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## SUPPORTING COMMERCIAL SPACEPLANE OPERATIONS IN THE UK

Consultation on criteria to determine the location of a UK spaceport

Machrihanish Airbase, Campbeltown

**Response Document 2 of 2**

Submitted by Argyll and Bute Community Planning Partnership, on behalf  
of Machrihanish Airbase, Campbeltown, Argyll and Bute



Capital  
Ambassadors

Response submitted by

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Campbeltown, Machrihanish, Scotland- NASA Designated Space Shuttle landing site

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## How to read this document

This document has been submitted in response to the consultation paper

“SUPPORTING COMMERCIAL SPACEPLANE OPERATIONS IN THE UK Consultation on criteria to determine the location of a UK spaceport” dated 15<sup>th</sup> July 2014.

The submission is for Machrihanish Airbase, Campbeltown and provided in two parts; one from MACC Development Ltd, owner of the airbase and one from the Economic Development Team of the Argyll and Bute Community Planning Partnership (CPP) including Highlands and the Islands Enterprise (HIE) and Argyll and Bute Council (ABC).

Both documents have been drafted in conjunction with each other and represent a coherent unified response which reflect the enthusiasm and strong support for a UK Spaceport in general and for Machrihanish Airbase, Campbeltown specifically. The opportunity is recognised as being of Regional, Scottish and UK importance.

We believe Machrihanish Airbase, Campbeltown offers technical and commercial advantage that de-risk this opportunity thereby significantly enhancing the probability of success. This document considers the suitability of both the local area and wider region; highlighting the strong correlation between the needs of a spaceport operator and associated stakeholders and the facility.

Both parts of the Machrihanish Airbase, Campbeltown submission have been structured in relation to the Consultation document as follows:

1. Executive Summary
2. Highlights from the consultation question responses
3. Specific detailed responses to the 11 consultation questions
4. Submission comments in brief in relation to specific paragraphs of the Department of Transport documents
5. Appendices containing further supporting information
6. Glossary of Terms

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Flight time Machrihanish to Glasgow, 30 minutes; Machrihanish to Belfast, 30 mins; Machrihanish to London 90 minutes

## Executive Summary

***IMAGE REMOVED IN ELECTRONIC FILE FORMAT***

***Sally Loudon***

Chief Executive, Argyll and Bute Council

Argyll and Bute Council Community Planning Partnership has pleasure in submitting this paper in response to the document "SUPPORTING COMMERCIAL SPACEPLANE OPERATIONS IN THE UK Consultation on criteria to determine the location of a UK spaceport" dated 15<sup>th</sup> July 2014.

### **Registration of strong interest**

We recognise that customers cannot be mandated to use a UK spaceport; it must be technically, commercially, politically and environmentally viable, and also be competitive with other facilities. Unlike an airport, potential spaceport customers could select any spaceport in the world to use as a point of departure. The UK spaceport must offer compelling reasons to operators, customers, visitors and to the support and supply community in order to be globally competitive.

In creating this submission, we believe that a UK national spaceport demands

- a stable and predictable business and regulatory environment
- runway & associated facilities that in the main already exist in some form or do not require extensive development, at least in early stages
- comprehensive and flexible launch/ recovery capability in order to attract and sustain business
- a remote and attractive but easily accessible location for both visitors and operators (e.g. Campbeltown offers excellent road links to Glasgow, flight times: Machrihanish to Glasgow, 30 minutes; Machrihanish to Belfast, 30 mins; Machrihanish to London 90 minutes)
- a strongly supportive community at the local and regional level

We believe Campbeltown, the Machrihanish Airbase and Argyll and Bute can strongly satisfy all these criteria.

We believe that a highly positive regulatory and investment environment must be created in order to produce the necessary conditions to develop, support and maintain a UK Spaceport over a sustained period of time. In addition, it must also provide investment returns at a level commensurate with the level of business risk. The many complex and inter-relating issues pose a challenge to assimilate. To deal with this, we have taken a systems approach, and an initial, necessarily draft, high level analysis has been included within this document.

Our initial analysis has been carried out in relation to a set of criteria published in the consultation document and we believe demonstrates clearly the excellent fit of Machrihanish Airbase, Campbeltown to stated needs, and provides an initial view of

priorities.

In addition, the analysis implies a higher level of criteria that must be in place in order for a technically viable UK spaceport to succeed. We have provided this data.

As a result of the following characteristics we believe that we can establish Machrihanish Airbase, Campbeltown as the pre-eminent European Spaceport:

- ease of use and cost effectiveness as a place to develop
- lack of conflicting interests
- potential for significant expansion and growth
- its attractiveness as a place to invest in
- accessibility

Securing the UK Spaceport at Machrihanish Airbase, Campbeltown will provide the necessary catalyst to stimulate and encourage the development of many related businesses ranging from hi tech industries including aero engineering, technical operations, academic research and sustainable tourism and hospitality.

### **The strengths of Machrihanish Airbase, Campbeltown in Argyll and Bute**

#### *Location*

Machrihanish Airbase, Campbeltown is a uniquely suitable location for UK Spaceport. It is the only location that could bring significant benefits to not only Scotland, but also to Northern Ireland. Both these territories are home to world class universities, engineering and technology companies.

#### *The facility*

Machrihanish Airbase, Campbeltown

- NASA accredited, 3,000m runway for Space Shuttle landings
- meets required safety criteria by being remote from population centres (Argyll and Bute has an average population density of 0.13 persons per hectare. This compares to a Scottish average of 0.65 persons per hectare) and has water on three sides of the facility
- accessible via trunk road and sea ferry links, has an active airport operated by HIAL. This airport facilitates visitor and business transit but will not inhibit the necessary segregated airspace for space launch and recovery
- has over 1,000 acres of available low cost real estate land for the expansion of related operations and the development of many kinds of businesses supported by a highly favourable planning policy background
- housed 2,000 military personnel. Utilities are still on-site to support extensive operations

#### *Environmental*

- UK Spaceport air movements are likely to be very low; current global orbital launches are below 100 per year, and we envisage that spaceplane movements will build over time but not to commercial airport levels. This means operations are unlikely to have any significant adverse impacts environmentally beyond that of airport operations (especially if hydrogen

fuel generated by the local wind, tidal and wave energy farms become the prime spaceplane fuel).

#### *Infrastructure*

- Machrihanish Airbase, Campbeltown is adjacent to modern port facilities. Campbeltown has two commercial civil piers in addition to a NATO jetty. One of the piers has not only 9m depth but a linkspan thereby having the potential to enable large ship-borne items/materials to be driven onto land without craneage (capable of handling 130m, 9m draft vessels. The Council owns the linkspan and the rest of the harbour, with a 110t maximum load and 1000t on the quay). The airbase and port are linked by a road network designed to accommodate the movement of 100m towers for land and sea based wind farms. The towers are manufactured by an established high technology company adjacent to the airbase. A NATO refuelling dock at the harbour is directly connected by underground pipeline to the airbase's 6.2M litre fuel storage and handling facilities. The site has a number of en-suite accommodation and hospitality blocks and recreational facilities for operations staff already available on site.

#### *Economic*

- Campbeltown and wider Argyll and Bute's economy is diverse with specific strengths in the Tourism, Food and Drink, Energy and Life Sciences sectors.
- Our offer includes significant, sustainable economic assets combined with close proximity to the resources of the central belt of Scotland. The territory benefits from having world class hospitality, iconic tourist attractions, a leading role in renewable energy, whisky, golf, world class sailing and leisure assets. Campbeltown itself has been subject to circa £50 million investment in the fabric of the town and associated infrastructure to ensure it plays a key role in the development of the renewable energy industry given the harbour's close proximity to the Irish Sea, Solway Firth and West Atlantic.

