by explaining that launching an unmanned satellite into orbit could cost from $40 million to $200 million depending on the type of rocket required. (*Id.* at 1:31-35.) Mueller and others recognized that substantial cost savings could be realized by reusing booster stages. (Kaplan Decl. ¶ 25.) Mueller '653 attempted to respond to these issues with "a reliable, reusable and cost-effective system for deployment of payloads to low Earth orbit." (*Id.* at 2:23-26 (emphasis added).)

Ishijima similarly provides an express motivation by explaining that reusable launch vehicles "have the potential to reduce the cost of space transportation." (Ex. 1003 at 192.) Both references therefore confirm that one of ordinary skill in the art would have appreciated that reusing portions of a launch vehicle would avoid the need to obtain new portions for each launch and reduce the amount of wasted material generated by each launch. (Kaplan Decl. ¶¶ 190-191.)

2. Claim 5 is Obvious over Ishijima in view of Mueller '653

Claim 5 depends from claim 1 and, like claim 4, addresses the reuse of a portion of the space launch vehicle. Claim 5 differs from claim 4 by providing three specific steps for the claimed reuse: [a] "transporting the space launch vehicle on the landing structure to a refurbishment facility;" [b] "refurbishing at least a portion of the space launch vehicle at the refurbishment facility;" and [c] "reusing at least a portion of the space launch vehicle after refurbishment."

As explained for claim 1[c] and 1[d] above, Ishijima teaches landing its booster stage on a tanker at sea. (Ex. 1003 at 192.) Ishijima further states that the "first stage is recovered and transferred to the launch site on a large tanker or pontoon." (*Id.*) As explained previously, the launch site in Ishijima is the Tanegashima Space Center on the island of Tanegashima, off the southern tip of Kyushu, Japan. (*Id*. at 193.)

But to the extent that Ishijima does not specifically disclose what happens between recovery of the rocket to the launch site and subsequent reuse of a launch vehicle, such as the servicing steps required to return the launch vehicle to service, Mueller '653 does and is readily combinable.

First, Ishijima and Mueller '653 disclose "transporting the space launch vehicle on the landing structure to a refurbishment facility," as recited in claim 5[a]. As noted, Ishijima discloses that the "first stage is recovered and transferred to the launch site on a large tanker or pontoon," (Ex. 1003 at 192), thus indicating that the first stage can be transported to the launch site on the landing structure (the tanker). Mueller '653 also discloses that the "launch site" includes a refurbishment facility. Specifically, Mueller '653 discloses a "reconfiguration and assembly complex" (450) located near the launch take-off area (20). (Ex. 1005 26:28-41 ("As best seen in FIG. 24, the assembly and launch transport vehicle 18 carries the aerospace vehicle 10 in the substantially horizontal position to a reconfiguration and assembly complex 450."), 26:39-41 ("The assembly complex 450 includes an assembly building 452 with a road 454 extending from the take-off area 20 into an interior area 456 of the building.").) The combination of Ishijima and Mueller

‘653 therefore discloses transporting the space launch vehicle on the landing structure (*e.g*. sea tanker) to a refurbishment facility located at the launch site.

Second, Mueller ‘653 discloses “refurbishing at least a portion of the space launch vehicle at the refurbishment facility,” as recited in claim 5[b]. As explained for claim 4 above, Mueller ‘653 explains that at least a portion of the launch vehicle is refurbished in a “reconfiguration and assembly complex” (450). (Ex. 1005 at 26:52-56 (“The remainder of the aerospace vehicle 10 is refurbished while on the assembly and launch transport vehicle 18 with the airbags, parachutes, drogue chutes and the like being replaced with repacked units.”).)

Finally, Mueller ‘653 discloses the step of “reusing at least a portion of the space launch vehicle after refurbishment,” as recited in claim 5[c]. Specifically, the transport vehicle (18) moves the refurbished launch vehicle from the reconfiguration and assembly complex (450) to a take-off area (20) for its next launch. (*Id.* at 26:57-65.) “The aerospace vehicle 10 then fires the lower stage engines 56 and takes off along its ascending trajectory as discussed above.” (*Id*. at 27:50-52.)

Ishijima and Mueller ‘653 therefore disclose all aspects of claim 5. One of ordinary skill in the art would be motivated to combine the teaching of these references to achieve the cost and other benefits of refurbishing and then reusing portions of the launch vehicle, as explained fully in connection with claim 4 above. (*See also* Kaplan Decl. ¶¶ 205-207.)

