

Appendix 6 – Design Principle Justification Questionnaire

Introduction

The Sea Launch activity being led by Gravitilab Aerospace Services, sees the development and seeks approval for a vertical launch spaceport safety area located on the North Sea, off the Norfolk coast. In addition to the requirement for conducting the necessary Assessment of Environmental Effects (AEE) for this area, there is also a regulatory requirement that ensures any activities that may be hazardous to other airspace users, are also segregated accordingly. This is normally achieved by establishing airspace restrictions in the form of a notified Temporary Danger Area (TDA). These danger areas are activated when required though existing airspace Notice to Airman (NOTAM) processes and procedures.

To enable Sea Launch to operate, the method for establishing segregated airspace around the launch site is enabled through the Civil Aviation Authority (CAA) Airspace Change Proposal process (ACP) as defined in Civil Aviation Publication CAP1616. The CAP1616 process comprises 7 stages each of which are considered by the CAA separately and sequentially, whereby each stage informs the next. In this particular instance, the requirement to launch sub-orbital and orbital small satellite rockets from the North Sea has been presented to the CAA at Step 1A of the ACP process and the CAA has agreed that an airspace change is an appropriate means by which to achieve the requirements for Sea Launch.

Details of this step can be found on the CAA's online airspace change portal at:

https://airspacechange.caa.co.uk/PublicProposalArea?pID=318

The ACP is just one part of the full regulatory process to enable Sea Launch to become fully operational. Other processes underway include planning consent, launch operator licencing, spaceport licencing, marine licencing and range control licencing. By necessity, several of these processes overlap. In particular those where stakeholder engagement and consultation is necessary. It should be noted, that this is actually a part of the ACP process (Step 1B), by which we need to consult with all viable stakeholders to inform and help plan the airspace design. Further engagement on the actual airspace design occurs during Stage 2 (April 2022), followed by formal consultation on the establishment of the airspace occurring in Stage 3, which is likely to occur around May 2022.

For information about our sea launch project, please see the project brief PDF attached in the email. Additionally, you can view our application for airspace change via the Airspace Change Portal:

<u>Airspace change proposal public view (caa.co.uk)</u>

Responding to the Survey

You may email your responses to the questions below to the email address, or you can reply by post to the following address:

Building 295G Scottow Enterprise Park Lamas Road Badersfield Norfolk NR10 5FB



In order to collate as many stakeholder responses as possible, we ask that that you please respond before **Friday 5th November 2021**.

1. Safety.

The first and most important design principle that we considered is ensuring the safety of other air users, marine users, as well as the public. This is because we believe, that for obvious reasons, the importance of this consideration is paramount. Rocket launches will be conducted under strict safety procedures, taking account of both the potential and kinetic energy, as well as both the vertical and horizontal range of the rockets. The safety procedures are expected to be laid out in the secondary legislation to the Space Industries Act (SIA) 2018 and will form part of the spaceport license. Gravitilab will ensure that a safety case, adhering to the "as low as reasonably practicable" (ALARP) principles, is developed.

Other air users that we will be considering are commercial air traffic, military and general aviation, consisting of both fixed and rotary wing aircraft. We will also be considering any unmanned aerial vehicles (UAVs) that may be in operation in the area.

The public refers to any members of the public who are not involved in the rocket launch.

DP 1. The Safety of other airspace users and the public is the paramount design principle that ensures the safety of launch operators and neighbours at all phases of the launch procedure.

Do you agree that this constitutes a reasonable design principle?
If you do not, please provide comments in the box below
YES/NO
Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.
If you wish to give more detail, please use the box below.

2. Volume.

As individual launches will all fly different ground tracks, the airspace should reflect this by activating the minimum volume of airspace required only.

There are also several recreational aviation organisations which operate in the area, who we have contacted and are liaising with to ensure their activities are not interrupted massively by our operation, as well as ensuring their safety is not compromised in any way.

The airspace situated above the potential launch site and to the North is heavily utilised for military air activity. Numerous combat air squadrons from both the Royal Air Force (RAF) and United States Air Force in Europe (USAFE) operate 24/7 in that area. Additionally, depending on the size of the area, if a 'splashdown zone' will be required it may extend the size of the area.



This may extend it further north than the proposal currently states, which may impact on the heavily utilised D323 Managed Danger Area (MDA) complex, numerous Air to Air Refuelling Areas (AARAs) and UK Orbit Areas. This is a possibility, however unlikely. This will undoubtedly increase the list of impacted airspace elements that the military use and may well introduce more stakeholders. However, this can be evaluated as we move through the process and provide potential design options and more detail as to the volume of the proposed airspace. This however can be managed effectively by liaising with the right stakeholders and effectively designing the airspace to accommodate for both our operations and theirs.

DP 2. Airspace design will be of the smallest possible volume to safely segregate activities from other airspace users. Airspace volume should be designed to minimise impact on air traffic. Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.