In consideration of the foregoing, I commend this document for consideration.

### ***Sally Loudon***

Chief Executive  
Argyll and Bute Council  
Kilmory

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## Highlights from the consultation questions raised

1. In order to make a UK spaceport viable, a stable, predictable (and by implication long term) positive business environment must be created. This will allow the necessary investment to be made by both the public and private sectors.
2. The question as to exactly what capabilities are to comprise the UK spaceport is fundamental. The optimum business would possibly include vertical launch capability, and would certainly need to take into account the introduction of fully orbit capable spaceplanes.
3. Early decisions are required in order to meet published timescales.
4. We suggest the cheapest location that is technically suitable in terms of initial operating capability **and** enhancement for heavy, long take off, fully orbital capable spaceplanes and possibly vertical launch will be the least risky solution and most likely to produce a good return on investment.
5. A vertical launch capability may be possible if sufficient land is available at a suitable site allowing a northerly polar launch but a more probable solution would be to associate a sea-borne launch platform (barge or perhaps re-purposed decommissioned oil platform) with the spaceport. This solution would allow the spaceport to provide resources to operate and may assist in creating economic viability for both types operation (vertical and horizontal launch).
6. It will be extremely important to protect the environment, and there would appear to be a major opportunity to consider the involvement of renewable energy sources (such as those readily available at Campbeltown) in operating a spaceport/ vehicles. This may prove to be an important opportunity in its own right.
7. Commitment and support of the local community will be a key factor in establishing a UK spaceport.
8. The potential business benefits identified to the UK are large, but will only be realised if UK spaceport is established as a business driven, needs driven enterprise.

## Consultation Questions

### CAA's high level recommendation

Q1

Do you agree with the CAA's high-level recommendation that, if a decision were taken to proceed, sub-orbital operations should preferably commence, either on a permanent or a temporary basis, from one (or more) of the following:

- an existing EASA-certificated aerodrome;
- an existing UK CAA-licensed aerodrome; and/or
- an existing UK military aerodrome, subject to approval from the MOD.

Response:

We suggest that sub-orbital operations should commence from an existing EASA or CAA licensed airport because many (but not all) of the facilities and assets (including certifications and planning approvals) that would be required can be provisioned efficiently and economically by means of an existing airport.

This will greatly assist meeting the stringent timescales for Initial Operating Capability (IOC) published and greatly enhance the business case (reducing cost and risk and making a sound investment case more likely). Initial investment requirements will be a fraction of the "green field" option and will significantly de-risk the programme.

Some similar advantages apply to an existing MoD military airbase but with the added complication of a defence decision which may delay/complicate the case which will add risk and cost to the programme.

Q2

Do you agree that in order to make maximum use of existing infrastructure, the location should preferably still be active but at a low level of aircraft movements and should have existing and appropriate ground infrastructure/facilities and service provision?

Response:

We agree that an existing active but low utilisation airport is the most suitable location. This provides existing and appropriate ground infrastructure/facilities and service provision and also air transport capability for the low levels of suborbital passengers, staff and visitors. However, space vehicles will require significant enhancement of the fuelling and servicing capability, so the location will need to be capable of handling these materials in a safe and environmentally friendly manner. There may be a technical case for selecting a site that can utilise the output of wind farm or other renewable energy source (Kintyre has a significant wave and tidal resource in close proximity) to provide the main electrical power source; hydrogen fuel processing may be suitable for being supplied by a large but interruptible electricity supply.

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Photograph 1: Machrihanish, Campbeltown Existing 3,000m Runway and Taxiway

Q3

Do you agree that greenfield sites should not be considered?

Response:

We agree that a greenfield site should not be considered or considered only if all possible existing runway locations are proven to be unsuitable.

The use of an existing site is likely to make the difference between the business case succeeding or failing. However, use of an existing site may not be able to provide the necessary facilities for all three types of likely required launch (suborbital, fully orbital and vertical). It is suggested that a single launch centre would be the most advantageous in terms of environmental, operational and commercial factors so that may entail the extension of an existing site into "greenfield". By this we suggest, either an existing site "footprint" is enlarged to 45 square kilometres (partly by means of a coastal location) or that a sea launch capability is associated with a vertical launch spaceport. An alternative would be to use a sea platform (possibly a re-purposed decommissioned oil platform) which was serviced from a marine dock associated with the spaceport.

This is similar to the launch facility provided by Energia's Sea Launch capability. The Sea Launch Program launches from an ocean based platform that is taken to a launch site in the Pacific ocean. Launching from the ocean, if sufficiently away from land masses, provides the capability to launch with any azimuth in the open sea, thus making launches free of political risks, simplifying international cooperation during spacecraft launches, as well as making unnecessary any reservation of tracts of land for both the launch site with its safe area, and areas where the jettisoned rocket stages and payload fairing halves impact on the ground. The Sea Launch system also reduces the numbers of personnel participating in the work, and, therefore, the cost of the operation.

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Indicative Horizontal and single vertical launch site approx 45 square kilometres (UK Government review of commercial spaceplane certification and operations: technical report, July 2014). It is possible that the vertical launch platform is built into the sea adjacent to or serviceable by the horizontal launch facility.

Figure 1 Potential Combined Horizontal/ Vertical Launch Site

## CAA's criteria

Q4

Do you agree with CAA's analysis identifying the criteria to be considered in identifying a permanent location for a UK spaceport? If not, please explain why.

Response:

We agree with the criteria identified for a technically viable UK spaceport supporting sub-orbital space planes. However we feel that the criteria do not relate to the high level political, technical and commercial issues (see Q5 response below), which we have tabulated in Figure 2 below, together with potential estimated weightings.

Legend		
⊕	Strong Relationship	9
○	Moderate Relationship	3
▲	Weak Relationship	1
+	Strong Positive Correlation	
+	Positive Correlation	
-	Negative Correlation	
-	Strong Negative Correlation	
▼	Objective Is To Minimize	
▲	Objective Is To Maximize	
X	Objective Is To Hit Target	

Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	Demanded Needs (a.k.a. "Stakeholder Requirements" or "Whats")	Column #							
					Direction of Improvement: Minimize (▼), Maximize (▲), or Target (X)							
					Existing suitable licensable airport with runway /min 3000m capable of development for orbital spaceplans	▲	▲	X	▲	▼	▲	▲
					Site has suitable geographic/ topographic/ meteorologic conditions for facilitating both horizontal and vertical launch/ vertical recovery	⊕	⊕	⊕	⊕	⊕	⊕	⊕
					Prompt timetable for decisions in terms of location selection & planning and regulatory approvals	⊕	⊕	⊕	⊕	⊕	⊕	⊕
					On-going stakeholder engagement process to obtain Critical Success Factors & Assimilate	⊕	⊕	⊕	⊕	⊕	⊕	⊕
					Development of a pro-business economic and regulatory environment to make proposition as attractive as possible for both private and public stakeholders	⊕	⊕	⊕	⊕	⊕	⊕	⊕
					Integrated marine & Spaceport	⊕	⊕	⊕	⊕	⊕	⊕	⊕
					High level business and political support	⊕	⊕	⊕	⊕	⊕	⊕	⊕
1	9	10.3	100.0	Operationally viable Spaceport	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
2	9	9.8	95.0	Business friendly planning and regulatory framework	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
3	9	9.8	95.0	Long term governmental commitment to allow necessary investment cases to be built	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
4	9	9.3	90.0	Flexibility of operational capability (suitable for vertical/ horizontal, sub-orbital/ fully orbital vehicles)	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
5	9	9.3	90.0	Early commitment (before other countries step in/ need to develop business rels. now)	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
6	9	8.8	85.0	Stable and predictable business environment	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
7	9	7.7	75.0	Local community/ government at local/ regional/ national support	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
8	9	9.8	95.0	Stakeholder requirements/ critical success factors drive the programme	⊕	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Difficulty (0=Easy to Accomplish, 10=Extremely Difficult)					5	5	0	0	0	0	0	0
Max Relationship Value in Column					9	9	9	9	9	9	9	9
Weight / Importance					426.8	426.8	460.8	584.5	589.2	176.3	589.2	
Relative Weight					13.1	13.1	14.2	18.0	18.1	5.4	18.1	

Although this is only an initial draft analysis it does demonstrate the likely need for High level business and political support and the development of a pro-business economic and regulatory environment to make proposition as attractive as possible for both private and public stakeholders.