D. Ground 4: Claim 6 is Obvious over Ishijima in view of Kindem

Claim 6 depends from claim 1 and recites: "The method of claim 1, further comprising transferring a reusable portion of the space launch vehicle from the landing structure to a transit vessel while the landing structure remains in the body of water to receive a subsequently launched vehicle." Claim 1 is anticipated by Ishijima for the reasons explained above. The additional limitation recited in Claim 6 is also conventional, and adds nothing of patentable significance and is suggested by U.S. Patent No. 6,024,006 to Bjørn Kindem et al. ("Kindem") [Ex. 1006].

As explained for claim 1[c] and 1[d] above, Ishijima discloses a landing structure in the form of a "tanker on the sea." (Ex. 1003 at 192.) Ishijima further discloses that the first stage "is recovered and transferred to the launch site on a large tanker or pontoon." (*Id.* at 192.) While Ishijima does not disclose the further step of transferring the recovered first stage from the tanker onto a transit vessel, as recited in claim 6, this limitation would have been obvious over Ishijima in view of Kindem, which specifically describes techniques for transporting and transferring rockets by ship. (Ex. 1006, Abstract.) Kindem discloses a technique for transferring a rocket from a ship onto a floating platform at sea. (*Id*. at 1:60-64.)

The floating platform includes a ramp and a lifting device for transferring the rocket from the ship and lifting it into proper position. (*Id*. at 2:55-60.)

Petitioner acknowledges that Kindem describes the transfer of a rocket from a transit vessel to a floating platform for launch, while claim 6 recites the process in reverse – transfer of the rocket from a floating landing platform where it landed to a transit vessel. As explained by Dr. Kaplan, one of ordinary skill in the art would have found this distinction trivial because the procedure for transferring a rocket from a ship to a floating platform, and from a floating platform to a ship, are substantially identical, and one of ordinary skill in the art would understand that the processes disclosed in Kindem could be reversed. (Kaplan Decl. ¶ 215.)

It would have been obvious to one of ordinary skill in the art to combine Ishijima with Kindem, with no change in their respective functions, predictably resulting in the launch system of Ishijima in which the recovered first stage (*i.e.* portion of the space launch vehicle) is transferred from the landing tanker in Ishijima to another transit ship for transit, allowing the landing tanker in Ishijima to remain in the body of water and receive a subsequently launched vehicle. One of ordinary skill in the art would be motivated to make this combination to achieve several benefits, including increasing the speed of transport to land. (Kaplan Decl. ¶¶ 216-217.) One of ordinary skill in the art would also be motivated to achieve the benefit of freeing the landing tanker in Ishijima of the burden of transporting a recovered launch vehicle after landing, allowing the tanker to maintain at a constant position at sea between launches. (*Id.*) Claim 6 is therefore obvious over Ishijima in view of Kindem.

E. Ground 5: Claim 7 is Obvious over Ishijima in view of Spencer, further in view of Waters

Claim 7 depends from claim 1 and recites a number of additional limitations, many of which are restatements of limitations already recited in claim 1. This ground of unpatentability adds: a) Jack Waters, et al., *Test Results of an F/A-18 Automatic Carrier Landing Using Shipboard Relative GPS*, Proceeding of the ION 57th Annual Meeting and the CIGTF 20th Biennial Guidance Test Symposium (2001) ("Waters") **[**Ex. 1007]) for certain limitations in claim 7 relating to the receipt of "positional information" from the landing platform; and b) U.S. Patent No. 6,450,452 to Robert B. Spencer et al. ("Spencer") [Ex. 1008] for a limitation in claim 7 relating to separating the upper stage from the booster stage at a predetermined altitude. Waters and Spencer both qualify as prior art to the '321 patent under at least 35 U.S.C. § 102(b) because they published in 2001 and issued in 2002, respectively, years before the earliest application filing date for the '321 patent.

Waters discloses the results of a test of a Precision Approach and Landing System ("PALS") that provided precision navigation and two-way air traffic control for sea-based aircraft operations. (Ex. 1007 at 842). Waters describes successful tests of automated landing of aircraft on an aircraft carrier. (*Id.* at 842, 846.) The Waters PALS implements a system similar to traditional Global Positioning Systems ("GPS") known as Shipboard Relative Global Positioning System ("SRGPS"). (*Id.* at 842). A ship-based reference station received signals from the GPS constellation indicative of the aircraft carrier's position and transmitted that information to the approaching aircraft. (*See id.* at 842-844.) The test aircraft received the positional information, which it used to calculate its position relative to the aircraft carrier, and automatically altered its landing approach based on this positional information. (*Id.* at 846-47.) The test included ten successful automated carrier landings based on the SRGPS data. (*Id.* at 848.)

