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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 1 of 2

Submitted by **MACC, Machrihanish Airbase Community Company**, owner of
Machrihanish Airbase

MACC

Capital
Ambassadors

Response submitted by

Ian Wardrop

Chairman

Machrihanish Airbase Community Company

Building 79

Machrihanish Airbase

Campbeltown

Argyll, PA28 6NU

Telephone: 07881-972093

e-mail: iwardrop59@gmail.com

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Machrihanish, Campbeltown 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 paper

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

The submission is for Machrihanish Airbase, Campbeltown and is provided in two parts; one from MACC, owner of the airbase (this document) 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.

This document highlights the issues in relation to airbase suitability and the strong likely match between the needs of a spaceport operator to the currently available assets. For a discussion of the wider area and regional issues please refer to the CPP document.

Both parts of the 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

Executive Summary

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Ian Wardrop

Chairman, MACC Ltd

MACC 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 15th July 2014.

Basis of submission

This submission has been made by the Machrihanish Airbase Community Company (MACC) which is a company limited by guarantee with charitable status owned and controlled by local people within the postcode area of Kintyre. We, as the landlord of Machrihanish Airbase (incorporating Campbeltown Airport) have written this document in cooperation and in conjunction with the Community Planning Partnership (CPP) of Argyll and Bute Council who have submitted a separate but closely related paper. Both documents express and contain the strong, committed will of interested local and regional parties to support UK Spaceport in order to make it a sustainable, successful enterprise that will be of significant benefit to the local, regional and national interest.

Registration of strong interest

The owners and management of Machrihanish Airbase would like to express their interest in becoming the location of the United Kingdom's first spaceport. As an organisation MACC is a powerful and effective construct that embodies the will of the local populace, we have an efficient "can do" style of management and a proven track record. MACC has been working closely with Highlands and Island Enterprise, to attract high technology industry to the site as well as supporting our largest tenant, Highlands and Islands Airports Limited with approximately 17% of the local voting population as members of the organisation this provides for the best possible support for the UK spaceport and we believe can be a major de-risking factor for the proposed business.

We strongly believe in the need and projected benefits to the local area, region, and nation of a UK spaceport and that the assets at our disposal (which include a 3,049 metre runway that was accredited by NASA for Space Shuttle landings with

a 2,970 metres taxiway) may be an excellent match against the criteria published in the consultation document. We also believe that we are a strong match against the critical success factors that we have identified in our own “broad brush” based analysis, details of which we provide in this document.

We believe that it is vital, for the success of UK Spaceport, that a business friendly environment is created that will allow the necessary investment to be made, and to that end, UK spaceport should be requirements driven by the key stakeholders. To make the UK spaceport as attractive as possible to customers and investors we believe the case should be expanded from suborbital vehicles to fully orbital capable and perhaps more urgently considered, vertical launch. Vertical launch may provide the earliest, largest income stream and be of strategic value to the UK.

Given the shortage of available land for a large “safety footprint” it may be viable to look in detail at seaborne launch perhaps providing integration/decommissioning and other services from the land site. We recommend that these issues be investigated as soon as possible, since it will have a profound impact on the capability requirements and assets that must be planned for and financed. These suggestions are based upon the Sea Launch SA Energia Odyssey platform concept (please refer to Question 3 response) but further more detailed comments are subject to commercial confidentiality and cannot be submitted in this document.

MACC is a small but efficient organisation, agile and flexible, integrated into and well supported by the local community, it can react swiftly to the needs of the business and would be an excellent partner following downselection to assist in the rapid development of business plans and to participate in the necessary governance and regulatory approval process in order to create the best conditions for achieving Initial Operating Capability within the desired timescales, whatever that capability is decided to be.

On MACC's 1,000 acre site assets include plenty of low cost space for businesses, accommodation on site suitable for construction crews designed to house 2,000 personnel, existing hanger space of varying size, large aircraft hard standing aprons, conventional fuel storage capacity of 6.2M litres, fuelling facilities and many dispersal sites. Although we are in a remote location, there are excellent transport links (we are 43 miles from Glasgow, 50 miles from Belfast by air, have good ferry links and a first rate road link, the A83 to Glasgow,). We have extensive experience of moving large fabrications (of large aircraft fuselage size, in fact wind turbine towers) from the recently refurbished marine dock to and from the site.

Vision & Mission Statement

Our vision is to create a value proposition for space launches and recovery that aims to make UK spaceport the pre-eminent European facility by means of its ease

of use, cost effectiveness and flexibility. We believe such a business would attract high technology engineering service companies, operators, spaceplane builders and academic institutions, and deliver the required knock on benefits.

Our mission statement would include strong safeguards for the environment, and a commitment to deliver using an ethos of openness, transparency and ethical behaviour. This is extremely important in order for the UK spaceport to operate in the required remote location, which in Scotland will be, whatever location is selected, an area of outstanding natural beauty.

MACC's unique position, thanks to the far sighted nature of its constitution, would provide for a hosting site for the UK Spaceport that would "hit the ground running" and we believe, exceed expectations of success. Should we be downselected we would pursue the programme with the utmost vigour and enthusiasm and a dedication to uphold the highest standards in everything that we do. We recognise the need to operate at "eight sigma" and to interface and align our processes and procedures to operators and other related organisations at that level.

