



# **Design Principles**

## **Gateway Submission**

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## Glossary of Terms

Acronym	Meaning	Acronym	Meaning
ACP	Airspace Change Process	LOA	Letter of Agreement
AFUA	Advanced Flexible Use of Airspace	MOD	Ministry of Defence
ALARP	As Low as Reasonably Practicable	NATS	National Air Traffic Services
AMS	Airspace Modernisation Strategy	NGO	Non-Governmental Organisation
ANSP	Air Navigation Service Provider	NOTAM	Notice to Airmen
ASM	Airspace Management	OCA	Oceanic Control Area
ATS	Air Traffic Services	SAR	Search and Rescue
AUP	Airspace Usage Plan	SIA	Space Industries Act
CAA	Civil Aviation Authority	SIC	Shetland Islands Council
DIT	Department for International Trade	SSC	Shetland Space Centre
FBZ	Flight Planning Buffer Zones	UKSA	United Kingdom Space Agency
FIR	Flight Information Region	UAS	Unmanned Air System
FRA	Free Route Airspace	UIR	Upper Flight information Region
GATCO	Guild of Air Traffic Control Officers		

# Development of Airspace Change Design Principles

## Introduction

The Design Principles step of the Airspace Change Process (ACP) is when the change sponsor, in this case Shetland Space Centre (SSC), develops those design principles that will underpin the airspace change. These principles will be a mix of safety, environmental, operational and strategic (adhering to government policies relating to airspace use). They are developed after consultation and engagement with stakeholders, not just those directly involved in aviation but anybody who could be affected by the proposed change. Once established these principles can be used to assess design options.

This document outlines how SSC has undertaken the public engagement to support our ACP proposal, in accordance with the Civil Aviation Authority's (CAA) publication CAP 1616, Stage 1B.

[Statement of Need - 147315.DAP1916-166 V2](#) was submitted to the CAA on 20/09/2019.

SSC is developing a vertical launch spaceport on the island of Unst, Shetland. The spaceport will launch small rockets into space from Lamba Ness on Unst in a Northerly direction over the sea. To ensure that other air users and the public are protected from rocket launches SSC are undertaking an Airspace Change with the CAA. The ACP is only one part of the regulatory engagement that SSC will have to undertake, some of the others being a planning application (Shetland Islands Council SIC) and grant of a Spaceport operator's license (United Kingdom Space Agency UKSA). All of the regulatory engagements have some overlap and also call for regular public and community engagement.

## Principles Development

Stage 1 of the ACP requires the sponsor to establish a statement of need and a list of design principles. These principles can only be developed post a two-way engagement with affected stakeholders, be they aviation related or members of the public.

SSC identified and contacted a range of groups and organisations that could be impacted by the ACP; however, SSC were keen to ensure that they reached out to a wider group, particularly the local population and the wider public. To this end SSC undertook two public sessions in Shetland, one in Lerwick (Mareel, 19 December 2019. 16.00 – 19.00) and one in Unst (Saxa Vord Resort, 08 January 2020. 15.00-18.00). These sessions were publicised in the local press and during a radio interview with BBC Shetland and allowed SSC to explain that an ACP was ongoing and hand out questionnaires, Appendix 1.

SSC also placed announcements on their Twitter feed, Facebook page and website, all of which contained links to a web page where respondents could share their views.

SSC also contacted those organisations that would be using the airspace to gather their views and perhaps gain an idea of "best practice" from their experience in other parts of the world.

SSC offered the following contact methods to affected stakeholders:

- Direct email
- Web site link
- Facebook link
- Twitter link
- Public Sessions offering questionnaires in hard copy

The questionnaire was also uploaded independently to the website of some of the stakeholders we had contacted such as GATCO and Rocketeers.

A full list of those contacted and who responded is at Appendix 2.

## **Questionnaires**

The questionnaires were distributed by the above methods and tried to outline why SSC were looking for an airspace change, what the process was and how people could reply with their views. The questionnaire also sought to set a number of outline questions through which SSC could begin to craft design principles. The questionnaires were distributed by email between 10 and 17 December 2019 and asked for a reply by 10 January 2020. However, during this process some respondees suggested other organisations and individuals, who were then contacted subsequently and the reply deadline was extended.

