SPACE LAW

The Space Industry Regulations 2021: Another Giant Leap?

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Introduction

Following the seminal Space Industry Act 2018,[1] the Space Industry Regulations 2021[2] were promulgated following two consultations which drew 52 responses from a range of industry specialists, including Orbital Operators, users of satellite services, launch operators and academic institutions;[3] the author amongst those responding. From this came the voluminous Draft Space Industry Regulations 2021, which were laid before both Houses of Parliament on 24 May 2021 and came into force on 29 July 2021, having passed the affirmative resolution procedure. Whereas the Space Industry Act 2018 greatly expanded the landscape of UK Space Legislation, the Space Industry Regulations 2021 greatly expanded on the Space Industry Act 2018, laying the foundations for the budding UK Space Industry to become fully operational as per the government's ambitions. As a follow-up to the author's original piece on the Space Industry Act,[4] this article will seek to examine the scope of the new regulations and seek to highlight any potential gaps or problems that may arise as the countdown begins to the UK's new space age.

International space law

For a lay reader or even a seasoned international lawyer, international Space Law is largely obscure. The impetus for international regulation followed the seminal launch and successful orbit of the Soviet Sputnik 1 satellite in 1957. Shortly thereafter, UN General Assembly Resolution 1348 of 1958 posed the 'Question of the Peaceful Use of Outer space'.[5] Following this, there was Resolution 1472 - on 'International co-operation in the Peaceful uses of Outer Space.'[6] This foreshadowed the 'Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space'. All of these relatively 'soft' measures led to the seminal 1967 Outer Space Treaty[7], still the most famous legal instrument in this field.

Due to the prevailing Cold War tensions, the 1968 'Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space' - [8] known as the "Rescue Agreement" - was then promulgated. Next came the 1972 Convention on International Liability for Damage Caused by Space Objects[9] which expanded on Article 7 of the 1967 Treaty.[10] The Convention established one of the important cornerstones of international Space Law, that *"*A launching State shall

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[1] C5. For an overview of the main parts of the Act, see the author's previous article, '*The Space Industry Act 2018: a giant leap?'* Simmonds, A., Coventry Law Journal. 24, 2, p. 95 -104.

[2] SI 2021No. 792.

[3] *Unlocking Commercial Spaceflight for the UK',*8, 5 March 2021 online <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/968535/Space-Industry-Regulations-Consultations-summary-of-views-and-government-response-accessible.pdf> accessed 12 September 2021

[4] N1 above.

[5] UNGA Res 1348 (XIII) (13 December 1958).

[6] UNGA Res 1472 (XIV) (12 December 1959).

[7] Treaty on Principles Governing the Activities of States in Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (adopted 27 January 1967, entered into force 10 October 1967) 610 UNTS 205 (Outer Space Treaty).

[8] UNGA Res 2345 (XXII) (22 April 1968).

[9] UNGA Res 2777 (XXVI) (29 March 1972).

[10] *Ibid* 8.

be absolutely liable to pay compensation for damage caused by its space object on the surface of the Earth or to aircraft in flight."[11] The Liability Convention was shortly followed by the 1975 Convention on Registration of Objects Launched into Outer Space,[12] which obliged all parties to establish a domestic registry for any space objects they were responsible for. Lastly came the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies.[13] In addition to these treaties, there have been many other agreements which do not need to be mentioned in any detail here.[14]

Other relevant national law

Prior to the Space Industry Act, the Outer Space Act 1986[15] was the only piece of national space legislation, and was created primarily to safeguard the UK's treaty obligations,[16] with s.4 giving life to Article VI of the Outer Space Treaty,[17] and s.7 creating the "Register of Space Objects" in honour of the Registration Convention.[18] There was a licensing regime under the Act, whereby issues of "public health or the safety of persons or property", or inconsistency with the "international obligations of the United Kingdom," or "national security of the UK." could result in rejection[19]. Since s.1(3) of the Space Industry Act, however, the Outer Space Act 1986 now only applies in respect of spaceflight activities taking place outside of the UK by UK based entities.

The Space Industry Act positively exploded the national space legislation scene bringing with it 72 sections and 12 schedules, in contrast to the Outer Space Act's 15 sections. Whilst, at the time, this seemed like a dramatic change, the new Space Industry Regulations effectively dwarf their parent Act.

The Space Industry Regulations 2021

Overview

The Space Industry Regulations 2021 (hereafter 'the regulations') put a considerable amount of flesh on the substantial bones of the Space Industry Act 2018. There are 17 Parts, many containing multiple chapters and 8 Schedules. The first substantial Part, Part 3, focusses on the granting of licenses to spaceport operators and range control services, laying down conditions that must be fulfilled by applicants, in the hope of preventing unsuitable individuals from being granted such potentially destructive capabilities. Relatedly, Part 4 seeks to define and lay down the parameters of acceptable risks and how such risks should be assessed. Part 5 concerns the granting of 'spaceport licenses' in a similar fashion to Part 4. Part 6, 'Range Control Services', lays down rules regarding the range of spaceflight activities and the identification of 'hazard areas.'[20] Part 7 on 'Training, qualifications and medical fitness' prescribes minimum standards for personnel directly involved with spaceflight activities including those who would be tasked with actually flying into space in addition to the training

[11] *Ibid* article 2.
[12] UNGA Res 3235 (XXIX) (14 January 1975).
[13] UNGA Res 34/68 (5 December 1979).
[14] See, for example, 'The Principles Relating to Remote Sensing of the Earth from Outer Space', UNGA Res 41/65 (3 December 1986), 'The Principles Relevant to the Use of Nuclear Power Sources in Outer Space', UNGA Res 47/68 (14 December 1992). 'The Declaration on International Cooperation in the Exploration and Use of Outer Space for the Benefit and in the Interest of All States, Taking into Particular Account the Needs of Developing Countries', UNGA Res 51/122 (13 December 1996).
[15] C38.
[16] Impact Assessment: Review of the Outer Space Act 1986, online <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/493187/OSA_Impact_Assessment_FINAL_BIS0067.pdf> accessed 4th November 2019, 5.
[17] *Ibid* 8.
[18] *Ibid* 15.
[19] The Outer Space Act 1986 c38, s4(2)(a)-(c).
[20] Chapter 4.

manager responsible and the details of the training manager themselves.[21] Part 8, the largest Part within the Regulations, covers safety as it relates to the operator's spaceflight activities covering the specific safety personnel who must be appointed as a condition of being granted a license[22] in addition to launch and return preparations[23] and emergency response.[24] Chapter 5 of Part 8 lays down further safety requirements for flights involving 'human occupants, and delineates specific duties as regards the 'pilot in command' and 'flight crew'.[25] There are also a number of new criminal offences created under this part relating to failures of the pilot in command and other associated personnel.[26] Part 9 makes provisions regarding the limitation of exposure to cosmic radiation for all such 'human occupants' and Part 10 deals with Spaceport Safety. Part 11 considers all aspects of security from that associated with the launch site itself and cyber security in addition to the vetting of personnel. Part 12 relates to the 'Informed Consent' to be given by human occupants prior to undertaking a spaceflight activity and includes such details as what the consent form should contain[27] and the information to be given to the occupant prior to signing[28] in addition to procedural and evidential requirements of this process. Part 13, the shortest chapter of the Regulations, but possibly one of the most important, concerns liability and indemnity. The lengthy Part 14 considers Monitoring and Enforcement including the obligation to provide information to the regulator,[29] and the appointment of inspectors.[30] Part 15 concerns Civil Sanctions and Part 16 relates to Occurrence reporting with Part 17 being titled 'Miscellaneous' covering offences and penalties not considered elsewhere. The 8 comprehensive schedules cover a wide range of matters chiefly related to safety. It is worth mentioning here that an important revelation comes in the form of Regulation 3 which confirms the Civil Aviation Authority as being the Regulator.