We believe MACC would make an excellent start point for a safe, strong, sustainable, environmentally sound and profitable business which would nurture and support many enterprises and help accelerate and enhance the benefits to meet local, regional and national expectations.

For the above reasons I commend this document for consideration.

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Ian Wardrop

Chairman, MACC

Campbeltown

Further questions/ clarifications please contact:

Malcolm McMillan
Business Manager, MACC

Telephone: 01586 551555
e-mail: malcolm@maccdl.co.uk

Highlights from the consultation questions raised

In answering the questions posed in the consultation document both the formal questions 1-11 and the other issued raised elsewhere in the narrative, it would appear to us that the following process is indicated:

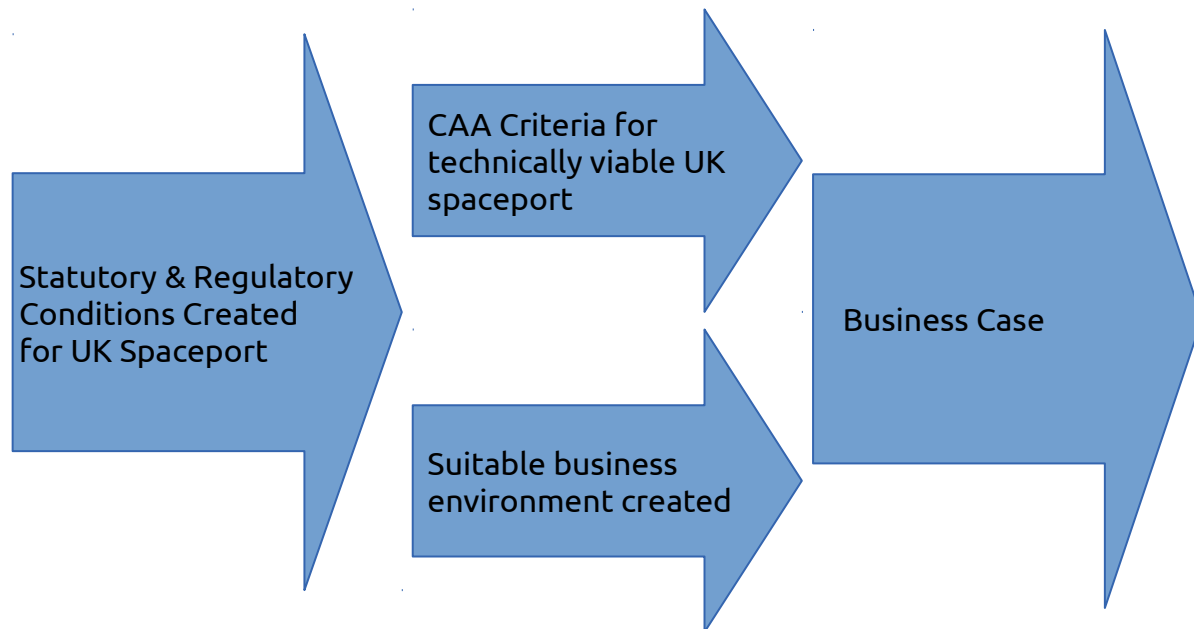


Figure 1 Precursor processes for UK Spaceport

We feel it is necessary for the statutory and regulatory conditions to be in place in order to determine the criteria that need to apply in order to create an enabling business environment and a technically viable spaceport.

Once these conditions are in place business cases can be created and investment made.

In relation to the business case, we feel that three possible modes of spaceflight need to be considered; suborbital, fully orbit capable and vertical launch. The best business case will probably be created if two or all three modes can be facilitated. The requirement is to create the most flexible and capable UK spaceport otherwise the customers might not materialise.

If successful, on downselect of Machrihanish , Campbeltown, we would mobilise a joint team including our own management, Community Planning Partnership, Argyll and Bute Council and Highland and Islands Enterprise along with other relevant stakeholders and specialists to investigate and identify solutions to the many interrelated and complex issues involved. Among these would be the transformational path from commercial airport/airbase to spaceport, as well as the commercial and operational structures required to achieve IOC (Initial Operational Capability). Also requiring careful consideration would be the nature of any suitable operational relationships/

partnerships required to enable the spaceport to become commercially active both quickly and to the economic benefit of the region in particular and the UK in general.

Spaceplane operations will take place at high sigma levels of quality, and we are aware that it is important in order to meet those targets that we embed the correct processes right at the beginning. If Machrihanish, Campbeltown is selected this will take place and will build upon systems engineering processes that we have already initiated/ are in place.

The timing of the decision making process is critical. Significant investment may have to be made and made quickly in order to meet the desired timescales for Initial Operating Capability, and a rapid decision is therefore required in order for the successful site to commence the transformation process (which will be complex). Timing is also of the essence in relation to potential deals- we are working within a globally competitive space and need to play against strongly developing alternatives in other countries. We cannot progress certain commercial discussions nor yet provide details of our innovative solutions due to commercial confidentiality.

The implications of the above are such that the site with the best existing assets that most closely meets the required need (for whichever mode of spaceflight launch) will be best placed to meet timescales at the most economic costs with the least risk. For these reasons we are confident that Machrihanish, Campbeltown offers the UK spaceport an excellent opportunity to meet the key factors of success.