3. Trajectory.

All launches are expected to be in a northerly direction. Exact ground tracks will vary with altitude targeted and rocket type e.g., single or double stage. The initial launch is expected to be directly above the North Sea.

Gravitilab will design the trajectory such that risk and disturbance to marine and air users at the launch pad exclusion zone, above the launch area and at the landing area are effectively minimised. Gravitilab has contacted several marine and air management organisations already, so we can plan our activities alongside theirs, to ensure successful operations of our rockets, without widely affecting any air or mariner activities that these organisations are aware of and are responsible for.

DP 3. Gravitilab will design the trajectory such that risk and disturbance to marine and air users are effectively minimised.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below

YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.



4. Operations.

Sub-orbital launches last only a few minutes, however, the preparation (e.g. fuelling, tank pressurisation etc.) begins some hours before with a multitude of technical checks needing be carried out prior to launch. For this reason, launches are normally planned within a "launch window", during which the rocket may be launched. Once the rocket has been successfully launched and the spent stages have returned to earth the airspace can then be de-activated.

The duration that any special use airspace (SUA) is active has a direct impact upon other air users, therefore the duration should be kept to a minimum and the airspace returned to other air users as soon as possible. This will minimise the impact on other aviation stakeholders, including military activity. In line with the CAA's SUA Policy, ideally the minimum amount of airspace is utilised for this activity, for the minimum possible time and that any airspace conforms to the current flexible use of airspace (FUA) principles and integrates airspace design into the extant airspace management (ASM) procedures and protocols to ensure efficiency for all airspace users.

In order to keep track of the airspace networks, Gravitilab needs to liaise with range control organisations eg. NATS, Eurocontrol etc. to determine safe flight regions so we can effectively integrate our operations. Most of our analyses have predicted that launches and subsequent recovery would all operate within the London Flight Information Regions (FIR), however it may also be useful to look at FIRs within close proximity as well. These include the Scottish FIR and the Amsterdam FIR.

DP 4. Factors such as launch frequency and time of day will be chosen to best accommodate existing airspace users. The duration of the airspace activation should be kept to a minimum.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below

YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.



5. Emergency Communications.

Other air users (e.g. MoD or Coast Guard) may require to enter any reserved airspace at short notice, meaning that launch operations will need to be halted. These air users will need to be able to communicate their intentions and receive notice that launch operations have been halted.

Gravitilab will always give the upmost priority to all emergency vehicles needing our airspace at the time of launch for as long as they need and will ensure we will establish communications to be informed when required.

DP 5. Give priority to all emergency vehicles needing our airspace for as long as possible and establish communications to be informed where needed. This requires the ability to halt launch operations at any point during countdown.

Do you agree that this constitutes a reasonable design principle?
If you do not, please provide comments in the box below
YES/NO
Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.
If you wish to give more detail, please use the box below.

6. Environmental.

Whilst space and small satellites provide exceptional benefits when it comes to environment conservation, by monitoring and combatting environmental challenges (eg. Climate change etc.), Gravitilab still appreciates these launches may still come with some environmental costs, however minimal. For this reason, we have reached out to various environmental and wildlife trusts, agencies and conservationists (eg. Marine Management Organisation, Natural England, Wildlife Trust etc.) around the East Anglian region. This cost will potentially include short rerouting of commercial air traffic resulting in increased fuel burn and CO2 output to avoid the initial launch plus the re-entry of spent stages. For this reason, Gravitilab is planning "Green" launches by choosing alternative propellants, which substantially decreases our effects on the surrounding area the environment in general. This will allow us to not hinder the air or water quality in that region where we launch.

Rocket launches will also generate extraneous noise in and around the launch site. This is mainly caused by the pyrotechnic shocks caused by the exhaust gasses interacting with the Launchpad and the rocket eventually becoming supersonic. The noise will have an effect upon the local population and wildlife. As part of the spaceport licensing processes, Gravitilab will produce a noise analysis report. This will also be used in the airspace design process.

Gravitilab intends to use best practice from other spaceports, mainly those in USA and also through our strong communication with Spaceport1 in Scotland, and employ sound analysis to effectively mitigate any effect of noise on the public and local wildlife.



DP 6. Gravitilab will investigate and produce a report on the noise and environmental impacts resulting from regular operation of our sea launch platform in the North Sea.

Do you agree that this constitutes a reasonable design principle?
If you do not, please provide comments in the box below
YES/NO
Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.
If you wish to give more detail, please use the box below.

7. Notice period.

Rocket launches are normally planned many months in advance. Initially the "launch window" may be as large as a month to cater for many potential delays e.g. payloads not being ready etc. However, as the launch comes closer a more definitive "window" becomes clear and is reduced to a week. This then becomes further defined to a specified day and time (3-hour window), depending on weather forecasts (eg. no cloud coverage, wind speeds, wind direction etc.).