Demarcation of the Regulations

Questions of semantics aside, the Regulations could be crudely split into 3 categories; Regulations directly concerned with spaceflight activities, Regulations indirectly concerned with spaceflight activities and Regulations peripherally concerned with spaceflight activities.

In the former category are regulations regarding the actual launch and subsequent spaceflight activities, i.e. whereby an object has been physically launched from a spaceport? In the second category are Regulations concerned with matters such as risk assessment and licensing of spaceports and spaceflight operators and in the third category are regulations concerned with the safety and security of such installations. Although it is true that 'all roads lead to Rome' and that, by definition, each of these regulations is concerned with spaceflight by virtue of being part of the regulations themselves, some regulations are much more relevant to the physical act of spaceflight than others and it is those on which this article will mainly concern itself.

The Regulations

With the aim of establishing a clear framework for space activities from within the UK, the Regulations are extremely detailed, laying down an extensive licensing regime for those who wish to conduct spaceflight activities and making the grant of any such license contingent on an array of strict factors. Safety appears to be well and truly at the forefront in this regard as the applicants must provide detailed

[21] Chapter 2.
[22] Section 3.
[23] Section 5.
[24] Section 8.
[25] Chapter 5, Section 4.
[26] Chapter 6.
[27] Chapter 3.
[28] Chapter 4.
[29] Chapter 2.
[30] Chapter 3.

safety information to the regulator where necessary and conduct their own safety analyses and risk assessments.

Although the Regulations all pertain to 'Space Flight', some are much more directly related than others. However, there is far from a clear-cut distinction in some cases, particularly as regards those related to licensing and safety. Some of the regulations are only concerned with Spaceflight in a very peripheral sense. These are judged to be Part 11 (Security), Part 14 (Monitoring and Enforcement), Part 15 (Civil Sanctions), Part 16 (Occurrence Reporting) and Part 17 (Miscellaneous) and do not contribute anything significant to the law on actual 'Space Flight'.

The Regulations which are most directly concerned with Space Flight are those concerned with the personnel directly and indirectly involved with the actual launch and the safety provisions that have been drawn up surrounding them in addition to regulations connected with the actual launch-sites. Those which are not as directly related are those which pertain to the licensing arrangements in respect of the various functions the regulations have laid down, specifically Operators, Range Control, and Spaceport Operators. This article will first inspect these more peripheral regulations before moving on to inspect those directly related to Space Flight.

Peripheral Regulations

Licenses

Should anybody wish to conduct space activities they will have to apply for an operator license. Depending on the type of activities to be conducted, a different license will have to be applied for. The available licenses are a 'Launch Operator License', a 'Spaceport License', a 'Range Control License' or a 'Return Operator License'.[31]

Regulation 6 specifies that certain individuals will be ineligible to apply for a Space Port or Operator License. These are undischarged bankrupts or those under similar debt-related sanctions, those who have been disqualified from being a Company Director and those who have been convicted of offences of dishonesty or an indictable offence where this conviction is not considered spent under the Rehabilitation of Offenders Act 1974 or the equivalent measure in Northern Ireland.[32] If a license is obtained for any of these activities, the licensee must then appoint an 'accountable manager', a 'safety manager' and a 'security manager'[33]. Likewise, a Range Control Licensee must appoint a 'range safety manager' a 'range operations manager', an 'accountable manager', a 'security manager' and a 'training manager'. By virtue of Regulation 5(1)(b) and (c) the conditions regarding ineligibility also apply to these managers.

The mandatory appointment of such managers may mean that licensees are able to discharge themselves from liability by assigning blame lower down the pecking order in the event of a catastrophe, but Regulation 12 provides that licensees must ensure that individuals appointed "have the necessary resources and means to carry out their duties". If a legal argument could be sustained that this has not been the case, managers may have a fighting chance at avoiding or at least mitigating liability should a licensee attempt to indemnify themselves from the consequences of a disaster. Moreover, licensees are under a duty to keep the regulator informed as to changes to these individuals and keep them updated if there is a change in circumstances such as a death or the manager leaving their post in whatever capacity. Failure to do this could result in a conviction under Regulation 14; the maximum punishment on summary conviction under reg. 14(2)(a) being a fine and under (c) on indictment, imprisonment for up to 2 years or a fine or both. Furthermore, nothing in the Space Industry Act or Regulations suggests that the doctrine of Vicarious Liability would not arise in any case.

31 Part 1.
32 R6(1)(a).
33 R7.

Part 4 of the Regulations is entitled 'Grant of a spaceflight operator license: risk'. Chapter 2 is headed 'Risks to persons who are not crew or spaceflight participants' and Section 1 is headed 'Steps applicant must take to ensure that risks are as low as reasonably practicable'. Under Regulation 26 a Flight Safety Analysis must be carried out by the applicant in which they '(a) identify the major hazards that could, whether or not the launch vehicle malfunctions - i) arise from, or cause a major accident during the proposed spaceflight activities or ii) arise from the launch vehicle or any part of it during the proposed spaceflight activities.' The applicant must then comply with Regulation 28 in respect of each identified hazard and also, under 26(c) 'estimate numerically the risk of death or serious injury arising from the identified hazards 'referred to in paragraph 18(2) of Schedule 1. These are (a) the locations of individuals who could be harmed by any of the identified hazards; (b) the applicant's own and each proposed range control service provider's capabilities in— (i) tracking; (ii) telemetry; (iii) communications; (c) how any flight safety system will be activated if its activation is necessary; (d) how the applicant will coordinate and communicate with air traffic control service providers, meteorological information providers and emergency services; (e) any legal requirements relevant to the applicant's proposed use of airspace; (f) information available about any known space object with which there is a risk of the launch vehicle colliding.

The further matters in paragraph 18(2) that the applicant must consider as a possible consequence of the activities are (a) blast overpressure; (b) fragmentation debris; (c) thermal radiation; (d) toxic release; (e) major accident hazards arising from— (i) any discarded part of the launch vehicle and any object, including any payload, released or separated from the launch vehicle; (ii) collision with a space object; (iii) meteorological or environmental conditions; (iv) the use of a carrier aircraft, if applicable; (v) re-entry of the launch vehicle, or any part of it, from orbit, if applicable'

Regulation 27(1) stipulates that, in the case of applicants for launch operator licenses, a 'ground safety analysis' must also be carried out to identify 'major accident hazards that could arise-(a) during, or cause a major accident during, preparations for the launch from the time when the launch vehicle or its components arrive at the spaceport or other place from which the launch is to take place, or (b) from the launch vehicle, or any part of it, or from a payload, upon or after landing, whether or not the launch vehicle malfunctions.

Under Regulation 29 an applicant for a 'launch operator' or 'return operator' license must also provide a- not insubstantial- 'safety case' to the regulator which contains the information required under Schedule 1- essentially all the expected details about the flight, such as the details of the vehicle itself, the payload and details about the surrounding area.[34] In addition, Schedule 1(2) also requires information about 'the applicants organisation and management structure'. Curiously, under Regulation 33, the applicant only appears to be compelled to submit a risk assessment to the regulator if the spaceflight activities concerned would involve 'human occupants'[35]. In practice, this may be counterbalanced by the stringent requirements of the Safety Case discussed previously.

