State Responsibility and Liability for Air-Launch over the High Seas*

Yuri Takaya-Umehara[**], *Seiji Matsuda*[***], *Takayoshi Fuji*[****] *and Mitsuteru Kaneoka*[*****]

Abstract

Air-launch is a unique way of commercial launching that uses a combination of two vechicles, carrier aircraft and rocket, to deliver small satellites in LEO. Some of the current programs plan to conduct air-launches over the High Seas under international cooperation that highlight legal issues related to the limited application of air law, the scope of state responsibility and the condition to apply the space liability regime to any damage caused by vehicles/satellites during those two launch phases. Due to the lack of consistent state practice concerning the legal status of the carrier aircraft, the author aims to clarify the need to register it before its operation as a space object in a national and international space registry in order to ensure a stable application of the liability regime over the air-launch activities.

Introduction

With a growing market for small satellite, air-launch attracts attention to launching states that prioritize three elements in space business: reliability, flexibility and responsiveness. The launch uses a combination of two vehicles, carrier aircraft and rocket, to deliver small satellite in low earth orbit (LEO). The carrier aircraft is designed as normal aircraft and departs from airport/spaceport, while it carries a small rocket for the second launch at an altitude of 8-10 km. As of 2013, there are 7 space-faring states that pursue 9 air-launch programs[1] and a few of them plan to conduct air-launch activities over the

* Any views in this article pertain to the first author only.
** Kobe University, Japan, yuritakaya_japan@hotmail.com.
*** IHI Aerospace Co, Ltd., Japan, matsuda-s@iac.ihi.co.jp.
**** Japan Space Systems, Japan, fuji-takayoshi@jspacesystems.or.jp.
***** CSP Japan, Inc., Japan, kaneoka@csp.co.jp.

1 DARPA-Airborne Launch Assist Space Access program by US; STARLAB program by US; Polyot program by Russia, Germany, Ukraine and Indonesia; NLR Air-Launch by The Netherlands; Yuzhnoye UAV program by Ukraine; and three US companies started feasibility studies: Virgin Galactic, Stratolaunch System Inc., Boeing.

High Seas, namely US-Japan joint project of Air Launch System Enabling Technology (ALSET) and Polyot program by Russia-Germany-Ukraine-Indonesia cooperation.
Air law or space law, which law applies to a carrier aircraft that is used for air-launch over the High Seas? A similar question was raised when reusable launch vehicles (RLV) for manned space flight entered into space business that also highlighted a need for consideration from the perspective of state responsibility and liability; however, the difference between RLV and the carrier aircraft is that the former reaches into outer space while the latter does not.
Focusing on the uniqueness of using carrier aircraft for air-launch, particularly over the High Seas, this article aims to clarify a need to register it in the UN Registration of Space Objects in advance for stable application of space liability regime to the activity and for "safety" in naviagation at sea, in air and outer space. For this purpose, it examines the issues related to: the limited application of air law [I]; the scope of state responsibility [II] and the condition to apply state liability to the accident over the High Seas [III].

I. The Limited Application of Air Law

Applicability of air law has been one of the major issues that emerged in space tourism where aerospace planes for sub-orbital and full-orbital flight were designed differently. In line with debates over it, the definition and delimitation of outer space was also reconsidered. Some scholars reached a persuasive conclusion by dividing the types of aerospace planes into two, namely sub-orbital and orbital flight, and by applying air law to the former and space law to the latter.[2] This solution seemed ideal until the carrier aircrafts for air-launch entered into the scope.
To explore further possible solution, this chapter reviews the existing debates related to: the definition and delimitation of outer space [1.1.]; and the legal status of carrier aircrafts for air-launch over the High Seas [1.2.].

