Virgin Orbit Operations from Spaceport Cornwall (Southern Trajectory)

SMA-131

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Change History

Revision	Description of Changes	Affected Pages/ Sections	Release Trac Ticket	Date
1.0	Initial Release	All	7220	15-SEP-2021
2.0	Significant update to operations and included stakeholder feedback	All	7541	11-MAR-2022
2.1	Updated with feedback from regulator	All	7580	28-MAR-2022
3.0	*Pre-Final Released (INTERNAL - NOT RELEASED)*		*N/A*	*11-MAY-2022*
3.1	Final Submission Part 1	All	7631	18-MAY-2022
4.0	Updated the rocket flight description Reworked the TDAs and added TDA 5 (significant update) Updated the TDA timeline Updated notification timeline Updated ACP schedule Added new airspace analysis Added additional engagement Added LOA and Operational meetings Moved NATS and MOD feedback to Appendices Added Appendix D – Traffic analysis Moved preliminary traffic analysis to Appendix E Added VO request for traffic analysis Various updates throughout	Sec 2.3 Sec 4 Sec 5 Sec 7.2 Sec7.3 Sec 8 Sec 9 Sec 9.3.3 Appendix A Appendix D Append E Appendix F All		28-SEP-2022

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1 Introduction

Virgin Orbit will be conducting launch operations from Spaceport Cornwall (also known as Cornwall Airport Newquay). Virgin Orbit has identified a need for dedicated, segregated, airspace in the SOTA, SHANNON, LISBOA, and SANTA MARIA FIR for use in a LauncherOne rocket launch originating from Spaceport Cornwall in Cornwall, UK. Due to the requirement of segregated airspace Virgin Orbit, in conjunction with CAA, have decided the optimal path forward would be to use a Temporary Danger Area (TDA). This particular launch and flight path will be a one-time event therefore eliminating the need for a permanent airspace change.

This document details the background, locations, timelines, notifications, and stakeholder impact/feedback using the CAP1616 process.

1.1 Airspace Change Proposal Background

Virgin Orbit submitted a Statement of Need (SON) in March 2021 to CAA. Subsequently, Virgin Orbit identified the need to separate the SON into two ACPs. The first ACP is for a southern trajectory launch originating south of Ireland and travelling south. The second ACP was created for a northern trajectory also originating to the south of Ireland but travelling north. These updated ACPs were submitted in October 2021 to support the rocket launch using a carrier aircraft (Boeing 747-400) and a small 2-stage liquid fueled rocket. The operation would launch several small satellites into a Sun Synchronous Orbit (SSO). In order to conduct the operations, segregated airspace is required to conduct a safe flight and mission success.

Virgin Orbit held an Assessment Meeting with the CAA on 14-JUL-2021 where a scope and timeline were agreed upon. The path forward was discussed to highlight the steps necessary to complete prior to submitting the final package as well as an overview of stakeholder engagement.

1.2 General Description

Refer to Figure 1. Virgin Orbit will use LauncherOne (L1) to provide Low Earth Orbit (LEO) deployment service for small satellites. Currently, L1 has a total payload capacity of 300 kilograms (kg) for SSO and 500 kg for equatorial orbit. Subsequent versions of L1 will have increased capacity and range. L1 is a two-stage rocket with a clamshell fairing. The first stage and fairing are separated prior to orbit and fall back to Earth.

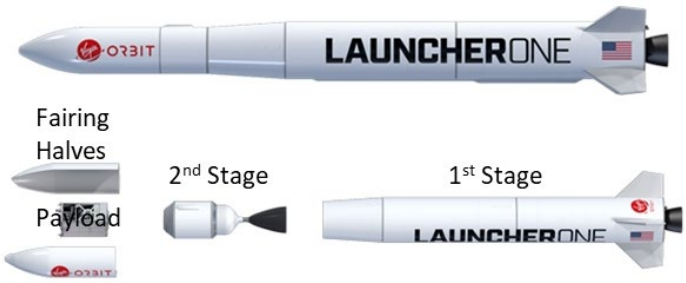


Figure 1 - Virgin Orbit LauncherOne

Refer to Figure 2. Virgin Orbit uses an air-launched rocket system consisting of L1 and Cosmic Girl, a 747-400 equipped to carry and deploy L1 using a custom pylon mounted to the 747's existing non-functioning fifth engine underwing mount.

Figure 2 - Air Launched Rocket System

2 Description of Flight

2.1 Overview of Flight

The 747 carries the rocket to a drop point over open ocean in a phase called "Captive Carry". The 747 will proceed on a predetermined flight path to a point over the ocean where

it will enter a holding pattern or racetrack. The racetrack is an oval shaped flight path (see white area of flight path in Figure 3) that allows the pilots to enter into the correct azimuth for launch. Once the 747 reaches the racetrack, the pilots will complete one cold pass run. This allows the pilots to do a test run, while the rocket system completes final checkouts. The second run is a hot pass where the rocket is armed and ready for ignition. At the end of the racetrack, the pilots will pitch up the aircraft and release the rocket from the wing. The aircraft will bank to the side while the rocket drops away. Approximately 5 seconds after the drop of the rocket, the first stage engine will ignite on its way to space. The 747 will then fly back to Spaceport Cornwall and land.

2.2 Detailed Description of Launch Day Captive Carry Flight

The flight crew, consisting of two pilots and two launch engineers are cleared to approach the aircraft on the completion of fueling the rocket approximately 45 minutes prior to take-off. Once boarded, the process of handing control of the rocket from Mission Control to the flight crew begins. On completion, the carrier aircraft, call sign *Cosmic Girl* will taxi to the departure runway. Departure tracks have been planned for either runway (30/12) to ensure no population centers are overflown. Regardless, the default is a Runway 30 departure and 12 arrival due to the over water ground track flown on both. Departure time from NQY of the 747 is planned to the nearest 10 minutes of launch, weeks before hand. Essentially providing a launch window time of ±10 minutes up until the day of launch. Forecast winds are then used to refine the takeoff time on the day of launch, and the launch timeline will be adjusted to reflect this target.

The expectation is to be given own navigation or radar vectors to RIGDI. A Traffic/Deconfliction service will be given initially by Newquay Radar followed by Swanwick/ Western Radar to join the upper air as GAT and finally controlled by Irish Air Traffic Control (ATC) within the racetrack. Flight planned routing avoiding Danger Area 064 is RIGDI TESDO LULOX DCT. Once airborne Cosmic Girl will climb to FL300. The priority is to get above 20,000ft initially where an unlimited supply of engine bleed air can take over the role of conditioning the rocket. Subsequently FL300 is targeted due to the colder outside air temperatures meeting the predicted thermal profile for the captive carry phase. During captive carry cruise to the drop area, it is desirable to follow the route filed to the drop location, however deviations are acceptable as required by ATC.

As discussed above, the racetrack is the name given to the flight path followed by Cosmic Girl within the TDA. It is generically a 19-minute oval track which allows a careful choreograph of timing, location and rocket preparation to occur. The successful execution results in Cosmic Girl being at the drop location, on release heading at the correct time with the rocket having just completed ‘terminal count’ and therefore ready to drop. The timing in the racetrack from entry to drop is planned to be 19 minutes; however, the total time will change to accommodate any timing error.

Throughout the captive carry phase to the drop location, the rocket is monitored and controlled by the Launch Engineers onboard Cosmic Girl supported by a control room on the ground split between both Spaceport Cornwall and Virgin Orbit HQ in Long Beach, CA, USA.

The launch occurs at the end of a phase known as the Launch Release Maneuver. This is a dynamic maneuver that places Cosmic Girl at a 32.5 degree nose up attitude at the point of release. After release, Cosmic Girl returns to Spaceport Cornwall with no special consideration given over that of a regular 747. Cosmic Girl will return under the opposite handoff of airspace managers: Irish ATC > Swanwick/Western Radar > NQY Radar.

It is possible throughout the captive carry cruise phase that an issue could occur with the Rocket or Cosmic Girl that would necessitate a return to base with the rocket. If the anomaly passes a set threshold, then an emergency would be declared. Recovery with the rocket will follow the pre-determined ground tracks avoiding population centers. The

preferred arrival is to runway 12 via an overwater track. On landing, Cosmic Girl will return to its start point where control of the rocket is handed back to mission control at which time the flight crew would de board.

2.3 Detailed Description of Launch Day Rocket Flight

The trajectory is created to produce a Sun-Synchronous Orbit. Virgin Orbit has requirements for safety, telemetry sites, and inclination that will bound the location of rocket drop and trajectory. In Figure 3, the location chosen meets all of these requirements.

Flight Safety Analysis (FSA) has been conducted to show compliance to safety regulations and has been reviewed by CAA. Section 4 describes the 5 Temporary Danger Areas required for Captive Carry and rocket flight. These TDAs will be communicated to affected parties via a Notice to Airmen (NOTAM). A brief description of each TDA is given below

- TDA 1 is generated to mitigate an anomaly of the rocket/747 prior to drop of the rocket
- TDA 2 mitigates an anomaly of the rocket first stage engine ignition. This is where there is higher probability of failure at engine ignition
- TDA 3 mitigates the possibility of a failure of the rocket in the early stages of Stage 1 burn and debris falling on aircraft
- TDA 4 mitigates the dropping of the first stage and fairing into the ocean after separating from Stage 1. Note that this TDA is the only area that is expected to have falling debris in a nominal flight. Once the first stage of the rocket has expended all its propellant, it will separate from the second stage and payload. The first stage will fall back to Earth and splashdown within this downrange TDA (Figure 6). Along with the first stage, the fairing will separate shortly after and fall back to Earth landing within the TDA. Virgin Orbit conducts statistical analysis to determine the location of impacts. Using this analysis, Virgin Orbit can bound the area with a high probability (6σ) of assuring splashdown within that region. An additional buffer of 10nm is added around the full area
- TDA 5 mitigates a second stage anomaly during steady state burn prior to achieving orbit. This TDA covers Portuguese and Spanish islands in the Atlantic Ocean

Virgin Orbit's original proposal was to allow air traffic to traverse between TDA 2 and TDA 4, however, after consultation with UK CAA, it was determined that the risk level was too high to allow aircraft to travel perpendicular and under the rocket flight. Virgin Orbit shows a probability of impact to aircraft in the region of ~1E-7 or 1 in 10,000,000 chance of impacting an aircraft with debris. CAA requires a probability of impact of 1 in 100,000,000 (1E-8) or less for cross traffic approval. Similarly, with TDA 5, the probability of impact is ~1 in 10,000,000 therefore a TDA was generated per CAA requirements. Virgin Orbit has coordinated with both Portugal and Spain to understand the need of this TDA. The area has not currently been approved but is under review by both parties.

Ship Hazard Areas (SHA) are also included in the FSA. Notice to Mariners (NOTMAR) will be sent to applicable Coast Guard agencies to notify these hazard areas.

3 Environmental Assessment

Virgin Orbit has submitted and completed public review of an Assessment of Environmental Effects. The document has been reviewed by CAA and the United States FAA for completeness and will be approved under the Spaceflight Operator License Virgin Orbit has applied for.

The Assessment of Environmental Effects (AEE) addresses the potential environmental effects of the United Kingdom (UK) Civil Aviation Authority (CAA) issuance of a launch operator license to Virgin Orbit, to conduct launches from Spaceport Cornwall. The AEE has been prepared based on the Guidance for the Assessment of Environmental Effects (Department for Transport [DfT] et al. 2021). The AEE covers the following potential impacts:

- Climate

- Noise and vibration
- Biodiversity
- Marine environment
- Environmental Effects due to major accidents and disasters
- Cumulative effects

The analysis within the AEE concludes that there would be no significant effects with the mitigation proposed, except for climate change. However, VO will work with Spaceport Cornwall to achieve its targeting of being net carbon zero by 2030 (e.g., purchasing carbon offsets during each year of VO operations at Spaceport Cornwall) and this will mitigate against long-term residual effects.

Based on the findings of the AEE, it is considered that there are no significant environmental impacts. Table 1 provides a summary of the effects of proposed VO operations at Spaceport Cornwall/CAN and within airspace over and the marine environment of the Atlantic Ocean to the west, north, and south of the UK.

Table 1 - Summary of Effects to Scoped Environmental Topics

Topic	Receptor	Potential Effects	Significance of Effects	Mitigation	Residual Effects	Significance of Residual Effects
CLIMATE – GREENHOUSE GAS EMISSIONS						
Relative Emissions*	Environmental receptors	Increased emissions affecting climatic variables	Moderate	Purchase of carbon offsets	Negligible	Insignificant
NOISE AND VIBRATION						
Aircraft movements	All social receptors	Increased noise from additional aircraft movements	Negligible	None	Negligible	Insignificant
Ground operations	All social receptors	Increased noise	Negligible	None	Negligible	Insignificant
Sonic boom from rocket launches – terrestrial	All social and environmental receptors	Short-term increase in noise	Negligible	None	Negligible	Insignificant
BIODIVERSITY (TERRESTRIAL ECOLOGY, FLORA, AND FAUNA)						
Sonic boom from rocket launches	Environmental receptors	Short-term increased noise	Negligible	None	Negligible	Insignificant
MARINE ENVIRONMENT						
Sonic boom from rocket launches	Environmental receptors	Short-term increase in noise	Negligible	None	Negligible	Insignificant
Rocket debris	Environmental receptors	Short-term presence of debris in water column	Negligible	None	Negligible	Insignificant
		Long-term presence of debris on ocean bottom	Negligible	None	Negligible	Insignificant
Unused Stage 1 rocket propellant	Environmental receptors	Short-term presence of propellant on ocean surface	Negligible	None	Negligible	Insignificant

*Includes rerouting of aircraft

3.1 Flight Below 7000ft

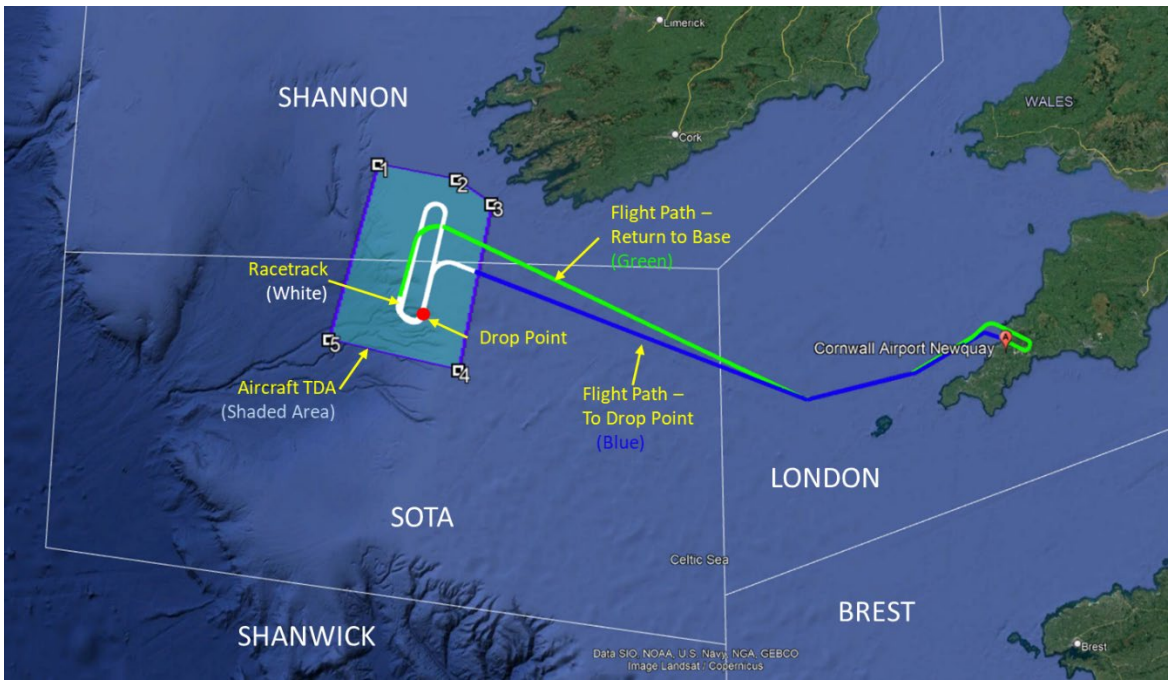
Virgin Orbit will fly as a typical 747 aircraft from Spaceport Cornwall to the first TDA. Flight will be at 30,000 to 35,000ft once cruising altitude is reached. No impact to flights below 7000ft will be anticipated for this portion of the flight path. Once entering the TDA, a surface to FL400 (TDA-1) and surface to unlimited (TDA-2) are requested, however, the operation is over open ocean approximately 25nm away from land (please see section 6.3 for all vertical dimensions). The working altitude and distance from land over open ocean indicate no impact to flights below 7000ft will be impacted.