Part 5 governs the grant of Spaceport Licenses and is similar in scope and depth to Part 4 as regards Spaceflight Operator Licenses. Regulation 36 likewise lays down a 'Safety Case' requirement, additionally, a description of the aerodrome must be included if the spaceport would be a horizontal spaceport along with a description of the surrounding areas in any case. Under R36(4)(d) a plan of the proposed spaceport is also to be submitted containing details of the infrastructure which would reside there along with hangars and storage facilities for hazardous waste. Interestingly it also enquires as to the location of any 'proposed static engine or other test areas'.

Regulation 35 makes provision for horizontal spaceports, stating that these must be both CAA licenced and Certified under sections 12,13,13A 14 and 15 of the Aviation Security Act 1982(a). Vertical space ports are not mentioned in the Regulations. Regulation 37 requires that the Applicant be able to demonstrate that it can put in place an 'appropriate safety clear zone to ensure that the risk to any person

[34] Schedule 1(2).
[35] 33(1)(b).

from blast overpressure, fragmentation debris, thermal radiation or toxic release will be as low as reasonably practicable during any hazardous pre-flight and post-flight operations. However, the above does not apply if the safety case shows that a safety clear zone will not be required.

Part 6 covers Range Control Services. This Part essentially lays down rules for the organisation of Range Control Licensees in respect of such services. It compels the Licensee to ensure that they are capable of discharging the duties that they have assumed such as identifying an appropriate range or tracking the progress of a flight and a space object's return to earth. R46 compels the licensee to identify an appropriate range subject to the characteristics of the launch vehicle and its planned trajectory, in addition to prevailing environmental and meteorological conditions. Reassuringly, R46(e)(i) and (i) provide that this must also extend to considering the populated areas in the vicinity of the proposed activities or in any area where they could be impacted upon. Areas whereby the launch vehicle (or parts thereof) could fall to earth must also be identified as part of the range control activities. All such details must be reported to the regulator. Under R47 'hazard areas' must also be identified. These areas may be designated as 'exclusion zones' whereby 'persons or things' who either may pose a hazard to or be exposed to potential hazards, could be forbidden to enter. There must also be a time limit stipulated but no limit is placed on this.

The licensing application process appears to be rigorous. Regulation 19 also provides that, as part of the process, the applicant may be required to surrender to an inspection of the 'site, facility, craft or equipment to be used in connection with the activities which are the subject of the application as the regulator may specify'.

Some activities connected with space flight do not require a license. For example, under Regulation 15, operators of carrier aircraft are not required to hold an operator license if the aircraft is being used merely to transport a space object or launch vehicle (or components thereof) from one place to another, as opposed to carrying a space object to the required altitude prior to launch. For anybody interested in applying for a license, the Civil Aviation Authority have published guidance on the process.[36]

One point of legal interest here regarding the granting of such licenses, particularly to Contract Lawyers perhaps, is the potential situation whereby a proposed operator enters into an agreement with a Spaceport licensee to launch a satellite from the spaceport in question. What would be the effect of the flight being rejected on the basis of a deficient safety case (or, vice versa, the Spaceport License being rejected)? This is quite possible given the amount of information that must be provided to the regulator as the requirements appear very exacting and is too voluminous to recount here. Would such a situation amount to frustration of Contract or would the failed licensee seek to indemnify themselves by attempting to claim damages from the Regulator? In any case The Space Industry Act 2018 enables a refused applicant to appeal[37] and such a process is supported by the Space Industry Appeals Regulations 2021[38]. Regulation 24(8)(a)- on deleting information on appeals from the internet if a judicial review is brought- may prove to be a harbinger of sorts should an appeal be disputed.

There is also no elaboration on s11 of the Space Industry Act 2018 – "Grant of licenses: assessments of environmental effects" although this is referenced by footnote within Regulation 20(9). This indicates that the legislator considers the environment to be a closed matter in terms of space activities.

Other Important Peripheral Matters

'Members of the Public'

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[36] The Civil Aviation Authority, *Applying for a License under the Space Industry Act 2018* online <https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=10550> accessed 7 October 2021.
[37] Section 60; Schedule 10.
[38] SI No 186.

Chapter 3 of Part 5 is entitled 'Members of the public'. It fleshes out the provisions of the Space Industry Act under s2(7) on duties and powers of the Regulator and s10 on the 'Grant of Spaceport License'. For the sake of clarity, the Regulator's main duty under s.2(1) of the Space Industry Act is to "exercise the regulator's functions with regard to spaceflight activities with a view to securing public safety" which takes priority over a number of other important matters, including environmental objectives,[39] and national security.[40]

Under R39 and 40 various people are excluded from this definition such as human occupants of spacecraft and others 'taking part in spaceflight activities' and individuals attending spaceports at the invitation of licensees. Controversially, perhaps, employees of the regulator or those acting on behalf of the regulator are also not so classed, and neither are employees of the emergency services, members of the armed forces of the Crown or employees of qualifying health and safety authorities. Essentially these classes of individual appear expendable in the event of a catastrophe. Taking a purposive approach to this regulation would surely disclose, however, that it is not supposed to mean 'employees of the emergency services' or 'members of the armed forces' at large, but rather those who may be working in connection with the space activities at the time of any relevant catastrophe. With these distinctions drawn, however, Chapter 3 of Part 5 throws the legislative thrust of this new regime into sharp relief - safety for those not connected with space activities is paramount.

Notification Requirements

Chapter 5 of Part 6 imports some important notification requirements. Under Regulation 49 local authorities, emergency services, property owners, lessees and occupiers or any other person deemed relevant who fall within the identified range within Regulation 46 must be notified of the proposed spaceflight activities 'no longer than 4 weeks prior.' The notification must also contain such information relating to the activities so that those notified- in particular, owners, lessees or occupiers of land- do not pose a hazard or put themselves at risk of such hazards. A curious point arises under Regulation 51(2)(C) which states that a warning must "be issued in a manner which is reasonably necessary to alert the individuals referred to in paragraph (3) to the operator's spaceflight activities". Paragraph 3 contains two classes of individual:

> (a) an individual whose regular place of work is situated on any part of the land falling within the designated range, and
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> (b) any individual who might enter or traverse any part of the land falling within the designated range in exercise of a legal right, entitlement or privilege including, but not limited to, an easement or a public right of way

The designation of individuals under subsection (a) is relatively uncontroversial but a curious point arises in relation to subsection (b), particularly as regards individuals such as tourists. Hill walkers and mountaineers- from across the UK- famously and frequently exercise legal rights of way over the countryside of Scotland. In particular, the Land Reform (Scotland) Act 2003[41] provides under s.1 that "everyone" has the right to "be on land" and has "the right to cross land" for recreational purposes. Unsurprisingly the Act does not mention excluding land from these provisions on the basis of nearby 'Space Activities' but section 8 gives Ministers the power to 'Adjust land excluded from access rights' 'by order'. Section 8(3) states, however, that before this can be done there must be consultations of potentially interested people. Using s.8 to exclude land being used for recreational purposes could be a rather cumbersome and time-consuming process. More pressingly insofar as notice requirements are concerned, launches in Scotland will need to be accompanied by alerts sent to every potential hill walker in the UK if the requirements of Chapter 5 are to be satisfied.

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[39] S2(2)(e).
[40] S2(2)(f).
[41] ASP 2.