1.1. Definition and Delimitation of Outer Space

Traditional debates over the definition and delimitation of outer space started in the first *Ad Hoc* Committee on the Peaceful Uses of Outer Space (COPOUOS) in 1959.[3] Since then, two major approaches have been developed as "spatialists" and "functionalists." Spatial approach prefers to establish "a demarcation line between air and outer space,"[4] while functional approach focuses on the goal of activity or function of the vehicle itself. In the 1990s, scholars identified

2 Varlin J. Vissepó, "Legal Aspects of Reusable Launch Vehicles," *Journal of Space Law*, vol. 31, 2005, pp. 165-218.
3 UN Doc. A/4141 of 14 July 1959, Part III, III.A, "Report of the Ad Hoc Committee on the Peaceful Uses of Outer Space".
4 Katherine M. Gorove, "Delimitation of Outer Space and the Aerospace Object – Where is the Law?, Journal of Space Law, vol. 28, 2000, p. 11, 16.

the third approach "not to define" outer space[5] and explored the fourth as "effective" or "hybrid" approach.[6]

Although the spatial approach has been accepted as customary international law[7] that demarcates 100-110 km at altitude from the sea level of the earth, the functional approach gains more support from space-faring states to cover their advanced aerospace activities. In fact, recognizing that a line between air and outer space limits territorial sovereignty in air space, states are losing their motivation to demarcate outer space from a national security point of view.

Regarding UN efforts, since the principle of non-sovereignty in outer space in Article II of the Outer Space Treaty (OST)[8] is deeply related to the principle of free uses and exploration of outer space in Article I, it had attempted to solve the issue by fixing the line at 100-110 km altitude and according the right of innocent passage through the underlying airspace above foreign territories.[9] However, because no agreement reached between space powers US and the former USSR for decades, the issue still remains on the COPUOS agenda.[10] To focus on state practice related to the definition, a working group was established in the Sub-legal Committee of COPUOS that submitted its report, though not all states answered, proving that most of states have no national legislation defining outer space but a few states define at 100 km altitude.[11]

Regarding the fourth "effective" approach, in other word "hybrid" approach, focuses on (1) the intended purposes, or (2) the effects of hybrid vehicular activity, or both (1) and (2). According to this approach, if the vehicle's purpose or effects is that of aircraft, air law applies, and if the other is of spacecraft, space

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5 Bin Cheng, *Studies in International Space Law*, Clarendon Press, 1997, p. 445.

6 Carl Q. Christol, Legal Aspects of Aerospace Planes, in The Highways of Air and Outer Space Over Asia, 77, 83. Also see Vissepó, *supra* note 2, pp. 172-184.

7 Stephen Gorove, "Legal and Policy Issues of the Aerospace Plane: A Case Study of Things to Come," *Developments in Space Law: Issues and Policies*, Martinus Nijhoff Publishers, 1991, p. 358.

8 Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies, 27 January 1967, 610 UNTS 205.

9 Gorove, *supra* note 7.

10 UN Doc. A/68/20, "Matters relating to the definition and delimitation of outer space and the character and utilization of the geostationary orbit, including consideration of ways and means to ensure the rational and equitable use of the geostationary orbit without prejudice to the role of the International Telecommunication Union," p. 27-28. Texts are available at: <www.oosa.unvienna.org/pdf/gadocs/A_68_20E.pdf> (last accessed on 16 Sept. 2013). UN COPUOS also endorsed the recommendations of the Subcommittee and its Working Group on the Definition and Delimitation of Outer Space, reconvened under the chairmanship of José Monserrat Filho. *See*, UN Doc. A/AC.105/1045, paras. 62 and 63, and annex II, para. 8.

11 States with national legislation defining outer space at 100 km altitude are Australia and Kazakhstan. UN Doc. A/AC.105/C.2/2013/CRP.8.

law applies.[12] This approach seemed ideal to deal with aerospace plane for sub-orbital and full orbital flight until when air-launch programs started, using an aircraft for satellite launching.
Considering that this issue takes further time, the applicability of air law to the carrier aircraft for air-launch should be examined independently in order to ensure safety in space operations over the High Seas where the second ignition taken place.