Machrihanish, Campbeltown's assets are appropriate, modern, well maintained, suitable and built around the longest civil runway in Scotland, capable of enhancement and extension and a modern control tower. However, we note that even at 3,049 metres our runway is likely to only just support sub-orbital spaceplanes – and fully orbital spaceplanes may require longer runways that are doubly reinforced (source: REL). This must surely be a critical factor for UK spaceport success, as to select a location that is not likely to be able to be enhanced for such vehicles would have a limited usefulness. Without such ability, the more ambitious government aims are unlikely to be met since the academic, engineering and operational business would follow the 'fully capable' operational locations, leaving a "limited UK spaceport" behind and the goals below having a low probability to be met:

- 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
- d) promotion of high level skills;
- e) spin-off benefits such as tourism or other jobs related to spaceplane operations; and

Lastly, people are also one of the greatest assets. The Machrihanish Airbase is community owned (approximately 17% of the voting population are members); we have solid local support from the population, which we believe will be a key factor in the success of UK spaceport together with experienced existing ground and control tower staff who could rapidly form the nucleus of an operational team for UK spaceport.

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 strongly agree with this statement. However, we believe that the substantial commitment required for UK spaceport (for investment in the spaceport facility, for all the necessary supply chain development, development of dedicated specialist assets etc.) necessitates a decision to be taken promptly. It is difficult to see how an investment case could be made for a temporary location unless it were only for a strictly limited purpose i.e. only for White Knight One/ SpaceShipOne. If this were to be the case we believe a major business, technical, and scientific opportunity may be lost to the UK as operators and customers will simply go elsewhere and much of the hoped for positive knock on effect will evaporate.

Selecting from existing licensed/ military facilities will reduce costs and time to initial operating capability (IOC). Reducing cost and risk which will make the investment case for both public and private investment far more viable. The better and more suitable the existing resource, the better the investment case.

The Campbeltown runway, at 3,049 metres is the longest civil runway in Scotland, was NASA approved for Space Shuttle landing, and offering good potential for extension, however, we note that Spaceport America has had to upgrade their 3,048 metre runway to 3,658 metres on safety grounds at the request of Virgin Galactic, a condition which will probably have to apply to UK spaceport also.

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 selection of an existing airport with a relatively low level of current aircraft movements is the best way forward. This helps ensure that spaceplane operations can be built up from existing aviation assets and process, which is the most cost effective and easiest way to de-risk the development of a spaceport (a greenfield site may prove very difficult to finance). In addition, Machrihanish, Campbeltown could utilise its 2,970m taxiway to accommodate current and increased levels of aircraft movements in tandem with spaceplane operations. This would provide an additional level of flexibility, with little additional investment.

At this moment in time it is not clear how the regulatory environment will operate in relation to aviation and spaceplanes, and the need to consider the move towards "Open Skies". We therefore suggest selection of a site having low levels of utilisation is the best way forward.

In the case of Campbeltown, there are excellent fuelling facilities from an ex-NATO jetty which would avoid road transport of fuel. Large fuel stores (6.2M litres) and the associated delivery hardware (currently for aircraft) are presently under care and maintenance and could easily be brought back into service and modified for the required vehicle type.

Campbeltown, also has large hard standing aprons available in addition to fuelling ("lollipops") and active existing, well trained ground crew trained in operations including de-icing, hazardous material handling (together with the necessary facilities) and an existing manned control tower.

These existing assets will require some investment to upgrade/ update but likely to be several orders of magnitude lower than building onto greenfield.

Q3

Do you agree that greenfield sites should not be considered?

Response: A greenfield site will dramatically increase the cost, time to first operations, and programme risk. Furthermore, a greenfield site will not benefit from experienced ground crews/ control tower staff that will be needed although additional skills training will clearly be required for a spaceport.

We believe it may be difficult, perhaps impossible, to create a viable business case for a greenfield site.

However, we suggest for vertical launch, either an existing site footprint is enlarged to 45 square kilometres (partly by means of a coastal location) as an “existing plus greenfield” site or that a sea launch capability is associated with a “non greenfield” vertical launch spaceport. A sea launch platform (possibly a barge or re-purposed decommissioned oil platform) could be serviced from a marine dock associated with the UK spaceport.

This is similar to the launch facility provided by Sea Launch SA of Switzerland (using RSC Energia services). The Sea Launch Program launches from an ocean based platform, *Ocean Odyssey*, 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.

We would be interested in investigating such possibilities provided it is arranged in such a way as not to delay the main UK spaceport site selection decision.

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Photograph 1 Launch of Zenit-3SL rocket from the Sea Launch platform *Ocean Odyssey*

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 CAA's analysis identifying operational criteria to be considered in identifying a permanent location for a UK spaceport, but in addition believe two main points must be made:

1. An over-arching set of criteria must be considered concerning the governance of the overall concept of a UK spaceport- that the criteria relating to a viable and sustainable business case must have overall priority, which would then allow the CAA's suggested criteria to be applied and
2. Additional criteria must be considered as a result of the over-arching criteria – for example, those that relate to fully orbital capable vehicles and vertical launch services (which will help identify or discount suitable sites that can offer the most comprehensive and flexible set of capabilities).

Without these being taken into account, we suggest the UK Spaceport risks failing due to a viable business case not being possible, or the Spaceport not being attractive to potential customers, or being uncompetitive against other sites that are currently available or may soon be available in the future.