Both these items scoring the highest priority in support of the critical key success factors identified (listed as "Demanded Needs")

A full page version of this chart, with detailed explanation is provided in Appendix 1

Figure 2 High Level (Level 0) Suggested Criteria

Q5

Do you think there are any other criteria that should also be taken into consideration? If so, please explain why.

Response:

We agree that the criteria identified by the CAA are pertinent and relevant. However, our view is that these criteria relate to a key sub-set of issues, that of a technically viable sub-orbital capable spaceport. We believe a higher set of criteria also need to be considered, without which a technically and commercially viable UK spaceport cannot be built;

1. Long term government commitment to allow the necessary investment cases to be built
2. Business friendly planning and regulatory framework
3. Flexibility of operational capability (to allow sub-orbital, fully orbital and vertical launch)
4. Early commitment (to avoid competitor locations in other countries taking away the business)
5. Stable and predictable business environment.
6. Local community/ government at local, regional and national support.
7. Key stakeholder requirements / critical success factors drive the programme

We have charted these factors in Figure 2 above.

In addition, spaceports are not like airports in terms of their customer profiles- who are to a certain extent captive. The commercial success of a spaceport, in terms of satellite/ cargo launch and passenger use depends on making the location more attractive than other possible sites. If the UK Spaceport is not attractive to this business it will not flourish, hence we have listed the over-arching (level 0) criteria but in addition we suggest the following (level 1) criteria be added to the existing ones suggested by the CAA:

1. 3000m runway suitable for enhancement in terms of strength and length as required by spaceplane operators
2. Existing airport that can support necessary air transport links but also segregated airspace for vertical & horizontal ops
3. Local population small enough to support safety case but large enough to supply/ house initial core of workforce
4. Suitability of site to house large construction/ development team & support gradual increase in staff and supply chain personnel with minimum impact on adjacent communities.
5. Significant re-location of local population unnecessary

6. Infrastructure capable of & experienced in handling visitors/ world class tourist facilities/ large crowds
7. Remote but accessible; good existing transport links for people/ large fabrications to the Central Belt and beyond.
8. Good existing logistical capability to handle safe fuel delivery/ storage/ hazardous materials
9. Local agencies track record of working with/ accelerating high tech industry
10. Strong positive support from a united and cohesive local community with a track record of support for new industrial development and further population and economic growth.
11. Availability of likely required construction materials close to site or at a nearby (for example, in Campbeltown's case, at the super quarry at Glensanda if required).
12. Good connectivity to renewable energy sources for potential fuel processing

We have charted these factors in a QFD matrix, figure 3 below:

Legend		
⊖	Strong Relationship	9
○	Moderate Relationship	3
▲	Weak Relationship	1
++	Strong Positive Correlation	
+	Positive Correlation	
-	Negative Correlation	
▼	Strong Negative Correlation	
▼	Objective Is To Minimize	
▲	Objective Is To Maximize	
X	Objective Is To Hit Target	

					Column #	1	2	3	4	5	6	7	8	9	10	11	12	13		
Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	D demanded Quality (a.k.a. "Customer Requirements" or "Whats")	Quality Characteristics (a.k.a. "Functional Requirements" or "Hows")	Direction of Improvement: Minimize (▼), Maximize (▲), or Target (x)														
						3000m runway suitable for enhancement in terms of strength and length as required by spaceplane operators	Existing airport that can support necessary air transport links but also segregated airspace for vertical & horizontal ops	Local population small enough to support safety case but large enough to supply/ house initial core of workforce	Suitability of site to house large construction/ development team & support gradual increase in staff and supply chain personnel	Significant re-location of local population unnecessary	Infrastructure capable of & experienced in handling very large visitor crowds	Remote but accessible; good existing transport links for people/ large fabrications	Good existing logistical capability to handle safe fuel delivery/ storage/ HAZMAT	Local agencies track record of working with/ accelerating high tech industry	Strong positive support from a united and cohesive local community with a track record of support for new industrial development	Availability of likely required construction materials close to site	Good connectivity to renewable energy sources for potential fuel processing	Integrated marine port with spaceport	Benchmark	
1	9	13.2	100.0	Runway length		⊖			○	⊖	⊖		▲	▲	▲		⊖			
2	3	9.9	75.0	Local airspace complexity			○													
3	9	11.3	85.0	Population Density			▲	⊖	○	⊖	○	○				▲				
4	9	9.9	75.0	Weather Conditions		⊖	▲													
5	9	6.6	50.0	Environmental considerations		○	○						⊖	○	○	○	○	⊖	○	
6	9	6.6	50.0	Transport links			⊖				○	⊖	○				○		⊖	
7	9	6.0	45.0	Contribution to local & national growth		⊖	⊖	○	○		▲	⊖		⊖	⊖	⊖		○		
8	9	4.0	30.0	Advancement of science and innovation										⊖						
9	9	4.0	30.0	Growth of space & aerospace sector inc. stimulating jobs in wider supply chain or support existing space clusters		⊖	⊖	▲	○		⊖	⊖	▲	⊖	⊖	⊖				
10	9	4.0	30.0	Synergy or support to existing economic usage of spaceport location		⊖	⊖	○	○			○		⊖	⊖	○	⊖	○		
11	9	4.0	30.0	Promotion of high level skills		⊖	○							⊖						
12	9	7.9	60.0	Spin off benefits such as tourism or jobs related to spaceplane operations		⊖	⊖	⊖	⊖	○	⊖	⊖	○	⊖	⊖					
13	9	12.6	95.0	Deliverability		⊖	⊖	⊖	⊖	⊖	○	⊖	○	⊖	⊖	○	○	○	⊖	
				Difficulty (0=Easy to Accomplish, 10=Extremely Difficult)		5	5	0	0	0	0	0	3	0	2	0	5			
				Max Relationship Value in Column		9	9	9	9	9	9	9	9	9	9	9	9	9		
				Weight / Importance		574.2	452.3	359.6	379.5	357.6	204.6	392.7	158.3	414.6	341.1	208.6	151.0	204.6		
				Relative Weight		13.7	10.8	8.6	9.0	8.5	4.9	9.4	3.8	9.9	8.1	5.0	3.6	4.9		

Figure 3 Level 1 Selection Criteria Mapping against possible UK Spaceport

For a detailed explanation of the above matrix please refer to Appendix 1. We have mapped published selection criteria against possible characteristics using the QFD method in order to obtain possible priority values. The above matrix results are draft and indicative only, however they do suggest how strongly supportive and hence important some characteristics might be to a successful UK spaceport. This analysis could be re-run at some time in the future post downselection as part of risk mitigation, programme management and design processes.