1.2. Legal Status of Carrier Aircraft for Air-Launch

US-Japan program ALSET plans to use a carrier aircraft for air-launch that departs from and lands on airport/spaceport. In the Chicago Convention of 1944,[13] the definition of an aircraft is "[a]ny machine that can derive support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface." Different from aerospace plane for sub-orbital/full-orbital flight, the carrier aircraft does not reach into outer space during its mission, falling into the definition of the aircraft; however, its mission is to launch a space object. If the applicability of air law follows the spatial approach, air law might apply; on the other hand, if the functional approach or the effective approach, space law might apply. To avoid the same argument, state practice is to be examined.
There are two programs that plan to conduct air-launch over the High Seas, ALSET by US-Japan cooperation and Polyot by Russia-Germany-Ukraine-Indonesia cooperation. They apply different laws to the carrier aircraft. In the US-Japan ALSET program, as US is in the position of the functional approach for the delimitation of outer space, space law applies to the carrier aircraft. It plans to apply for a launching license for commercial space transportation in US Federal Aviation Authority (FAA), and already obtained Technical Assistance Agreement (TAA) for a drop test in US national air space. Thus, the carrier aircraft in ALSET program is regarded as space launch vehicle. On the other hand, for the Polyot program, air law likely applies to its carrier aircraft in accordance with the German Air Traffic Act[14] even after its separation from small launcher "as long as the payload is in air space," though it does not necessarily exclude the possibility of applying space law.[15] It should be noted that regardless of the legal status of the carrier aircraft, during its mission in air space, carrying its small rocket from airport/spaceport to the air-launch zone, the carrier aircraft needs to fly in conformity with the Standards and Recommended

12 Christol, *supra* note 6.
13 International Civil Aviation Organization (ICAO), Convention on Civil Aviation ("Chicago Convention"), 7 December 1944, 15 *UNTS*. 295, available at: <www.refworld.org/docid/3ddca0dd4.html> (last accessed on 12 September 2013).
14 §1 II Luftverkehrsgesetz.
15 *See*, Bernhard Schmidt-Tedd, et al, "The legal problems of providing the space activity of space objects launching by aerospace launch systems with the participation of several States (Polyot Air Launch Project as an example), in Proceedings of the 54th Colloquium on the Law of Outer Space.

Practices (SARPs) under International Civil Aviation Organization (ICAO) for aviation safety management.
In sum, no consistency in state practice is established for applying air law or space law to the carrier aircraft for air-launch over the High Seas. Therefore, the following section examines the scope of state responsibility to identify how safety in its air-launch operation be ensured.

II. The Scope of State Responsibility

To emphasize the need to register the carrier aircraft as space object, this chapter examines the issues related to: the scope of state responsibility [2.1.]; the legality of air-launch over the High Seas [2.2.]; and a notification for continuing supervision [2.3.].

2.1. The Concept of State Responsibility in Space Law

The concept of state responsibility in space law remains unique and exceptional to the concept developed in the International Legal Committee (ILC). The first part of Article VI of the OST stipulates that states parties bear international responsibility for national activities in outer space, whether such activities are carried on by governmental agencies or by non-governmental entities. This provision "automatically" attribute all private activities to their national state, establishing a derogation to the rules on attribution codified by the Draft Articles on Responsibility of States for Internationally Wrongful Acts,[16] approved on second reading by the ILC.[17] Furthermore, the term "national activities in outer space" is interpreted as covering whole preparatory and relevant works before and after a launch on earth.
The second part of Article VI requires non-governmental entities to obtain authorization and continuing supervision from the "appropriate" state party. In general, the appropriate state is interpreted as the state of nationality where private entities register. If the entities are multi-national, they can choose their appropriate state for authorization and continuing supervision by their registration. Regarding authorization and continuing supervision, although they are obligations imposed on the appropriate state, some scholars point out that "continuing supervision" does not immunize the state from its responsibility,[18] while the others concern about the possibility of escaping their responsibility by proving their implementation of authorization and continuing supervision.

16 ILC, "Draft articles on Responsibility of States for Internationally Wrongful Acts, with commentaries 2001". (hereinafter: Draft Articles on State Responsibility) Texts are available at: <http://untreaty.un.org/ilc/texts/instruments/english/commentaries/9_6_2001.pdf> (last accessed on 18 September 2013).

17 Marco Pedrazzi, "Outer Space, Liability for Damage," Max Planck Encyclopedia of Public International Law. Texts are available at: <www.mpepil.com> (last accessed on 18 September 2013).