Campbeltown airport's customers have a choice to travel and if so to use the airport, or other means of travel. If they decide to fly they can only practically use Campbeltown. However, the spaceport customers, having decided to use a spaceport facility in general do not have the constraint of having to use a geographically local facility. As an example, a space tourist can choose whichever spaceport is nicest and gives the richest experience. Likewise a small satellite launch customer might chose the launch facility that can offer the earliest slot or meet best price/performance criteria. This is why the above issues are of prime importance.

It is vital to create the conditions for investment, the ability satisfy the need to attract space operators and support associated companies and organisations in the commercial, scientific and potentially military domains. Furthermore, it is essential that there is solid local support for a careful and controlled development.

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

In the case of Campbeltown, we have learned much and gained much by holding the airbase in community ownership. Approximately 17% of the voting population are members of MACC, the corporate owning body, and this ensures local views and concerns are given a strong and effective voice and are acted upon. This unique corporate structure has many strengths – extremely pertinent in relation to the development and operation of the first and possibly only UK spaceport.

We believe such an arrangement may be a key factor in the success of UK Spaceport- necessary to meet the stringent Initial Operating Capability timetable, developing environmental, safety and regulatory approval and key to business success.

Strong local support adds a great deal to the business proposition, reduces risk and increases the investment potential. It increases the opportunity for inward investment, exploitation of all the business opportunities at the local, regional and national levels.

In addition, spaceports are not like airports in terms of their customers- 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. The maximum possible existing runway length suitable for enhancement in terms of strength and significantly in length as required by spaceplane operators (assuming the REL SKYLON may be typical of fully orbital capable vehicles and using its design specification, the runway and taxiways will need to be capable of supporting vehicle fully loaded gross weights of in the order of 435,000kg with high point loadings due to a "minimal" configuration of undercarriage wheels. Such a vehicle will require a runway somewhat longer than 3,000m).
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
5. Significant re-location of local population unnecessary
6. Infrastructure capable of supporting and experienced in handling visitors/ world class tourist facilities/ large crowds
7. Remote but accessible; good existing transport links for people/ large fabrications
8. Good existing logistical capability to handle safe fuel delivery/ storage/ HAZMAT
9. Local agencies track record of working with/ accelerating high technology industry
10. Strong positive support from a united and cohesive local community with a track record of support for new industrial development
11. Availability of likely required construction materials close to site
12. Good connectivity to renewable energy sources for potential fuel processing

We also believe that if possible, the optimal location selected should also be best placed to be able to provide commercial, engineering, and academic links and benefits with Northern Ireland as well as with the region and in general, the UK.

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Photograph 2 Spaceport America terminal/ hangar facility as of October 2010

Q6

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

Response:

At this stage, without additional 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 (weighting) orders:

1. High level political and business support (investable)
& =1 Development of a pro-business economic & regulatory environment to make the proposition as attractive as possible to both private and public investment
- 3 Ongoing stakeholder engagement process to obtain Critical Success Factors & assimilate
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 vertical and horizontal flight.
& =5 Existing suitable licensable runway with minimum of 3,000 metres length capable of development to support sub-orbital and fully orbital capable spaceplanes.

For spaceport to be a success it will require significant investment which will deliver a long term Return on Investment. In order to make a successful business case it will need to demonstrate flexibility in use and capability. Therefore it will need 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 service what would appear to be growing a requirement.

At this stage, it is too early to make qualitative statements regarding potential vertical launch, however, there are precedents for sea-borne launch from barge/ platform which would appear to offer a viable solution to the UK's lack of uninhabited land space. In order to allocate budgets and to produce authoritative comment it is likely that downselection will have to take place first. It is therefore important to be able to keep this option open during the downselection process, this would most likely be for polar orbit.

In addition to the usual set of aviation environmental concerns of pollution, noise, etc. environmental impacts will need to be considered for the special aeronautical

characteristics of spaceplanes/ rocket engines. For a vehicle such as SpaceShipOne, the carrier craft will operate generally as a conventional aeroplane, but the SpaceShipOne will need fuelling and will fire a rocket engine. It is not clear, at this stage what type of fuel that will be and hence what environmental impact mitigations would be required. If hydrogen fuel is to be used (such as by REL's Skylon), the environmental criteria are very different, and consideration to creating and processing that fuel in an environmentally friendly way may offer significant challenges, but substantial gains by utilising available renewable energy sources.

We feel that the presence of space launch/ landing operations will attract large volumes of visitors. This in turn will have a potential environmental impact that will need to be carefully mitigated in order to ensure that there is a positive impact on the locale and not a negative one. This might be similar to a large airshow, such as that held at Machrihanish.

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:

We suggest the selection of the successful site should be governed by the "level 0" criteria we have listed in answer to Q6, which help create the environment needed for public and private investment necessary to fund and sustain the spaceport. We believe these factors are more important than the CAA stated criteria which are nonetheless vital but are subservient to Level 0. Without the Level 0 criteria being satisfied it will not be possible to commit the financial, technical and commercial resources necessary to get UK spaceport into operation meeting the CAA criteria. Higher level criteria 1-4 relate directly to supporting local and national growth, and allow development of compelling propositions to support this agenda.