There were a limited number of responses, only 13 in total. The reasons for this limited response may be the low population numbers in Shetland and particularly Unst, plus the fact that the airspace in and around Unst is fairly quiet. Another reason may be the ACP running concurrently with the Sutherland Space Hub. They had sent out their questionnaires a few weeks before and some organisations may have believed that the questionnaire was a duplicate sent in error and that they had already responded. One of the respondees did mistake Sutherland for Shetland.

We also received a reply from Isavia, Iceland ANSP, stating that they had no comments to make at this stage of the process but asked to be kept informed.

A full copy of the responses is at Appendix 3.

## **Focus Groups**

SSC had intended to hold focus groups, however, the paucity of responses suggested that these would not be productive and would not add to the views already gathered by the questionnaire. Nevertheless, as the ACP progresses it is hoped that more stakeholders will make themselves known and SSC intend to listen to all views throughout the ongoing process.

## **Review of Design Principles**

The responses to the questionnaires were assessed and added to further analysis by SSC after which a list of potential design principles was established. These were then sent out as a second round of engagement for comment. Stakeholders were asked to say whether they agreed with a design principle and to rank those principles in order of importance. These potential design principles were sent out on 04 February 2020. A copy of the suggested principles as sent out is at Appendix 4.

# Potential Design Principles

## List of Potential Design Principles

	Category	Design Principle
DP 1	Safety	The Safety of other air users and the public is the paramount design principle to be used in the ACP.
DP 2	Environment	SSC will produce a report detailing the environmental and noise effects of rocket launch from Unst.
DP 3	Volume	The airspace volume should be as small as possible to minimize the impact on existing air users.
DP 4	Duration and Timing	The duration of the airspace activation should be kept to a minimum and SSC should look at the possible impact of concurrent operations of other airspace e.g. Cape Wrath.
DP 5	Notification	Airspace notification should be timely and accurate with an established method for rapid notification.
DP 6	Communications	A process to allow some special air users to enter the airspace safely and halt launch operations should be established.
DP 7	International	Other International airspace agencies should be included in the airspace design process.
DP 8	Other Regulations	Airspace design should meet duties and requirements of other public agencies placed upon SSC.
DP 9	Local Agreements	Local agreements to minimize the impact of the space port on its neighbours will have to be negotiated.
DP 10	Ongoing and Continuing Airspace management and policies	The Airspace change will take account of ongoing and continuing airspace management and policies.

### **DP 1. The Safety of other air users and the public is the paramount design principle to be used in the ACP.**

The Statement of Need proposed that a safety area was required to “provide protection during launch”, this clearly caused some confusion with one respondent stating *“If segregated airspace is required it is not the launch vehicle that requires protection but rather other airspace users from that vehicle. This must be the premis under which airspace is designed and should guide the principles under which this ACP is conducted.”* After assessment SSC believe that the design principle should take heed of this comment and, indeed, go further by also adding the public.

The safety of other air users and the public is of paramount importance. Rocket launches will be conducted under strict safety procedures, taking account of both the potential and kinetic energy of the rocket. 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. SSC will ensure that a safety case, adhering to the “as low as reasonably practicable” (ALARP) principles, is developed.

Other Air Users are commercial air traffic, military and general aviation, consisting of both fixed and rotary wing. Unmanned Air systems are also included.

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

**DP 2. SSC will produce a report detailing the environmental and noise effects of rocket launch from Unst.**

Noise and the environment were of particular concern to members of the public, with one stating

*“I would be opposed the proposed rocket launching site because of its impact on the very special eco system that exists in this area”.*

Naturally these respondents concentrated on the local effects and not those further afield.

Whilst space and small satellites are of great use in the combatting and monitoring of climate change, e.g. illegal logging monitoring, sea temperature etc, SSC appreciate that the launch of rockets will have an environmental cost. This cost will potentially include short re-routing of commercial air traffic resulting in increased fuel burn and CO<sub>2</sub> output to avoid the initial launch plus the re-entry of spent stages. CO<sub>2</sub> will also be produced by the rockets launched; therefore, the most direct/efficient trajectory should be flown to reduce fuel requirements.

Additionally, SSC may need to consider the environmental impact of spent stages being deposited in the sea during the ACP. This environmental impact is expected to be relevant in the grant of a spaceport license and also a license to the rocket provider to launch from the UK. It will also no doubt be part of a Marine Scotland license.

Rocket launches will also generate increased noise in and around the launch site, mainly caused by the exhaust gasses and the rocket becoming supersonic. The noise will have an effect upon the local population and wildlife. As part of the planning and spaceport licensing processes SSC will have to produce a noise analysis report. This report will also be used in the airspace design process.