4 Temporary Danger Area Sequence

4.1 TDA 1 - Racetrack

- **Duration of Activation**: 30 minutes maximum starting from aircraft entering racetrack (approximately 1 hour after takeoff from NQY)
- **Size**: Approximately 74nm x 50nm. Encompasses the racetrack with a buffer of 11nm minimum
- **Hazard**: Nominal events will pose no hazard. Off-nominal events could pose a hazard if there was a rocket or aircraft failure
- **Safety Case**: CAA currently assessing safety case and will provide approval upon completion
- **Probability of Impact to Aircraft**: During the Captive Carry phase of flight, Virgin Orbit assesses the probability of impact based on Boeing 747-400 failure data and adjusts that number to account for the rocket on the wing. For the entire flight from Spaceport Cornwall to TDA 1 and the race track, the analysis shows a 2 in 1,000,000 probability of impact. It is difficult to separate out only the TDA area from this number, however, it would be approaching zero within the TDA itself.
- **TDA Responsibility:** Area Control Centre Shannon is responsible for the provision of an ATS within the Shannon FIR/UIR and within the NOTA and SOTA airspace delegated to ACC Shannon by Shanwick OAC (Prestwick). TDA 1 falls within SHANNON and SOTA FIR. Virgin Orbit will generate the NOTAM request and the Irish Aviation Authority will send notification of the NOTAM. Once the 747/rocket are within the TDA, Shannon ATC will terminate ATC service.

Once the aircraft with rocket arrives at the intended drop location, a TDA is established around the racetrack. This TDA is set to protect against a failure of the rocket prior to drop. The TDA will be in place for a maximum of 30 minutes after the aircraft has entered the area. Airspace may be released after exiting the area.



TDA 1 (EUVIRGIN 1)			
Point Number	**Latitude**	**Longitude**	**Path**
1	514132.99N	0113752.58W	then straight line to
2	513604.93N	0104652.46W	then straight line to
3	512633.74N	0102355.76W	then straight line to
4	502009.88N	0104324.56W	then straight line to
5	503058.39N	0120549.16W	then straight line to
6	514132.99N	0113752.58W	-

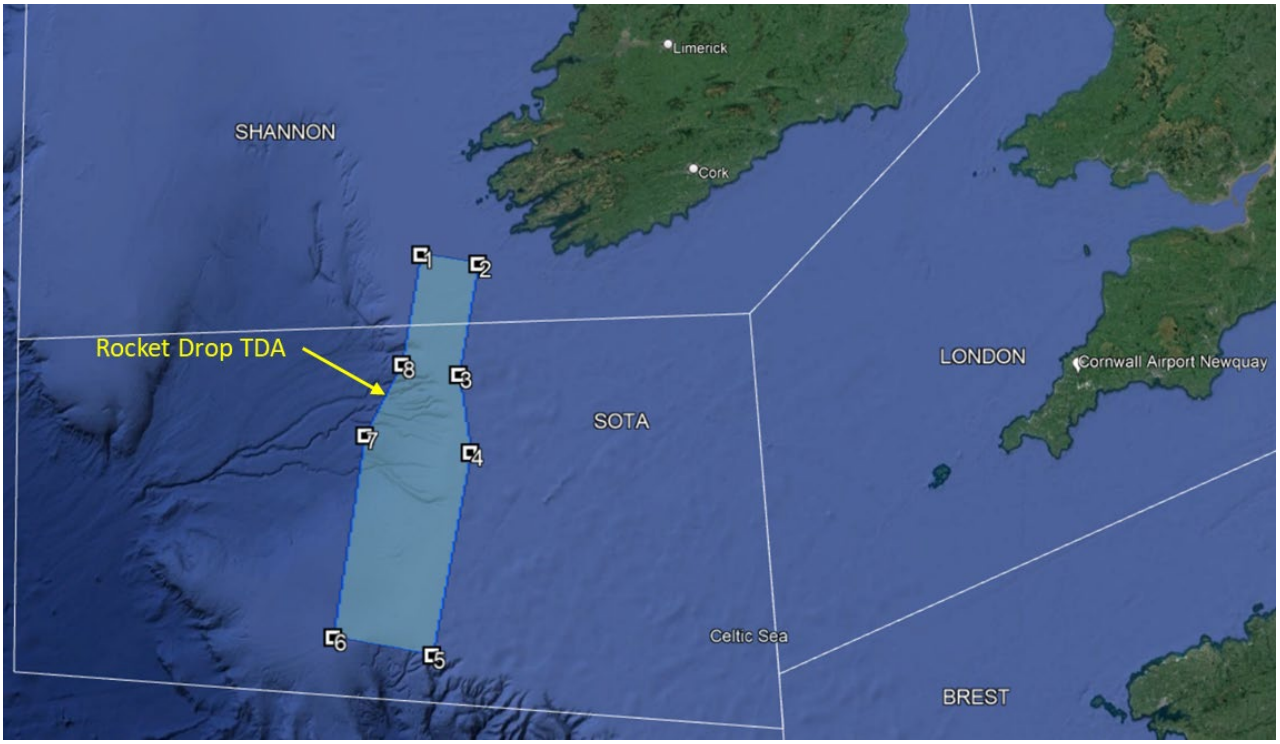
Figure 3 – Flight Path of Virgin Orbit 747 to Rocket Drop Point and Aircraft TDA (TDA 1)

4.2 TDA 2 – Rocket Ignition

- **Duration of Activation**: 60 minutes maximum starting from aircraft entering racetrack (approximately 1 hour after takeoff from NQY). Overlaps TDA 1 thru 5 timelines (see Figure 8)
- **Size**: Approximately 155nm x 36nm. Encompasses all scenarios of a failed rocket during ignition with the addition of a 10nm buffer. Virgin Orbit calculates a failed rocket debris cloud and the furthest potential debris travel, then adds the 10nm buffer on top of that prediction.
- **Hazard**: Nominal events will pose no hazard. Off-nominal events could pose a hazard if there were a rocket failure
- **Safety Case**: CAA currently assessing safety case for rocket flight and will provide approval upon completion. Virgin Orbit complies with regulations set forth by the United States Federal Aviation Authority (FAA) for rocket launches during both captive carry and rocket flight. These requirements have been assessed in the CAA safety case
- **Probability of Impact to Aircraft**: Virgin Orbit has calculated the probability at greater than 1 in 1,000,000 and has been validated by UK CAA. As described above this is an off-nominal event only, zero impact would occur during a nominal flight.
- **TDA Responsibility:** Area Control Centre Shannon is responsible for the provision of an ATS within the Shannon FIR/UIR and within the NOTA and SOTA airspace delegated to ACC Shannon by Shanwick OAC

(Prestwick). TDA 2 falls within SHANNON and SOTA FIR. Virgin Orbit will generate the NOTAM request and the Irish Aviation Authority will send notification of the NOTAM.

A second TDA is established once the aircraft enters the racetrack. This TDA accounts for the drop of the rocket from the aircraft and subsequent ignition of the first stage engine. A nominal launch will not produce a hazardous event. Virgin Orbit accounts for the higher probability of a failure at the early stages of ignition and provides the TDA to account for any off-nominal event.



TDA 2 (EUVIRGIN 2)			
Point Number	**Latitude**	**Longitude**	**Path**
1	512833.69N	0110625.08W	then straight line to
2	512419.80N	0103343.52W	then straight line to
3	504446.68N	0104742.04W	then straight line to
4	501640.36N	0104303.03W	then straight line to
5	490424.29N	0110859.26W	then straight line to
6	491209.65N	0120256.82W	then straight line to
7	502413.78N	0114154.24W	then straight line to
8	504915.24N	0111943.20W	then straight line to
9	512833.69N	0110625.08W	-

Figure 4 – Rocket TDA for Drop and Ignition (TDA 2)

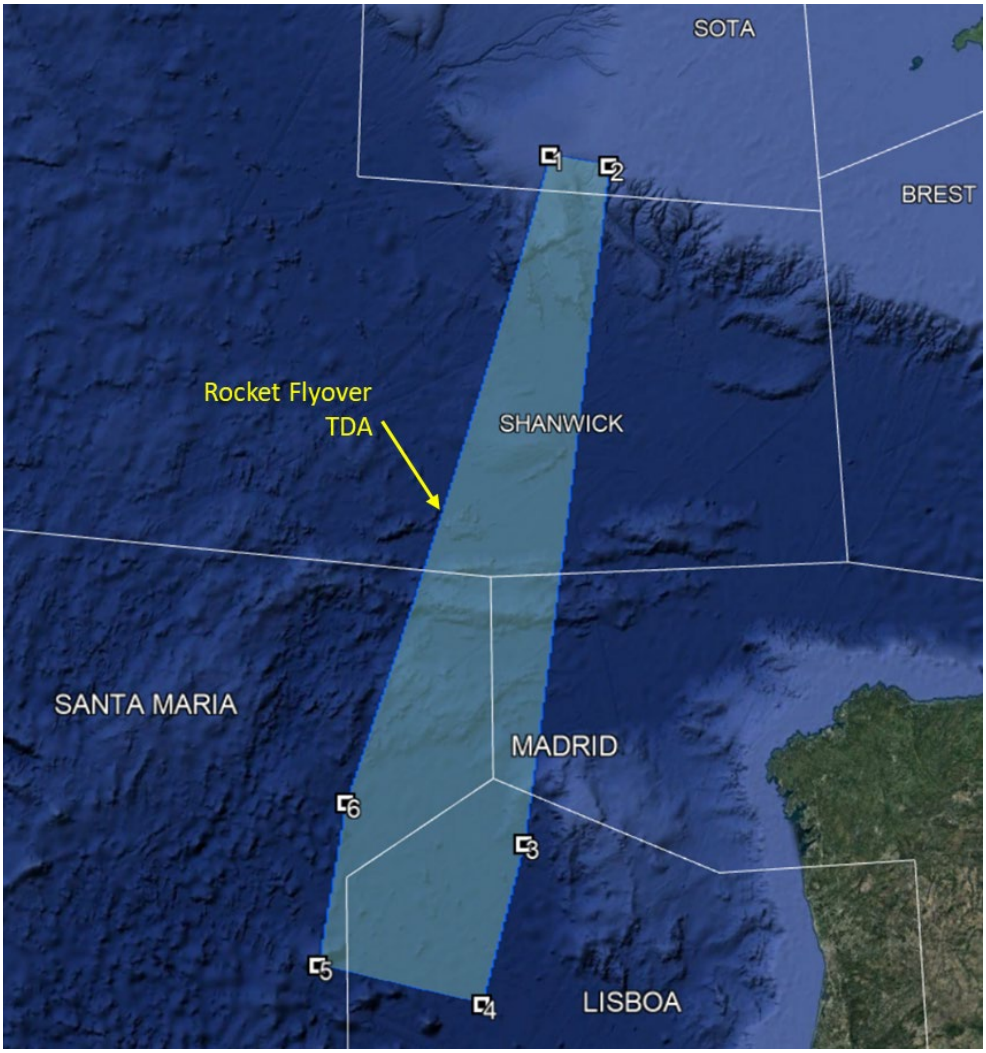
4.3 TDA 3 – Rocket Flyover Area

- **Duration of Activation**: 60 minutes maximum starting from aircraft entering racetrack (approximately 1 hour after takeoff from NQY). Overlaps TDA 1 thru 5 timelines (see Figure 8)

- **Size**: Approximately 500nm x 110nm (at max extent). Encompasses all scenarios of a failed rocket during rocket stage 1 steady state burn with the addition of a 10nm buffer. Virgin Orbit calculates a failed rocket debris cloud and the furthest potential debris travel, then adds the 10nm buffer on top of that prediction.
- **Hazard**: Nominal events will pose no hazard. Off-nominal events could pose a hazard if there were a rocket failure
- **Safety Case**: CAA currently assessing safety case for rocket flight and will provide approval upon completion. Virgin Orbit complies with regulations set forth by the United States Federal Aviation Authority (FAA) for rocket launches during both captive carry and rocket flight. These requirements have been assessed in the CAA safety case
- **Probability of Impact to Aircraft**: Virgin Orbit has calculated the probability at approximately 1 in 10,000,000 in the center of the hazard area, decreasing in probability as distance from the center to the outside increases. This analysis has been validated by UK CAA. As described above this is an off-nominal event only, zero impact would occur during a nominal flight.
- **TDA Responsibility:** TDA3 is a complex area that is split between 5 different FIRs. Starting in the northern part of the area, TDA 3 is controlled by ACC SHANNON (part of SOTA). Travelling downrange, the area intersects the SHANWICK FIR (controlled by NATS Shanwick Oceanic Area Control (Prestwick)), the MADRID FIR (controlled by Enaire), LISBOA FIR & SANTA MARIA FIR (both controlled by NAV Portugal). Virgin Orbit has divided the area between the relevant authorities and produced coordinates for a NOTAM that will be sent by each respective group.

This third TDA was not in the first submission of the ACP. Virgin Orbit's analysis show's a small portion of the center of the TDA to have a probability of impact greater than 1 in 100,000,000. Virgin Orbit's standard requirements for launches in the USA are set to a probability of 1 in 1,000,000 and are therefore in compliance. This would preclude the use of a TDA between the higher probability areas. UK CAA differs in the approach and sets a more stringent requirement at 1 in 100,000,000. Due to this difference in philosophy, a TDA connecting TDAs 2 and 4 is required.

During the overflight of this area, the rocket is in a steady state stage 1 burn. Probability of failure of the rocket during this leg of the flight is low.



TDA 3 (EUVIRGIN 3)			
Point Number	**Latitude**	**Longitude**	**Path**
1	491209.65N	0120256.82W	then straight line to
2	490434.29N	0110859.26W	then straight line to
3	422121.89N	0123503.92W	then straight line to
4	404445.00N	0131114.86W	then straight line to
5	410655.27N	0152220.79W	then straight line to
6	424532.34N	0150015.26W	then straight line to
7	491209.65N	0120256.82W	-

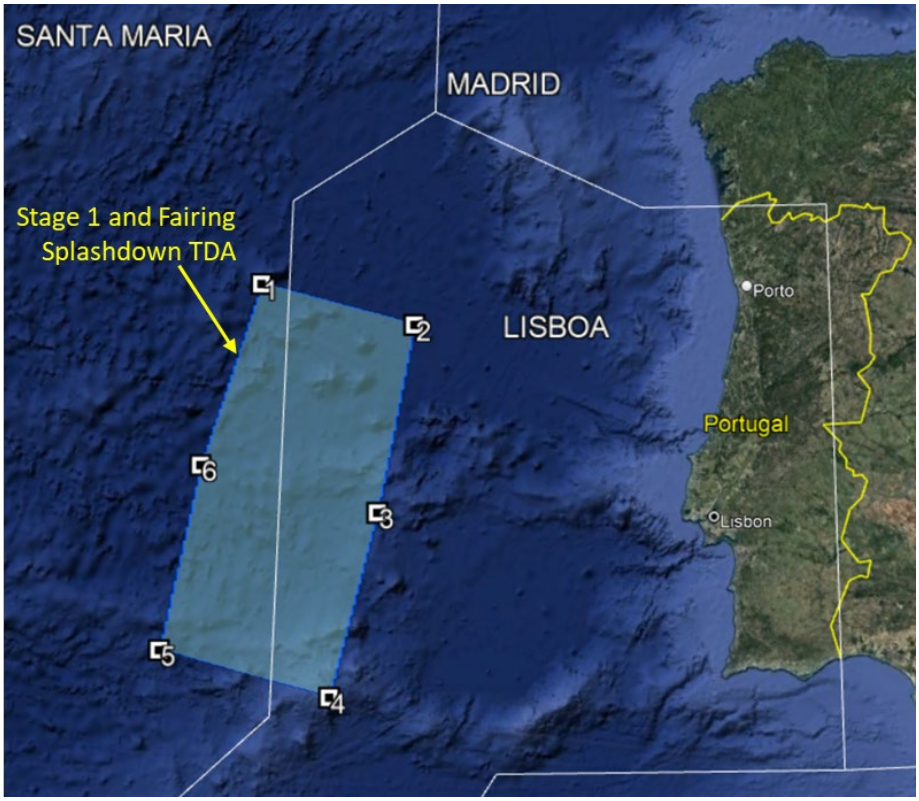
Figure 5 –TDA for Rocket Flyover (TDA 3)

4.4 TDA 4 – Stage 1 and Fairing Splashdown

- **Duration of Activation**: 60 minutes maximum starting from aircraft entering racetrack (approximately 1 hour after takeoff from NQY). Concurrent with TDAs 1 thru 5 timelines (see Figure 8)
- **Size**: Approximately 219nm x 112nm. Encompasses a 6σ statistical analysis for debris fall into the water with an additional 10nm buffer around all sides.

- **Hazard**: Nominal events will pose a hazard to aircraft and ships that are in the area. Debris consisting of the first stage and fairing of the rocket will fall to the ocean.
- **Safety Case**: CAA currently assessing safety case for rocket flight and will provide approval upon completion. Virgin Orbit complies with regulations set forth by the United States Federal Aviation Authority (FAA) for rocket launches during both captive carry and rocket flight. These requirements have been assessed in the CAA safety case
- **Probability of Impact to Aircraft**: There is 100% probability of debris falling within TDA 4 during a nominal mission. Probability of impact to aircraft is greater than 1 in 1,000,000 in the center of the hazard area, decreasing as distance from the center to the outside increases. This analysis has been validated by UK CAA. As described above this is an off-nominal event only, zero impact would occur during a nominal flight.
- **TDA Responsibility:** TDA4 is split between the LISBOA FIR & SANTA MARIA FIR (both controlled by NAV Portugal). Virgin Orbit has generated the coordinates to send to NAV Portugal which will then issue the NOTAM prior to launch.

This TDA is located roughly 200nm off the coast of Portugal. The TDA accounts for the splashdown of the stage 1 and fairing halves. As described in Section 2.3, these three items are predicted to fall in the center of the area with a 10nm buffer for the furthest predicted debris.