A key immediate problem relates to current UK-based fully orbital capable spaceplane developers; we understand that potential equatorial launch site viability studies have already been funded and assessed (relating to the Guiana Space Centre near Kourou in French Guiana). If that is so, there is a need to develop a strategy to identify what can be done to make a UK spaceport site attractive over other European sites (for example the North European Aerospace Test Range, located in Northern Sweden) and if

necessary, incentives developed. This might be at a UK strategic level but would, if so, clearly have a large impact on the UK spaceport business case.

In addition, we believe time is of the essence. Even for a potentially suitable and well qualified site as Machrihanish, Campbeltown, a significant change programme will need to be put in place. This will take the "As Is" to the "To Be" state as efficiently and economically as possible but will require extensive planning and programme management. A transformation roadmap will need to be created reflecting the likely step changes in capability loosely identified in figure 3.1 of *"UK Government Review of Commercial Spaceplane Certification and Operations: Technical Report July 2014"*. The sooner this activity can start, the soonest risks can be identified, verified, impact-assessed, frequency estimated, and mitigated.

It is envisaged that a wide range of feasibility and capability assessments will be required. A strong programme management team will be required having a long term mind-set to manage this activity.

The above activities will be complex and need to be allocated sufficient time to ensure that they are carried out completely, comprehensively and with appropriate accuracy.

Particularly in relation to the level of inter-dependency of programmes of this type, it will be necessary for the management team of the selected site to be able to demonstrate that it can work closely with partner organisations, effectively and efficiently.

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 believe that a coastal location offers many potential advantages to UK spaceport that are unlikely to be negated by changes in the safety case of orbital spaceplanes. A

coastal location having access to good marine dock facilities reduces transport and logistical problems and cost, and improves the safety case. For example moving fuels by sea rather than by road is preferable from a safety perspective in addition to being more environmentally friendly.

Furthermore, segregated dock facilities that separate fuel transport and storage from other goods and materials is preferable from the standpoint of operational and safety process.

However an over-arching consideration relates to the potential of sea borne launch for vertical take off. For such operations, a coastal location would offer advantages that may be essential. At this stage it is not clear whether sea borne launches are viable or desirable or required, however, such a service might be stand alone but more probably be dependent on sustainability from the main UK spaceport.

Finally a coastal location offers the possibility of moving large fabrications to the site by means of marine transport. This would avoid the need, for example, to transport large vehicle components such as fuselages by road although at Campbeltown both methods are likely to be viable (currently large wind turbine towers are transported this way onto and out of the site from the town's excellent dock facilities via a straight road free from obstruction). As an example, the SKYLON fuselage as currently designed is 82 metres in length and 6.3 metres in diameter. We assume other spaceplanes with similar capability may be of similar size. It therefore seems reasonable to suggest that a coastal location such as Machrihanish, Campbeltown, that can offer existing logistical facilities for loads of that size would be a prudent consideration.

Q9

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

Response:

We are only able to comment on Machrihanish Airbase, Campbeltown.

Machrihanish Airbase, a 1,000 acre site with 200 buildings, a 3 kilometre runway that was approved by NASA for emergency Space Shuttle landings and a 2,970 metre taxiway, has few limitations in order to be enhanced for sub-orbital and fully orbital capable spaceplanes, has a coastal location potentially necessary should vertical launch facilities be viable, but most importantly is owned and controlled by the local population. In addition to having the support of the local community, MACC has close ties with Highlands and Islands Enterprise, Argyll and Bute Council and the Scottish Government and these unique relationships create a team that is agile, flexible, efficient and embodies a spirit of "can do".

This is uniquely advantageous and is a significant de-risking factor that will enhance the investment case and is likely to be a key factor in reducing the time to Initial Operating Capability (IOC).

Machrihanish is home to one of the UK's two wind turbine manufacturers, is one of few operational NRIP (National Renewables Infrastructure Plan) sites as well as the existing Campbeltown airport. MACC's management in conjunction with Highlands and Islands Enterprise have proven their ability to cooperate as an effective team able to attract new industry and encourage its development. This is a reflection of a "Can Do" attitude that pervades the existing business and local community. Should Machrihanish, Campbeltown be downselected for UK Spaceport the opportunity will be enthusiastically and vigorously pursued to ensure that the enterprise becomes an outstanding success.

Construction and development, in accordance with a technology and development roadmaps will possibly require large volumes of construction materials to strengthen and potentially lengthen the runway- substrate materials are available close to the perimeter (these sources were used to build the airbase) and ex-MoD accommodation for 2,000 personnel (some requiring re-commissioning) is available to house construction teams, if necessary.

Machrihanish, Campbeltown's site includes a large amount of hard standing, 'conventional' fuelling facilities and hardened shelters. One such shelter area has been provisionally allocated for an engine test cradle (assuming maximum thrust of up to 1,500kN).

Close to Campbeltown are large existing or planned off shore wind farms, and several tidal energy sites, and subject to detailed investigation, these renewables generators might be suitable to become a key component in an environmentally efficient hydrogen generation processing plant for possible spaceplane coolant/fuel.

Q10

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

Response:

We would request that any location that cannot be considered for permanent operations, or that cannot feasibly support potential fully orbital spaceplane operations

should be disregarded, in order not to prejudice long term business plans for a permanent UK spaceport which would have to include provision for fully orbital capable vehicles.