Regulations Specifically Concerned with Spaceflight

The most novel and exciting aspect of the Space Industry Regulations 2021 is perhaps the fact that they legislate for what could be termed the minutiae of human spaceflight, certainly a first in British legislative history. Chapter 5 of Part 8, for example, details 'Specific obligations of pilot in command, flight crew or remote pilot',[42] and Chapter 6 lays down criminal penalties for failing to meet said obligations. Part 7 deals with training, qualifications and medical fitness in respect of those participating in space activities and Part 9 puts forward rules attempting to mitigate expected levels of exposure to 'Cosmic Radiation'. An entire part of the Regulations, Part 12, is even dedicated to 'Informed Consent' of spaceflight participants, building on s.17 of the Parent Act. This part of the article will address these regulations in ascending order beginning with Part 7.

As above, Part 7 of the Regulations is concerned with 'Training, qualifications and medical fitness'. Regulation 56 defines the following as 'specified roles' for the purpose of the eponymous s18(4)(b) of the Space Industry Act 2018: the launch director,[43] the flight termination personnel,[44] the flight crew and remote pilots[45], the sub-orbital aircraft engineer,[46] the range operations manager,[47] and the range safety manager.[48] Part 1 of Schedule 3 then lays down what could be termed competence criteria for people assigned to these specified roles, for example, members of flight crew ("MFC") for sub-orbital craft must hold either a commercial pilots license with instrument rating or an ICAO compliant commercial pilots license with instrument rating and also be qualified to fly a turbo-jet aircraft. Interestingly, "(3) An MFC who is a pilot of a launch vehicle which is a balloon must hold — (a) a commercial pilot's licence for balloons issued by the CAA, or (b) an ICAO compliant commercial pilot's licence for balloons.". The idea of using a balloon as a launch vehicle may seem strange but, in fact, 'Rockoons' have been used by NASA at least as far back as 1955,[49] to research levels of radiation in the upper atmosphere. Essentially a 'Rockoon' is a balloon that lifts a rocket to a high altitude. The rocket will then ignite and head into space. Modern research indicates that they could be an effective way of launching microsatellites.[50] Other advantages of such air launch methods are considerable including the potential for greater efficiency and hence less pollution.[51] Whether a launch has ever taken place from a manned balloon or not is beyond the scope of the author's knowledge and, likewise, is the feasibility of launching a manned vehicle from a balloon (manned or unmanned). The law relating to the use of unmanned balloons is contained in Regulation (EU) No 923/2012 of 26 September 2012 retained under the European Union (Withdrawal) Act 2018. No license appears to be required as such but rule 1.1 at p 286 states that a high-altitude balloon shall not be operated without permission of the state, and, further, rule 5.1.1. states that at least 7 days' notice should be given as regards the launch of a balloon in the medium-heavy category. Rockets or 'Rockoons' do not feature in this legislation and balloons only receive minimal attention in the 2021 regulations. This is possibly one area where further legislative input is required.

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[42] Section 4.
[43] (a).
[44] (b).
[45] (c).
[46] (d).
[47] (e).
[48] (f).
[49] Eugene M. Emme, '*Aeronautics and Astronautics Chronology, 1955-1957*', online at <https://history.nasa.gov/Timeline/1955-57.html> accessed 7 October 2021.
[50] Michael Hepfler, *'Successful "rockoon" launch makes space more accessible to microsatellites'* online at <https://engineering.purdue.edu/IE/news/2019/hepfer-leo-rocket-launch.> accessed 7 October 2021.
[51] Marti Sarigul-Klijn, Nesrin Sarigul-Klijn, *'Flight Mechanics of Manned Sub-Orbital Reusable Launch Vehicles with Recommendations for Launch and Recovery'* online <http://www.spacefuture.com/archive/flight_mechanics_of_manned_suborbital_reusable_launch_vehicles_with_recommendations_for_launch_and_recovery.shtml> accessed 7 October 2021.

Section 17 of Schedule 3 also requires that "An MFC must be able to demonstrate the MFC's ability to withstand the mental and physical stresses of spaceflight including disorientation, illusory effects, rapid acceleration, microgravity, noise and vibration, in sufficient condition to be able to operate the launch vehicle throughout all phases of flight safely and competently". Further, s.18 states that "(2) Whether the MFC satisfies the criteria in sub-paragraph (1) must be tested in a centrifuge device or an aircraft, or in a combination of the two, that is able to replicate the effects on the human body of the forces of acceleration, the rate of change of those forces and their duration, in conditions equivalent to the periods of the flight when those forces are most acute.". Moreover, "20. An MFC must have previous experience as a member of the flight crew or as a remote pilot in a launch vehicle or aircraft that exposed the MFC— (a) to a workload which is equivalent to that expected of an MFC or a remote pilot undertaking the spaceflight activities, and (b) to effects on the body of rapid onset and diminution of acceleration at least equivalent to those which would be experienced during a typical flight of the spaceflight operator's launch vehicle."

Unsurprisingly, Regulation 58 specifies that individuals within such specified roles must be medically fit and competent to fulfil the role they have assumed. Part 7 is also concerned to a significant degree with training and Chapter 2 is dedicated entirely to the role of the 'training manager'. Regulation 61 provides for the appointment of a Training Manager, outlines their functions and duties and provides rules relating to their approval. Chapters 3 and 4 relate to the Training Manual and Training Program respectively and follow broadly similar structures. Regulation 70 provides for 'Competence Assessments' which must be conducted by the training manager at regular intervals.

Chapter 5 of Part 7 is connected with medical fitness, with Regulation 72 requiring the licensee to ensure that flight crew and other roles hold a valid medical certificate issued by an 'approved aeromedical examiner'[52] and that none of the crew has "…suffered a decrease in fitness due to illness or injury since the date of issue of their medical certificate which might affect their ability to— (i) withstand the physical and mental rigours of spaceflight; (ii) perform safety-critical functions reliably during the spaceflight activities; (iii) carry out any emergency procedures which may be required during the spaceflight activities, including the evacuation of the launch vehicle" and, further establishing that "no person takes part in spaceflight activities, either as a crew member or a spaceflight participant, if that person is not medically fit to fly". Regulation 75 however states that spaceflight participants with a disability or reduced mobility may be allowed to fly if they are certified as fit under regulation 73(1) and that their presence on board would not compromise flight safety or otherwise obstruct other members of the crew in the exercise of their duties.

An interesting feature of Part 7 is that Regulation 60 states that records relating to a number of important training matters should be kept for 'at least 2 years. This does not square with the 1982 Limitation Act whereby the limitation period for claiming in the case of an accident is taken to be 3 years from the date that an individual could reasonably be expected to know they could claim from. Surely for evidential purposes it would be more sensible to keep training records for longer than 2 years.

Where Part 7 lays down the requirements for the qualification and fitness of the actual spaceflight participants and associated personnel, Part 8 revisits the idea of 'safety', but this time in the context of the actual spaceflight activities themselves. It is the longest chapter, containing 55 regulations and is arguably the most interesting and novel part of the instrument.