Spencer discloses a reusable launch vehicle system, which specifically recovers the booster stages of the system to save money. (Ex. 1008 at 1:10-14.) The recoverable and reusable booster stage described in Spencer can be used in connection with conventional launch vehicles, either as a single first stage booster or in pairs or larger groupings. (*Id.* at 6:41-45; Fig. 4.) Spencer illustrates in Fig. 6 a flight path for a launch vehicle using multiple reusable first stage boosters to launch a space shuttle. The flight path includes a vertical launch and separation of the reusable boosters at a predetermined time, elevation, or velocity. (*Id.* at 7:11-15; 2:34-38; 8:9-16, Figs. 6-7.) After separation, the boosters continue to ascend and an attitude control system is activated to control the attitude in preparation for a return flight path. (*Id.* at 7:19-28.) The boosters alternatively glide or fly back to a landing strip (e.g., under rocket or jet-engine power) close to the launch facility. (*Id.* at 7:25-27, 48-50; 3:10-27.) Once at the landing strip, they make a controlled autonomous landing. (*Id.* at 8:29-35.) The boosters can then be refurbished and reused. (*Id.* at 8:35-46.)

As explained in detail below, Ishijima, Waters, and Spencer disclose all limitations of claim 7.

The first element of claim 7 recites, "[t]he method of claim 1 wherein the space launch vehicle includes a payload carried on an upper stage mounted to a booster stage." Ishijima discloses that the launch vehicle "can transport payloads to various orbits." (Ex. 1003 at 192.) Because only the second stage is inserted to mission orbit, as shown in Figure 1, the payload is carried by the second stage. (*Id.* at 193.) Table 2 of Ishijima also discloses the payload mass attributable to the second (i.e., upper) stage (*id.* at 193, Table 2), further confirming that the payload is carried on the upper stage. (Kaplan Decl. ¶ 227.)

Ishijima further teaches that the upper stage "is mounted to a booster stage," as recited in the claim. Figure 1 indicates that after launch and ascent, the next event is "Separation of the first and second stage," (Ex. 1003 at 193), clearly indicating that the first (booster) stage was mounted to the second stage. (Kaplan Decl. ¶ 228.)

The next few limitations of claim 7 are substantially similar to limitations in claim 1 except that they refer to a "booster stage" instead of a "space launch vehicle." In particular, claim 7 next requires: "wherein igniting one or more rocket engines includes igniting one or more rocket engines on the booster stage to launch the space launch vehicle from a launch site on land." Ishijima discloses this requirement for the same reasons as explained in claim 1[a] above. As explained for claim 1[a] above, the first stage ignites its engines to launch from the "Tanegashima Space Center" on land. (Ex. 1003, at 193 (Table 1).)

Claim 7 next recites: "wherein reorienting the space launch vehicle includes reorienting the booster stage to a tail-first orientation." Ishijima discloses these limitations for the reasons explained for claim 1[b] above.

Claim 7 next recites the step of "turning off the one or more rocket engines on the booster stage." Ishijima discloses these limitations for the reasons explained for claim 8[d] above, i.e. Ishijima teaches that the rocket engines on the booster are turned off between launch and the "Glide Phase." In particular, Ishijima explains that "[a]fter the glide, the vehicle <u>re-ignites</u> the main engines" (Ex. 1003, at 193 (emphasis added)). The fact that the launch vehicle "re-ignites" the rocket engines indicates that the engines were turned off at some point between launch and the glide phase. (Kaplan Decl. ¶¶ 235, 143-144.) One of ordinary skill in the art, in fact, would recognize that the "Glide Phase" indicates that the launch vehicle was travelling without propulsion, in other words, with its engines turned off. (*Id*.)

Claim 7 next recites: "separating the upper stage from the booster stage at a predetermined altitude." Figure 1 of Ishijima plainly depicts the separation of the upper and booster stages after initial launch and ascent. (Ex. 1003 at 193, Fig. 1.) Spencer adds the teaching of that separation point occurring at a predetermined altitude: "[t]he separation point 602 may be selected <u>at a particular elevation</u>, at a particular velocity, or to occur at a certain time after liftoff." (Ex. 1008 at 7:14-16 (emphasis added).)