18 Takane Sugihara, *Lectures on International Law*, Fuzanbo, 2011, p. 357.

To avoid such confusion, UN General Assembly resolution 59/115 of 10 December 2004 on the "Application of the concept of the "launching State" recommend states to enact national space legislation to authorize and provide continuing supervision.[19] In 2012, while several states enacted already, the UN COUPOS Working Group on National Legislation released its findings/recommendations on state practice to implement obligations under international law as well as space law, and to enhance consistency and transparency with regard to the authorization and supervisions.
Although the implementation of obligations under Article VI for state responsibility does not influence on the absolute liability regime in space law, the consistency in authorization and continuing supervision serves to mitigate the risk of accident in air and outer space.

2.2. Legality of Air-Launch over the High Seas

Because the scope of state responsibility in space law is not limited to the internationally wrongful act that violates international law, the legality of launching from the High Seas needs to be clarified. This issue was intensively examined when the Sea Launch Co., started its unique style of launching business.[20] It is a private entity incorporated in the Cayman Islands, consisting of four launching states, US, Norway, Russia and Ukraine. The difference between sea-launch and air-launch is in the vehicle to carry rocket; the former uses vessels and the latter uses carrier aircraft. Both cause no legal conflict with the existing space law that ensures the freedom of use of the outer space under Article 1(2) of the OST. In terms of the freedom of the high sea, the freedom of overflight is ensured in Article 87(1) of the United Nations Convention on the Law of the Sea (hereinafter: UNCLOS) [21]. Article 87(1) stipulates that "[T]he high seas are open to all States, […], under the conditions laid down by this Convention and by other rules of international law" including "(b) freedom of overflight." In order to enjoy the freedom, states are required under Article 87(2) to ensure due regard for "the interests" of other States in their exercise of the same freedom as well as for the rights under UNCLOS with respect to activities in the area. Considering that the principle of freedom of the High Seas covers its air-space, there is no legal conflict in air-launch over the area.

2.3. Notification for Continuing Supervision

Notification in advance and after the accident during the air-launch mission is closely related to "continuous supervision" in Article VI and information-sharing in Article XI of the OST. The latter requires states to inform the UN Secretary-General, the public and the international scientific community of the

19 UNGA Res. 59/115, "Application of the concept of the "launching State," 10 December 2004.

20 For example, *see*, Armel KERREST, "Launching Spacecraft from the Sea and the Outer Space Treaty: The Sea Launch Project," *Air and Space Law*, 23 pp. 16-21.

21 United Nations Convention on the Law of the Sea, opened for signature on 10 December 1982 in Montego Bay. 21 *ILM* 1982, 1261.

nature, conduct, location and results of such activities. Although it is not explicitly written whether the term "the public" includes relevant international organization, space-faring states are obliged to inform the International Maritime Organization (IMO), the ICAO, besides the International Telecommunication Union (ITU), to ensure peaceful uses of outer space as well as safety in international aviation and navigation.

The obligation of "notification" is imposed not only by space law. For safety, regularity and efficiency in international air navigation, Annex 15 and Article 37 of the Chicago Convention of 1944 requires space-faring states to alert aircraft pilots of any hazards en route or at a specific location that could affect the safety of the flight, namely "NOTAM (Notice to Airmen)." In addition, for air traffic control, Appendix 11 Standard 2.17.1 of the Convention requires states to coordinate arrangements with the appropriate air traffic services authorities for activities potentially hazardous to civil aircraft, whether over the territory of a state or over the high seas.

For safety in international navigation at sea, spacefaring states also need to arrange advance notification of launching to IMO for World-Wide Navigational Warning Service.[22] Such a notification supports the prevention of environmental damage under Article 198 and 199, as well as the supervision of pollution risks under Article 204 and 205 of UNCLOS.

Furthermore, in the case of any accident, distress, emergency or unintended landing on the High Seas, not only notification but also necessary cooperation are required under Article 1, 4 and 5 of the Rescue Agreement of 1968[23] to rescue the astronaut/pilot and to return parts of the carrier aircraft to the launching states though RA does not use the term "launching states" but "each contracting party."