Chapter 2 – 'A spaceflight operators' duty' – places a duty to ensure that "spaceflight activities are carried out safely" squarely on the shoulders of the spaceflight operator. The definition of carrying such activities out safely is defined by Regulation 79(2) as carrying them out 'in accordance with the current safety case by… (i) preventing a major accident from occurring, and (ii) mitigating the consequences of such an accident if it does occur and…(b) by securing the safety of a human occupant" as required by the current risk assessment. Chapter 3 requires that the Safety Case be kept under review at all material times with the operator obligated to do this should a range of circumstances arise which may

[52] Regulation 73(1).

affect the parameters of the spaceflight activities,[53] with the overarching imperative that the safety duty mentioned in Chapter 2 is always considered.[54] In pursuance of the safety agenda, regulation 83 provides that the Operator must demonstrate compliance with Regulations 84 – 104. 83(2) provides that the operator's risk assessment must cover certain regulations beyond these where the activity is a crewed flight with human occupants. Regulation 84 places the onus on the operator to ensure they have adequate resources to handle the space activity they intend to carry out. Section 3 of Chapter 4 lists requirements of roles specific to safety, such as the safety manager[55], the accountable manager[56], the launch director[57] and, in cases where there is a non-autonomous flight safety system, flight termination personnel[58]. Section 5 provides details on launch preparation and the qualities of the launch vehicle[59] along with other such details about the range and a duty to observe the weather conditions[60] and the situation regarding dangerous goods on board a spacecraft.[61] The bottom line is that the operator should not seek to use any equipment or vehicles etc. which are not fir for purpose, i.e., which "do not conform with (certain) technical requirements."[62] Regulation 99 of s.6 lays down conditions that must be met before the spaceflight activities begin. There are 12 in total, including requirements that the vehicle,[63] spaceport,[64] and designated range,[65] are all fit for the purpose of whatever the activities may be. Other requirements are that the 'relevant emergency services have confirmed that they are on stand-by"[66] and a suitable rehearsal has been carried out.[67] Regulations 100 and 101 provide for the monitoring of and, if necessary, the possible termination of the flight in the event of an emergency.

Regulation 101(1)(c)(i), borrowing language from the first UN Convention on Space Law, puts an obligation on the spaceflight operator to ensure that the spaceflight is carried out both safely and 'in compliance with the international obligations of the United Kingdom'. In particular, "the spaceflight operator must after a launch vehicle has reached a stable orbit…take reasonable steps to…avoid the launch vehicle interfering with the space activities of other persons in the peaceful exploration and use of outer space". 101(1)(c)(iii) also places the obligation to take reasonable steps to "…prevent contamination of outer space arising from the launch vehicle in orbit or adverse changes in the environment of the earth from that vehicle in orbit". 101(3) makes special provisions for disposing of launch vehicles by re-entering the earth's atmosphere. For the uninitiated, re-entering the earth's atmosphere at the 'wrong' angle will cause a space object to burn up[68]. Under these provisions, the operator must take care to ensure that this is done safely and in the least hazardous way in the circumstances.

Section 7 sets out some important provisions on the retaining of information relating to the space activity. Regulation 102 requires that a list of the names and addresses of all human occupants must be made along with a list of any dangerous goods on board and stored for a period of 3 years. Although this is longer than the 2-year period required for training records under Regulation 60, it should still be borne in mind that claims in respect of personal injuries can arise beyond this strict 3 year period in

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[53] Regulation 80(2).
[54] Regulation 80(3).
[55] Regulation 86.
[56] Regulation 87.
[57] Regulation 88.
[58] Regulation 89.
[59] Regulation 91 / 93.
[60] Regulation 97.
[61] Regulation 98.
[62] See Regulation 93(2)(b)(i).
[63] Regulation 99(2)(a).
[64] Regulation 99(2)(b).
[65] Regulation 99(2)(c).
[66] Regulation 99(2)(e).
[67] Regulation 99(2)(d).
[68] For a vivid illustration of this concept see the movie 'Apollo 13' (1995).

certain cases where the knowledge that a claim could be made is said to arise.[69] This could be an important legal point since there are unknown hazards in connection with spaceflight which could lead to a claim developing several years down the line. The same is also true of data associated with the flight such as correspondence between the spaceflight operator and the regulator 'before launch and during the operator's spaceflight activities'[70] amongst a host of other data pertinent to the flight. Under Regulation 103(4) this information must also be retained for a period of 3 years with the notable exception of information recorded on the vehicle's flight recorder when the "launch vehicle has not been involved in a spaceflight accident arising from or in the course of the operator's spaceflight activities.". Regulation 103(4) even states that "Where no spaceflight accident arose from or in the course of the operator's spaceflight activities, information recorded by the launch vehicle's flight recorder must only be retained until the completion of those activities.". The use of the word 'must' is curious here. Why shouldn't this be at the operator's discretion? Regulation 78 on interpretation states that a ""flight recorder" means any device for recording data relating to the flight of the launch". This is an extremely broad definition and could relate to a number of things – on board cameras and voice-recorders perhaps, as with the classical 'black boxes' installed on commercial airlines. Surely such data could be crucial in the event of a personal injury claim. Indeed, the definition of 'accident' is very broad. Section 20(3) of the Space Industry Act 2018 states that "accident" "includes any fortuitous or unexpected event by which the safety of any spacecraft or person is threatened". Furthermore, in the separate instrument, The Spaceflight Activities (Investigation of Spaceflight Accidents) Regulations 2021[71], it is stated in the footnote to Regulation 2 that "The definition of "accident" in s.20(3) (investigation of accidents) of the 2018 Act is wide and includes unexpected events which threaten the safety of any spacecraft or person, whether or not any person is injured or the spacecraft is damaged.". It stems from this that what and what is not classed as an "accident" is not particularly cut and dry and could ultimately lie to be anointed at the behest of a steward's enquiry sometime after the event. In such cases, the absence of flight recorder data would certainly make matters tricky, if not ultimately impossible to resolve.

Regulation 104 lays down the requirement for the spaceflight operator to have an emergency response plan as regards the operator's spaceflight activities. Such a plan must be fairly comprehensive and must also be tested and reviewed at intervals not exceeding 3 years.[72] The results of such a test must be communicated to the regulator along with the details of any revisions.[73]

Chapter 5 lays down 'Additional Safety requirements for launch vehicles with human occupants. Regulation 105 puts the central duty of those in charge of a space craft in stark terms: "(2) A pilot in command, pilot or a remote pilot carries out the flight safely by carrying it out— (a) in accordance with the current safety case by— (i) preventing a major accident from occurring, or (ii) mitigating the consequences of such an accident if it does occur, and (b) in accordance with the current risk assessment, by securing the safety of a human occupant."

Section 2 requires that a spaceflight operator must ensure that, on crewed flights, the members of the crew are aware of their roles and responsibilities,[74] and that the crew must have all necessary information regarding the flight in order for it to be carried out safely.

Under section 3 there exists a layer of extra conditions where a launch vehicle is crewed by a human occupant. If a human occupant is on board, a launch vehicle must have adequate life support systems in place[75] in addition to redundancies in the event of depressurisation or accidental oxygen depletion in

[69] Limitation Act1980 s11(4)(b).
[70] Regulation 103 (2)(b).
[71] SI 2021 No.793.
[72] Regulation 104(3).
[73] Regulation 104(4).
[74] Regulation 106.
[75] Regulation 109(a).

the inhabited areas.[76] There must also be a system to warn the pilot in command/remote pilot of ice build-up on the launch vehicle's exterior,[77] a smoke detection system,[78] and, interestingly, "a system capable of restraining any member of the crew or any spaceflight participant in their seat when necessary to ensure that the flight is carried out safely". It is uncertain what kind of circumstances are foreseen here – does it mean a system to restrain unruly passengers or something akin to a safety belt on a commercial airliner which should be fastened when the pilot in command warns of turbulence or severe weather? Under aviation law the pilot in command "must take all necessary measures so as to minimise the consequences on the flight of disruptive passenger behaviour"[79]. Additionally, s.52(1) of the Space Industry Act provides that, by statutory instrument, a regulation could provide that ss.94 and 95 of the Civil Aviation Act 1982[80] apply to a spacecraft. Section 94(2) provides that:

> If the commander of an aircraft in flight, wherever that aircraft may be, has reasonable grounds to believe in respect of any person on board the aircraft—
>
> (a) that the person in question has done or is about to do any act on the aircraft while it is in flight which jeopardises or may jeopardise—
>
> (i) the safety of the aircraft or of persons or property on board the aircraft, or
>
> (ii) good order and discipline on board the aircraft, or
>
> (b) that the person in question has done on the aircraft while in flight any act which in the opinion of the commander is a serious offence under any law in force in the country in which the aircraft is registered, not being a law of a political nature or based on racial or religious discrimination,
>
> Then, subject to subsection (4) below, the commander may take with respect to that person such reasonable measures, including restraint of his person, as may be necessary—
>
> (i) to protect the safety of the aircraft or of persons or property on board the aircraft; or
>
> (ii) to maintain good order and discipline on board the aircraft…"

Such regulations have yet to materialise. On a more important note, the extent to which the Civil Aviation Act is to govern the actions of pilots of launch vehicles is wholly unclear. The fact that regulations have to be made in order to import certain parts of the Act implies that it has no automatic application. Furthermore, nowhere is this explicitly stated unless it is to be somehow assumed. Nor is it clear whether Regulation (EU) 2018/1139 is to apply. This could cause significant issues as regards the interpretation of the duties of pilots in command and other crew listed within these regulations as can be seen with the provisions of Part 8 of these regulations when contrasted with the EU Regulation- which, itself, does not appear to cover launch vehicles or spacecraft. Another telling distinction maybe that the term 'flight' is used throughout the Civil Aviation Act as defined under s105 as meaning "…a journey by air beginning when the aircraft in question takes off and ending when it next lands". By way of contrast, the Space Industry Act is concerned with regulating "space activities… sub-orbital activities

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[76] Regulation 109 (b).
[77] Regulation 109 (c).
[78] Regulation 109 (d).
[79] Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018 on common rules in the field of civil aviation and establishing a European Union Aviation Safety Agency, and amending Regulations (EC) No 2111/2005, (EC) No 1008/2008, (EU) No 996/2010, (EU) No 376/2014 and Directives 2014/30/EU and 2014/53/EU of the European Parliament and of the Council, and repealing Regulations (EC), No 552/2004 and (EC) No 216/2008 of the European Parliament and of the Council and Council Regulation (EEC) No 3922/91, Annex V, Article 3(g).
[80] C 16.

(and) associated activities"[81]. Section 1(4) defines "space activity" as "launching or procuring the launch or the return to earth of a space object or of an aircraft carrying a space object…operating a space object" or "any activity in outer space".[82] Moreover, Regulation 2 of the Space Industry Regulations makes clear that a "launch vehicle" is a separate entity to a "carrier aircraft" and is specifically used for "spaceflight activities". Moreover, "pilot in command" is defined as the "pilot who takes part in the operator's spaceflight activities on board the launch vehicle". "Spaceflight", then, appears both semantically and legally distinct from "flight".

Regulation 110 states that a safe number of crew must be chosen by the spaceflight operator in accordance with the launch vehicle's safe capacity and the general mission parameter in addition to "any medical needs of a human occupant"[83]. Regulation 111 places the onus on the spaceflight operator to ensure "that instruments, systems and equipment within the launch vehicle are readily operable and accessible from the station where…(a) any pilot in command who needs to use them is seated, and (b) another member of the flight crew who needs to use them is seated. This seems like an unusual duty to place on a spaceflight operator since the user interface of any vehicle is usually determined at the design stage and, it is to be assumed, would be beyond the control of the spaceflight operator unless they are also to commission such vehicles. Astronauts during the Apollo program and, even before, were intimately involved with the design of the functional dimensions of the spacecraft interior and key instruments such as the 'hand controller' – the spacecraft equivalent of a control stick in a fighter jet- and other facilities such as environmental control systems[84]. It is to be presumed that, unless the systems referred to in Regulation 111 are a purely aftermarket affair, that any launch vehicle must have gone through, or been inspired by, a similar design process. Contrastingly, under aviation law, the instruments in this sense are the pilot in command's responsibility. Annex V, Article 2 (c) (iii) of Regulation (EU) 2018/1139 on common rules in the field of civil aviation[85] stipulates that "instruments and equipment as specified in point 5 required for the execution of that flight are installed in the aircraft and are operative, unless waived by the applicable MEL (Minimum Equipment List) or equivalent document" No such limitation is included in Regulation 111.

Regulation 112 dictates that the spaceflight operator must ensure that adequate emergency equipment and an emergency evacuation procedure are in place. Moreover, the onus is also on the spaceflight operator to ensure that emergency procedures and the location of emergency equipment is known to each human occupant[86]. Akin to the procedure in commercial air travel, the operator must also ensure that "immediately before the flight, each human occupant is provided with information about how to use the emergency equipment and means of emergency evacuation and that such information is available on board the launch vehicle"[87]. Regulation 113 obligates the spaceflight operator to ensure the adequacy of the atmospheric conditions onboard the launch vehicle.

Section 4 deals exclusively with the "specific obligations of pilot in command, flight crew or remote pilot". Similar to aviation law, Regulation 114 obliges the pilot in command or remote pilot to "(a) perform an inspection of the launch vehicle and its systems and equipment to the extent that it is practicable to do so, and (b) consult any of the spaceflight operator's written records relating to the

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[81] Section1(1)(a)-(c).
[82] (a)-(c).
[83] Regulation 110 (g).
[84] Andrew Chaikin, *A Man on The Moon; the Voyages of the Apollo Astronauts*, Penguin, 1994, p46. Also see Michael Collins, *Carrying the Fire*, Pan Books, 1974 in which the author- the recently deceased Command Module Pilot of the Apollo 11 moon mission- explains that the aircraft flight instruments of a fighter jet are purposefully placed as close as possible to the middle of the dashboard so that the pilot can still read them, even if so affected by g-force that their vision begins to suffer from radial blur or peripheral blackening.
[85] Above at N79.
[86] Regulation 112 (2)(a).
[87] Regulation 112(2) (b).

fitness, condition and preparation of the launch vehicle, in so far as necessary to ensure the flight is carried out safely".

Regulation 115 sets out the scope of the obligations on the pilot in command to 'carry out flight safely', with 115(1) stipulating that the pilot (or remote pilot) 'must give commands, make appropriate decisions and take appropriate actions during the flight of that vehicle which are necessary to ensure that the flight is carried out safely'. Reg. 115(2) places an obligation on the pilot in command to report to the spaceflight operator and regulator should any such command, decision or action not comply with either this instrument or the Space Industry Act 2018. Regulations 117. 118 and 119 are all concerned with the obligations of crew, spaceflight participants and the Launch Director/Safety Manager alike regarding duties vis-a-vis human occupants to remain at stations before launch, on landing and '…during periods of flight when the effects on the human body of the forces due to acceleration and their duration are most acute'[88]. Section 5 on 'Space Flight Participants' likewise places an obligation on spaceflight participants to remain at their station. Underpinning the above provisions is Chapter 6 which creates a raft of criminal offences and penalties to be incurred by the launch director, flight termination personnel, pilot in command /remote pilot in the event of various safety related failures. Spaceflight participants also come under this chapter with regulation 132 creating the offence of 'Failure of a spaceflight participant to remain at station'. The available punishment for these transgressions on summary conviction is a fine and, on trial on indictment. Imprisonment for two years, a fine or both. Whether two years in prison is a proportionate punishment in respect of acts or omissions which could potentially endanger the lives of hundreds, if not thousands of people, is debatable and beyond the scope of this article.