We believe that a runway length of approximately 3,000 metres would be an absolute minimum to support the requirements for the current generation of sub orbital spaceplanes (based on the original length of Spaceport America's runway of 3,048 metres which has been extended to 3,658 metre length at the request of Virgin Galactic on safety grounds). Lengthening would also be required to support fully orbital capable vehicles such as REL's SKYLON. There may also be a case to disregard a location that would prohibit or could not support sea borne vertical launch.

It is not yet clear whether a UK spaceport will be attractive enough for a fully orbital capable vehicle operator to use. We believe the European Space Agency (ESA) has already funded a viability study to assess the change case for utilising the ESA site in French Guiana (Centre Spatial Guyanais (CSG)) and also it has been publicised that such vehicles may use a Swedish European spaceport. We suggest therefore, that any location that cannot deal with such "competition" should not be considered.

We believe there is a window of opportunity to develop a truly comprehensive and flexible UK spaceport but that if a site is chosen as a temporary location, such an action could effectively harm the business case for a permanent site. We strongly believe this would not be in the the interest of the UK in general and it's space industry in particular.

Q11

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

Response:

We are not aware of any other suitable location.

Submission comments in relation to specific paragraphs

Consultation Document Text



Introduction

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 have the potential to

Our Comments



Comments

We agree that a strong case exists for a UK Spaceport, based on the rapidly developing market in space tourism, the development of spaceplane technology and need to support alternative/ cheaper satellite launch services.

We strongly support this ambition and believe that our existing asset could form a large component of a viable and sustainable and commercially attractive proposition.

Although we concur with these possible timescales, we believe that significant benefit can be achieved for the UK space industry, the local, regional and national economy by the early designation of a UK Spaceport. This will allow commercial, technical and academic relationships to be created in a timely manner with the purpose of exploiting the market and developing new ones and may accelerate technical and scientific progress. Early designation will also allow the very substantial business planning and relationship development, funding and transformation work, etc. to commence.

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

what would be required – from an operational and regulatory perspective – to enable spaceplanes to operate from the UK within the timescales

Comments

We agree that the costs and flexibility of satellite launch may be transformed, but this depends on ensuring that the programme has a business and requirements driven focus.

We agree there could be significant positive knock on effects, but that will depend on the UK Spaceport closely and accurately reflecting the needs of the operators and other key stakeholders. Since this is a highly complex business, much will depend on the careful matching of the best available resources that can be developed as economically as possible to reflect all stakeholder needs. We emphasise the “prize” depends on a prompt decision making process using needs-driven, outcomes based thinking.

Conversely, there are already potentially large business opportunities being generated, and the earliest a decision is made the earliest those opportunities can be exploited and not lost to the UK.

Photo removed in electronic file format

Photograph3 REL Heat Exchanger/ Precooler

REL heat exchanger technology developed from spaceplane development that offers immense spin-off benefit.

that operators 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.

Comments

We note the CAA recommendations and in particular their reference to the importance of vertical launch. We believe it is necessary to consider suborbital, fully orbital capable and vertical launch together since they are all part of a single business. Consideration in isolation could lead to one or other of the segregated business opportunities collapsing or failing to initiate or being eliminated by a spaceport competitor. Such a risk may prohibit the satisfactory development of viable business plans.

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

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 barge/ sea platform launch service operated, for example, from the marine port of Campbeltown or by means of a "federated site" that may possibly utilise a decommissioned oil platform.

Depending on how the above issue is dealt with, the safety "footprints" will vary considerably.

1.13 One of the most important factors in 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

It should be noted that the term "spaceplane" encompasses vehicles with quite different operational capabilities and needs. Virgin Galactic's White Knight Two and SpaceshipTwo are very different in characteristic to REL's SKYLON. In addition, REL's hypersonic transport, A2 being developed under the LAPCAT European FP6 study and LAPCAT II follow on project, has yet a different set of characteristics and a much longer timeline of development and planned introduction to service. It is essential that UK spaceport decisions are based on a reasonable view of the developing market encompassing the different likely types and are not biased against a single category of vehicle.

Utilisation of an excellent existing infrastructure (such as at Machrihanish, Campbeltown which was certified for emergency landing of NASA's Space Shuttle) will reduce time to operate, development costs and investment risk. However, such an approach must take into account the potential for development and enhancement for probable future vehicular operations or potentially face medium to long term failure.

We note and agree with the listed criteria and further recommend the additional ones in this response 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 licensed 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

The CAA's summary and conclusions Chapter 2 is an interesting and useful summary of technologies but does not differentiate between the very different spaceport needs of the vehicles listed.

We believe the REL approach for fully orbital capable vehicles, is probable, utilising long rollout distance and reduced undercarriage weight by reducing the number of wheels, dramatically increases the point loads and implies that a Spaceport runway will need to be planned to evolve to support such needs or face obsolescence.

It is assumed that rules AST-200 may apply but that other regulatory matters such as Regulation and Analysis and Safety Inspection (AST-300 & AST-400) will be undertaken by European or UK based authorities due to issues of jurisdiction

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 important to note that Spaceplanes and related hypersonic transports may both require similar Spaceport facilities as the engines and fuelling could be closely related (SABRE/ SCIMITAR). We understand the A2 is planned to operate at commercial civil aviation safety standards, SKYLON at approximately military aviation standards which is why the A2 planned introduction is perhaps more than 20 years after SKYLON, but nonetheless will require careful consideration and potentially incorporation into a UK spaceport technology roadmap.