Thus, as long as the air-launch is carried out over the High Seas, the scope of state responsibility needs to cover obligations under air law and law of the sea, particularly in terms of continuous supervision and information-sharing over the accidents.

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22 IMO resolutions A.705(17), "Promulgation of Maritime Safety Information" and A.706(17), "World-Wide Navigational Warning Service" require spacefaring states for advance notification of their launching activities. Both resolutions were approved by the Maritime Safety Committee of IMO at its 85 session (MSC 85) in November/December 2008. To improve maritime distress and safety radio-communications, IMO and its Member Governments are in close cooperation with the International Telecommunication Union (ITU) and other international organizations such as the World Meteorological Organization (WMO), the International Hydrographic Organization (IHO), the International Mobile Satellite Organization (IMSO) and the Cospas-Sarsat partners.

23 Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space, 22 April 1968, 672 *UNTS* 119.

III. The Condition to Apply State Liability

The liability regime in space law consists of Article VII of the OST and the Liability Convention of 1972 (LC)[24] aiming for the prompt payment of a full and equitable measure of compensation to victims of damage. In the regime, there is no explicit connection between the state responsible for its national space activities and the state liable for damage caused by a space object;[25] however, Article I(c) and II of the Registration Convention of 1975 (RC)[26] complete this link.

Taking this into consideration, to clarify a need to register the carrier aircraft for air-launch as space object, this chapter examines: the identification of launching states for air-launch over the High Seas [3.1.]; the damage caused by space object [3.2.]; and absolute liability rule [3.3.].

3.1. Identification of Launching States for Air-Launch

Does the air-launch over the High Seas make any difference in identifying launching states? According to Article I(c)(i)(ii) of the LC, the definition of a launching state is: a state which launches or procures the launching of a space object; or from whose territory or facility a space object is launched. This definition is wider than the state of nationality over an aircraft. While "the appropriate state" in Article VI of the OST that authorizes and continuously supervises national activities is single, the air-launch mission involves plural states liable for damage, resulting into no difference in the number of launching states.

In the case of air-launch, the first candidate for launching state is the state of nationality of the carrier aircraft because the private entity operating it needs to have authorization from its national state and continuing supervision for its commercial air-launch activities. The second is the owner state of "facility," namely airport/spaceport located in its "territory," where the carrier aircraft departs. It is also possible to interpret the carrier aircraft itself as "facility".[27] If an air-launch takes place in other state's air space, the state "allowing" the launch "within its territorial air space" is also a launching state.[28]

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24 Convention on International Liability for Damage Caused by Space Objects, 29 March 1972, 961 *UNTS* 187.

25 Pedrazzi, *supra* note 17.

26 Convention on Registration of Objects Launched into Outer Space, 14 January 1975, 1023 *UNTS* 15.

27 In this regard, in legal studies on Sea Launch project, Prof. Kerrest pointed out that the home port is not considered as the place where the launch is done. However, the author regard the places where ship or aircraft departs for launching as launching sites because such departure is a part of launching activity. Kerrest Armel, "Launching Spacecraft from the Sea and the Outer Space Treaty; The Sea Launch Project, Proceedings of the 40th Colloquium on the Law of Outer Space, p. 264.

28 Schmidt-Tedd, *supra* note 15.

Regarding the state that procures the air-launch, there are wide interpretations due to the lack of clarity in the term "procures" in Article I(c)(ii) of the LC. Although some scholar concludes that the sub-contractor state that undertakes the fabrication of the launcher and integration of the payloads is not launching states,[29] it might depends on the degree where it is substantially involved in the case where the sub-contractor state is a member of international project.