TDA 4 (EUVIRGIN 4)			
Point Number	**Latitude**	**Longitude**	**Path**
1	410655.27N	0152220.79W	then straight line to
2	404445.00N	0131114.86W	then straight line to
3	384435.31N	0133714.61W	then straight line to
4	364503.65N	0141126.56W	then straight line to
5	370858.18N	0163047.65W	then straight line to
6	390917.45N	0160503.49W	then straight line to
7	410655.27N	0152220.79W	-

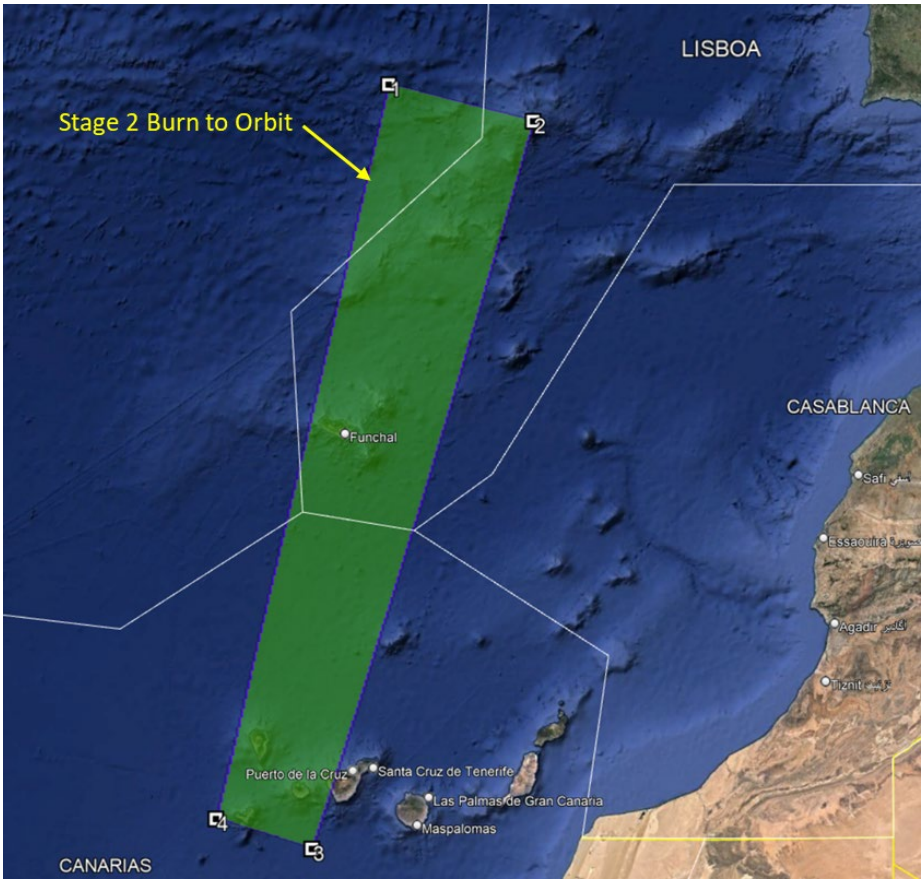
Figure 6 –TDA for Splashdown of Stage 1 and Fairing (TDA 4)

4.5 TDA 5 – Stage 2 Burn to Orbit

- **Duration of Activation**: 60 minutes maximum starting from aircraft entering racetrack (approximately 1 hour after takeoff from NQY). Concurrent with TDAs 1 thru 4 TDA timelines (see Figure 8)
- **Size**: Approximately 570nm x 115nm (at max extent). Encompasses all scenarios of a failed rocket during stage 2 steady state burn with the addition of a 10nm buffer. Virgin Orbit calculates a failed rocket debris cloud and the furthest potential debris travel, then adds the 10nm buffer on top of that prediction.
- **Hazard**: Nominal events will pose no hazard. Off-nominal events could pose a hazard if there were a rocket failure.
- **Safety Case**: CAA currently assessing safety case for rocket flight and will provide approval upon completion. Virgin Orbit complies with regulations set forth by the United States Federal Aviation Authority (FAA) for rocket launches during both captive carry and rocket flight. These requirements have been assessed in the CAA safety case

- **Probability of Impact to Aircraft**: Virgin Orbit has calculated the probability at approximately 1 in 10,000,000 in the center of the hazard area, decreasing in probability as distance from the center to the outside increases. This analysis has been validated by UK CAA. As described above this is an off-nominal event only, zero impact would occur during a nominal flight.
- **TDA Responsibility:** TDA5 is split between the LISBOA FIR & SANTA MARIA FIR (both controlled by NAV Portugal) and CANARIAS FIR (Controlled by Enaire). Virgin Orbit has generated the coordinates to send to NAV Portugal and Enaire which will then issue the NOTAM prior to launch.

This TDA extends south of Portugal to the southern Canary Islands. The TDA accounts for a rocket anomaly during stage 2 steady state burn. This is a period of low probability of failure, however, as described in Section 4.3, the risk is non-zero and must be evaluated by the affected stakeholders. Virgin Orbit has discussed the overflight with both Portugal and Spain due to the TDA covering their islands (Madeira, Santo Porto, and the Canary Islands). The overall risk has been assessed and conveyed. Multiple stakeholder meetings were held to present the operations and allow evaluation of the risk. Portugal and Spain will look to the full evaluation completed by CAA for input into the option to activate TDA 5 or not.



TDA 5 (EUVIRGIN 5)			
Point Number	**Latitude**	**Longitude**	**Path**
1	370858.18N	0163047.65W	then straight line to
2	364503.65N	0141126.56W	then straight line to
3	272309.44N	0170023.71W	then straight line to
4	274035.39N	0182500.43W	then straight line to
5	370858.18N	0163047.65W	-

Figure 7 –TDA for Flight to Orbit (TDA 5)

5 Temporary Danger Area Timeline

The rocket launch will be scheduled for one primary date and two backup dates over consecutive days with the same TDA activation timeline each day. Virgin Orbit is requesting a 3-day range between 29-OCT-2022 and 04-JAN-2023 (90 days from the publication of the AIC on 06-OCT-2022). Additional risk is accounted for with international partners accepting the operation.

The timeline of events is as follows:

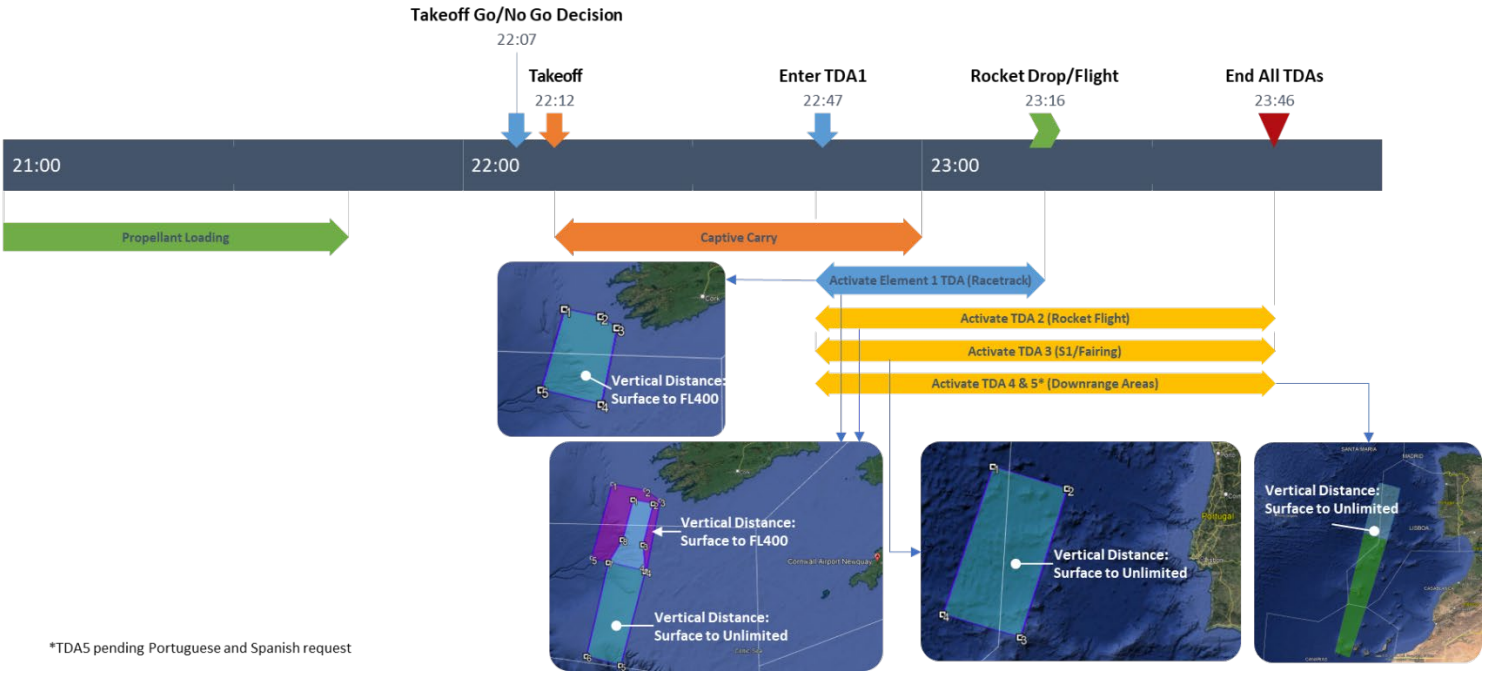


Figure 8 - TDA Activation Timeline

Figure 8 offers the nominal timeline. Virgin Orbit's orbital requirements allow the drop of the rocket between 22:46-23:46 UTC, therefore a request for this timeline to be adjusted to fit within that window is being made. This means the rocket could be dropped anytime between 22:46 and 23:46 with TDA activations from 22:16 to 00:16 and the timeline in Figure 8 would be shifted to adjust. The TDA activation window would not exceed the 2 hours proposed.

6 Virgin Orbit Operation from Spaceport Cornwall

Virgin Orbit's ground operations will take place on the Echo Apron at Spaceport Cornwall (Newquay Aerodrome). Once loading of propellants is completed, the 747 will take off with the rocket attached and proceed to a drop point west of Cornwall as described above. This mission would be a **one-time mission only**, hence the request for a temporary ACP. Virgin Orbit has submitted an Airspace Change Proposal (ACP) for this trajectory under **ACP-2021-031**.

6.1 Real-Time Coordination on Launch Day

Virgin Orbit coordinates and participates in real-time range activity. Starting with the Captive Carry flight of the 747+LauncherOne rocket real-time coordination is established with affected parties 30 minutes prior to takeoff of the 747. Virgin Orbit plans to include the following agencies on a comm channel for flight:

- CAA: overall regulator and agency that will oversee the launch
- NATS: air traffic management group with real-time capabilities to direct air traffic around the hazard areas
    - NATS will not be controlling the hazard areas as they are within Irish ANSP control
- Irish Aviation Authority (IAA): air traffic management for the hazard areas within Irish controlled airspace
- UK Coastguard and UK Hydrographic Office: ship traffic management. Coordinate with shipping lanes around the hazard areas (may not need to be on a real time call unless a mishap occurs)
- Eurocontrol: air traffic management across Europe, working to address air traffic that may cross hazard areas and rerouting.
- Portuguese National Civil Aviation Authority: air traffic routing around hazard area off the coast of Portugal

- Enaire: air navigation manager in Spain
- United States agencies: as a US company, Virgin Orbit must coordinate launches with the appropriate US regulator and accommodate FAA inspectors in the MCC (currently in work whether FAA will be on the comms line during launch)

Virgin Orbit has successfully conducted launch communications with outside parties in this manner for five previous flights.

Concept of communication link:

1. Carrier Aircraft: the 747 has 4 communication systems; 2 voice, and 2 data.
2. All Virgin Orbit operators are connected to the Virgin Orbit Mission Control Center data system with data flowing from the rocket.
3. The external communication system connects to a repeater of the internal data system.
4. The external communication system is then broadcast to the affected parties using a Microsoft Teams web interface over the internet. Verbal confirmation of events will be included on a hotline conference number as a secondary form of communication in case of a failed internet connection.
5. On the web interface, a Graphical User Interface (GUI) will be displayed providing the location of the aircraft and rocket superimposed on a map which the connected parties may view.
6. A Virgin Orbit employee will provide real-time information and updates on the location of the aircraft/rocket, the launch event step, and notification of airspace release.

6.2 Emergency Plan and Procedures

Virgin Orbit has created Emergency Response Procedures (ERP) to notify agencies in the event of an anomaly. As part of the emergency response, real-time information would be provided on the launch hotline as described in section 6.1 to affected agencies. This will allow a snapshot of where a hazardous event would take place in the event of an anomaly. The ERP also provides checklists for Virgin Orbit personnel to contact specific people/agencies to provide official notification of an emergency. The ERP is currently under review at CAA as part of Virgin Orbit's Safety Case.

Virgin Orbit has the ability to abort the mission at any point prior to drop of the rocket. In extreme events, Virgin Orbit may jettison the rocket over water, but standard procedures are to bring the rocket back to Spaceport Cornwall. Procedures are in place between the Launch Engineers that monitor the rocket on the aircraft and the pilots to coordinate an abort of the mission.

Due to the short duration of the TDA and launch window, DACS/DAAIS will not be provided. Access for military, emergency services, or aircraft in an emergency will be facilitated through the communications plan above.

6.3 Vertical Dimensions

Virgin Orbit would require two separate vertical dimensions for the airspace structure. The first would be included in in TDA 1 for the racetrack portion of the flight and second for rocket flight:

1. TDA 1: **Surface to FL400** – this structure would allow for the 747 flight within the racetrack to be segregated up to FL400 with margin. The planned 747 flight path flies to a maximum FL350 for nominal operations (see Figure 3).
2. TDA 2 through 5: **Surface to Unlimited** – this structure accounts for the rockets lofted trajectory within the airspace. The rocket angle of attack increases quickly after drop, requiring the surface to unlimited vertical dimension.

7 Airspace Management

7.1 Notional Notification Timeline

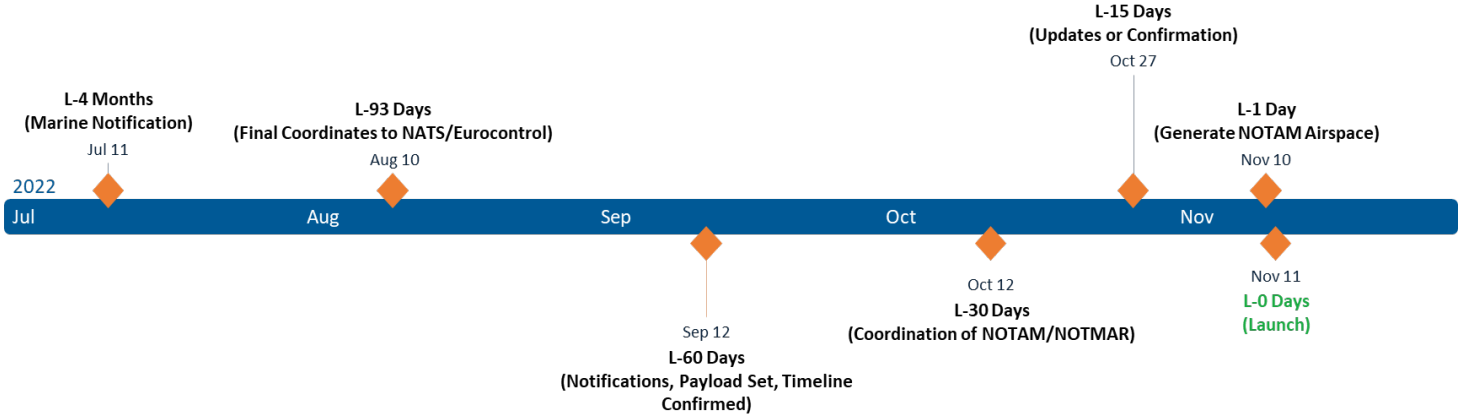


Figure 9 - Notification Timeline Assuming a 11-NOV-22 Launch

7.2 Notifications

Virgin Orbit's primary means to communicate rocket launches and hazard areas will be through Notice to Airmen. Virgin Orbit will send a planning package to UK regulators, NATS, Eurocontrol, Enaire, and NAV Portugal in order to announce the intent to launch as well as updates prior to the launch date in the following timeframes with specified information:

L = Launch Day

Time	Event	Action by:	Comments	Notes
Pre-Launch Day				
L – 60D	AIC Available	CAA UK	Supplement shared with all ANSP's involved to align NOTAM'd Airspace Data and launch details.	
L – 56D	Network Management Reservations Created	EC NM	Coordinates in Eurocontrol NM (Network Manager) System	ANSP's Create Buffers as required.
L - 28D	Cold Run Trial Flight	VO	Flight Profile Flown Fully	Timings TBC: Real Time Flight from Newquay
L – 15D	Launch Date/Window Confirmed	VO	NOTAM's Requested by Virgin Orbit (VO)	NOTAM to cover the Launch Window (3 Days)
	NOTAM Published (By all States)	ANSP's	NOTAMs for launch to be published by AMC (UK/IRL/Spain) and/or ANSP's NOF's as required.	VO - Contacts for each region - See Below
L – 1D	Reservations Generated for NOTAM'd Airspace	ANSP's	ANSP's ATC Systems Updated and loaded with TDA details ahead of Launch Day	Added to ANSP systems as required ahead of Launch
L - CANX	**Launch Activity Cancelled**	VO/ANSP's	Launch Cancelled – VO to inform all ANSP's and request State NOTAM's Cancelled with immediate effect. Eurocontrol NM to be informed.	NOTAM will inform all ANSP activity/TDA Cancelled

7.2.1 Timing of information

As described above, the planning package will be delivered at Launch(L)-30 days and L-15 days, and with NOTAM generation at L-1 days. Any updates to the primary or backup launch dates will be communicated as soon as they are known.