Q6

Do you agree that these are relevant criteria? What weight should be attached to them?

Response:

At this stage, without more detailed technical and commercial analysis which cannot commence without further sanction, priorities are somewhat subjective. However initial analysis of the criteria mapped against possible characteristics of a successful UK spaceport give the following priority orders (please refer to Figure 2)

1. High level political and business support (creating an investable case)  
& =1 Development of a pro-business economic & regulatory environment to make the proposition as attractive as possible to both private and public investment
- 3 On-going stakeholder engagement process to obtain Critical Success Factors & act upon.
4. Prompt timetable for decisions in terms of location selection & planning regulatory approvals.
5. Site selected has suitable geographic/ topographic/ meteorological conditions suitable for both horizontal take off and vertical launch platforms.  
& =5 Existing suitable licensable runway with min. 3000 metres length capable of further development to support fully orbital spaceplanes.

For a UK spaceport to be successful it will require significant investment which will in turn result in long term ROI. In order to make a successful business case it will need to demonstrate flexibility in its use and capability. It will need therefore to be able to commence operations for sub-orbital vehicles but must be capable of enhancement to facilitate fully orbital spaceplane capability. The strongest business case to be made would be based on being able to support the additional capability of vertical take off for polar orbit. This capability would facilitate what would appear to be growing a requirement.

Q7

If more than one location closely meet the essential operating criteria, safety, meteorological, environmental and economic criteria, do you agree that we should also consider factors around the contribution to local and national growth? If so, what weight should be given to these factors?

Response:

Yes we strongly agree. We also wish to state that we believe the “factors around the contribution to local and national growth” should be considered at “level 0” - repeated below from response to Q5. Without positive contribution to local and national growth criteria 1 and 6 are unlikely to be fulfilled which would result in a likely failure of the UK Spaceport.

1. Long term government commitment to allow the necessary investment cases to be built
2. Business friendly planning and regulatory framework
3. Flexibility of operational capability (to allow sub-orbital, fully orbital and vertical launch)
4. Early commitment (to avoid competitor locations in other countries taking away the business)
5. Stable and predictable business environment.
6. Local community/ government at local, regional and national support.
7. Key stakeholder requirements / critical success factors drive the programme

Weighting factors for these criteria and those proposed in the Consultation document are given in Figures 2 & 3. A fuller explanation as to how these factors are computed is given in Appendix 1.

## A coastal location?

Q8

Do you agree with the CAA's analysis and strong recommendation that until there is a better understanding of sub-orbital spaceplane safety performance, spaceplane operations should only take place in areas of low population density and the resulting view that only a coastal location is suitable to protect the uninvolved general public?

Response:

We strongly agree a coastal location is the most suitable, both in terms of protection for the uninvolved public, but also because it will greatly ease and enhance operations. A good associated marine dock facility will facilitate construction/ development/ fuel transfer with minimum environmental and community impact, and may allow sea borne launch capability to be serviced. In addition, large fabrications may be transported to/ from a UK Spaceport more easily.

In addition, it is considered appropriate to mention that one of the business drivers for a UK Spaceport is tourism. A coastal location will enhance the traveller/ tourist experience and may have significant additional positive impact on the local and indeed national economy.

IMAGES REMOVED IN ELECTRONIC FILE FORMAT

Photograph 2 NATO Fuelling Jetty

Photograph 3 Campbeltown Harbour

Q9

What are your views on the CAA's shortlist of eight potential sites?

Response:

This submission has been made on behalf of Campbeltown/Machrihanish in Argyll and Bute so we can comment only on that location.

Machrihanish Airbase, Campbeltown is community owned and therefore strongly supported and has many key advantages.

It should be noted that although remote, Campbeltown is only 43 nautical miles from Port Glasgow and its hinterland of important engineering industries and strong employment pool.

As a result of the following characteristics we believe that we can establish Machrihanish Airbase, Campbeltown as the pre-eminent European spaceport:

- ease of use and cost effectiveness as a place to develop
- lack of conflicting interests
- potential for significant expansion and growth
- its attractiveness as a place to invest in
- accessibility

Our concept aims to provide a value proposition for space launches and recovery that seeks to establish Machrihanish Airbase, Campbeltown as the pre-eminent European Spaceport by means of its attractiveness as a place to invest in, live and work, accessibility, potential for significant expansion and growth, lack of conflicting interests, ease of use and cost effectiveness. Securing the UK Spaceport at Machrihanish Airbase, Campbeltown will provide the necessary catalyst to stimulate and encourage the development of many related businesses ranging from hi tech industries including aero engineering, technical operations, service industries, academic research and sustainable tourism and hospitality.

#### *Location*

Machrihanish Airbase, Campbeltown is a uniquely suitable location for UK Spaceport. It is the only location that could bring significant benefits to not only Scotland, but also to Northern Ireland. Both these territories are home to world class universities, engineering and technology companies.

#### *The facility*

Machrihanish Airbase, Campbeltown

- NASA accredited, 3,000m runway for Space Shuttle landings
- meets required safety criteria by being remote from population centres (Argyll and Bute has an average population density of 0.13 persons per hectare. This compares to a Scottish average of 0.65 persons per hectare)

- and has water on three sides of the facility
- accessible via trunk road and sea ferry links, has an active airport operated by HIAL. This airport facilitates visitor and business transit but will not encumber the necessary segregated airspace for space launch and recovery
- has over 1,000 acres of available low cost real estate space for the expansion of related operations and the development of many kinds of business supported by a highly favourable planning policy background
- was designed to house 2,000 military personnel. Utilities are still on-site to support extensive operations

#### *Environmental*

- UK Spaceport air movements are likely to be very low; current global orbital launches are below 100 per year, and we envisage that spaceplane movements will build over time but not to commercial airport levels. This means operations are unlikely to have any significant adverse impacts environmentally beyond that of airport operations (especially if hydrogen fuel generated by the local wind, tidal and wave energy farms become the prime spaceplane fuel).

#### *Infrastructure*

- Machrihanish Airbase, Campbeltown is adjacent to modern port facilities. Campbeltown has two commercial civil piers in addition to the NATO jetty. One of the piers has not only 9m depth but a linkspan thereby having the potential to enable large ship-borne items/materials to be driven onto land without craneage (capable of handling 130m, 9m draft vessels. The Council owns the linkspan and the rest of the harbour with a 110t maximum load and 1000t on the quay). The airbase and port are linked by a road network designed to accommodate the movement of 100m towers for land and sea based wind farms. The towers are manufactured by an established high technology company adjacent to the airbase. A NATO refuelling dock at the harbour is directly connected by underground pipeline to the airbase's 6.2M litre fuel storage and handling facilities. The site has a number of en-suite accommodation and hospitality blocks and recreational facilities for operations staff already available on site.

#### *Economic*

- Campbeltown and wider Argyll and Bute's economy is diverse with specific strengths in the Tourism, Food and Drink, Energy and Life Sciences sectors based around the potential of our significant, sustainable economic assets and close proximity to the central belt of Scotland. The territory benefits from having world class hospitality, iconic tourist attractions, a leading role in renewable energy, whisky, golf, world class sailing and leisure assets. Campbeltown itself has been subject to circa £50 million investment in the fabric of the town and associated infrastructure to ensure it plays a key role in the development of the renewable energy industry given the harbour's close proximity to the Irish Sea, Solway Firth and West Atlantic.

Q10

Are there any locations on the CAA's shortlist which you consider should be disregarded? If yes, please give your reasoning.