3.2. "Damage" Caused by Carrier Aircraft

Liability regime applied to the damage caused by space object and by aircraft is totally different; therefore, it needs to be clarified whether the carrier aircraft is space object or not. According to the definition "space object" in Article I(d) of the LC, it includes "component parts of a space object as well as its launch vehicle and parts thereof," the carrier aircraft, carrying a small rocket and its payloads, is a launch vehicle, namely a space object. Then, the principle of absolute liability, to be explained in [3.3.], applies to the launching states for the damage caused by the carrier aircraft during its mission. In this context, though designed as normal aircraft, it needs to be registered as space object in national registry as well as UN Registry of Space Object in accordance with Article III of the RC and General Assembly Resolution 1721 B (XVI).[30]

As to the scope of damage covered under the LC, Article I(a) defines it as "loss of life, personal injury or other impairment of health; or loss of or damage to property of States or of person, natural or juridical, or property of international intergovernmental organizations." Although it includes the damage on the ship/airplane on the High Seas, it does not include explicitly "environmental damage" on the High Seas. This is one of the reasons why space-faring states choose the area for air-launch to reduce the risk of full compensation for the damage.

3.3. Absolute Liability Rule

Article II of the LC stipulates the absolute liability rule in line with Article VII of the OST that a launching state is absolutely liable for the damage caused by its space object on the surface of the Earth or to aircraft in flight. To exonerate a launching state from its absolute liability, Article VI(1) of the LC requires the launching state to establish gross negligence or an act or omission intended to cause damage on the part of a claimant state. However, if the damage was resulted from a violation of international law on the part of a launching state, Article VI(2) does not grant any exoneration.

This condition of exoneration is important in the case of aircraft accident at the airport/spaceport. Because 3 different types of space vehicles (aerospace plane for sub-orbital flight, for full-orbital flight, and carrier aircraft for air-launch) might share airport/spaceport with other normal aircraft, the risk for accident is higher than a collision in outer space. If those 3 space vehicles are not regis-

29 Ibid, 28.

30 UNGA Res. 1721 (XVI), "International co-operation in the peaceful uses of outer space," 20 December 1961. Texts are available at: <www.oosa.unvienna.org/oosa/SpaceLaw/gares/html/gares_16_1721.html> (lastly accessed on 12 December 2013).

tered as space objects in advance, the fault-based liability principle in air law might apply to the accident at the airport/spaceport. On the other hand, if they are registered as space objects in national and international space registry, the absolute liability principle applies to any accident with normal aircraft. The latter seems lessening the interest of launching states; however, it is much easier to establish gross negligence or an act or omission done with intent to cause damage on the part of a claimant state, regarding the accident at the airport/spaceport.
Furthermore, when the air-launch program over the High Seas, such as ALSET or Polyot, become operational, it is most likely that the contract between customer/user and the air-launch entity requires to obtain a space insurance against launch failure or the damage caused by the launch.
For those reasons, consistency in the law applied to the carrier aircraft is important not to delay or confuse the assessment of damage and to ensure prompt compensation in line with the goal of the LC.

Conclusion

The uniqueness of using carrier aircraft for air-launch over the High Seas highlighted legal issues related to the limited applicability of air law, the scope of state responsibility and the condition to apply the liability regime in space law to its accident.
Due to lack of agreement on the definition and delimitation of outer space and the difficulty for states to limit their territorial sovereignty in air space, it is not practical to connect the issue of air law applicability to the definition of outer space. Therefore, Chapter I concludes that the applicability issue should be considered independently and separately from the delimitation issue.
Chapter II clarifies that space-faring states carrying out the air-launch over the High Seas are obliged to notify relevant international organizations, considering that "notification" is closely related to "continuous supervision" in Article VI and information-sharing in Article XI of the OST.
Due to the high risk at the airport/spaceport where 3 space vehicles, namely aerospace plane for sub-orbital flight, for full-orbital flight, and carrier aircraft for air-launch, work with normal aircraft, Chapter III emphasizes that the application of the liability regime to the air-launch accident needs to be stable by registering the carrier aircraft as space object in advance.
In conclusion, to ensure safety in international navigation at sea, in air and outer space, the air-launch over the High Seas requires the launching states to ensure notification to relevant international organizations, before launching and after an accident, in accordance with space law, air law and law of the sea. And for the stable application of the liability regime to the air-launch over the High Seas, it is indispensable to register the carrier aircraft as space object in advance.
For further success of air-launch activities, consistent guidelines for safety in navigation at sea, in air and outer space need to be formalized among relevant stake-holders with urgency.