SSC intend to use best practice from other spaceports, mainly in the USA, and employ analysis tools developed for the space industry e.g. RUMBLE. SSC will also use lessons learned at other spaceports in how to mitigate the effect of noise on the public and local wildlife.

**DP 3. The airspace volume should be as small as possible to minimize the impact on existing air users.**

The size of the airspace was mentioned by a number of existing air users or organisations directly involved in commercial aviation. The comments concentrated on restricting the volume of airspace to the minimum required to provide safety to other air users and the public.

*“The airspace construct should be the minimum required to safely accommodate the activity being undertaken”*

*“the airspace should be designed in a mosaic such that only the area required for a given launch is requested rather than a single larger area as a default”*

Other comments concentrated on minimising the effects upon existing airspace in and around Shetland.

*“The designated airspace must not affect Shetland Mainland so as to interfere with SIC Inter Island flights. At present only to Fair Isle, Foula and Papa Stour.”*



*“Consideration should be given to the Class D Controlled Airspace surrounding Sumburgh Airport and any impact the launches would have on operations around Sumburgh.”*

All orbital and sub-orbital launches are expected to be in a northerly direction. Orbital launches will be to sun synchronous and high inclination orbits in the Low earth orbit altitude range. Exact ground tracks will vary with orbit targeted, altitude and inclination, and rocket type e.g. two or three stage. Initially these orbital launches will be almost directly upwards, in the area of the launch site, before beginning to arc northwards to achieve orbit. The rockets will spend the vast majority of their flight well above air breathing aircraft, only passing through this lower airspace during initial launch and the subsequent re-entry of spent stages and fairings. The initial launch is expected to be directly above Unst with the spent stages and fairings coming down well to the North in the North Norwegian Sea and Arctic Ocean. As individual launches will fly different ground tracks the airspace should reflect this and only activate the minimum of airspace required.

Although the airspace above Unst and to the North is fairly quiet there are active commercial airfields to the South, namely Scatsta, Tingwall and Sumburgh, all on the mainland of Shetland. There is also the unlicensed airfield of Baltasound on Unst some 5nms South of the launch site, which may, as part of the spaceport development, be brought back into use. The airspace volume should be as small as possible to have as little impact as possible upon existing airfields in Shetland.

**DP 4. The duration of the airspace activation should be kept to a minimum and SSC should look at the possible impact of concurrent operations of other airspace e.g. Cape Wrath.**

Many of the respondents stressed the need for the airspace activation duration to be kept to a minimum and that consideration should be taken of other nearby airspace and what the effect would be of concurrent activation.

*“Dependant on size, NATS would expect the activation of segregated airspace to be co-ordinated with both QinetiQ and the MOD to ensure that the overall effect of multiple segregated airspace requirements do not overly impact upon the UK Upper Airspace networks ability to maintain a viable solution for commercial aviation.”*

*“To ensure that segregated airspace is only instigated for the minimum time necessary”*

Both Orbital and Sub-Orbital launches last only a few minutes, however, the preparation e.g. fuelling etc begins some hours before with a multitude of technical checks being carried out prior to launch. For this reason, launches are normally planned within a “launch window”, generally about 3 hours, 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 be deactivated.

Clearly the duration that any special airspace 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.

Unst is some 180 nms from the Cape Wrath danger area, Scotland, and 270 nms from the Benbecula missile ranges. If both, Benbecula and Cape Wrath, are active at the same time trans-Atlantic commercial air traffic is affected. Whilst Unst is some distance from both pieces of airspace consideration should be made of the possible effect on trans-Atlantic traffic if Unst was active concurrently with either of the others. SSC should look at the possible impact of concurrent activation of Unst airspace and these other areas.



**DP 5. Airspace notification should be timely and accurate with an established method for rapid notification.**

Methods of notification and the accuracy of that notification was particularly mentioned by those organisations responsible for air traffic or those planning air tasks.

*“would expect initial notification of any segregated airspace requirements for the campaign to be provided by at least D-21 for a launch to the UK Airspace Management Cell. With confirmatory airspace segregation activation provided no later than D-1.”*

*“would expect notification of cancellations and early completion of activity”*

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), often being driven by weather forecasts.

Other air users require as much notification as possible of any restrictions in airspace to minimize 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.

Some of the launches may though be required at short notice, for instance to provide an observation or communications satellite to support an NGO during a humanitarian emergency.