Response:

We believe that any location which cannot offer a minimum of circa 3,000 metres runway upgradeable for fully orbital spaceplanes should be disregarded since such a location could likely only provide a temporary facility that would soon be outgrown and if selected would damage the business case for other more suitable permanent locations that could launch a fully orbital capable spaceplane such as SKYLON.

Q11

Are there any additional locations that you consider should be on the CAA's short list? If yes, please explain why.

Response:

We believe it is extremely important to consider the associated possible vertical (potential sea launch) location as an integrated part of the decision. If this capability were to be possible it could have significant value to the UK.

## Submission comments in relation to specific paragraphs

### Consultation Document Text



Introduction

### Our Comments



Why a UK Spaceport?

1.1 In its Plan for Growth (2011), the Government identified the space industry as one of eight key sectors: an acknowledgement of the contribution that the sector makes to driving economic growth and creating jobs.

1.2 By 2030, the global space economy is expected to be worth £400billion per annum.

1.3 The Government's ambition is that the United Kingdom's space economy should account for 10% of the global economy by 2030 - worth some £40 billion per year.

1.4 A key part of this ambition is for the UK to be the European centre for sub-orbital spaceflight.

1.5 By the end of 2014, we might see the first paying participants on a sub-orbital spaceflight experience launching from the US. We anticipate that other commercial space flight operations will be ready to begin operations in the US by 2016 and elsewhere over the following 5-10 years. Spaceplanes are widely acknowledged as the most likely means of enabling commercial spaceflight experience and scientific payloads in the near future. In the longer term, they also

We recognise the opportunity identified and the note the progress made so far by Highlands and Islands Enterprise in the area of remote satellite enabled medical communications and Space and Life Sciences. We believe these initial experiences provide a guide to what is possible, given enthusiasm, local support and good stakeholder relationships.

We concur that the UK Spaceport will be a key part of meeting the economic growth ambitions on the proviso that it is business driven and is capable of meeting the needs of the key stakeholders.

have the potential to transform the costs and flexibility of satellite launches, and for the delivery of cargo to space.

1.6 Potential spaceflight operators have expressed a strong interest in conducting sub-orbital spaceplane operations from the UK by 2018.

1.7 If spaceplanes are operated from the UK, then there is strong potential for operators to base themselves here – which would provide knock on benefits for a range of related industries. As space is a research and development-intensive sector, there could also be significant benefits for UK science and innovation. These benefits could include research and development using spaceplanes, a strengthened supply base for the space sector, increased education and training resulting in high value employment and other local spin-off benefits such as increased tourism or related jobs and growth activity.

#### Civil Aviation Authority (CAA) Review

1.8 The Space Innovation and Growth Strategy 2014-2030 and Space Growth Action Plan both include an ambition to “establish a Space Port in the UK by 2018 and identify further reforms to regulation needed to allow commercial space flight in the UK”.

1.9 In 2012, the Department for Transport and UK Space Agency tasked the UK Civil Aviation Authority (CAA) with undertaking a detailed review of that would be required – from an operational and regulatory perspective – to enable spaceplanes to operate from the UK within the timescales that operators

#### Comments

Initial operations by 2018 will require rapid decisions to be made so that an appropriate operational/ regulatory framework is in place and that stakeholders can be engaged at the earliest opportunity in order to ensure Critical Success Factors are identified and acted upon. Critical to Quality requirements must be identified and designed for; this should be done in tandem with the business case development and investment process.

It is clear that significant benefit can accrue before flight; REL's SABRE engine precooler technology, for example, appears a major technical and business achievement perhaps a decade before a related vehicle flies. To gain maximum advantage of “knock-on benefits” decisions on spaceport must be made so that there is a predictable and investable business environment and that necessary relationships can be developed as soon as possible. This will maximise potential and avoid loss of business opportunities which are already building.

have proposed, should a decision be taken to do so.

1.10 The CAA has completed their review. This Consultation seeks views on the CAA's conclusions and recommendations on potentially feasible locations for a UK spaceport. This will feed into the Government's considerations into the feasibility and benefits of a UK Spaceport. It should be noted that the CAA, in identifying potentially feasible locations for a spaceport, did not consider the willingness of any civil or military aerodrome to host spaceplane operations; it considered only whether aerodromes met a set of criteria identified by the CAA.

1.11 The Government mandate to the CAA included:

- an analysis and recommendations regarding the appropriate regulatory requirements for spaceport operations; and
- recommendations as to the most suitable locations for a spaceport in the UK.

A Summary of the review and conclusions and the full Technical Report can be found alongside this consultation paper.

1.12 In their review, the CAA have identified that in the US the regulatory framework places the protection of the uninvolved general public as its highest safety priority – and propose that this should also be the case as it works towards enabling spaceflight operations to commence from the UK by 2018.

1.13 One of the most important factors in

#### Comments

Feasibility of potential locations depends on attractiveness to operators and their customers as well as being operationally viable.

UK Government review of commercial spaceplane certification and operations Summary and conclusions July 2014 (CAA) states:

*"Recommendation 22 A separate vertical launch site should be identified, which due to the restricted operational criteria for vertical launch to orbit, should be on the north coast of Scotland."*

This requirement might be met by means of a site that is capable of providing a 45 square kilometre safety footprint or by an integrated site that can provide a barge launch service operated from a Marine port such as Campbeltown or by means of a "federated site" that may possibly utilise a decommissioned oil platform. These proposals require in-depth technical evaluation, however the concept of a site capable of vertical launch appears important since it would provide a strong commercial basis for operation, particularly for small satellite launch operations. This could be a critical factor in the establishment of a successful UK spaceport. Splitting the business in two might make both types of site difficult to sustain in the long term.

protecting the uninvolved general public is the choice of launch site for spaceplanes - the spaceport.

1.14 Although there is an ambition to have a spaceport in the UK, no decision has yet been taken and the location has not been determined. The necessary infrastructure for spaceplane operations does not yet exist (though the infrastructure in place for aviation can provide the basis). Furthermore, spaceplane technology is still comparatively in its infancy and, compared to civil aviation activities, largely unproven. Airspace in the UK is both busy and complex – and any future spaceplane flights would need to be safely accommodated with present and future levels of commercial, recreational and military flights.

1.15 For the purposes of this consultation, we envisage that a spaceport would be developed at an existing aerodrome and would initially be for sub-orbital flights, of short duration, taking off and landing from the same runway.

1.16 As part of its review, the CAA has identified what it considers to be key operational, safety, meteorological, environmental and economic criteria for determining a suitable site for a spaceport. Based on these, the CAA has identified 8 potentially feasible locations for a UK spaceport, should a decision be taken to develop one.

1.17 This consultation paper seeks views on the criteria identified by the CAA and whether there are any other factors or criteria that should also be considered in determining a site for a spaceport.

#### Comments

The excellent existing infrastructure at Campbeltown has already been certified for NASA's Space Shuttle landing. It has large and numerous hard standing areas, fuel handling and storage facilities and construction staff accommodation already in place. There are excellent marine dock facilities close by supporting transport of large fabrications and fuel.

The quarry and aggregate resources need to increase runway strength for orbital capable vehicles is close to the site perimeter (and were used in the current runway construction).

Current airport operations are at a very low level which should ease the segregated airspace issue.

We believe that the business case for a UK Spaceport is likely to require consideration of capability for fully orbital and vertical launch, otherwise it risks failure due to competitors/ lack of attractiveness to potential customers.

Campbeltown proposes tourism as an additional important factor since it could generate significant revenue for the locale or even be a significant factor in the UK Spaceport balance sheet.