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.

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

To protect the uninvolved general public,

Comments

Based on information from spaceplane developers and Spaceport America, we believe a runway length in the region of 3,000 metres is the minimum required length and that the runway selected for UK Spaceport must be capable of additional lengthening and reinforcement as economically as possible otherwise it could rapidly become obsolete.

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 significant public interest.

Comments

We believe that a UK Spaceport decision should be based on maximising the flexibility and attractiveness of the site, possibly by offering vertical as well as horizontal launch capability. This may be a key factor in ensuring the spaceport is a viable financially supportable business.

We believe a coastal location offers many operational and business advantages in addition to safety, although it is a key factor.

We suggest that many potential sites have "micro-climates" that vary significantly from the surrounding countryside (beneficially or in some cases negatively). For example, Machrihanish, Campbeltown tends to benefit from this phenomenon and meteorological data for that site is given in Appendix 1.

We agree that current environmental regulations would apply for known impacts, but additional consideration should be given to rocket engine fuelling/ testing and flying and/or the operation of hybrid engines – the characteristics of which we have yet to understand (including hydrogen generation/ processing).

Other environmental impacts in addition to operations that must be mitigated will include small/regular visitor numbers, infrequent but large crowds (e.g. similar to an airshow) and construction.

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 demonstrate the additional factors of

Comments

We agree that the listed environmental issues are important, but also the wider environmental impacts of the spaceport development and its associated indirect impact on the community; construction and development, increased numbers of residents and tourists, additional requirements on local infrastructure, transport, services such as medical, schooling, utilities, shops and restaurants etc.

The selected site should be remote but having excellent existing transport links, together with world class hotel and leisure facilities making it suitable as a space tourism location.

We agree that the criteria are valid fundamental operational issues but would qualify as follows:

1. The runway should be suitable for use or development by suborbital AND fully orbital capable vehicles.

2. Higher level governance and business issues must be resolved prior to dealing with the "technical/operational" criteria.

We believe the higher level governance and business issues must be satisfactorily resolved in precedence to the criteria given in para 2.13.

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?

2.16

In order to make maximum use of existing infrastructure, the CAA make a high-level recommendation that sub-orbital

Comments

We agree that other factors around the contribution to local and national growth should be considered, however, the factors a) to e) should be considered as benign knock on effects that are desirable but not essential. Factor f), deliverability is a critical success factor. If the regulatory/governance framework is unworkable, or the spaceport cannot be financed, or a location is chosen that is unsuitable then UK spaceport will fail and there will be no positive effect whatsoever. Please refer to our responses to Q5 & Q6, where we have attempted to identify and prioritise key critical success factors.

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 – 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

Comments

We do not support a temporary site since it could damage or destroy the business case for a permanent UK spaceport.

We believe that a 3,000 metre runway length on an existing EASA certified or CAA licensed airport is a minimum requirement. Since fully orbital capable vehicles are likely to require longer rollouts, the selected runway must be capable of extension and reinforcement to cope with the likely point loads. Machrihanish, Campbeltown, for example, is already NASA certified as an emergency Space Shuttle Landing site and is a CAA licensed airport and highly suitable for development.

Machrihanish, Campbeltown could utilise its 2,970m taxiway to accommodate current and increased levels of aircraft movements in tandem with spaceplane operations. This could provide a level of flexibility, with little additional investment.

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 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

Comments

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Figure 2 Example of connectivity of a coastal site

Since the operational drivers for a coastal location look strong, we do not think it likely that a coastal location will become irrelevant nor unwanted by a spaceport operator because such a location would seem to offer many advantages. We also believe that a coastal location will enhance the connectivity of the site, particularly where a location can access Northern Irish as well as Scottish hinterlands. Please refer to our response against Q8.

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.

2.30 It should be noted that these are locations which the CAA believe may be technically suitable for spaceplane

Comments

We assume AST-200 applies

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Photograph 4 Aerial view of Machrihanish, Campbeltown runway

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

Please refer to our responses to Q9 & Q10.

Machrihanish Airbase, which includes Campbeltown airport is owned and managed by Machrihanish Airbase Community Company (MACC)- it is a company limited by guarantee with charitable status owned and controlled by local people within the postcode area of Kintyre. This unique position provides strong local support, (it has 660 members which is 17% of the voting public of Kintyre), which together with it's readily extendable runway of currently 3,049 metres (which has already been NASA accredited for emergency Space Shuttle landing), a 2,970metre taxiway, 1,000 acres of land and 200 buildings makes the location a perfect candidate for UK Spaceport.