Although the duties of the pilot in command et al under Section 4 may seem, at first blush, prescriptive, it is worth noting further the content of Annex V of Regulation (EU) 2018/1139[89] on common rules in civil aviation which applies in the UK. It is more expansive than the provisions within Space Industry Regulations as regards the responsibilities of commercial pilots. Additionally, there is a requirement under s.2(g) regarding the amount of fuel on board an aircraft – "the amount of fuel/energy for propulsion and consumables on board must be sufficient to ensure that the intended flight can be completed safely, taking into account the meteorological conditions, any element affecting the performance of the aircraft and any delays that are expected in flight. In addition, a fuel/energy reserve must be carried to provide for contingencies. Procedures for in-flight fuel/energy management must be established when relevant." Fuelling is not mentioned anywhere in the Space Industry Regulations but is mentioned in Schedule 1 of the Space Industry Act which specifies that "requirements regarding the assembling, integration and fuelling of spacecraft or carrier aircraft, mating of spacecraft or carrier aircraft to their payloads and fuelling of payloads" may require compliance as a license condition.[90] This seems to be a strange place to provide for such things given the potential gravity of the subject matter. Adequate fuelling is surely as important to the successful flight of a spacecraft as it is a commercial aircraft.

Regarding 'human occupants', the next most important part of these regulations is Part 12 on 'Informed Consent'. An interesting feature from the outset of Part 12, is that a 'human occupant' as defined in Regulation 2(1) means crew members or spaceflight participants. Regulation 206 (1)–(2) shows that both 'space tourists' and crew members have to give informed consent prior to launch. From an employment law perspective this could raise some interesting questions. The author has been unable to find much material on the legality of an employer requiring an employee to sign a consent form, indeed, the only case that has been found so far bearing any similarity to situations envisaged here is *Cassley and ors v. GMP Securities Europe LLP and anor,*[91] whereby a waiver that an employer issued to an employee did not mean that the duty of care no longer applied in circumstances where a company executive was killed in an air accident. Coulson J stated that, in his view, if the waiver- which, in this

[88] Regulations 117(b), 118(b) and 119(b).
[89] N79 above.
[90] Schedule 1(1)(b).
[91] [2015] EWHC 722.

case, had not been signed, had in fact, been signed, it '…would have been invalid under the Unfair Contract Terms Act 1977as an attempt to exclude liability for death or personal injury'[92]. It would be reasonable to assume that this would also apply in the case of independent contractors.

Vastly expanding upon s.17 of the Space Industry Act 2018, this part legislates the requirements for informed consent to be given by those engaged in 'space activities' to the possibility and occurrence of death or personal injury. Regulation 205 begins by establishing that, to give valid consent, a person must be at least 18 years of age[93] and have capacity within the definition given in the Mental Capacity Act 2005 or equivalent instrument if in Scotland or Northern Ireland.[94] Chapter 3 is dedicated to the format of the consent form itself, stipulating the details that it must contain, i.e. the full name, address and date of birth of the human occupant, the name and address of the spaceflight operator and details about the vehicle to be used and certain details from the risk assessment which must be in an 'easily understandable form'.[95] Regulation 207 provides that certain statements are to be given in the consent form, pinning the human occupant to assertions that they have received and understood training given in paragraphs 50 and 52 of Schedule 3, has read and understood the details of the risk assessment in addition to information under Regulations 209 and 210 and have also been given the opportunity to ask questions and to have received answers thereto. Crucially, Regulation 207 (d) pins the human occupant to the important undertaking that they accept and understand "…that the operator's spaceflight activities carry an inherent risk of danger and in particular that— (i) the activities may result in death or injury, (ii) the regulator has not certified that the launch vehicle complies with any national or international safety standards". The author has a special interest in Regulation 209 having submitted a published article as evidence under the open consultation on the draft regulations[96]. The essential elements of Regulation 209 are that the human occupant must receive and consider certain information before signing the consent form. Such information must include " a copy of any safety recommendations made as a result of a safety investigation relating to the operator's spaceflight activities"[97] "information in writing and in an easily understandable form about any actions taken to improve safety following a spaceflight accident relating to the operator's spaceflight activities"[98] in addition to the number of launches the space flight operator has undertaken, the number of people who have died or sustained injury/suffered a medical emergency thereon, and the number of accidents the operator's spaceflight activities have been subject to[99].Under Regulation 210 information must also be given about the risk assessment 'in an easily understandable form'.

The essential gist of the authors previous article on the matter of informed consent, was that under current medical law practices, informed consent can be vitiated if it can be shown that a patient has been 'bombarded' or 'overwhelmed' with information. Giving a human occupant too much information could prove, in a legal sense, to be just as bad as not giving them enough under the present law. Within the draft instrument, proposed Regulations 197 and 198– drafted in essentially identical terms to Regulations 209 and 210- stipulated that the information should be given to the human occupant 'at least 12 hours' before the consent form is signed[100]. The evidence given by the author and corresponding argument was that 12 hours would not be enough because such information given – no matter how clear – could still be difficult to understand for a lay person and, having too little time to read and understand such information could possibly result in what the law may term 'bombardment'

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[92] Ibid para 292.
[93] Regulation 205.
[94] Regulation 205(2).
[95] Regulation 206 1(a)-(d).
[96] The UK Perspective on Informed Consent in Commercial Space Travel
Simmonds, A., 1 Sep 2020, In: Air & Space Law. 45, 4/5, p. 367-390.
[97] Regulation 209(2)(b).
[98] Regulation 209(2)(c).
[99] Regulation 209 (3)(a)-(c).
[100] The Draft Space Industry Regulations 2020 available online at
<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904345/the-space-industry-regulations-2020.pdf> accessed 6 October 2021.

and therefore invalidate consent. The actual regulations now stipulate 24 hours rather than 12 which is a desirable improvement. However, the effects of this could be undermined by Regulation 123 which asserts that before "…an operator's spaceflight activities commence, the spaceflight operator must give each human occupant the information referred to in regulations 209 and 210 which has become available since that occupant signed the consent form referred to in section 17". There are seemingly no requirements for a second consent form to be signed assenting to the new information or any time for the asking of questions, nor is there a minimum timeframe as per Regulations 209 and 210.

Part 9 is concerned with Cosmic radiation requirements: crew of a launch vehicle and crew of a carrier aircraft. The effect of Cosmic Radiation on 'Space Crew' has been the subject of regulations previously in 2019[101] made under the authority of the Civil Aviation Act 1982.[102] The general standard is that a spaceflight operator should not expose individuals engaged in space activities to a dose of cosmic radiation 'that exceeds 6mSv in a calendar year unless the individual is a classified crew member'. "mSv" is an abbreviation of "Millisievert", a unit of measurement for radiation exposure,[103] 6mSv being a threshold laid down in European Council Directive 2013/59/EURATOM[104]. Article 40 of the Directive makes the distinction between 'category A' and 'category B' workers – 'category A' workers are those 'liable to receive an effective dose greater than 6 mSv per year…'[105], hence, the provision in the Regulations regarding 'classified' crew members. With what could perhaps be regarded as remarkable foresight, the Directive makes specific reference to 'spacecraft crew' under Article 52(1)(a) stating that such individuals could be made the subject of a 'Specially Authorised Exposure' by the competent authority providing that such exposure is managed accordingly.[106] The remainder of this part of the Regulations gives life to the provisions of the EU Directive. Regulation 141 obliges the operator to investigate should they have 'reasonable cause' to suspect overexposure in the case of a crew member.