Additional criteria identified by Campbeltown are listed as "Level 0" criteria- they are issues that are essential to create and sustain a technically viable UK Spaceport as laid out in the consultation document.

1.18 In addition, we are seeking views on the eight potentially feasible

locations which the CAA identified based on its criteria – whether any of these locations should be disregarded and why? And also, whether other locations should be considered further.

## Criteria for a UK Spaceport

### Spaceplanes

2.1 Chapter 2 of the CAA's Summary and Conclusions provide an overview of the development of current and emerging sub-orbital spaceplane operations.

2.2 If spaceplane operations were to take place by 2018, the spaceplanes most likely to be able to launch from UK at this time would be of US design, which has implications for the model of regulation that the UK should adopt and also will have implications arising from US export control laws.

2.3 In the US, space regulation is the responsibility of the Federal Aviation Administration Office of Commercial Space Transportation (FAA AST). The FAA AST issues licenses and permits for the operation of commercial space vehicles, including sub-orbital spaceplanes. Commercial space launches can only take place from sites licenced by the FAA AST.

2.4 Launch of US designed spaceplanes in the UK would require an FAA AST license, in addition to any UK-developed regulations. Therefore, the FAA AST site licence requirements will be a key factor in determining the location of UK spaceport.

#### Comments

Although it is recognised the necessary infrastructure for full spaceplane operations does not yet exist in the UK, two runways have already been designated for spaceplane landing, RAF Fairford and Campbeltown. Of these two locations, only Campbeltown is currently short-listed for UK Spaceport due to its remoteness and potential to access segregated airspace. Operational requirements for fully orbital capable vehicle launches may require substantial runway enhancement. Sites should be disregarded that have no such potential otherwise it will not be possible to create viable business cases.

This approach is most likely to succeed since it will greatly reduce cost and time to commence operations and strength the business case for viability. It is likely the runway will be able to used for low earth orbit vehicles with minimal enhancement, which will allow a staged approach to development to accept fully orbital capable spaceplanes (eg Skylon) which will require runway enhancement, for example runway strengthening due to point loadings of the undercarriage on take off.

2.5 This consultation assumes that the necessary export licences would be in place to allow US sub-orbital operations in the UK and is not seeking views on this.

## Safety of Spaceplanes

2.6 The CAA's analysis is that the prevailing body of civil aviation regulation would apply to spaceplanes. However, at this stage in their development, commercial spaceplanes cannot comply with many of these regulations. Spaceplanes cannot currently demonstrate the same safety standards as commercial aviation – and it might not be possible for them ever to do so.

2.7 Therefore, to enable spaceplane operations in the foreseeable future, the CAA view them as “experimental aircraft” under the European Aviation Safety Agency (EASA) Basic Regulation which takes them out of core EU-wide civil aviation safety regulation and allows the UK to regulate them at a national level.

2.8 Experimental aircraft do not typically conduct public transport operations (i.e. carrying fare-paying passengers). However, space tourism or spaceflight experience for fee-paying participants is a key goal for spaceplane operators. The UK is therefore considering what regulatory changes or measures would need to take place to enable spaceplane operations.

2.9 It envisaged that a key part of such a regulatory framework will entail crew and flight participants being informed of the inherent risks of spaceplane operations before the flight and acknowledging receipt of this information in writing. This concept is known as informed consent. In

### Comments

It is assumed that a UK Spaceport will aim to provide as many services to spaceplane /space launch operators as possible. This would include facilities for experimental vehicles that do not carry passengers, and associated engineering and test facilities such as engine test cradles, and potentially service of orbital craft built in the UK but being transported to equatorial sites for orbital launch.

Machrihansih Airbase, Campbeltown has designated a potential rocket engine testing location on site which will be subject to a technical viability study on downselect.

doing so, participants will acknowledge and accept that they will not benefit from the normal safeguards expected of public transport operations. In so far as this requires regulatory change, that approach will be developed and consulted upon separately.

2.10 The CAA conclude that if the inherent greater risk associated with spaceplane flight is accepted by law-makers, crew and participants – then the highest safety priority of regulatory oversight should be protecting the uninvolved general public. One of the most important factors in protecting the uninvolved general public would be the choice of a launch site for spaceplanes.

## Criteria for identifying suitable locations for a Spaceport

2.11 The CAA review identified five key criteria for identifying a suitable location for a UK spaceport:

### 1. Essential Operating Criteria

Based on current spaceplane designs and known operating requirements a spaceport will need to be established on a large site with a runway that is at least, or is capable of being extended to, 3000m (9,800 feet) in length. Spaceplane operations would also need to be conducted in segregated special use airspace, to manage them safely in line with the underlying priority of protecting the uninvolved general public.

### 2. Safety Factors

#### Comments

We believe a c 3,000m runway is a minimum requirement and must be enhanceable and extendible if fully orbital vehicles are to be accommodated or the spaceport risks obsolescence as soon as fully orbital capable vehicles become available.

To protect the uninvolved general public, spaceports should be located away from densely populated areas. Relevant health and safety legislation, including for example the safe storage of any hazardous materials involved in spaceplane operations, will also have to be considered when choosing a site. The CAA has therefore recommended a coastal location be used for any spaceplane operation, given the population density of most areas in the United Kingdom.

### 3. Meteorological Considerations

Strong crosswinds could restrict spaceplane operations and, from information received to date, they are expected to operate clear of cloud under visual meteorological flight rules. There may also be commercial considerations, such as participants wishing to see the earth from space and if cloud cover restricted that, the experience may not live up to expectation. Regional variation in weather conditions may therefore have a significant bearing on the economic case for a particular location.

### 4. Environmental Concerns

International aviation environmental regulation exists for aircraft, aerodromes and airspace covering issues such as noise, air quality (including carbon emissions) and the storage of hazardous materials. Accepting that in the UK, spaceplanes would be considered aircraft, for at least part of the journey, aviation environmental regulations would apply to spaceplane operations.

Even with legislative restrictions in place, issues of noise, air quality and impact on the local area are likely to be of

#### Comments

Campbeltown has a population of 6,423 at the 2011 census, of which 67.9% were economically active. Please refer to attached document [Campbeltown\\_profile.pdf](#) for greater detail.

The document "*UK Government Review of Commercial Spaceplane Certification and Operations: Technical Report*", July 2014 para 9.56 (page 194) suggests potential spaceport layouts from SSTL - Figure 9.4 would require a 45 square kilometre site. This would likely be possible at Campbeltown if a seaborne vertical launch facility was associated with the site operations, but requires detailed investigation.

Campbeltown has a benign micro climate that benefits operations.

Environmental concerns differ greatly depending on the type of vehicle. Suborbital may be assisted by carrier plane launch but contain fuel for a high altitude rocket firing, SKYLON is hydrogen fuelled and vertical launch would be a traditional rocket. Handling of these materials from an environmental and safety perspective is very different. Machrihanish, Campbeltown has the capability to handle fuels including hazardous materials

significant public interest.

Therefore, environmental issues of noise, air quality and storage and use of hazardous materials, such as fuels, need to be considered. [Integration of some spaceplane operations with other air traffic may prove feasible in the future but at least in the near term - until the operation matures and as confidence builds - segregated special use airspace will be a necessary first step.]

## 5. Economic Issues

The site would need to be accessible to both employees and visitors. Employees and visitors would also require accommodation in the vicinity. Good transport links would be required.

2.12 We would welcome views on the validity of these criteria and whether there are other criteria which should also be taken into account and why?

2.13 The fundamental criteria appear to be runway length, availability of segregated airspace and a low local population density. Then additional factors such as local weather conditions, environmental issues and ease of access to the site need to be considered. We would welcome views on the relative impact and weight that should be given to the criteria identified and any criteria which it is thought should be included but are not currently.