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

**DP 6. A process to allow some special air users to enter the airspace safely and halt launch operations should be established.**

The requirement for entry into the airspace for priority air traffic was mentioned by a number of respondents, all of whom asked for a method by which this entry could be done safely and swiftly.

*“Search and Rescue Operations will always take precedence over launch. Please ensure that any NOTAM or ERF (R) reflects that aircraft operating on behalf of the Maritime and Coastguard Agency have dispensation to enter any ERF (R) for the purposes of search and rescue and lifesaving operations.”*

*“In the event of aeronautical SAR requirement either fixed wing or rotary there will be an expectation that the planned launch is delayed until it is deemed safe for air operations to take place within the projectiles intended flight path. SAR and lifesaving must take precedence over commercial space activities in all cases”*

*“management of priority aircraft (e.g. CAT A, Emergency or on a Defence Operational Tasking)”*

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.

**DP 7. Other International airspace agencies should be included in the airspace design process.**

Whilst CAP 1616 is a UK publication and process the nature of space launch is that it is a truly global undertaking and will require international agreements between the UK and its neighbours. Much of this work will be done by the UKSA and the DIT, nevertheless the need to include international bodies in the ACP was raised by a few respondents.

*“Iceland and Norway aviation regulatory bodies are considered key international stakeholders.”*

*“The location of Unst and the intended northerly direction of launches, coupled with the expected size of any danger area to segregate such activity, also introduces an international aspect to this potential ACP. The Reykjavik Flight and Upper Information region exists north of 61N and the Norway Flight and Upper Information Region exists to the East of 000W. In each case these respective airspace volumes are not the responsibility of the UK CAA and as a result additional processes beyond CAP 1616 will undoubtedly be required.”*

*“All adjacent FIR’s/UIR’s”*

The Reykjavik FIR is only about 11nms North of the launch site; however, Area IV of the UK ATS lies in a wedge from Surface to FL85 for about another 60nms North from the FIR boundary.

Any spent stages would be returning through Reykjavik OCA and FIR and possibly the Nuuk FIR.

SSC did contact both airspace authorities, however, as the ACP was in such an early stage neither felt they could comment at this stage. SSC do though intend to keep them both appraised of progress and plans. It is worthy of note that the Space Industry Act (SIA) 2018 placed a duty on the regulator, in this case the UKSA, to take “account of any international obligations of the UK.” Therefore, SSC will also keep the UKSA updated on plans and progress.

**DP 8. Airspace design should meet duties and requirements of other public agencies placed upon SSC.**

None of the respondents made a comment about other duties and responsibilities that would fall upon SSC during the development of the spaceport. This is not considered surprising as, although the SIA was passed into law in 2018 the secondary legislation is still being crafted by the UKSA, due for public consultation in the Spring of 2020. It is the UKSA who will license SSC to operate a spaceport and part of this licensing process is expected to include safety of the public during launch. In this instance the public is defined as anyone not directly involved in the launch. Therefore, the design of the airspace will have a direct impact upon the grant of a spaceport operator’s license.

The development of a Spaceport on Unst will require the approval or licensing of several other UK public agencies e.g. the UKSA and Shetland Islands Council, each of whom will have their own process to follow. Nevertheless, each process will have many of the same requirements e.g. Environmental impact analysis and place similar duties upon SSC e.g. safety. The airspace should be designed to meet these other duties and use the same reports, where appropriate, to create a common understanding and transparency within these agencies.

**DP 9. Local agreements to minimize the impact of the space port on its neighbours will have to be negotiated.**

Many respondents brought up the need for local agreements, in many cases offering help in crafting such agreements.

*“Animal welfare during launch, which would need to be covered by a management agreement”*

*“we would need a LoA drafting and agreeing to give us access in a controlled and expeditious manner, like other emergency services”*

*“NATS is working with the UK Space Agency and CAA to provide them with a template LOA as NATS expects that due to the anticipated dimensions and activation cycles that all ranges as defined by the SIA will require LOAs in respect of notification principles and methodologies. Dependant on size, precedent agreements for airspace activation may be required.”*

*“If co-ordination is necessary between the Met Office station at Lerwick and SSC regarding radiosonde launches or any other matters, then I would expect the requirements of each party to be laid out and how any co-ordination should be managed to enable the operational activities of both to be carried out while minimising risk to both.”*

*“The MOD anticipate that some formal agreements may be required to cover, but not limited to, primacy/priority of airspace and activities, notification, activation and deactivation protocols, management of priority aircraft (e.g. CAT A, Emergency or on a Defence Operational Tasking)”*

Whilst the airspace above and around Unst is relatively quiet SSC acknowledge that we are part of a greater Shetland community and wish to limit the impact of the spaceport upon our neighbours. The best way to do this will be by the negotiating local agreements with our neighbours during the design process.