7.3 ACP Schedule

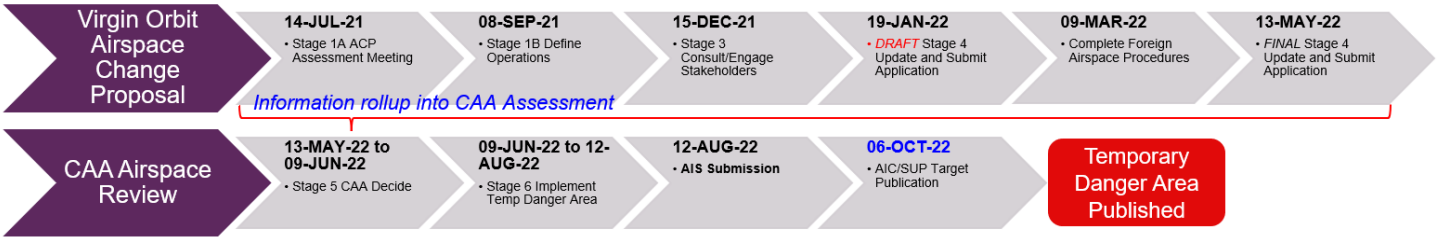


Figure 10 - ACP Schedule

8 Airspace Analysis

Virgin Orbit understands that air traffic impact can be severe based on the extent of the required TDAs above and requested a traffic analysis to be completed by the ANSPs. The request details all TDAs as described above plus the times and dates to analyze air traffic. NATS led the effort to collate all subsequent analysis and provide a report to Virgin Orbit to assess the impact. The launch window is set for local late night and helps provide relief with heavily trafficked times.

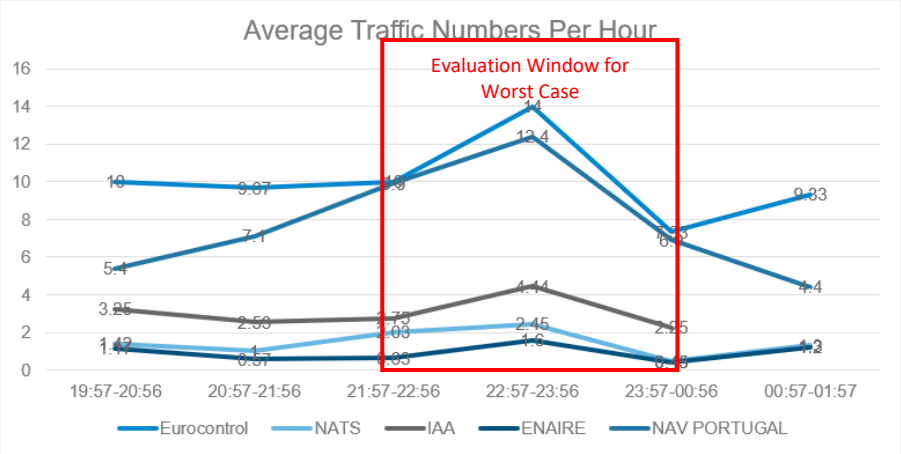
The request was for an evaluation of a launch in October using 2019 data to be conservative with the amount of traffic. A summary of the findings is shown in the table and graph below. The following areas were assessed by the groups listed below:

- Eurocontrol – TDA 2, 3 AND 4.
- NATS - TDA 3, affecting Shanwick region only, South of SOTA, North of 45N
- IAA – TDA 2
- Enaire – TDA 3, affecting Madrid ACC zone
- NAV Portugal – TDA 3 and 4

Looking at the data from Eurocontrol that completed an assessment from TDA 2-TDA4, a maximum of 14 flights would be impacted during a 1-hour window covering the launch. However, Virgin Orbit's proposed timeline could extend from 22:16 – 00:16 and therefore overlaps the hour windows prior and post this 14-flight evaluation. It is difficult to separate out the number of flights pre and post the 1-hour block but taking a conservative approach and adding up all three hours, the number of impacted flights raises to a total of 31.

NAV Portugal's assessment of TDA 3 and 4 and IAA TDA 2 assessment line up with the Eurocontrol analysis giving credence to the results.

Virgin Orbit believes the assessed levels of traffic impact are reasonable for a one-time launch. By keeping a local late night launch, the impact is lessened.



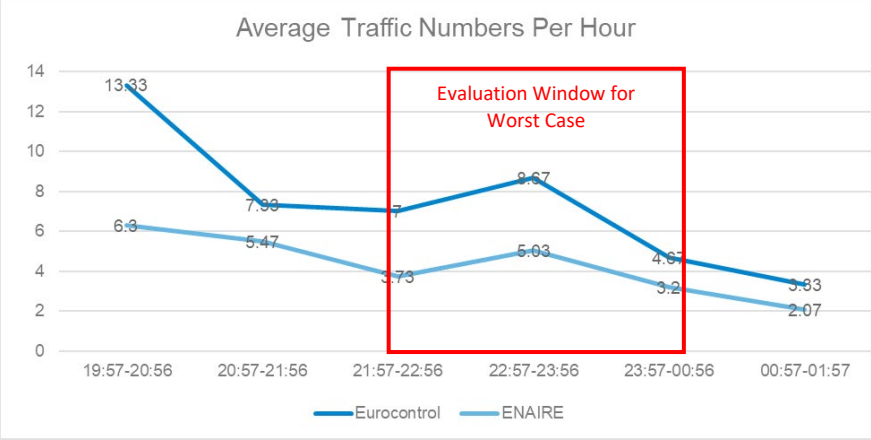
Range of values	19:57-20:56	20:57-21:56	21:57-22:56	22:57-23:56	23:57-00:56	00:57-01:57	Total
NATS	0-4	0-3	0-7	0-6	0-2	0-4	**2-14**
IAA	0-10	0-7	0-7	0-13	0-6	*	**6-32***
ENAIRE	0-3	0-4	0-2	0-6	0-2	0-2	**0-11**
NAV Portugal	2-14	2-15	2-22	5-20	1-14	1-8	**23-47**

*Does not include 00:57-01:57 – actual total expected to be higher.

Figure 11 - Air Traffic Assessment

Please see Appendix D for the full assessment.

In addition to TDAs 2-4, TDA 5 was also evaluated by both Eurocontrol and Enaire. Results shown below suggest approximately 20 flights would be impacted in this area if the TDA were activated.



9 Stakeholder Impact and Engagement

9.1 Stakeholder Methodology

Stakeholder engagement is a critical step in determining impact due to the proposed operations on airspace and airspace users. CAP1616 facilitates the transparency between Virgin Orbit, the CAA, and the public.

As Virgin Orbit is a company that resides in the United States, the stakeholder engagement process relied heavily on web conference meetings, e-mails, and phone calls. Virgin Orbit identified several operators that may be impacted by the rocket launch airspace change and reached out with an engagement information that included a description of operations and rocket/carrier aircraft, location of the airspace change, flight path, expected impacts, and notification procedures. Feedback was requested by 15-NOV-2021, however all feedback was collected independent of when it was received. The information was also posted to the Airspace Change Portal on 23-NOV-2021.

Virgin Orbit had setup preliminary engagement meetings prior to official engagement to gauge airspace managers and airspace user impact due to the proposed operations. These engagement meetings involved foreign airspace managers as well, due to operational impacts outside UK territory. The official engagement period started 10-SEP-2021 through 15-NOV-2021. Additional stakeholders were identified after the official engagement period and solicited for feedback in DEC-2021. Ongoing coordination is taking place and will continue up to launch.

Virgin Orbit has engaged with the Department for Transport (DfT) as a liaison with foreign counterparts. Prior to working the lower-level details of the ACP procedures and obtaining a Letter of Agreement with Ireland or Portugal, a higher-level government-to-government agreement was required. DfT has facilitated these high-level interactions with Ireland and Portugal allowing Virgin Orbit to address the procedural side. Agreements are in work with both countries.

9.2 Stakeholder Impact

Virgin Orbit has coordinated with members of CAA, NATS, Eurocontrol, foreign aviation authorities, and airlines in order to determine how to conduct operations with the least impact to existing flights. Common feedback from stakeholders has centered around 3 areas of concern

1. The amount of time Virgin Orbit was initially proposing to block off airspace: After significant Concept of Operations (CONOPs) review, Virgin Orbit was able to decrease the launch window from 4 hours to 2 hours. Virgin Orbit proposes to fly from Cornwall to the racetrack and once entering the racetrack will start the 1-hour launch window clock (a second hour is used to allow aircraft time to route around the hazard areas). The drop will be required to occur within 30 minutes allowing the second part of the window to account for debris fall time.
2. The size of Virgin Orbit's aircraft and ship hazard areas: Virgin Orbit's initial hazard areas were large and spanned over significant portions of air traffic routes. The flight safety team reviewed the current analysis used to create those areas and were able to update overly conservative assumptions to substantially reduce hazard areas. However, these efforts were not sufficient to use a reduced hazard area and therefore remain large.
3. Time of day for launch window: Virgin Orbit understands there are times of day that would be less or more impact to existing operations. The launch window has been set at late night local time falling in a time of low impact to nominal airspace operations.

The impact to stakeholders will likely be limited to flight and ship rerouting during the launch operations with potential for a multi-day impact if the first launch window is not used. Virgin Orbit has worked with Eurocontrol, NATS, and ANSPs to understand the overall impact with the results in Appendix D.

Virgin Orbit has also contracted a marine consultancy (ABPmer) to determine shipping traffic for a 1-year period within the TDAs. Virgin Orbit has included this data in the navigational risk assessment.

9.3 Key Stakeholder Engagement Feedback and Response

9.3.1 Chronology of engagement

Date of Meeting	Group/Agency
30-Aug-21	MCA/IAA/Irish Coastguard/MMO/Trinity House
2-Sep-21	Eurocontrol
2-Sep-21	NATS
3-Sep-21	IAA
22-Sep-21	Portuguese Space Agency/Portuguese Airspace Management
23-Sep-21	Airlines UK
1-Nov-21	Eurocontrol
2-Dec-21	MCA
8-Dec-21	Qinetiq/MOD
Follow Up Discussions	
10-Feb-22	Eurocontrol
25-Feb-22	Portuguese Air Force/Airspace Management/Eurocontrol
2-Mar-22	MCA
4-Mar-22	IAA
8-Mar-22	MOD
Air Traffic Management Meetings	
8-Jun-22 to Present	Weekly meetings discussing impacts to air space, launch status, actions for the sponsor. Meetings include NATS, UK CAA, Enaire, Portugal ANAC, IAA, 78 Sqn, NQY ATC, and Eurocontrol
Letter of Agreement/Procedure Meetings	
14-Jun-22 to Present	Weekly meetings to establish a set of procedures for the launch event and completing a letter of agreement between all participants. Meetings include NATS, UK CAA, Enaire, NAV Portugal, IAA, 78 Sqn, NQY ATC, and Eurocontrol

9.3.2 All Stakeholder Feedback

Please see Appendix A: for feedback table and responses

9.3.3 Letter of Agreement Meetings

In addition to stakeholder feedback, Virgin Orbit has conducted numerous meetings led by NATS to complete a Letter of Agreement (LOA) with all affected ANSPs. This group includes UK CAA, NATS, Eurocontrol, Enaire, Portugal ANAC, and IAA. The meetings were started in June of 2022 and have continued to present. Operational management of the air space and 747 is coordinated between regulators, ANSPs, and the sponsor (Virgin Orbit).

A timeline of events was first established including all notifications that are required to be sent to the various authorities. Virgin Orbit developed the timeline leading up to launch and the actual launch event.

Air space managers were identified for each leg of rocket flight in order to understand how NOTAMs will be generated and sent out publicly. During this process, it was determined that Spanish airspace would be affected and Enaire was brought into the weekly meetings.

Procedures were also developed for the Captive Carry phase of flight. Virgin Orbit's 747 will be controlled by NQY ATC, handed off to the RAF 78th Squadron, and finally to IAA where it will enter TDA1.

The LOA is currently with the various groups for signature.

9.3.4 Operational Meetings

A second set of meetings were started in June 2022 in order to understand a higher-level operational plan for the launch. These meetings are conducted with the same groups but on the regulatory side. During the lead up to submitting coordinates for the AIC, the operational meetings enabled coordination on timing, location, and responsibility for each section of the TDAs.

The operational meetings also were set to coordinate the traffic analysis discussed in Section 8.

10 Feedback and Contacts

Feedback: Virgin Orbit requested further feedback, comments, concerns, or questions from stakeholders.
Information: general information requests were directed to info.uk@virginorbit.com
Complaints: complaints based on planned operations, airspace management, or general were directed to complaints.uk@virginorbit.com

- Complaints are monitored for the duration of the ACP process, up to and including the launch of the rocket. The e-mail address listed above is connected to a shared account that is collected by Virgin Orbit personnel.
- Any received complaints will be collated by date and sender and attached to a report delivered to CAA. A running list of complaints will be kept, and a summary report issued on a weekly basis. Currently no complaints have been received.

Appendix A: Stakeholder Feedback

A.1 Airlines UK

Airlines UK representative expressed interest in impact to the NQY airport operations and whether any other spaceports were considered. Virgin Orbit detailed timelines for the operation and no further comments were received. Virgin Orbit also detailed the reasoning behind choosing Spaceport Cornwall with the primary reasons being that NQY becoming a Spaceport and the airports location near the ocean (prevents carrier aircraft overflight of land).

The representative stated that the information covered in the meeting would be disseminated to the members of Airlines UK. The final comment from the representative was to obtain any air traffic analysis once completed. This is an open task and will be addressed once air traffic analysis is completed.

A.2 Airspace4All

Correspondence with Airspace4All was conducted solely over email. Response was sent back with no objections to the operations.

A.3 British Business and General Aviation Association (BBGA)

Correspondence with BBGA was conducted solely over email. Response was sent back with the information sent to the BBGA Operations Workgroup. No further comments received.

A.4 General Aviation Alliance (GAA)

Correspondence with GAA was conducted solely over email. A response was received asking for clarification if the airspace change is further than 10nm off the UK coastline. Virgin Orbit confirmed that the ACP is further than 10nm and GAA responded with “no further comment”.

A.5 Eurocontrol

Several e-mail exchanges and meetings were held with Eurocontrol to review Virgin Orbit’s operations and procedures for conducting the rocket launches. The following meetings took place. Please see Appendix B.5 for details.

- 29-March-2021: Meeting held with a consortium of stakeholders
  - Spaceport Cornwall, NATS, DAATM, Eurocontrol, Irish Aviation Authority
  - Main discussions revolved around drop point locations and pros/cons of each
  - Commercial vs state flights; which has priority
  - Control of airspace
- 02-September-2021: Virgin Orbit/Eurocontrol discussed many topics from procedures for launch to a Letter of Agreement (LOA) to solidify the operation. Eurocontrol requested additional information on airblocks and vertical dimensions. These items were sent back to Eurocontrol along with an example LOA to start the agreement process. Eurocontrol offered to complete an initial airspace analysis that would provide Virgin Orbit with potential impacts of the rocket launch operation.
  - Spaceflight will need a priority in the airspace structure
  - NOTAMs will be needed at least 3 days prior to operation and no longer than 90 days
  - Eurocontrol to facilitate a meeting with the Portuguese
  - Review Tango routes and determine impacts

- 01-November-2021: Eurocontrol completed the initial airspace analysis and provided an overview to Virgin Orbit.
    - It was noted that times of the day from 0000-0600 local time were a much lower impact to air traffic at all TDAs
- 17-November-2021: Virgin Orbit presented to the SW Axis 50 group to discuss operations. No actions were taken from the meeting.
- 10-February-2022: Held meeting as a catch-up on the operation
    - Virgin Orbit presented updated coordinates and drop point move further west
    - Eurocontrol provided insight on heavily trafficked times on the Tango routes
    - Eurocontrol requested to understand how the aircraft will be controlled (NATS or Mil)
    - Reiterated the need for a priority in the airspace structure

A.6 Irish Aviation Authority (IAA)

Virgin Orbit held meetings and e-mail exchanges with the IAA to provide a briefing on the rocket launch operations. IAA expressed concern about impacts to air traffic. Virgin Orbit provided the mitigations detailed above. IAA stated that a higher Irish government to UK government agreements would be needed before proceeding into procedural negotiations with Virgin Orbit.

IAA also requested the process to allow Virgin Orbit's 747 flight worthiness certificate transfer to Ireland for flights within their territory. Virgin Orbit is working with CAA to transfer the certificate to the UK and will complete a similar task once a procedure is provided by the IAA.