Somewhat out of sequence, Part 10 deals with 'Spaceport Safety' and retains similar sentiments to the preceding safety-related parts- a safety duty is placed upon the spaceport licensee under Regulation 152 as is the requirement for a safety case. A marked difference is Chapter6 which relates to hazardous material storage facilities,[107] a requirement that propellants 'etc.' are fit for purpose[108] and a requirement that any 'static engine test area' be located at 'an appropriate area' for the purpose of conducting tests if such tests are to be conducted at the spaceport.[109] An emergency response plan is required under Regulation 165 and under Regulation 166 "firefighting personnel, facilities and equipment" must be provided at the spaceport "in a timely manner."[110] Regulation 167 confers powers on spaceport firefighters, enabling them to act pre-emptively should they suspect a fire is about to break out at a spaceport,[111] or otherwise do what they believe to be 'reasonably necessary' to avoid damage to persons or property.[112] Under Regulation 167(4), any individual obstructing such actions taken by firefighters could suffer a fine or two years in prison.

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[101] The Air Navigation (Cosmic Radiation: Protection of Air Crew and Space Crew and Consequential Amendments) order 2019 No.1115.
[102] C. 16.
[103] Radioactivity.eu.com, 'MilliSievert; A unit for low doses of radioactivity' online <https://www.radioactivity.eu.com/site/pages/MilliSievert.htm> accessed 4 October 2021.
[104] Council Directive 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom.
[105] Ibid Article 40(1)(a).
[106] Article 52(3).
[107] Regulation 158.
[108] Regulation 160.
[109] Regulation 161.
[110] Regulation 166(1).
[111] Regulation 167(1)(a)-(c).
[112] Ibid.

Another important aspect to these regulations is Part 13 on Liabilities and Indemnities. Regulation 218 sets out a long list of individuals who are 'prescribed' under s.34(3)(a) of the Space Industry Act 2018. This section excludes these individuals from the no-fault liability regime established under s.34(2). The individuals in the list consist largely of those who could be classed as being at the launch site of their own volition in a variety of capacities connected with the space activities themselves. Regulation 219 outlines the circumstances in which the operator must indemnify the government against claims brought for loss or damage in respect of its space activities. These are where damage has arisen under gross negligence/ wilful misconduct or otherwise through non-compliance of the license conditions or the Act / regulations made thereunder[113]. Regulation 220 requires the operator to place a limit on their liability for any such injury or damage with such a limit being subject to the regulators' approval.[114] Regulation 220(3) prescribes that this limit does not apply in cases of gross negligence/wilful misconduct or non-compliance with the license conditions or other obligations under the Act or associated regulations. Regulation 221 also makes clear that in cases of non-compliance with license conditions, the Act or Regulations or where there is gross negligence or wilful misconduct, the Secretary of State is under no obligation to indemnify the operator for damage thereto caused.

Regulations not specifically concerned with Space Flight

Part 11 on Security raises few points of interest for this article, other than to highlight the important role that 'US Technology' may play in the UK Space Program. This is defined in the Regulations as being "any US launch vehicles, US related equipment, US technical data or US spacecraft".[115] Predictably, the rest of this part deals with obligations to ensure that sites- and items/materials stored therein- which are connected with space activities are secure, both in a physical,[116] and 'cyber'[117] sense. Regulation 187 lays down a stringent vetting procedure for those applying for key roles in this area. Regulation 189 exposes another inconsistency within the regulations on retention periods with records relating to training and qualifications for security functions connected with an individual engaged in such a capacity need only be kept for as long as the individual is so engaged. As a matter of common sense, it would seem wise to keep such records for longer than this in case of any retrospective enquiry on a related matter. Underscoring the importance of 'US Technology', Chapter 6 is dedicated to the specific security provisions such technology is to enjoy whilst at a UK site. An element of extra-territoriality is implied under Regulation 196 which specifies that the US government must be permitted to oversee and monitor the launch activities of a 'special launch operator'.

Part 14 deals with monitoring and enforcement regarding space activities and connected sites and particularly relates to the duty to provide inspectors acting on behalf of the regulator with accurate information and/or access to sites of interest with Regulation 241 giving the inspector power of entry to space ports, space sites or other associated places. Relatedly, Part 15 deals with stop notices issued in respect of activities under the regulations. Essentially the Regulator can issue a stop notice to an operator should they have reason to believe their activity may cause, or risk causing serious harm to, inter alia, public safety.

Conclusions

These regulations are certainly a huge expansion of existing legislation, widening the scope of the law greatly in the relatively short time that the Space Industry Act has been live for. The new rules are, in many ways, extremely comprehensive and, in many areas, no stone is, it seems, left unturned. The emphasis on public safety that can be seen throughout the regulations is, likewise, very encouraging. It is good to see that practice in other industries is brought to bear on such matters, for example, the

[113] Regulation 219(a)-(b).
[114] Regulation 220(2).
[115] Regulation 168.
[116] Regulation 170.
[117] Chapter 3.

Offshore Installations (Offshore Safety Directive) (Safety Case etc.) Regulations 2015[118] require that operators in the oil industry provide safety cases for certain activities.[119]

As comprehensive as the Regulations are, there are still a number of matters which require clarity or further expansion. There is no particular treatment of vertical spaceports within the regulations, whereas horizontal spaceports are mentioned several times. Perhaps these will be the subject of future regulations or maybe there is no particular need for the time being owing to the expected initial launching methods. As also noted, there may also be contractual issues in respect of licenses being refused and the cancellation of certain arrangements – a potential spaceport operator may have their license application rejected leaving their prior agreement with a spaceflight operator in tatters. These kind of problems, however, would probably be regarded as being beyond the scope of regulations save for an option for joint applications to be made.

A further disappointing matter is the absence of any further treatment of environmental matters although it is to be hoped that this will be legislated on in future. Under Section 2(2)(d) of the Space Industry Act the regulator must exercise its functions in a way that respects "any environmental objectives set by the Secretary of State". Section 11 also makes the granting of licenses subject to an assessment of the environmental impact but is silent on the circumstances in which a license would be so rejected.

There are some areas where further expansion is needed. The notification regime for members of the public needs to ensure that it covers those in transit close to remote launching sites, namely proposed sites in the Scottish Highlands for the reasons detailed above and there also needs to be some consideration given to the matter of 'Rockoons'. There is also inconsistency across the board regarding limitation periods. Given that a claim for personal injury or tort could foreseeably arise in respect of such dangerous activities, it seems strange that so many records are required to be kept for less than 3 years.

One potential thorny issue lies with the duties of the pilot in command under these regulations and with the EU Regulation on rules relating to civil aviation[120]. The duties under the latter are more extensive than those under the former. An important question is whether pilots in command of space craft would, in addition to the duties enshrined in these regulations, also have to follow the laws as they relate to aircraft more generally, particularly since they are licensed by either the CAA or ICAO. It is not hard to envisage circumstances where an operator seeks to avoid liability by arguing that damage resulting from their space activities was the result of the pilot in command not following their duties as prescribed in other areas of aviation law of which they are also bound.

A final remark lies in respect of respect of one of the perceived strengths of this instrument – its comprehensiveness and attention to detail. If one looks at the United States rules in this area, it is clear that, whilst there have been some great strides made in this area, the UK still has a long way to go. The rules are to be found in Title 14 of the United States Code of Federal Regulations.[121] Although there are many similarities and, in some cases, the wording has been lifted almost verbatim,[122] in some parts the rules are far more detailed and technical, in some cases extending to importing complex mathematical equations for the purposes of risk analysis[123] and the complex diagrams contained within Appendix A and B for rule 420.

Thus, whilst these Regulations may have been, yet another giant leap for the U.K., they are still a relatively small step by some standards.

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[118] SI 2015 No.398.
[119] See Regulation 17 for example.
[120] Above at N83.
[121] 14 CFR Ch. III §400.
[122] See §460.45 on Informed Consent.
[123] See § 420, App C.