Other air users require as much notification as possible of any restrictions in airspace to minimise the impact upon their operations. However, activating airspace so early that the timing and duration are unsure would lead to disruption that could be avoided. For example, early notification of launches, planned well in advance, so as to fulfil the aforementioned FUA and ASM requirements will be required so as to deconflict with planned military activity. This is likely to be at least 3 months for impacts on the route network to take place.

There are many considerations regarding ASM, such as suppression of other SUAs and airspace, cancellation of airspace that isn't required any longer, notification to other airspace users and many other nuances that require to be understood, with procedures in place to ensure there is minimal impact on other airspace restrictions and users but also not compromising on safety. Liaison with the Airspace Management Cell (AMC), with both the Civil and Military Airspace Managers (CAM and MAM respectively), will be required to work through these areas. Already the military have strict activation protocols on which danger areas and other airspace restrictions can be activated simultaneously, so as not to block or restrict the civil route network unnecessarily. This ACP will need to understand and fit in with these FUA and ASM principles, processes and protocols. The cumulative impact on the route network may have implications on what areas the military can activate at the same time as your proposal; therefore more information and engagement will be required along these lines.

During the design phase the ideal notification timing between early notice but accurate launch windows should be established, whilst developing a method for rapid notification if required.



DP 7. A system should be established to inform all air and marine users of our launch windows far in advance of the launch, and also a confirmation of launch time a few hours before. They should be timely and accurate with an established method for rapid notification.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.

8. Regulations.

The development of a Spaceport on the North Sea will require the approval or licensing of several UK public agencies (e.g. the UKSA, CAA, Norfolk Councils etc.), each of whom will have their own process to follow. Nevertheless, the processes will still have many of the same requirements (e.g. Analysis of Environmental Effects and place intended duties upon Gravitilab e.g. safety, which we aim to follow regardless. The airspace needs to be designed in order to meet these duties and use the same reports, where appropriate, to create a common understanding and transparency between and within these agencies.

DP 8. Gravitilab will continue to monitor all changes to airspace policies and, if needed, adapt operations accordingly.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below

YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.

9. Asset Protection.

The North Sea is a region filled with a number of activities run by various organisations. As previously stated, these include air and marine activities through their respective networks, however, it is also covered with many tangible assets that need to be avoided at all costs. If



affected, the loss of the assets will lead to substantial issues to other organisations' own operations, leading to possible downtime and large financial losses.

Equinor owns 2 wind farms which we have taken into consideration, which are situated no more than 32km off the Norfolk coast, Sheringham Shoal and Dudgeon Wind Farms. By applying the right trajectory analysis, we aim to completely avoid these areas as much as possible, through the use of the proposed practices stated above. It should also be highlighted that from the perspective of the offshore oil and gas sector that it should be ensured that there is no disruption of flights to offshore facilities and that the launches went nowhere near Bacton terminal or any other onshore or offshore oil and gas facilities in the area.

Marine navigation service providers, Trinity House, have also a number of buoys situated in the area of launch which will also have to be avoided to prevent disruption of their operations and to avoid our operations being disrupted by their lawsuits.

DP 9. Gravitilab will ensure launch and recovery operations will not affect another organisations assets in anyway and will design the activity area accordingly to avoid this.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.

10. Job Opportunities.

To help bring this proposal into fruition, Gravitilab will need to employ a number of people to help with Sea Launch operations due to the calibre of the operations that need to be undertaken. These opportunities will mainly be mariner roles, who will operate the tugboats, command vessel and the recovery boat. The individuals operating these vessels will need to be licensed and somewhat experienced to do so. The recovery boat/s will also need to include several spotters, so the rocket is retrieved efficiently after "splashdown". Gravitilab will also need to acquire an operator's license.

Authorised personnel who are constantly in contact with traffic networks and the launch team are required as well, so that the operations can be halted in case of emergencies and to inform authorities or when Gravitilab will not be launching during planned windows.

Technicians will also be required on the barge to help with launch preparations before evacuating for safe launch.



DP 10. Gravitilab will look to increase job opportunities in and around Norfolk to help local communities as well as the UK economy.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.

11. Activity Expansion.

Gravitilab will continually assess the future scope and prospects of the business so that if there is potential of expansion, we are prepared accordingly to further define operations, so that they are altered in a way that will work in accordance with the operations of other organisations.

DP 11. Gravitilab will analyse the future potential of the business and keep in regular contact with everyone involved to ensure the potential of our growth can be approved without facing issues.

Do you agree that this constitutes a reasonable design principle?

If you do not, please provide comments in the box below

YES/NO

Please rank this design principle in order of its importance, 'A' being highest and 'E' being lowest.

If you wish to give more detail, please use the box below.