- 29-March-2021: See Appendix B.5.1
- 31-August-2021: Virgin Orbit met with a group arranged by UK MCA with IAA being a party to the discussions.
    - The majority of the discussions focused on marine issues, however, representatives from IAA on the meeting requested engagement with the aviation regulator as quickly as possible. IAA took the action to collect responsible party contacts internally and send to Virgin Orbit.
- 03-September-2021: A follow-up meeting dedicated to IAA was held in September 2021. Virgin Orbit presented the TDAs, 747 flight path, and estimated launch windows to IAA.
    - IAA stated that there is lower density in Shanwick
    - Bilateral discissions were underway with UK government
    - Virgin Orbit was requested to describe the sonic boom impact to Ireland (mostly associated with a "thunderclap" at the levels analyzed)
    - Recognition of airworthiness certificates for the 747 will be needed
    - Suggested establishing regular meetings between IAA and Virgin Orbit
- 4-March-2022: Meeting convened to discuss changes to ACP and status of government-to-government negotiations.
    - Virgin Orbit/IAA decided to work the lower-level tasks on the project to be ready for the gov-gov action to complete
    - Virgin Orbit took to action to review possible procedures of notification and whether an LOA would be necessary
    - IAA discussed the need again for mutual recognition of the 747 EAC
    - Virgin Orbit displayed and sent the updated coordinates to IAA
    - IAA expressed the need for our phraseology to align with ATC. Virgin Orbit will bring the 747 pilots to the next meeting to discuss

A.7 **NATS**

NATS: To minimise the impact of segregated airspace in oceanic operations the launch area and recovery protection zones must be subject to a sponsor guarantee of the containment of the activity within the defined zones which reduce the buffers that ANSPs are required to add around the segregated airspace. With the sponsors guarantee, the buffer sizes can be minimised within Shanwick to 30nm MNPS and 60 nm Non-MNPS reducing the impact of the airspace closure to other users. The closure will have additional time buffers added to ensure that flight planned traffic is clear of the airspace at the start of the launch procedure. The time buffers are typically -30/+15 minutes to enable transit of the flights ahead of start time. NATS would welcome any sureties in discussion which can minimize the time and geographic buffers necessary and hence reduce the impact on the network.

Virgin Orbit Response 1: Virgin Orbit will hold to the launch and recovery areas described in transmitted TDAs prior to launch. Due to final rocket engine tuning, the downrange area may slightly change (potential change in the 5nm range). However, once, transmitted for NOTAM and NOTMARs, the areas will be guaranteed. The launch time is considered set due to customer requirements, therefore limiting the amount of buffer required.

NATS: Airspace closures of the size proposed to support the safe launch of Launcher One, will create restrictions on other special use airspace activity, and it is unlikely the Airspace Management Cell (AMC) would approve a booking at the same time as significant other Danger Area activity within the region. Currently spaceflight has no declared priority within the airspace management protocols which are the defined basis for the airspace management cell decisions. These protocols are defined by the UK CAA for UK airspace and the joint NATS MOD provided AMC then manages the airspace bookings in accordance with the protocols.

Virgin Orbit Response 2: Virgin Orbit has requested DfT and CAA clarification on space launch priority in the airspace structure. Virgin Orbit is awaiting clarification from UK agencies. Coordination with any affected Danger Area will be completed prior to setting a launch date. Virgin Orbit's launch date is currently in flux based on agreements and licenses to be completed. Once a date is finalized, deconfliction with the affected danger will take place. Virgin Orbit has also creating routing to avoid danger areas such as D064.

NATS: NATS assumes there are no restrictions on aircraft movements and ANSP provided services between the aircraft hazard areas for launch and stage 1 / fairing recovery, i.e. that aircraft are free to operate beneath the trajectory between the aircraft hazard areas and that the CAA has approved the safety assurance containing the hazard areas to the defined volumes.

Virgin Orbit Response 3: Virgin Orbit agrees that aircraft are free to move in between the launch area and stage 1/fairing drop area. CAA is currently in review of Virgin Orbit's safety analysis and will give the final approval of this statement at the conclusion of the review.

NATS: The Network Manager at Eurocontrol requires 90 days to set up EU restrictions, which is based upon the buffer zones around the launch areas, and NATS and other impacted ANSPs would provide these to the Network Manager. There will be system adaptations and simulations of route viability to be conducted to inform the correct ANSP handling of traffic on the day. Therefore, NATS would need the final coordinates significantly in advance of 90 days of the launch in order to create the correct buffers, perform system adaptations, simulations etc.

Virgin Orbit Response 4: Virgin Orbit agrees with the procedures Eurocontrol has in place and will abide by them. Virgin Orbit is currently working a Letter of Agreement with Eurocontrol that will detail the required procedures for launch. Coordinates will be communicated to NATS through this document and again at L-112 days (25-MAR-2022) in order to fulfill the "significantly in advance of 90 days" requirement.

NATS: As we understand it, both proposals are for temporary airspace changes for one launch. The establishment of temporary areas introduces a lack of repeatability which will translate into a constraint on the future minimum time to launch as the airspace would need to be requested through CAP1616 afresh, reducing the agility of Virgin Orbit to respond new launch operation requests. NATS believe that if practicable for Virgin Orbit, there is benefit in establishing a regularised launch area, to decrease notification periods, reduce ANSP workload to implement, etc.

Virgin Orbit Response 5: Virgin Orbit agrees with NATS assessment for the benefit of a regularized launch area. Virgin Orbit's primary reason in using a TDA for the first 2 launches are due to using an early version rocket for these flights. At the outset of the upgraded rockets, a permanent airspace change proposal will be submitted and will likely be in a different area that has lower impacts on airspace use.

NATS: Virgin Orbit, is not the only mobile launcher system looking to operate from the UK (or Central / Northern Europe), and for efficiency, if the physics and orbital mechanics of the launches are sufficiently similar between the different proposals, you may wish to consider discussions with other operators as to the establishment of a permanent airspace structure that suits all of the operators, increasing potential responsiveness to launch proposals and sharing the financial costs associated with establishment of bespoke airspace structures.

Virgin Orbit Response 6: Virgin Orbit will take this under advisement and determine the most utilized orbital inclinations to determine if they line up with other operators' areas of interest.

NATS: The traffic through this area of the SOTA varies considerably with time of day and the prevailing weather on the day. Without information on launch timings, NATS cannot assess the likely impact of the airspace closures for a launch.

Virgin Orbit Response 7: The launch timing typically is a derived requirement from the payload provider. Virgin Orbit has identified a customer for this mission and set a *2300 UTC launch time*.

NATS: The current location of the launch point and associated aircraft hazard areas for the southern trajectory prevents the use of the TANGO routes in the Shanwick FIR. These routes, particularly T9 and T290 are important routes for NATS customers.

Therefore, NATS cannot support the proposal given the expected impact to these routes as this will significantly reduce the impact to traffic flows.

From 5th April 2022, on a 3-year rolling program, the 5 French ACC's (Reims/Brest/Marseille/Bordeaux/Paris) will embark on a training and ATM system implementation program for their new 4Flight system. There will be significant training and implementation capacity restrictions throughout this 3-year period. Network Manager has advised that this is likely to result in an additional, significant network impact, particularly on Shanwick T9 and T290 routes, with aircraft rerouted to avoid capacity constraints in French Airspace. Therefore, the comment above regarding the impact on T9 and T290 is of upmost importance.

The traffic through this area of the SOTA varies considerably with time of day and the prevailing weather on the day. Without information on launch timings, NATS is unable to assess the likely impact of the airspace closures for a launch.

The position of the aircraft hazard area to protect the launch will cause aircraft to route around the closure, adding track miles, and into adjacent Flight Information Regions, such as Shannon and Brest. This will potentially change the flow of the traffic across the European network, with traffic being onloaded on to ATC sectors in addition to their standard traffic profile.

Where capacity is available, the aircraft operators will incur the costs of additional flight distances, and domestic ANSP charges which are higher than Shanwick FIR. However, network capacity may be restricted where aircraft would plan to reroute, preventing the reroute and causing these flights to incur significant additional delays and charges disproportionate to the additional distance flown.

NATS has assumed that there are no specific requirements for the transit of the carrier aircraft to and from the launch areas and that the transit aircraft tracks are for illustration rather than a required route. The response assumes that standard aircraft maneuvers in response to ATC instruction are acceptable, (climb rate, speeds, rate of turn, wake vortex etc) and that standard horizontal and vertical separation requirements apply, e.g. if the aircraft exceeds FL280 in transit, that it is fully RVSM compliant.

Virgin Orbit Response 8: Virgin Orbit is working with Eurocontrol to understand the impacts of launches on airlines and airspace managers and would like to request an analysis completed by NATS using this document as the source material. Virgin Orbit has put in several mitigations such as reducing launch windows, flying to lower impact areas, and decreasing the size of hazard areas. The mission selected is also at a low impact time of day to aircraft. Virgin Orbit has further reduced impact to T9 and T290 by moving the drop point further west by ~100nm. A consideration when examining the impact of the Virgin Orbit launches is that this is likely a one-time event, therefore impact would be contained to 1 primary date and 2 potential backup dates. Real-time coordination during launches with airspace managers will reduce impact by allowing airspace to be released immediately after the rocket has been dropped and the carrier aircraft has turned toward NQY. The impact could be as low as 30 minutes for a year.

NATS: NATS remain unclear of the timeline that supports the path to activation for this TDA and would welcome a clear indication of dates by which this Airspace design (including ADQ compliant coordinates) will be approved vis-à-vis the earliest expected promulgation of activation, noting the notice period that AMC need to establish this airspace. Without this we are not yet able to provide confirmation that NERL and our partners can complete the necessary work to support this proposal and your launch activities.

Virgin Orbit Response 9: Virgin Orbit has provided a timeline within this document as the payload has been identified and orbital elements set.

NATS Full Document is attached within the PDF under attachments:

NATS NERL plc
Response to Virgin O

A.8 Portuguese Space Agency (PSA)/ Portuguese Air Traffic Organization

Virgin Orbit met virtually with the Portuguese Space Agency, Portuguese Air Traffic Organization, and Eurocontrol. Discussions were held on how the Airspace Management Cell would control the area during a launch. The air traffic representative expressed concern about traffic going to the Canary Islands. The rerouting is achievable; however, it will take coordination with Virgin Orbit, airspace managers, and airlines. PSA noted the heavy maritime corridors in the area.

Virgin Orbit addressed the concerns, but further coordination is required, and agreements are needed at the government-to-government level. Virgin Orbit awaits the international agreements to take place prior to creating procedures. As stated above, Virgin Orbit has also moved the trajectory further west, alleviating some North-South traffic concerns.

- 22-September-2021: Virgin Orbit meeting with PSA
  - Airspace Management Cell indicated how the messages are sent for a TDA and published for flight planning routes
  - LISBOA rep indicated the presented route could affect Canary Islands traffic, coordination early is important
  - PSA stated that there is heavy maritime traffic in the region of the TDA
  - Discussions with maritime agency needed (*possibly superseded by government-to-government agreement)
  - PSA took the action to discuss internally with airspace, maritime, defense (air force), and civil protection
- 25-February-2022: Follow-up meeting with Portuguese
  - Attendees included Air Force, Airspace Management, Space Safety, and Eurocontrol
  - New TDA affects the SANTA MARIA FIR
  - Discussions on buffers to the TDA, Virgin Orbit explained a buffer is already included
  - Discussions on safety of parallel flight to the trajectory
    - Parallel flight is safe and final approval will come from CAA
    - Information is detailed in Virgin Orbit's safety case (Spaceflight Operator Application)
  - Virgin Orbit was asked to do a final check on ceiling for debris
    - Virgin Orbit confirmed debris will fall into the TDA from a near vertical trajectory meaning debris will be above FL600 as it enters the TDA
  - Portugal would like real-time information on launch day

A.9 North Atlantic stakeholder community (NAT SPG)

Virgin Orbit met with a member of the North Atlantic Stakeholder Community to give a briefing on operations. Concerns of airspace closure were brought up. The representative suggested Virgin Orbit present to the North Atlantic System Planning Group. Virgin Orbit agreed and awaits a chance to brief the community.

- It is unknown at this time when the next meeting will occur and whether Virgin Orbit may present the operation, however, Virgin Orbit is following up with the appropriate parties

A.10 RVL Group

Virgin Orbit had email discussions with RVL Group on operations from NQY airport. No negative comments received.

A.11 MOD

A.11.1 Ministry of Defence (RAF/Navy) & Qinetiq

MOD: The hazard areas associated with the launch will affect the flow of traffic across the FIR, with the resultant flow adjustments potentially having the impact of requiring Danger Area suppression (particularly the D701 and D064 complexes) and therefore impact military activity

Virgin Orbit Response 1: Virgin Orbit will work with MOD on scheduling of the launches to make every effort to deconflict military operations. Virgin Orbit has reduced the typical launch window drastically to lessen the impact on MOD operations. Virgin Orbit would like to propose a notification and scheduling agreement with MOD that will allow transparency in launch dates/times in order to work around high priority events.

MOD: Activation of D701 by the MOD is subject to an agreement with NATS for how many times per year certain configurations can be activated due to the impact to Oceanic Entry Points, so a great deal of planning goes into when this can take place. It is not clear whether the trajectory protected area overlaps with the western and northern portions of the range and could therefore preclude the full extent of the complex to be used; therefore, greater clarity is requested regarding whether the range and the route overlap. Booking of the ranges (via QinetiQ, who operate the range complex) takes place a significant amount of time in advance. If the activities were to conflict and D701 require suppression for the launch to take place, military trials and exercise activities would be impacted. Engagement with QinetiQ as a stakeholder will be required and an agreement reached as to timings of the launch versus planned military activity.

Virgin Orbit Response 2: Virgin Orbit held meetings with MOD and Qinetiq on the proposed operations and trajectory. Virgin Orbit clarified that MOD operations are acceptable to continue under the LauncherOne trajectory in the danger area to the north of Ireland. Virgin Orbit will engage with Qinetiq as early as possible if scheduling is required, however at this time, it is believed that operations for Virgin Orbit and MOD may be conducted concurrently. Virgin Orbit has also coordinated directly with MOD airspace managers to brief the operation and understand constraints to move around the D064 area.

MOD: The MOD is unsighted as to where commercial space launches sit within the national priorities list – understanding of any agreement that has been made will allow MOD an understanding of what activities will be impacted, as well as providing a framework for the level 2 airspace management functions to be performed in accordance with extant policy.

Virgin Orbit Response 3: Virgin Orbit has requested DfT and CAA clarification on space launch priority in the airspace structure. Virgin Orbit is awaiting clarification from UK agencies. Virgin Orbit has also requested a flight priority level from MOD.

MOD: A collaborative approach will need to be adopted with all relevant stakeholders, to ensure early deconfliction of activities, or, so that impact can be minimised – this includes surrounding ANSPs who may also be affected by the flights. Protocols for when Managed Danger Areas can and can't be used as a result of the Hazard Area being active must be agreed in advance between all stakeholders, including MOD, so there is a shared understanding of what activities are and are not concurrently permitted.

To ensure minimal impact to Air Policing operations, robust communications procedures, including 'check-fire' arrangements will be required, to ensure air security can be maintained. MOD request that direct communications with the operator are arranged, so that messages can be passed if an essential pause is required prior to launch. For instance, if a non-cooperative foreign aircraft is being tracked through the area, the information can be shared. Without these procedures in place, there is a risk that an air security incident could not be effectively dealt with. These procedures may also potentially work both ways, as it could allow ATC to warn the operator of aircraft that may penetrate the hazard areas.

Virgin Orbit Response 4: As stated in response 1, Virgin Orbit is will deconflict and follow all applicable standards for scheduling as required by MOD/Qinetiq. Virgin Orbit strives to be as low impact as possible to existing operations. Requests have been sent to MOD for use of Air Traffic Control services from Swanwick Military

MOD: Although the restricted areas are outside the UK FIR, the launch would very much impact airspace management within the FIR and adjacent FIRs. The flight paths could also conflict with French Ariane launches from Guiana, as their 'drop boxes' are geographically similar – The Military Airspace Management Cell manage their launch requests. There will need to be a lead-in time of at least 4 months for the Airspace Management Cell to be able to model how the airspace will affect flows and Danger Areas, so that appropriate protocols can be agreed.

Virgin Orbit Response 5: Airanespace and Virgin Orbit rocket launches are very few throughout the year and coordination is not seen as an issue for timing.

03-MAY-2022

A.11.2 Defence Airspace And Air Traffic Management (DAATM)

Virgin Orbit Responses to DAATM Feedback. Responses are denoted with the blue font.
Thank you for taking the time to provide feedback to Virgin Orbit's stakeholder engagement as it relates to ACP-2021-031. MOD has provided valid points that are currently being assessed and addressed by Virgin Orbit. Virgin Orbit recognizes the importance of all points made; however, some may not be relevant to the ACP itself and therefore may not be fully addressed in this response. Virgin Orbit has proposed separate discussions on non-ACP related topics outside of the stakeholder engagement on the ACP.