Appendix 1 Meteorological Data

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Average annual climate values Machrihanish, Campbeltown

Year	T	TM	Tm	PP	V	RA	SN	TS	FG	TN	GR
1973	9.5	12.0	6.4	1003.27	23.4	275	29	4	32	0	33
1974	9.5	12.1	6.4	1088.37	26.0	282	15	3	16	0	26
1975	9.8	12.5	6.7	976.84	23.0	254	14	10	44	0	20
1976	9.8	12.3	6.6	1107.74	23.5	273	15	9	19	1	24
1977	9.1	11.8	6.0	1180.13	25.5	265	20	7	28	0	21
1978	9.0	11.6	6.2	1226.23	26.0	276	28	3	34	0	33
1979	8.3	10.9	5.4	1110.23	25.2	291	51	12	39	0	47
1980	-	-	-	-	-	-	-	-	-	-	-
1981	-	-	-	-	-	-	-	-	-	-	-
1982	-	-	-	-	-	-	-	-	-	-	-
1983	-	-	-	-	-	-	-	-	-	-	-
1984	-	-	-	-	-	-	-	-	-	-	-
1985	-	-	-	-	-	-	-	-	-	-	-
1986	-	-	-	-	-	-	-	-	-	-	-
1987	-	-	-	-	-	-	-	-	-	-	-
1988	-	-	-	-	-	-	-	-	-	-	-
1989	-	-	-	-	-	-	-	-	-	-	-
1990	-	-	-	-	-	-	-	-	-	-	-
1991	-	-	-	-	-	-	-	-	-	-	-
1992	-	-	-	-	-	-	-	-	-	-	-
1993	8.8	11.6	5.7	1140.00	22.7	263	17	3	21	0	23
1994	9.0	11.9	6.0	1244.97	23.9	290	32	7	17	0	39
1995	9.5	12.5	6.1	1134.51	22.0	266	39	6	24	0	37
1996	8.7	11.6	5.6	1288.84	21.6	63	14	0	0	0	2
1997	9.9	13.1	6.4	838.50	20.9	3	0	0	0	0	0
1998	9.7	12.5	6.7	1286.62	23.1	0	0	0	0	0	0
1999	9.8	13.0	6.5	2170.23	21.7	75	2	2	7	0	3
2000	9.5	12.5	6.2	1179.64	21.6	170	9	1	10	0	10
2001	9.3	12.3	6.2	953.33	21.9	94	3	0	4	0	2
2002	-	-	-	-	-	0	0	0	0	0	0
2003	10.0	13.3	6.5	911.87	21.6	0	0	0	0	0	0
2004	10.1	13.0	6.9	1293.67	22.4	0	0	0	0	0	0
2005	-	-	-	-	-	-	-	-	-	-	-
2006	10.0	13.0	6.7	1165.27	22.2	0	0	0	0	0	0
2007	10.2	12.9	7.1	965.14	22.8	0	0	0	0	0	0
2008	9.6	12.7	6.4	1276.08	23.5	0	0	0	0	0	0
2009	9.7	12.9	6.5	1370.95	22.8	0	0	0	0	0	0
2010	8.4	11.6	4.7	1005.94	19.5	0	0	0	0	0	0
2011	9.8	12.8	6.6	1473.16	23.2	0	0	0	0	0	0
2012	9.4	12.3	6.1	1353.26	21.7	0	0	0	0	0	0
2013	-	-	-	-	-	-	-	-	-	-	-
2014	-	-	-	-	-	-	-	-	-	-	-

Interpretation average annual climate values

T	Annual average temperature (°C)
TM	Annual average maximum temperature (°C)
Tm	Annual average minimum temperature (°C)
PP	Total annual precipitation of rain and / or snow (mm)
V	Annual average wind speed (Km/h)
RA	Total days with rain during the year
SN	Total days with snow during the year
TS	Total days with thunderstorm during the year
FG	Total days with fog during the year
TN	Total days with tornado or funnel cloud during the year
GR	Total days with hail during the year

If the table has no values, fields are marked with the symbol (-) this only indicates that there has been no mean, this happens if there are no sufficient data to compute.

The total rainfall value 0 (zero) may indicate that there has been no such measurement a

Source Tutiempo

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Photograph 5 Campbeltown Micro-climate

Appendix 2 Machrihanish Airbase, Campbeltown, Gallery

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Photograph 6 Campbeltown sheltered harbour

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Photograph 7 Machrihanish, Campbeltown aerial view

GLOSSARY OF TERMS

Term	Meaning
AST	<p>The Office of Commercial Space Transportation (generally referred to as FAA/ AST or simply AST is the branch of the United States Federal Aviation Administration (FAA) that approves any commercial rocket launch operations</p> <p>AST is organized into four divisions:</p> <ul style="list-style-type: none"> • Space Transportation Development Division (AST-100) • Licensing and Evaluation Division (AST-200) • Regulation and Analysis Division (AST-300) • Safety Inspection Division (AST-400)
CAA	The Civil Aviation Authority is the statutory corporation which oversees and regulates all aspects of civil aviation in the United Kingdom
CSF	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
Energia	<p>OAD RSC Energia is the leading rocket-space enterprise in Russia, a lead organisation in the field of manned space systems. Its efforts are focused on building automatic space and rocket systems (launch vehicles and orbital transfer</p>

Term	Meaning
	vehicles); high-tech, multi-use systems to be used in areas other than space.
EU	European Union
HAZMAT	Hazardous Materials & Items
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 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
Sea Launch SA	Sea Launch is an international spacecraft

Term	Meaning
	launch service that uses a mobile maritime platform for equatorial launches of commercial payloads on specialized Zenit-3SL rockets
Sigma	Used in relation to the term "Six Sigma" - Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing variability in manufacturing and business processes. The maturity of a process can be described by a <i>sigma</i> rating indicating its yield or the percentage of defect-free products/ process it creates. A six sigma process is one in which 99.99966% of the services/ products manufactured are statistically expected to be free of defects (3.4 defective parts/million). Generally aviation operates at eight sigma or above which delivers very high levels of quality.
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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