2.14 At this time, it is likely that the UK economy could only support one spaceport. However, it is possible that more than one feasible location could meet the fundamental criteria (runway length, local airspace complexity and population density) and satisfactorily

## Comments

Campbeltown is remote but highly accessible with excellent road, ferry and air links. Accommodation for large numbers of construction workers is already available on site and there are hotels in the region that range up to five star.

Key economic criteria relate to the development of credible business cases. These cases depend on a number on higher level factors, please refer to our formal response to Q5.

The fundamental operational criteria for a viable spaceport as given in paragraph 2.13 are agreed. However please refer to our formal response to Q5 for a description of the weighting and impact of these and higher level criteria necessary for a successful spaceport.

demonstrate the additional factors of weather, environmental considerations and transport links. We would welcome views on whether other factors around the contribution to local and national growth should also be considered in the event that, following further analysis, there is more than one potentially feasible location to choose from. We would also welcome views as to weighting of such factors. At this stage the view is taken that these could include the factors below. We welcome views on these and views as to the weighting of these factors:

a) advancement of science and innovation;

b) growth of the space or aerospace sector including stimulating jobs in the wider supply chain or supporting existing space sector clusters

c) synergy or support to existing economic usage of the spaceport

location;

d) promotion of high level skills;

e) spin-off benefits such as tourism or other jobs related to spaceplane operations; and

f) deliverability.

2.15 Any UK investment in a spaceport will, as with any investment potentially involving public funding, need to demonstrate that such a facility is economically viable and will provide value-for-money for this support.

## An existing aerodrome?

### Comments

Other factors for consideration:

1. The integrated nature of space tourism and general tourism which can generate revenue to help support operations and ensure long term financial viability.

2. Associated opportunities such as an off-shoot of the National Space Museum, engine test facilities, satellite control operations that could help create a "critical mass" of space related business.

3. The opportunity to attract research and engineering organisations to the site or close by if sufficient consideration is given to investment in the necessary infrastructure.

We strongly believe that a UK spaceport will stimulate the advancement of science and innovation – spaceplane technology is already demonstrating that in the UK and is being backed by the Treasury. We believe UK spaceport will stimulate jobs in the wider supply chain and is consistent with the existing Argyll and Bute Economic Development Action Plan, 2010, enclosed with this submission. Argyll and Bute Council has developed its Economic Development Action Plan (EDAP) to focus the Council's resources on the economic development activities that will have the greatest beneficial economic impact on its communities and Scotland as a whole. The Action Plan clearly articulates the Council's priorities for developing the Argyll and Bute economy, thereby facilitating focus, effective resource planning and partnership working at the local, national and European levels. We believe this will reduce risk and help greatly towards achieving the desired goals. In addition, coupled with the MACC organisation, landlord of the site, we believe this will enhance deliverability.

2.16

In order to make maximum use of existing infrastructure, the CAA make a high-level recommendation that sub-orbital operations should preferably commence, either on a permanent or a temporary basis, from one (or more) of the following:

- an existing EASA-certificated aerodrome;
- an existing UK CAA-licensed aerodrome; and/or
- an existing UK military aerodrome, subject to MOD approval.

2.17 The CAA recommends that the location should still preferably be active but at a low level of aircraft movements and that it should have existing and appropriate ground infrastructure/facilities and service provision. The

CAA does not consider greenfield sites in the Review at the present time but has considered sites that have the potential to be licensed.

2.18 We would welcome views on these high level recommendations.

## The CAA's review of feasible locations

2.19 CAA reviewed all operational civil and military aerodromes within the UK to identify those that met the fundamental criteria of runway length – i.e. airports which already had a runway of at least 3000m and airports with runways over 2000m that could be extended.

2.20 There were 46 aerodromes that were either 3000m long or could be extended –

### Comments

Campbeltown is already NASA certified as Space Shuttle Landing site and is a CAA licensed airport. This will greatly enhance the credibility of the investment/ business case.

We believe a temporary spaceport will be of limited value. It may quickly be made obsolete and damage the business case for a permanent site or optimally, will delay the business case with attendant loss of advantage to industry and the UK.

We believe that a c3,000 metre runway is a minimum requirement and must be extendible and capable of reinforcement for fully orbital operations. Selection of a shorter runway will be more expensive to develop and may not be possible to support fully orbital capable vehicles.

but some are not currently operational and were ruled out.

2.21 Figure 9.1 in the CAA's Technical Report provides a tabular analysis of these 46 aerodromes based on a general assessment of airspace issues and population density.

2.22 CAA excluded those civil airports where the volume of aircraft movements, creating areas of segregated special use airspace and managing spaceplane operations on the ground would be impractical. Based on these factors, the CAA excluded a further 20 sites, including the four civil aerodromes with runways over 3000m (Heathrow, Gatwick, Stansted and Manchester).

2.23 This left 26 potential sites which met the CAA's operating criteria – as shown in Figure 9.2 of the CAA's Technical Report.

A coastal location?

2.24 If a decision were to be taken to do so, the earliest spaceflight operations would most likely to initially involve US regulated spaceplanes. To date, the need to meet FAA AST minimum safety standards has resulted in the licensing operations only in areas of very low population density such as desert and coastal locations. As there are no land areas of similar low population density in the UK, in its review, the CAA strongly recommends that a UK spaceport should be established at a coastal location to protect the safety of the uninvolved general public.

2.25 The CAA consider that in the UK, a coastal location will therefore best ensure the safety of the uninvolved general

Comments

Please refer to our formal response to Q8: We strongly agree a coastal location is the most suitable, both in terms of protection for the uninvolved public, but also because it will greatly ease and enhance operations. A good associated marine dock facility such as that available at Campbeltown, will facilitate construction/development/ fuel transfer with minimum environmental and community impact, and may allow sea borne launch capability to be serviced. In addition, large fabrications may be transported to/ from the UK Spaceport more easily.

public and offer the best chance of enabling operations to take place in line with FAA AST launch site licensing requirements.

2.26 The review notes, however, that with a better understanding of sub- orbital spaceplane safety performance and the possibility of the development of suitable certification codes, it may, in future, be possible to relax the coastal location requirement.

2.27 We would welcome views on the CAA's strong recommendation that initial spaceplane operations should take place at a coastal location. The CAA's shortlist of eight potentially feasible locations

2.28

Based on the CAA's essential operating criteria and strong recommendation to base a spaceport at a coastal location, the CAA identified eight existing working aerodromes which might feasibly host sub-orbital operations. These are:

Campbeltown Airport

Glasgow Prestwick Airport

Kinloss Barracks

Llanbedr Airfield

Newquay Cornwall Airport

RAF Leuchars

RAF Lossiemouth

Stornoway Airport

29 We would welcome views on the CAA's shortlist of eight potential sites.

#### Comments

Campbeltown is already NASA certified as Space Shuttle Landing site and is a CAA licensed airport.

Please refer to our formal response to Q8.

Please refer to Executive Summary for views regarding suitability of Campbeltown.

2.30 It should be noted that these are locations which the CAA believe may be technically suitable for spaceplane operations – however, it should be noted that no agreement has yet been sought with the MOD, civil owners of these airports or the local communities in which they are based. Location owners are entitled to withdraw their property from consideration if they choose to do so. We will work to seek the views and agreement of all those with an interest in any proposed location that may be identified before any decisions are taken to proceed with a UK

spaceport.