1. DAATM was invited to comment on the VO engagement document at Reference A, noting that MOD has not been tasked to assist or contribute to this commercial venture. Following review, the staff came up with the following comments
2. Emergency procedures need expanding:

a. No detail available on decision points to divert, eject stores, route to BSD etc.

i. Virgin Orbit has included decision points in the Safety Case currently under review by CAA. A decision to divert would be made once it becomes clear that a Spaceport Cornwall landing is not possible. Emergency release of L1 is covered within the safety case, with the preferred release location within the TDA.

b. No mention of any need for fuel dump.

i. Virgin Orbit has included the standard procedures and Boring 747-400 manual in the Safety Case with the CAA. Fuel dump is addressed within nominal procedures and the Boeing flight manual.

c. Has QinetiQ agreed use of BSD iaw JSP360 charges?

i. Virgin Orbit is currently in preliminary discussions with BSD regarding the divert scenario and will agree to required charges outside of the ACP process.

d. It is assumed that the emergency aircraft will be controlled by 78 Sqn by this is not confirmed. Similarly, a diverting aircraft with or without a hung launcher may not, in itself, be an emergency but will require an ATS en route to BSD.

i. Virgin Orbit agree that control of the aircraft along the flight path is an open action and currently being worked. This will take place outside the process of establishing the TDAs. A diversion to BSD is not considered an emergency event.

3. The launch window Jul – Oct is very wide and so does not permit fine detail planning until last safe moment, but the most known date is 15 Jul 22 at 2300Z2. This makes setting priorities/assessing impact difficult. As yet, there is

no decision as to priority for MOD as Defence activity might be necessary during the launch period and may be at short notice.

a. Establishing priority for the Captive Carry flight is an action currently being worked by the CAA. Virgin Orbit understands that MOD will have priority in the event of emergency action and accept that a launch scrub may be required if notice is given to stand down. Virgin Orbit has requested a priority rating from CAA for rocket launches within the airspace structure.

4. The NAT track will determine level of impact to civil activity (noting they have a night launch, so the impact should be minimal), but by blocking the southern OEPs, there will likely be a need to not block the northern OEPs (ivo D701). QinetiQ and the MoD are keen to understand the timeline so it can be determined whether this will impact planned D701 activities. It is difficult to assess whether the OEPs and thus D701 activities would be affected. VO would like to propose a notification and scheduling agreement with MOD that will allow transparency in launch dates/times to work around high priority events, but no suggestion or request as to how this will be achieved.

a. Virgin Orbit is requesting NAT Track information from NATS to assess the level of impact to civil activity. With the launch window close to midnight local time, preliminary impact assessment is low.
b. Notifications are highlighted in section 6.2 of the ACP document. Virgin Orbit is willing to enter into an official agreement with MOD to provide notifications or add MOD to an overarching notification plan.

5. There is no acknowledgement of disruption to BSD, noting that BSD plan to switch to night flying for all Stn ops during the period. It is assumed that the Stn will be managing any adverse popn impact generated iso a commercial activity. It is assumed that the use of BSD is iaw JSP360 wrt charges.
a. Virgin Orbit is in preliminary discussions with BSD and addressing non-ACP related issues outside of the ACP process. Impacts to BSD are acknowledged. Currently Virgin Orbit does not have permission to use BSD and therefore detailed planning has not gone beyond a preliminary feasibility discussion

6. No discussion of use of D064 for trg sorties, which we know are required. No discussion of use of D701 for launch (see 2b and c above).
a. Virgin Orbit is requesting 2 training flights prior to the launch. An official request has been made for the use of D064 through MOD for one flight on a non-interference basis. This first flight is purely pilot training and does not require a TDA. This flight will be addressed outside of the ACP. The second training flight is a full mission rehearsal and does not require D064. A request for a simulated TDA to be activated will be made in order to practice the process. No priority has been requested as this is not a hard requirement to use D064.

7. No clear comms plan/comms card. It is assumed that the call sign COSMIC GIRL has been approved for use by CAA and IAA? Equally there is no mention of voice comms between COSMIC GIRL and msn control to confirm that VHF LOS as primary with a potential HF backup on RAF Flight Watch requested through Forest Moor.
a. Virgin Orbit files a flight plan for each flight using OBT01 as the call sign with 'OBT 01 is Cosmic Girl 01' stated in section 18. The communication plan to the Mission Control Center is outside the scope of the ACP, however, SATCOM is used for primary comms. The aircraft will be in communication with ATC through the aircraft VHF radio.

8. UK SPOC needs to be included4 in the planning discussions and tabletop exercises. ASACS liaison required to reassure NATO Air Policing msn.
a. Virgin Orbit will be reaching out to UK SPOC with regard to launch planning. These discussions are outside the scope of the ACP but will be addressed.

9. Clear Range procedures in the TDA will be challenging if the CAA launch authority requires TDA management:
a. There is no obvious primary radar sources. Cosmic Girl only has a weather radar and TCAS for monitoring of non-participating traffic in the area.
i. Virgin Orbit has addressed range control within the Safety Case submitted to CAA.

b. What is the available Irish radar coverage?
i. Virgin Orbit is currently in discussions with the Irish Aviation Authority and will address radar coverage
c. Non-participating traffic represent a risk. Foreign Long Range Aviation (LRA) disruption should be considered as a realistic risk, requiring a QRA response. Without a clear TDA management process or crossing procedure, LRA mitigation will be challenging.
i. Virgin Orbit proposes allowing the QRA controlling unit to communicate directly with the Mission Control Center that can then relay to Cosmic Girl. Alternatively the RAF can use the mission frequency to directly communicate with Cosmic Girl. This is an open action to be worked prior to launch.

10. Promulgation by AIC/ACN as well as NOTAM by 15 May 22 Decision Point (L-2 months) may be challenging to meet. Similarly, there is no acknowledgement of a Reserve Day (D+1) or third day (D+2) that will require airspace reservations in place and promulgated in order for EuroControl to have released en route flight plans through the Airspace Utilisation Plan (AUP), which is normally released ~48 hrs in advance in the Network Manager's Pre-Tactical phase. VO need to confirm Go/No Go times so that the TDAs can be collapsed via the Updated Utilisation Plan (UUP); this may be too late for D+1 TDAs to be collapsed and so the en route tracks may be disrupted on D and D+1 even if the launch on D is successful6. If D+1 is required, then the airspace reservations for D+2 will also be needed; there is therefore a risk that the trans-Atlantic flights could face some disruption for 3 periods over 3 days.
a. Virgin Orbit is assessing a launch slip that will provide further time for the decision point. This is currently in work and will be communicated when known. Reserve days are addressed in section 4 of the ACP document; A primary date is reserved with 2 consecutive backup dates. The TDA will be activated for the 3 days and released once a launch takes place. This will allow flights to plan accordingly.
b. A "Go" is always in effect for the launch until a "No Go" is warranted. A launch scrub is immediately communicated using e-mail, phone calls, and (if close enough to the launch event) on the real-time hot line with stakeholders.
c. Virgin Orbit understands the impact to Trans-Atlantic flights; however, it should be noted that the time of launch is during low traffic times and this ACP is for 1 single launch. Therefore, causing minimal impact.

11. It is not clear who is the preferred ATS provider when in the UK FIR in and out of EGHQ: a. 78 Sqn/Western Radar availability?
a. Assumes ATS from 78 Sqn and Shannon, yet to be agreed. COS BMFHQ and 78 Sqn are working a plan.
i. Virgin Orbit agrees

12. The launch TDA is requested for 30 mins, within which a 19 min calibration race track is required as well as a transit period from TDA edge to race track start point and exit point. If any non-race track element within the TDA is 10 mins (for example 5 mins in and 5 mins out), this leaves 1 min contingency. This assumes the race track calibration does not need more than one rotation. VO need to confirm that the TDA becomes active and inactive iaw the NOTAM and not when Cosmic Girl arrives on station; a 30 min TDA may not be sufficient.
a. Virgin Orbit has requested a 30-minute TDA activation between the 2200-2330 UTC. The aircraft TDA starts at the aircraft entering the racetrack which is denoted with the red dot in the image below (clarification will be added to the ACP document). From that point to dropping the rocket is a total of 19 minutes allowing 11 minutes in reserve.

Once entering the racetrack, timing is set, and confidence is high for a drop of the rocket. The rocket TDA is activated at the same time but will run for 1 hour.

13. Summary. There are still key pieces of liaison missing to enable a final operation order to be produced to reassure the various Stakeholders (deployment, trg flts, launch, recovery), making it difficult to finalise decisions. This is particularly important for airspace, coordination, and traffic flow matters, where long lead times exist and face relatively rigid promulgation timelines. Whilst the MOD is keen to support where possible, it is not yet appropriate to resolve these matters at desk

    Thank you again for reviewing our ACP document. We look forward to working with MOD and coming to an agreement on the open actions discussed above.

    Full documents are attached within the PDF under attachments:

20211112-ACP-2021-031_MOD Response-(

2020331-DAATM_Comments_VO_Engagem

A.12 Stakeholder Table

Organization	Name	Appointment	Means of Engagement	Contact Details	Response	Design Change?
Airlines UK		and Public Affairs Manager	E-mail, Meeting		Yes	No
Airspace4All			-mail		Yes	No
British Airways (BA)		Flight Dispatch Strategy Manager	E-mail			
British Business and General Aviation Association (BBGA)		CEO	E-mail			
			-mail			No
General Aviation Alliance (GAA)						
Ministry of Defence (RAF/Navy)		Military Airspace Manager Swanwick	E-mail, Meeting			
		Airspace Air Traffic Management (Airspace Plan)	E-mail, Meeting			
		Danger Area Airspace Manager	E-mail, Meeting			
		Defence Airspace Air Traffic Management (Airspace Operations)	E-mail, Meeting			
		Danger Area Airspace Manager SO3	E-mail, Meeting			
		Air Traffic Controller	E-mail, Meeting			
NATS		Principal Specialist, SMS Development & Commercial Space	E-mail, Meeting			
		of ATM Evolution & Design	E-mail, Meeting		Yes	Yes
Qinetiq		QinetiQ Air Traffic Management Advisor	E-mail, Meeting		Yes	Yes
United States Air Force Europe (3rd Air Force-Directorate of Flying)						
Eurocontrol		/High Level Operations Specialist	E-mail, Meeting			
		Operation Planning Expert	Meeting			
Irish Aviation Authority		ANSD	E-mail, Meeting			
		Operations Manager	E-mail, Meeting		Yes	Yes
Portuguese Space		President	Meeting			Yes
North Atlantic stakeholder community		Head of Airspace Modernisation	Meeting		No	No
Maritime and Coastguard Agency		Licensing Space Launch Lead	E-mail, Meeting		Yes	Yes
RVL		of Maritime Aviation	E-mail		Yes	No

A.12.1 Stakeholder Selection Process

Virgin Orbit commenced the stakeholder engagement process using the National Air Traffic Management Advisory Committee list to identify potentially impacted parties. The list was reviewed for stakeholders that operate in the TDA or potentially traverse through. In addition to NATMAC, Virgin Orbit had started pre-coordination with NATS, Eurocontrol, the Ministry of Defence, and international partners. Coordination and engagement proceeded throughout the ACP process.

Appendix B: Correspondence with Stakeholders

B.1 Airlines UK

From: [redacted]
[redacted]
Subject: Re: Virgin Orbit Operations in UK
Date: Tuesday, September 14, 2021 7:37:11 AM
Attachments: image002.png
Outlook-rarquvuf.png
Outlook-qyiez2m5.png
Outlook-44u3sws5.png
Outlook-qfrl3b50.png
Outlook-yptht1uw.png
Outlook-ylimmtro.png

[EXTERNAL EMAIL]

Hi [redacted],

I'd be glad to have a chat with you about this initially, I will then feedback to our member airlines and perhaps followup down the line if that sounds OK?

I would imagine something later in the day for me, earlier for you works best, I'll be at political party conferences from 27 Sept for a fortnight but available before or after.

Best,
[redacted]

[redacted]

AIRLINES UK
THE ASSOCIATION OF UK AIRLINES

Airlines UK
the association of UK airlines
web: airlinesuk.org
twitter: @airlines_uk
mob: [redacted]

With thanks to our Gold Members

THALES ICF COLLINSON Gallagher ICTS UK & IRELAND

From: [redacted]
Sent: 10 September 2021 22:44
To: [redacted]

Subject: Virgin Orbit Operations in UK

Hello,

My name is [redacted] I work for Virgin Orbit (VO) in California, USA. I would like to inquire if there is a representative of the organization I may contact regarding upcoming rocket launches from Newquay Airport in Cornwall, UK. VO will be starting operations in the middle of 2022 and I'd like to brief your organization on any impacts the launches may have on airspace in the region in order to receive feedback or comments. Please feel free to call or e-mail at your convenience.

Thank you,

[redacted]
4022 E CONANT STREET
LONG BEACH CA 90808
C [redacted]
[redacted]
W VirginOrbit.com

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B.2 **Airspace4All**

From: [redacted]
To:
Subject: RE: Virgin Orbit Operations in UK
Date: Thursday, December 16, 2021 5:39:18 AM
Attachments: image003.png
image005.png
image001.png
image002.png

[EXTERNAL EMAIL]

Hello [redacted]

No issues or objections from us.

[redacted]

[redacted]
Airspace4All Ltd
31 Walker Avenue, Wolverton Mill East, Milton Keynes, MK12 5TW
☎ Mob: [redacted] ✉ Email: [redacted] Web: www.airspace4all.org

From: [redacted]
Sent: 15 December 2021 23:11
To [redacted]
Subject: Virgin Orbit Operations in UK

[redacted]

My name is [redacted] I work for Virgin Orbit (VO) in California USA. My company is a rocket manufacturer that will be launching from various locations around the world. We are an air launched rocket which means we strap a rocket to a 747-400 aircraft, fly to a location over the ocean, drop our rocket, ignite the engines, and travel to space. Our next base of operations will be Newquay Airport in Cornwall, UK. The initial phase of operations will see 1-2 launches per year ramping up to 12 launches per year.

Our operations may slightly impact airspace in the region. I am reaching out to you to in order to brief you on the operations and listen to any feedback or comments you may have. If you have a chance to review the following Airspace Change Proposals, I would be very interested in your feedback. I look forward to hearing back from you.

https://airspacechange.caa.co.uk/PublicProposalArea?pID=406

https://airspacechange.caa.co.uk/PublicProposalArea?pID=373

Thank you,

[redacted]
4022 E CONANT STREET
LONG BEACH CA 90808
[redacted]
W VirginOrbit.com

B.3 **BBGA**

From: [redacted]
To:
Cc:
Subject: RE: Virgin Orbit Operations in UK
Date: Thursday, December 16, 2021 2:12:12 AM
Attachments: image003.png
image004.png
image001.png

[EXTERNAL EMAIL]

[redacted] good morning and exciting work.

I will pass your information to our Operations Workgroup where we look at the impact of things like this on our members in the region concerned.

Kind Regards

[redacted]
BBGA

[redacted]
British Business and General Aviation Association
m: [redacted]
www.bbga.aero

BBGA Events

2022

[redacted]

From: [redacted]
Sent: 15 December 2021 23:12
To: [redacted]
Subject: Virgin Orbit Operations in UK

[redacted]

My name is [redacted], I work for Virgin Orbit (VO) in California USA. My company is a rocket

manufacturer that will be launching from various locations around the world. We are an air launched rocket which means we strap a rocket to a 747-400 aircraft, fly to a location over the ocean, drop our rocket, ignite the engines, and travel to space. Our next base of operations will be Newquay Airport in Cornwall, UK. The initial phase of operations will see 1-2 launches per year ramping up to 12 launches per year.

Our operations may slightly impact airspace in the region. I am reaching out to you to in order to brief you on the operations and listen to any feedback or comments you may have. If you have a chance to review the following Airspace Change Proposals, I would be very interested in your feedback. I look forward to hearing back from you.

https://airspacechange.caa.co.uk/PublicProposalArea?pID=406

https://airspacechange.caa.co.uk/PublicProposalArea?pID=373

Thank you,

[redacted]

4022 E CONANT STREET
LONG BEACH CA 90808
[redacted]
W VirginOrbit.com

B.4 **GAA**

Cc: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall

Hi [redacted],

Thank you for your email.

> We are seeking a temporary airspace change
As far as we can see from the CAP1616 portal data there are no airspace proposals:
- over the UK mainland or islands,
- over the sea between UK mainland and islands
- elsewhere within 10nm of the UK coastline.
If that is so then the airspace proposals are probably of no concern to GAA members, always remembering that GAA members are free to make their own responses directly.
It is probably a good thing that GAA members will not be affected as the standard of the document that we have received is far below what CAP1616 expects an airspace sponsor to provide, and we would have been forced to request a pause in the stakeholder engagement process until a suitable document was provided.

Please correct any errors in the above with respect to the locations of the airspace proposals. If there are none then please confirm it and may we wish good luck with your endeavours.

GAA members will be copied with your response.

Regards

[redacted]

[redacted]
General Aviation Alliance

Email [redacted]

From: [redacted]
Sent: 23 November 2021 17:46
To: [redacted]
Cc: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall

Hi [redacted],

Thank you for the e-mail! We are seeking a temporary airspace change. Please find the two requests below:

https://airspacechange.caa.co.uk/PublicProposalArea?pID=406

https://airspacechange.caa.co.uk/PublicProposalArea?pID=373

Thank you,
[redacted]

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall
Date: Tuesday, November 23, 2021 2:01:55 PM
Attachments: image001.png
image002.png
SMA-132_VO_Operations_Spaceport_Cornwall_North.pdf
SMA-131_Virgin_Orbit_Operations_Spaceport_Cornwall.pdf

Hi [redacted],

Thank you for your prompt response.