It would have been obvious to one of ordinary skill in the art to trigger the stage separation technique of Ishijima with the predetermined altitude criterion disclosed by Spencer, with no change in their respective functions, predictably resulting in the stage separation of Ishijima occurring as a result of reaching a predetermined altitude, as taught by Spencer.

One of ordinary skill in the art would have been motivated to combine Ishijima and Spencer in this manner because both references teach the same stage separation technique for achieving the same purpose—enabling the orbital stage to proceed to orbit while permitting a booster stage to be recovered and reused. (Kaplan Decl. ¶ 241.) Moreover, one of ordinary skill would recognize that the stage separation in Ishijima would require some triggering event—Spencer merely identifies a predetermined altitude as one of these events. (*Id*.) For this additional reason, one of ordinary skill would have been motivated to combine the teachings of these references.

Claim 7 next requires: "receiving positional information from the landing platform and controlling a trajectory of the booster stage as is [sic] moves toward the landing platform in the tail-first orientation based on the positional information." Ishijima explains that the booster's trajectory is tightly controlled as it proceeds in a tail-first orientation for landing. (Ex. 1003 at 192.) In fact, Ishijima teaches that "to land in a limited area such as a tanker on the sea, the re-entry and terminal guidance should be accurate and robust." (*Id.*)

To the extent that Ishijima does not disclose a precise mechanism for controlling the booster's trajectory as it descends for landing, the receipt and use of "positional information" as recited in the claims is disclosed by Waters, which discloses a test aircraft that receives differential GPS "satellite measurements" from an aircraft carrier. As explained above, the positional information enables the aircraft to calculate the precise landing location and automatically adjust its trajectory on the basis of the received information. (Ex. 1007 at 842-43.)

It would have been obvious to one of ordinary skill in the art to adapt the system of Ishijima to add the positional information of Waters, with no change in their respective functions, predictably resulting in the system of Ishijima in which the booster stage receives GPS information indicative of the location of the landing tanker, and adjusts its trajectory based on that information. One of ordinary skill in the art would have been motivated to combine Ishijima and Waters in this manner to achieve the beneficial result of more precise landing of unmanned vehicles. (Kaplan Decl. ¶ 250.)

As noted above, Ishijima states that "[i]n order to land in a limited area such as a tanker on the sea, the re-entry and terminal guidance should be accurate and robust." (Ex. 1003 at 192.) One of ordinary skill in the art would have recognized that landing on a floating platform, potentially in turbulent or current-affected waters, could introduce a degree of uncertainty regarding the precise location of the platform. (Kaplan Decl. ¶ 251.) Knowing the precise location and orientation of the landing platform would be critical to a successful landing. (*Id*.) One of ordinary skill in the art would have certainly been aware of the prevalent use of differential GPS for precise locational information, including the use of automated aircraft landing on aircraft carriers—a procedure that shares the same need as Ishijima to ascertain the precise landing location on the floating landing platform. (*Id*. ¶ 252.) One of ordinary skill in the art, therefore, would have been motivated to incorporate the use of differential GPS from Waters into the control guidance procedures of the booster stage in Ishijima. (*Id.*)

The final limitation of claim 7 recites: "reigniting the one or more rocket engines on the booster stage prior to landing, wherein the landing structure is a mobile landing platform, and wherein vertically landing the space launch vehicle includes vertically landing the booster stage on the mobile landing platform." Ishijima discloses this limitation for the reasons expressed in claim 1[a] (reigniting one or more rocket engines on the booster stage prior to landing), 1[c] and 8[b] (the landing structure is a mobile landing platform), and 1[d] (vertically landing the booster stage on the mobile landing platform), above.

F. **Ground 6: Claim 11 is Obvious over Ishijima in view of Lane, and further in view of Waters**

Claim 11 depends from claim 8, which is obvious over Ishijima in view of Lane for the reasons expressed above. Claim 11 adds the step of "moving an aerodynamic control surface on the booster stage to at least partially control a flight path of the booster stage toward the platform based on platform positional information received from the platform." The only significant limitation added in claim 11 is the use of received "positional information" to enable the booster stage to control its flight path. This positional information is disclosed by Waters for substantially the same reasons expressed in Ground 5 above.