Beyond the confines of Shetland SSC are also part of the wider UK aviation community and fully understand the need for agreements between parties to ensure that airspace is managed in the most equitable manner.

**DP 10. The Airspace change will take account of ongoing and continuing airspace management and policies.**

Unsurprisingly the question of adherence to ongoing airspace changes and policies was only raised by those directly involved in air operations and once again all of the points were raised in a positive manner.

*“The introduction of Free Route Airspace as set out in CAP 1711 will impact upon the design of associated Flight Planning Buffer Zones (FBZ) and subsequent notification requirements.”*

*“The MOD believe that SSC should consider the initiatives within the AMS a part of their airspace development. In particular, Free Route Airspace and Advanced Flexible Use of Airspace. Although not part of the AMS, UAS proliferation and in particular UAS operations from ships may also be relevant.”*

*“Of the 15 AMS initiatives, the most relevant here would be:*

- 1. Free Route Airspace (FRA)*
- 2. Advanced Flexible Use of Airspace*

*airspace users to file and fly flight specific user-preferred trajectories (UPR) as opposed to a predictable trajectory in a fixed route environment. This means that there will be specific requirements to analyse potential trajectories and the interactions with any restricted areas and manage flight plan buffer zones accordingly.*

*For AFUA, principles around activation and deactivation of applicable areas, particularly when planned activities are delayed or cancelled, must be adhered to and follow principles laid out in CAP740.”*

The airspace change should comply with existing and planned UK airspace management as specified in CAP 740 *UK Airspace Management Policy* and associated documents e.g. CAP 1711 *Airspace Modernisation Strategy*. SSC recognise that the UK ASM policy is “to achieve the most efficient use of airspace through dynamic time sharing and, at times, the segregation of airspace amongst various categories of airspace users on the basis of short-term needs”.

## **Design Principles Review**

The responses to the potential design principles were all positive with no-one disagreeing with any of the principles so the proposed principles have not been changed. Respondents were also asked to rank each design principle in order of importance. These responses have been used in the following table.

The copy of the replies is at Appendix 5.

## List of Potential Design Principles with Ranking

	Category	Design Principle	Order of Importance
DP 1	Safety	The Safety of other air users and the public is the paramount design principle to be used in the ACP.	A
DP 2	Environment	SSC will produce a report detailing the environmental and noise effects of rocket launch from Unst.	A
DP 3	Volume	The airspace volume should be as small as possible to minimize the impact on existing air users.	B
DP 4	Duration and Timing	The duration of the airspace activation should be kept to a minimum and SSC should look at the possible impact of concurrent operations of other airspace e.g. Cape Wrath.	B
DP 5	Notification	Airspace notification should be timely and accurate with an established method for rapid notification.	A
DP 6	Communications	A process to allow some special air users to enter the airspace safely and halt launch operations should be established.	A
DP 7	International	Other International airspace agencies should be included in the airspace design process.	B
DP 8	Other Regulations	Airspace design should meet duties and requirements of other public agencies placed upon SSC.	B
DP 9	Local Agreements	Local agreements to minimize the impact of the space port on its neighbours will have to be negotiated.	A
DP 10	Ongoing and Continuing Airspace management and policies	The Airspace change will take account of ongoing and continuing airspace management and policies.	B

## Next Steps

Currently, the estimated timeline for subsequent stages of the SSC ACP are shown below:

CAP 1616 Stage	Status	Target Completion Date
Define Gateway	Expected	28 February 2020
Develop & Assess Gateway	Expected	29 May 2020
Consult gateway	Expected	28 August 2020
Formal ACP Submission	Expected	02 April 2021
Decide Gateway	Expected	08 October 2021
Target AIRAC	Expected	February 2022

## Appendices

Appendix 1 - SSC-CAA1012DPQ - Design Principles Questionnaire

Appendix 2 - SSC-CAA1012DPQ - Contact List

Appendix 3 - SSC-CAA1012DPQ - Responses

Appendix 4 - SSC-CAA0302DP1B -Design Principles

Appendix 5 - SSC-CAA0302DP1B -Responses