> The airspace change is further than 10nmi off the UK coastline
Thank you for the confirmation and therefore the GAA has no comment to offer upon the proposals.

> GAA members will be copied with your response.
Please see the cc list and www.gaalliance.org.uk.

Regards

[redacted]

[redacted]
General Aviation Alliance

Email: [redacted]

From: [redacted]
Sent: 23 November 2021 18:19
To: [redacted]
Cc: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall

Hi [redacted],

I have attached two documents with greater detail. Please review at your convenience and let me know what you think.

The airspace change is further than 10nmi off the UK coastline. Our flight path does take us over the coast, however, we are requesting no change to a standard 747 aircraft.

Thank you,
[redacted]

From: [redacted]
Sent: Tuesday, November 23, 2021 10:13 AM
[redacted]

Virgin Orbit

From: [redacted]
Sent: Monday, November 22, 2021 9:00 AM
To: [redacted]
Cc: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall

[redacted]

Thank you for your contact. Is it because you, or a colleague, will be seeking an airspace change under the UK CAA's CAP1616 process (https://www.caa.co.uk/Commercial-industry/Airspace/Airspace-change/Airspace-Change/) or is it just as a matter of good airmanship?

Regards

[redacted]

[redacted]
Programme Manager
General Aviation Alliance

Email: [redacted]

From: [redacted]
Sent: 21 November 2021 16:39
To: [redacted]
Subject: RE: Virgin Orbit Operations from Spaceport Cornwall

[redacted]

GA Alliance is a" Facilitated organisation" in that we work to ensure a common position across our member associations both in our position on various areas of interest and in responding, In this case relative to airspace issues. I would add that our member groups ensure we cover the full range of Sports & Recreational flying and Private flying in UK

In that context our [redacted] (copied as your note) [redacted] is the first "port of call". Might I suggest you discuss matters with him the first instance and we take it from there.

Best regards

[redacted]

[redacted]

From: [redacted]
Sent: 19 November 2021 21:29
To: [redacted]
Subject: Virgin Orbit Operations from Spaceport Cornwall

[redacted]

My name is [redacted] I work for Virgin Orbit (VO) in California, USA. I would like to inquire if you are the representative of the General Aviation Alliance (GAA) to discuss VO's upcoming rocket launches from Newquay Airport in Cornwall, UK. VO will be starting operations in the middle of 2022 and I'd like to brief your organization on any impacts the launches may have on airspace in the region in order to receive feedback or comments. Please feel free to call or e-mail at your convenience.

Thank you,

[redacted]
4022 E CONANT STREET
LONG BEACH CA 90808
[redacted]
W VirginOrbit.com

B.5 Eurocontrol

B.5.1 29-March-2021 Meeting Minutes

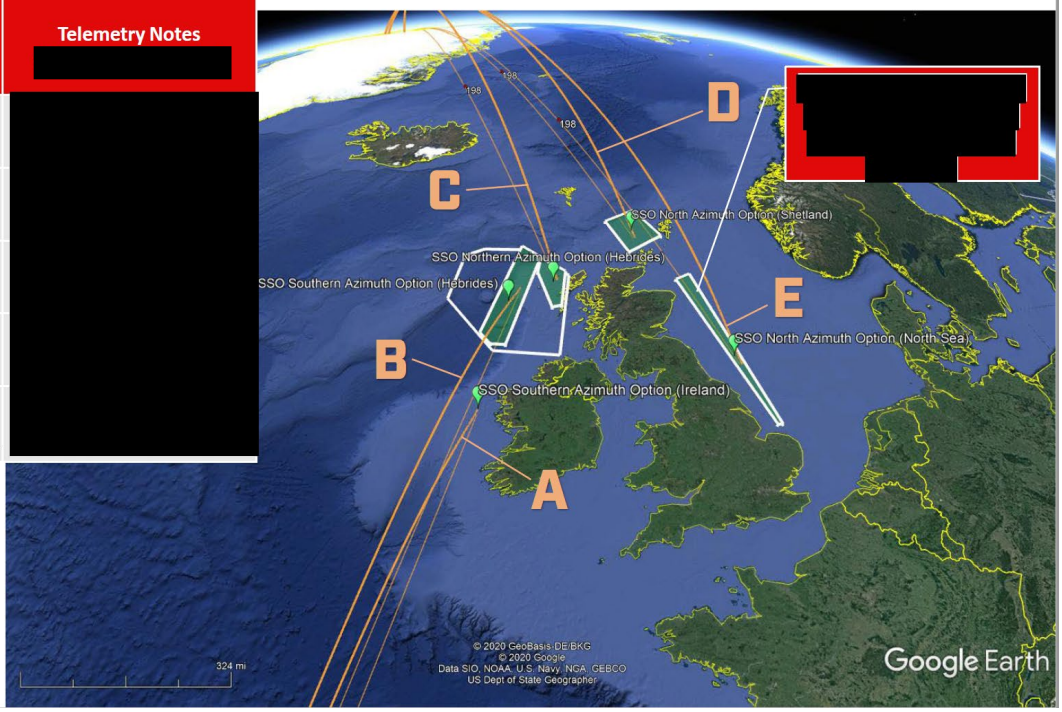
Attendees: Representatives from Spaceport Cornwall, NATS, MOD DAATM, Eurocontrol, Irish Aviation Authority, Virgin Orbit

Attachment

MISSION ANALYSIS DOWNSELECTION – SSO

Parameter	Azimuth	[redacted]	Telemetry Notes
Trajectory A (West Ireland)	Southern	[redacted]	[redacted]
Trajectory B (Hebrides)			
Trajectory C (Hebrides)	Northern		
Trajectory D (Shetland)			
Trajectory E (North Sea)			

- ❑ Trajectories A, B, C, and D under further review
- ❑ [redacted]



Notes

- VO to determine what the length of the Aircraft Hazard Areas are.
- Time of day for the operation is really important
- Need to build in portion by portion
    - VO to coordinate with Santa Maria - Portugal Azores
    - Air blocks would have times on them
        - Need to be named and appear on AMC
        - Published 24 hours before day of use
        - Plan can be updated
        - Purple airspace (open and closed in front and behind the rocket)
        - Airspace will need to be subdivided
    - Danger areas are transmitted each day
- Commercial vs state flights
    - VO will likely be commercial, however, a government payload could allow for state
    - A/C coming in from far away have priority
- From Military perspective must guarantee safety for air and sea
    - Military agrees with the Charlie drop point as best location
    - Danger area already exists in this location
- VO should work to minimize the footprint and time
- Understand that these are important pieces of airspace
- Need to get North Atlantic ATO
- Launches could create expense and environmental issues
- Notional timelines, height, width of air blocks should be determined
- Who controls airspace for A/C on takeoff?
- Showstoppers (Andy)
    - ACPs can take a long time
    - Oceanic airspace is much easier
    - Need support of airspace users
    - Move relatively quickly when over the sea

Subject: Virgin Orbit - launch range selection
Location: Microsoft Teams Meeting

Start: Mon 3/29/2021 7:00 AM
End: Mon 3/29/2021 8:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

All,

I apologise but we've had to push the meeting back to the following week; given the majority of you had good availability next week, I hope it's the same for Monday 29th. Find attached the Teams meeting invite and LauncherOne drop locations, [redacted]. **Please respect the confidentiality of the attached document and do not circulate.** At this stage, Virgin Orbit would like to keep the discussion high-level, to establish the feasibility of launching from these locations and highlight key considerations.

I appreciate your attendance and input in what I'm sure will be a meaningful discussion.

Kind regards,
[redacted]

Microsoft Teams meeting

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[redacted]
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B.5.2 02-September-2021 Meeting Minutes

Attendees: Eurocontrol, Virgin Orbit

- Start coordination with RAF air traffic services
    - Swanwick military center is likely controlling center
- Understand what priority space flight has in the airspace structure
- Need to be at least priority 2 (goes down to 7)
- Eurocontrol interested in a Letter of Agreement with VO
- Require a 60 days notice before a launch and subsequent notices
- In order to launch in July, AIRAC would need to know data by March
    - Not a Eurocontrol requirement but a AIRAC requirement
- Determine at what point from drop does the rocket reach FL600
- Will need coordinates of the airblocks (hazard areas)
- What is the top level of the fairing stage 1 airblock
    - What height will it be as it enters the area (above FL660?)
- NOTAM at least 3 days before operation, no longer than 90 days

- UK will likely issue an AIC
- Start Coordination with Portuguese Space Agency for hazard area off coast of Portugal
- There are 4 oceanic routes (tango routes) that are extremely busy at specific times of the year
    - Good to avoid these routes
- Ocean, euro and us - tripartite LOA between us
- Space launch does not have priority in the airspace structure and will need CAA determination to understand procedures better (require at least a priority 2)
- Virgin Orbit to send an example Letter of Agreement (LOA) to Eurocontrol for a starting point in an agreement with Eurocontrol (LOA sent and in process of aligning procedures)
- Notifications are needed at a minimum of 60

[redacted]

Subject: Virgin Orbital LOA
Location: online

Start: Thu 9/2/2021 5:30 AM
End: Thu 9/2/2021 6:30 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

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B.5.3 01-November-2021 Meeting Minutes

Attendees: Eurocontrol, Virgin Orbit

Notes:

- Meeting to review the analysis that was prepared by Eurocontrol to understand the traffic densities the occur within Virgin Orbit's preferred trajectories
- Understand what the gulfstream is doing and how rerouting is occurring
- 60N/10W is usually the winds
- Analysis is showing between midnight and 0630 routes are significantly less crowded
- Busiest day was 14-July-2019 and that was used to base the analysis for a conservative approach
- Virgin Orbit will use this conservative approach to understand impact of launch and help determine a launch time to avoid impacting airlines

[redacted]

Subject: Virgin Orbit
Location: Microsoft Teams Meeting

Start: Mon 11/1/2021 9:00 AM
End: Mon 11/1/2021 10:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

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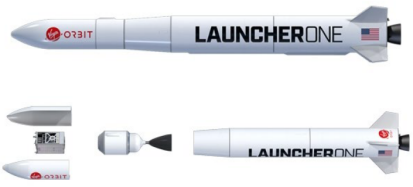
B.5.4 17-November-2021: Virgin Orbit presentation to SW Axis 50 group

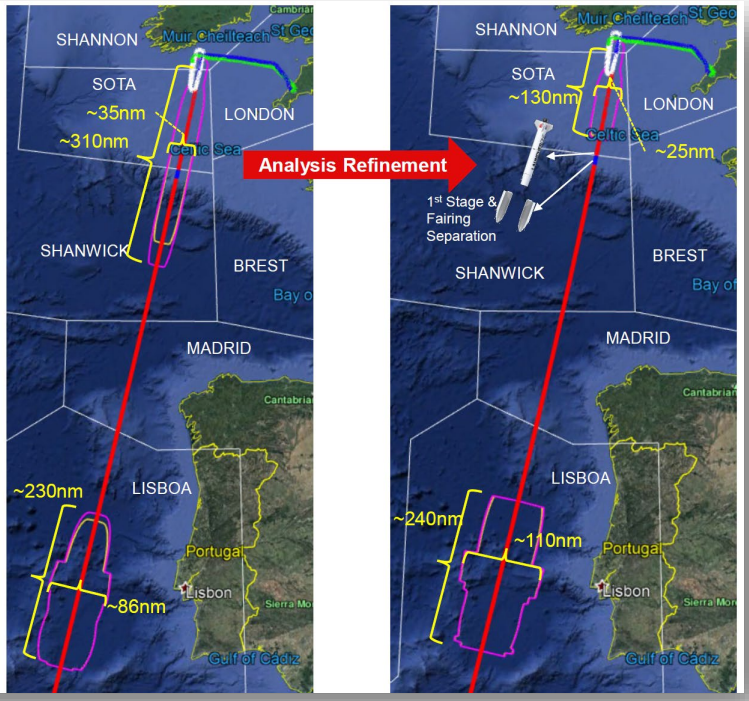
Overview

- VO will use LauncherOne (L1) to provide Low Earth Orbit (LEO) deployment service for small satellites from Cornwall Airport (NQY). Currently, L1 has a total payload capacity of 300 kilograms (kg) for Sun-Synchronous Orbit (SSO) and 500 kg for equatorial orbit. Subsequent versions of L1 will have increased capacity and range.
- VO uses an air-launched rocket system consisting of L1 and Cosmic Girl, a 747-400 equipped to carry and deploy L1 using a custom pylon mounted to the 747's existing, non-functioning, fifth engine underwing mount.
- The initial orbital parameters being considered from Cornwall are an SSO mission with a southern Trajectory and a polar orbit with a northern trajectory.
- Currently projecting 1-2 launcher per year but could increase in the future



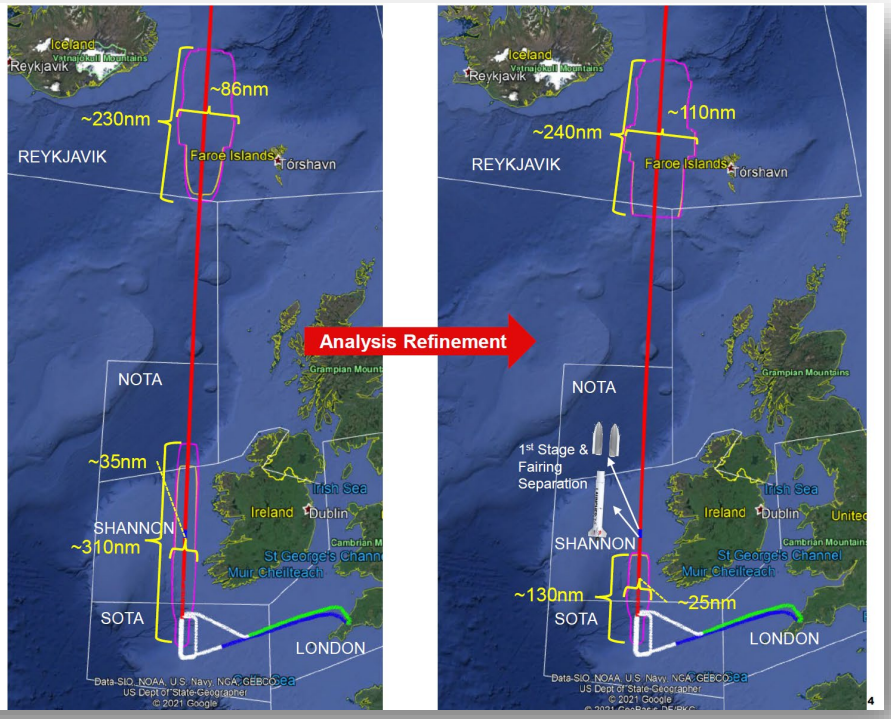
Southern Trajectory

- SSO for general customer
  - Most payload operators will want an SSO from Cornwall
- Refining all CONOPS to minimize impact to airspace and waterways
- Limiting launch window to 1 hour
  - 30 minutes to drop
  - 30 minute for debris fall time
    - Refining analysis to decrease fall time
- Significant refinement of assumptions in analysis cut hazard area by ~60%
- Coordinating with NATS, Eurocontrol, CAA, SPG, Portuguese Space Agency



Northern Trajectory

- Polar 88° orbit for a potential customer
- UKSA completed an MOU with Faroe Islands and Iceland to allow stage and fairing drop
- ACP in process
  - AIC/SUP publication 2-JUN-22



PROPRIETARY & CONFIDENTIAL

Next Steps

- Collect final feedback from stakeholders
  - Review feedback and mitigate as much as practicable
- Understand impacts to airlines and airspace
  - Eurocontrol has completed a preliminary airspace analysis assessment for both trajectories
- VO to understand optimal timing of a launch window to reduce impact to air and ship traffic
- Coordinate with CAA and airlines on optimal path forward
- Airspace agreements to be put in place
  - VO would like to include as many affected parties in one agreement as possible
- Assessment of Environmental Effects has been completed with a finding of no significant impact
  - Document with CAA
  - Addresses Notice to Airmen
  - Will be offered to stakeholders for review

B.5.5 10-February-2022 Meeting Minutes

Attendees: Eurocontrol, Virgin Orbit

Notes:

- Action to resent Eurocontrol the updated drop point and trajectory (COMPLETE)

- Eurocontrol needs an exact drop time/rocket ignition to better analyze traffic data
- Class echo above 60000ft alt
- Portuguese Space Agency is arranging an internal meeting for Portuguese Stakeholders in February 2022
- Possibility for VO to test a real-time telemetry data integration to Eurocontrol airspace
    - Eurocontrol to Send out ICD for the data integration
- VO Ops shouldn't impact the French at late night through BREST
- Defense questions
    - Who will handle airplane (NATS or military)
    - If it's a state aircraft (carrys an RAF payload) then Military takes priority
        - No priority assigned if not military
    - Do we have a divert airfield selected – Yes, Boscombe Down

[redacted]

Subject: Virgin Orbital
Location: online/phone

Start: Thu 2/10/2022 1:00 AM
End: Thu 2/10/2022 3:30 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

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Dial [redacted]
You can also dial [redacted] and enter your meeting number.

B.5.6 Correspondence

From: [redacted]
To: [redacted]
Subject: RE: Virgin Orbital Launches in European Airspace.
Date: Thursday, April 1, 2021 12:50:52 AM
Attachments: Spaceports 06- firuir_upper_airspace_ectl.pdf

[EXTERNAL EMAIL]

Hi [redacted] ,

I have included a Eurocontrol map giving the structure of European Airspace . I have slightly changed the map to include Spaceports and HAPS sites . I hope this helps you a little on our journey for Cosmic Girl's Rocket launch .