Ishijima teaches the use of aerodynamic forces to allow the booster to at least partially control its flight path: "After the separation, the first stage flies into the atmosphere and the guidance is performed by controlling aerodynamic force." (Ex. 1003 at 193.) Ishijima lacks detailed disclosure of the mechanism for such control, but as explained for claim 9 above, Lane teaches movement of aerodynamic control surfaces (e.g. flaps) to at least partially control the flight path, including through actuating nose flaps 38a-38d that stabilize flight in the tail-first orientation. (Ex. 1004 at 3:42-47, 4:44-47.) Waters similarly teaches movement of aerodynamic control surfaces to control an aircraft's flight path, which one of ordinary skill in the art would have understood is achieved by modulating the aircraft's ailerons, elevator, and/or rudder, as is common in all fixed wing aircraft. (Kaplan Decl. ¶ 267.) As explained in Ground 5 above, Waters also discloses controlling the flight path of an aircraft based on the receipt of GPS information from the landing platform. (Ex. 1007, at 842.) The combination of Ishijima, Lane, and Waters therefore disclose the claimed "aerodynamic control surface on the booster stage to at least partially control a flight path of the booster stage toward the platform based on platform positional information received from the platform."

It would have been obvious to one of ordinary skill in the art to adapt the GPS positional information in Waters to the launch vehicle landing systems of Ishijima and Lane, with no change in their respective functions, predictably resulting in the system of Ishijima in which the booster contained aerodynamic control surfaces (e.g. flaps) to at least partially control its flight path based on received GPS information. The motivation for this combination is substantially the same as explained for Ground 5 above, including the need to obtain precise landing location. (Kaplan Decl. ¶¶ 269, 249-252, 172-175.)

G. Ground 7: Claim 10 is Obvious over Ishijima in view of Lane, and further in view of Mueller '653

Claim 10 depends from claim 8, which is obvious over Ishijima in view of Lane for the reasons expressed in Ground 2 above. Claim 10 adds the step of "operating one or more propulsive thrusters mounted to the booster stage to facilitate reorienting the booster stage from the nose-first orientation to a tail-first orientation." This additional limitation is disclosed by Mueller '653.

Ishijima mentions the need to reorient from a nose-first to a tail-first orientation, but does not describe any particular mechanism for this maneuver. (Ex. 1003 at 193 (noting vehicle "changes its attitude from nose-first to tail-first").) Mueller '653, however, specifically discloses the use of propulsive thrusters to facilitate reorientation: "the lower stage 16 has redirection thrusters mounted to the proximal or distal ends of the lower-stage body, and the thrusters are activated to rotate the lower stage." (Ex. 1005 at 17:50-53.) This passage also teaches that the thrusters are mounted to the booster stage, as required by the claim. Mueller '653 further discloses that the reorientation caused by the thrusters causes the vehicle to rotate from a nose-first to a tail-first position. (*Id.* at 17:31-34.) Therefore, Ishijima in view of Lane further in view of Mueller ‘653 disclose all limitations of claim 10.

In addition to the reasons explained for claim 4 above, the artisan would be motivated to combine Ishijima with Mueller ‘653 because both disclose a TSTO launch vehicle with a booster that needs to be reoriented after separation. The artisan would understand that Mueller ‘653's propulsive thrusters can be used in Ishijima's booster for reorientation in the same manner as they are used in Mueller ‘653. (Kaplan Decl. ¶¶ 279-281.) Claim 10 is therefore obvious over the combination of Ishijima, Lane and Mueller ‘653.

VIII. CONCLUSION

The prior art references identified in this Petition contain pertinent technological teachings, either explicitly or inherently disclosed, that were not previously considered in the manner presented herein or applied during original examination of the ‘321 patent. At least by virtue of disclosing the limitations that served as the basis for the allowance of the claims at issue, the references relied upon herein should be considered important in determining patentability. In sum, these references provide new, non-cumulative technological teachings not previously considered and relied upon on the record, and establish a reasonable likelihood of success as to Petitioner's assertions that claims 1-13 of the ‘321 patent are not patent eligible pursuant to the grounds presented in this Petition.

Accordingly, Petitioner respectfully requests institution of *inter partes* review for claims 1-13 of the ‘321 patent for each of the grounds presented herein.

Dated: August 25, 2014

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CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. Sections 42.6 and 42.105, that a complete copy of the attached **PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO. 8,678,321**, including all exhibits (**Nos. 1001-1016**) and related documents, are being served by EXPRESS MAIL® on the 25th day of August, 2014, the same day as the filing of the above-identified document in the United States Patent and Trademark Office/Patent Trial and Appeal Board, upon the patent owner:

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and upon the patent prosecution counsel of record for the U.S. Patent No. 8,678,321:

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