2.31 The CAA also note that a discounted site could be re-instated following a more detailed operational and safety analysis in the future. The Government herein recognises that at this stage, it does not rule out the case that the optimal location for a spaceport may be at a location not on the list.

#### Comments

It should be noted that the Campbeltown airport option has the uniquely strong support of the local community due to their ownership the site.

## Appendix 1 Level 0 Criteria/ Priority Matrix

Detailed explanation

Please refer to Figure 4.

High level requirements for a UK spaceport have been derived from a SWOT analysis undertaken by Highlands and Islands Enterprise of the Regional relationship to a UK spaceport. In the event of downselection of one or more Scottish locations, it may be appropriate to revisit the data and review the scope which has been inferred and the associated Stakeholders and their Requirements.

For the purposes of the consultation submission we have taken 8 of the (apparently) current most important requirements and placed in a QFD matrix- entered (as "Demanded Needs/ Stakeholder Requirements/ "Whats") marked in figure 4 as "A". They have been given a potential estimated weighting/ importance value of between 75 and 100. The QFD matrix has calculated relative weights using the accepted standard method – marked in Figure 4 as "C".

Potential characteristics of the UK spaceport considered most likely, at this stage, have been entered as "Design Characteristics/ Functional Requirements/ "Hows") - marked in Figure 4 as "B"

Using the "traditional" QFD method, each of the high level/ critical "Demanded Needs" has been correlated against ALL of the likely "Design Characteristics". This method associates values between 0-9 depending on how well elements correlate- marked in Figure 4 as "D"

Apart from the graphical representation of closeness of match, the chart also calculates "relationship" multiplied by "relative weight" and each column is summated.

Using the currently available data (which will improve in accuracy as UK spaceport progresses) it can be seen that "high level business and political support" is the most important characteristic for a successful UK spaceport. Relative weightings for all of the design characteristics are calculated- marked in Figure 4 as "E".

We have used this method to review the CAA criteria, which we have entered into a "level 1) matrix (please refer to our response to Q5).

Please note:

- Using the "Traditional QFD" method weighting/ importance values calculated are relative not absolute values.
- The current matrices are based on outline information, at a very early stage of programme development and will significantly more useful as better input data becomes available.

Legend		
⊗	Strong Relationship	9
○	Moderate Relationship	3
△	Weak Relationship	1
⊕	Strong Positive Correlation	
+	Positive Correlation	
⊖	Negative Correlation	
▽	Strong Negative Correlation	
▼	Objective Is To Minimize	
▲	Objective Is To Maximize	
X	Objective Is To Hit Target	

Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	Design Characteristics (a.k.a. "Functional Requirements" or "Hows")	Column #						
					1	2	3	4	5	6	7
				Demanded Needs (a.k.a. "Stakeholder Requirements" or "Whats")							
1	9	10.3	100.0	Operationally viable Spaceport	⊗	⊗	⊗	⊗	⊗	⊗	⊗
2	9	9.8	95.0	Business friendly planning and regulatory framework			⊗		⊗		⊗
3	9	9.8	95.0	Long term governmental commitment to allow necessary investment cases to be built			⊗	⊗	⊗		⊗
4	9	9.3	90.0	Flexibility of operational capability (suitable for vertical/ horizontal, sub-orbital/ fully orbital vehicles)	⊗	⊗		⊗		⊗	
5	9	9.3	90.0	Early commitment (before other countries step in/ need to develop business reqs. now)	⊗	⊗	⊗	⊗	⊗		⊗
6	9	8.8	85.0	Stable and predictable business environment	⊗	⊗	⊗	⊗	⊗		⊗
7	9	7.7	75.0	Local community/ government at local/ regional/ national support				⊗	⊗		⊗
8	9	9.8	95.0	Stakeholder requirements/ critical success factors drive the programme	⊗	⊗	⊗	⊗	⊗		⊗
				Difficulty (0=Easy to Accomplish, 10=Extremely Difficult)	5	5	0	0	0	0	0
				Max Relationship Value in Column	9	9	9	9	9	9	9
				Weight / Importance	426.8	426.8	400.8	584.5	589.2	176.3	589.2
				Relative Weight	13.1	13.1	14.2	18.0	18.1	5.4	18.1

(B) Design Characteristics

(D) Correlations

(E) Calculated Importance Values

(C) Weightings

(A) Demanded Needs

Figure 4 QFD Matrix Explanation

## Appendix 2 Stakeholder Identification

In order to obtain a view as to the likely critical requirements for a UK spaceport, and specially a Campbeltown spaceport, for the weightings of those criteria we have extracted an outline and necessarily first draft listings of stakeholders.

We have used this data to create an outline scope (boundary analysis- which has not been submitted at this stage as is an early draft) and due to time constraints we have only been able to question a small sub-set for their views.

Construction companies	Port operators
Waste disposal airport chemicals	Scottish and National government departments
Rocket launch operators	Utilities (Nat. Grid, Water/ sewage/ gas/ telecoms)
Air traffic control	Tourism organisations
Meteorological office	Local businesses
CAA	Local residents
Space plane developers/ operators	Argyll and Bute council
Rocket fuel suppliers	Ministry of Defence
Fuel handling and storage logistics specialists	Highlands and Islands Enterprise
Cryogenic specialists	Scottish Enterprise
Emergency rescue services	International/ national investors
Navy/ maritime patrol (Coastguard)	Space community
Environmental impact specialists	US space companies
Port operators	Protest groups
Oil rig maintenance companies	Specialist corporate communication agencies

## GLOSSARY OF TERMS

Term	Meaning
CAA	The Civil Aviation Authority (CAA) is the statutory corporation which oversees and regulates all aspects of civil aviation in the United Kingdom
CSF	Critical success factor (CSF) is the term for an element that is necessary for an organization or project to achieve its mission
CTQ	Critical-to-Quality (requirements) are the key measurable characteristics of a product or process whose performance standards or specification limits must be met in order to satisfy the customer
EASA	The European Aviation Safety Agency (EASA) is a European Union (EU) agency with regulatory and executive tasks in the field of civilian aviation safety.
EDAP	Economic Development Action Plan
EU	European Union
HIE	Highlands and Islands Enterprise (HIE) is the Scottish Government's economic and community development agency
HIAL	Highlands and Islands Airports Ltd
IOC	Initial operating capability or Initial operational capability (IOC) is the state achieved when a capability is available in its minimum usefully deployable form
MACC	Machrihanish Airbase Community Company
MOD	Ministry of Defence
NASA	The National Aeronautics and Space Administration (NASA) is the United States government agency that is responsible for the civilian space program as well as for aeronautics and aerospace research
NATO	The North Atlantic Treaty Organization
QFD	Quality function deployment is designed to

Term	Meaning
	help planners focus on characteristics of a new or existing product or service from the viewpoints of market segments, company, or technology-development needs
REL	Reaction Engines Limited (REL) is a British aerospace company based in Oxfordshire, England
RAF	Royal Air Force
ROI	Return on investment, used to evaluate the efficiency of an investment in finance and economics
SABRE	SABRE (Synergistic Air-Breathing Rocket Engine) is a concept under development by Reaction Engines Limited for a hypersonic precooled hybrid air breathing rocket engine
SKYLON	Skylon is a design for a single-stage-to-orbit spaceplane by the British company Reaction Engines Limited (REL)
Spaceplane	A spaceplane is a vehicle that operates as an aircraft in Earth's atmosphere, as well as a spacecraft when it is in space
Spaceport	A spaceport is a site for launching (or receiving) spacecraft
SSTL	Surrey Satellite Technology Ltd is a spin-off company of the University of Surrey, now majority-owned by EADS Astrium

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