[redacted]

From: [redacted]
Sent: 01 April 2021 07:20
To: [redacted]
Subject: RE: Virgin Orbital Launches in European Airspace.

Thank you [redacted] ! It was great to talk to you as well and I appreciate your time to explain how the airspace works in that area. Definitely more complex than what I am used to!

Thank you,
[redacted]

From: [redacted]
Sent: Wednesday, March 31, 2021 5:14 AM
To: [redacted]
Cc: [redacted]
Subject: Virgin Orbital Launches in European Airspace.

[EXTERNAL EMAIL]

Hi [redacted] ,

It was great to talk on Monday and see what you are trying to do . If you need help and support from me at Eurocontrol just give me a shout .

All the best

[redacted]

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From: [redacted]
To:
Cc:
Subject: Briefing South/West Axis in Europe
Date: Wednesday, October 13, 2021 2:33:26 AM

[EXTERNAL EMAIL]

Good Morning [redacted] ,

I have had a request forwarded to me which is :-

Would you/ could you give a presentation to the South West Axis on the Southern route of Cosmic Girl at 15.00 CET on the 17th of November ?

The South West Axis are countries along the route of Cosmic Girl these are the ASNP's in plain speak the ACC's . My colleague is looking 20 minutes presentation and 10 minutes for Q&A .

Kind Regards

[redacted]

[redacted]

Email [redacted]

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From: [redacted]
To:
Cc:
Subject: RE: Updated Engagement Document
Date: Wednesday, March 30, 2022 10:56:14 PM
Attachments: image001.png
image002.png

Caution: This is an external email and may have suspicious subject or content. Please take caution when clicking links or opening attachments. When in doubt, contact [redacted]

Good morning [redacted] ,

I have a question have you passed this document to the Irish and Portuguese ? So they have a clear picture what is going on . For me I am going to have internal meetings inside Eurocontrol so the Airspace's are loaded in our database ready for July .

[redacted]

From: [redacted]
Sent: 30 March 2022 03:06
To: [redacted]
Subject: Updated Engagement Document

Hi [redacted] ,

I've attached an updated version of the engagement document for Virgin Orbit's southern trajectory. Please let me know if you have any questions or feedback.

Thank you,

[redacted]

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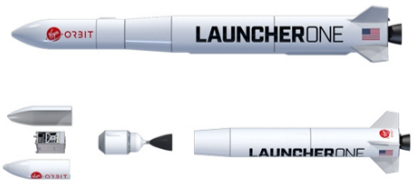
B.6 Irish Aviation Authority (IAA)

B.6.1 31-August-2022 Meeting Minutes

Attendees: Marine Coastguard Agency, UK Hydrographics Office, IAA, Trinity House, Marine Management Organization

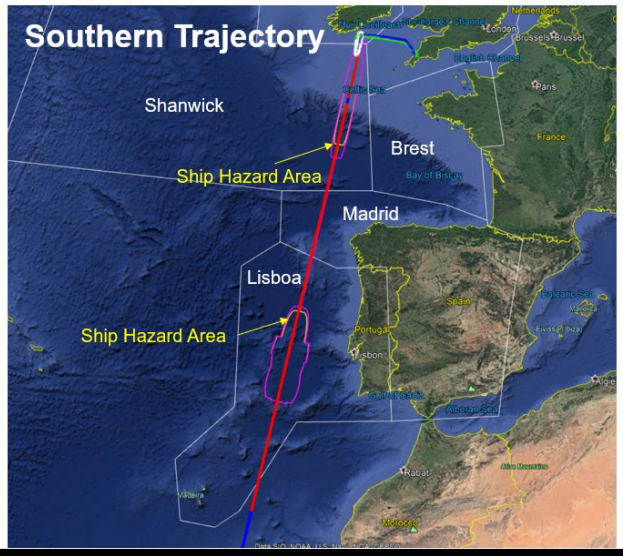
Overview

- VO will use LauncherOne (L1) to provide Low Earth Orbit (LEO) deployment service for small satellites from Cornwall Airport (NQY). Currently, L1 has a total payload capacity of 300 kilograms (kg) for Sun-Synchronous Orbit (SSO) and 500 kg for equatorial orbit. Subsequent versions of L1 will have increased capacity and range.
- VO uses an air-launched rocket system consisting of L1 and Cosmic Girl, a 747-400 equipped to carry and deploy L1 using a custom pylon mounted to the 747's existing, non-functioning, fifth engine underwing mount.
- The initial orbital parameters being considered from Cornwall are an SSO mission with a southern Trajectory and a polar orbit with a northern trajectory.

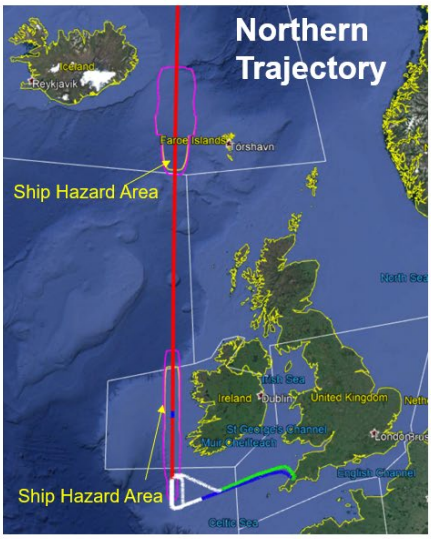


ORBIT Proprietary and Confidential 2

747 carries the rocket from Cornwall ~135nm west to a point south of Ireland. At this point the rocket drops and ignites



The initial hazard area at drop and downrange is to account for the higher probability of failure at ignition. The second hazard area is for the first stage and fairing drop into the ocean



ORBIT Proprietary and Confidential 3

Notes:

- Marine assessment requires environmental and safety objectives

- VO to reach out to Irish maritime equivalent with the help of MCA
- NOTA to the north and SOTA to the south (put on the map)
- Nav Area 1 for northern trajectory and Nav Area 2 for south
- Assessment on shipping impact needed and will be added to the Navigational Risk Assessment
- Detail on what sinks/floats should be included
- Marine licensing portals are in use by MMO
    - Submit license through the portal
- Impact on shipping needs to be addressed
- Irish Coastguard notes a concern that all this is done in Irish waters
- VO to speak to Irish maritime
- Negotiations require a higher-level input from Irish government
    - Risk to Irish coast and shipping? Assessed in the NRA
- MCA - Pre-app engagement should start immediately
    - Scope out all issues before applying
    - Maritime Safety Policy division (DfT) should be contacted
    - Need to understand who will provide the Marine licensing (issued by UK or Irish)
- Risk
    - What else is in the area (oil and gas, shipping, fishing)
    - Assessment of what we're introducing into the environment
    - MCA will be involved through CAA but might be Irish instead
- UKHO
    - Might not need to put them on charts
    - They would be more on the nav warning side
- IAA
    - Engage Irish regulator for aviation
- Actions
    - Follow up meeting on navigation risk

[redacted]

Subject: Virgin Orbit Initial Discussion
Location: Microsoft Teams Meeting

Start: Tue 8/31/2021 8:30 AM
End: Tue 8/31/2021 9:30 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

You are invited to an initial discussion with Virgin Orbit for their proposed launch from Newquay Airport. Please see attached details.

I have included Trinity House and MMO, and have asked Virgin Orbit to speak to MMO to determine if a Marine Licence is required on this occasion.

Agenda for today's meeting:

1) Welcome and introductions – All
2) Set the scene - [redacted]
3) Virgin Orbit presentation – [redacted]
4) Questions and discussion – All
5) Next steps and actions – [redacted]
6) Date of Next Meeting – [redacted]

Microsoft Teams meeting

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B.6.2 03-September-2021 Meeting Minutes

Attendees: IAA and Virgin Orbit

Notes:

- IAA would like the points of contact in CAA and FAA to discuss on a bilateral level - COMPLETE
- What is the duration of the TDA and what time would it be set? – VO provided dates and times
- The SOTA airspace is high density going in and out of Europe
    - IAA controls SOTA as part of an arrangement with the UK
- Shanwick has a lower density
- Bilateral discussions with UK are in work and progressing
- IAA would like to have the sonic boom analysis described in layman's terms -VO described it as a "thunder clap"
- Recognition of airworthiness certificates will need to be conducted for the 747

- VO currently reviewing process with CAA

[redacted]

Subject: Virgin Orbit Briefing to IAA SRD
Location: Microsoft Teams Meeting

Start: Fri 9/3/2021 8:30 AM
End: Fri 9/3/2021 9:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

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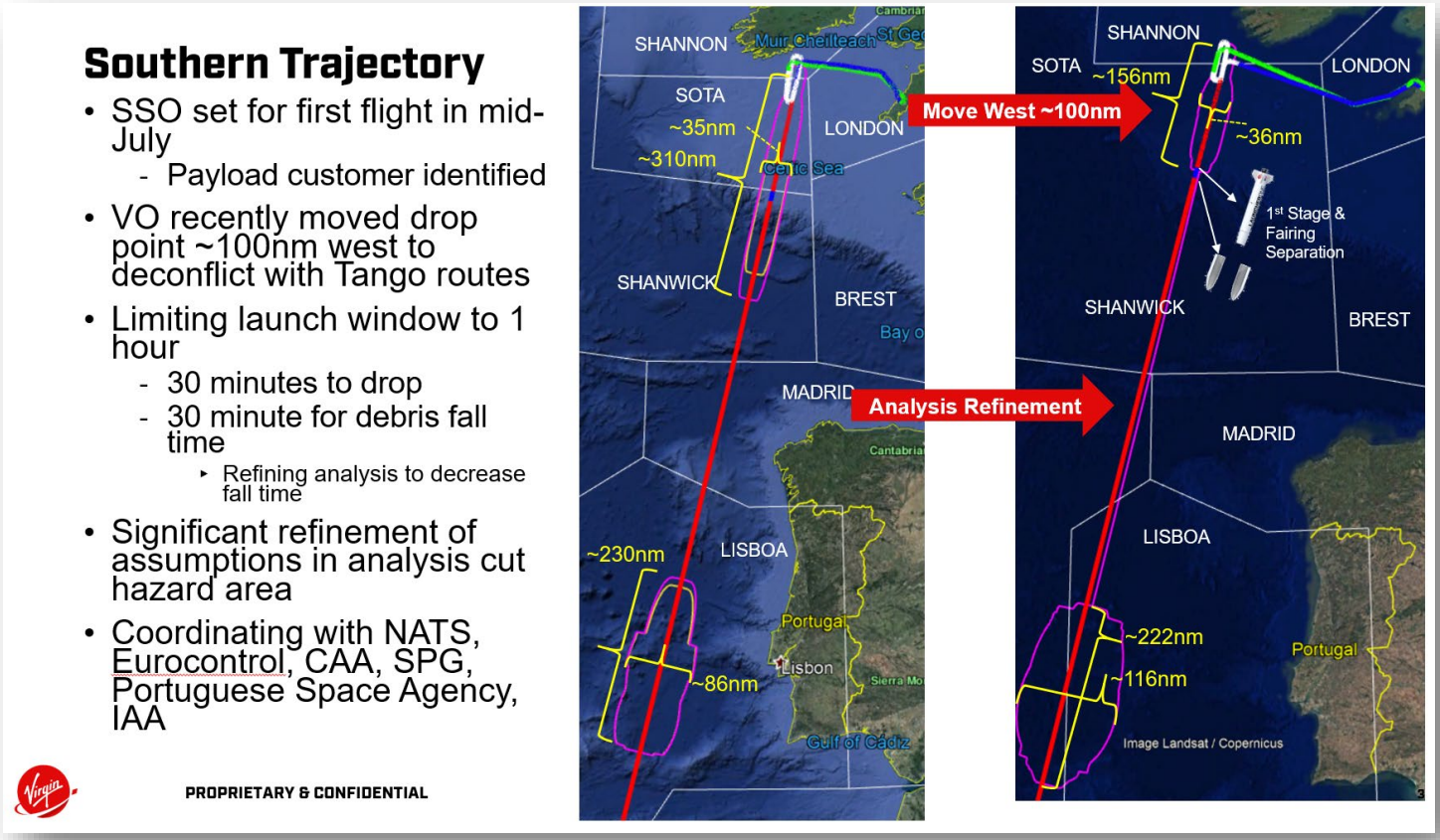
B.6.3 4-March-2022 Meeting Minutes

Attendees: IAA and Virgin Orbit



Notes:

- Virgin Orbit reviewed the updated AHA with IAA
- First launch will be around midnight for and have a launch window of ~1 hour
- Target date is still for mid-July with some schedule risk
- Procedures
    - Procedures for notification leading up to launch and day of launch need to be worked out
    - Letter of Agreement may be created between VO/IAA
    - VO to send LOA template to IAA - COMPLETE
    - Real time TM and flight path updates will be transmitted through a launch day hotline

- Aircraft
    - Mutual recognition is not there for UK EAC and will need to be discussed at the government-to-government level
        - IAA looking into this
    - VO to send updated coordinates to IAA - COMPLETE
- Phraseology – VO to setup meeting with pilots and IAA
- What is the aircraft, normal or test flight
- Communications process in place
- Flight planning restrictions in place

[redacted]

Subject: Virgin Orbit / IAA Meeting
Location: Microsoft Teams Meeting

Start: Fri 3/4/2022 8:30 AM
End: Fri 3/4/2022 9:30 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

Microsoft Teams meeting

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B.6.4 Correspondence

From:
To: [redacted]
Subject: Re: Irish Airspace
Date: Tuesday, August 31, 2021 12:18:19 PM

[EXTERNAL EMAIL]

Hi [redacted]

Happy to help. Allow me to introduce [redacted] (in CC). [redacted] is the [redacted] of the Irish regulator and would be an excellent point of contact to discuss the project from the regulatory perspective.

Best Regards

[redacted]

Sent from my iPhone

On 31 Aug 2021, at 18:16, [redacted] wrote:

* This message originated from outside the Irish Aviation Authority. Please treat hyperlinks, attachments and instructions in this email with caution. *

Hi [redacted],

It was nice to speak to you again today. Thank you for the recommendations and I'd like to please take you up on the offer to send over some contacts within the Irish Aviation regulator. If you could please send the contacts over at your convenience, I would appreciate it.

Thank you,
<!--[if !vml]-->
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<!--[endif]-->

[redacted]
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LONG BEACH CA 90808
C [redacted]
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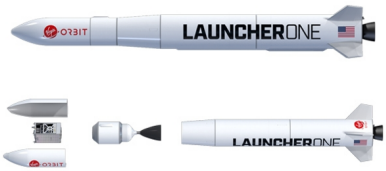
B.7 Portuguese Space Agency (PSA)

B.7.1 22-September-2021 Meeting Minutes

Attendee: PSA, Eurocontrol, Portuguese Airspace Management, Virgin Orbit

Overview

- VO will use LauncherOne (L1) to provide Low Earth Orbit (LEO) deployment service for small satellites from Cornwall Airport (NQY). Currently, L1 has a total payload capacity of 300 kilograms (kg) for Sun-Synchronous Orbit (SSO) and 500 kg for equatorial orbit. Subsequent versions of L1 will have increased capacity and range.
- VO uses an air-launched rocket system consisting of L1 and Cosmic Girl, a 747-400 equipped to carry and deploy L1 using a custom pylon mounted to the 747's existing, non-functioning, fifth engine underwing mount.
- The initial orbital parameters being considered from Cornwall are an SSO mission with a southern Trajectory and a polar orbit with a northern trajectory.
- Currently projecting 1-2 launcher per year but could increase in the future



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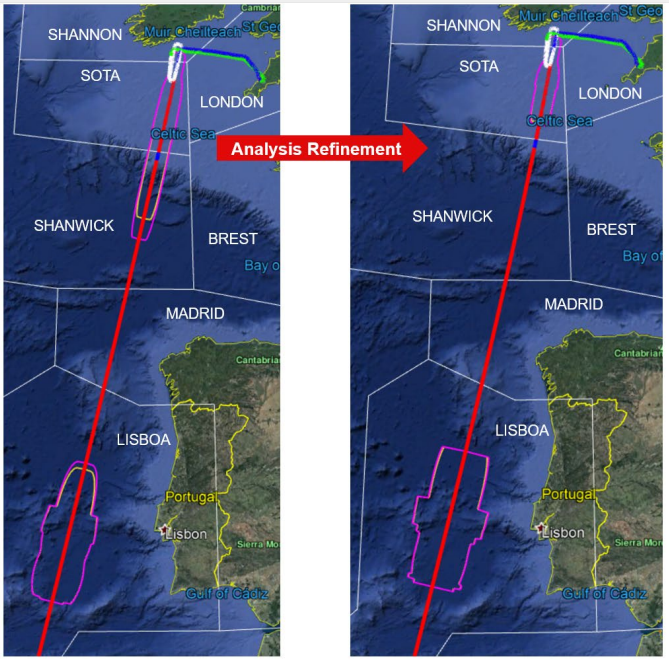
Southern Trajectory

- SSO for general customer
  - Most payload operators will want an SSO from Cornwall
- Coordinating with NATS, Eurocontrol, CAA, SPG, Portuguese Space Agency



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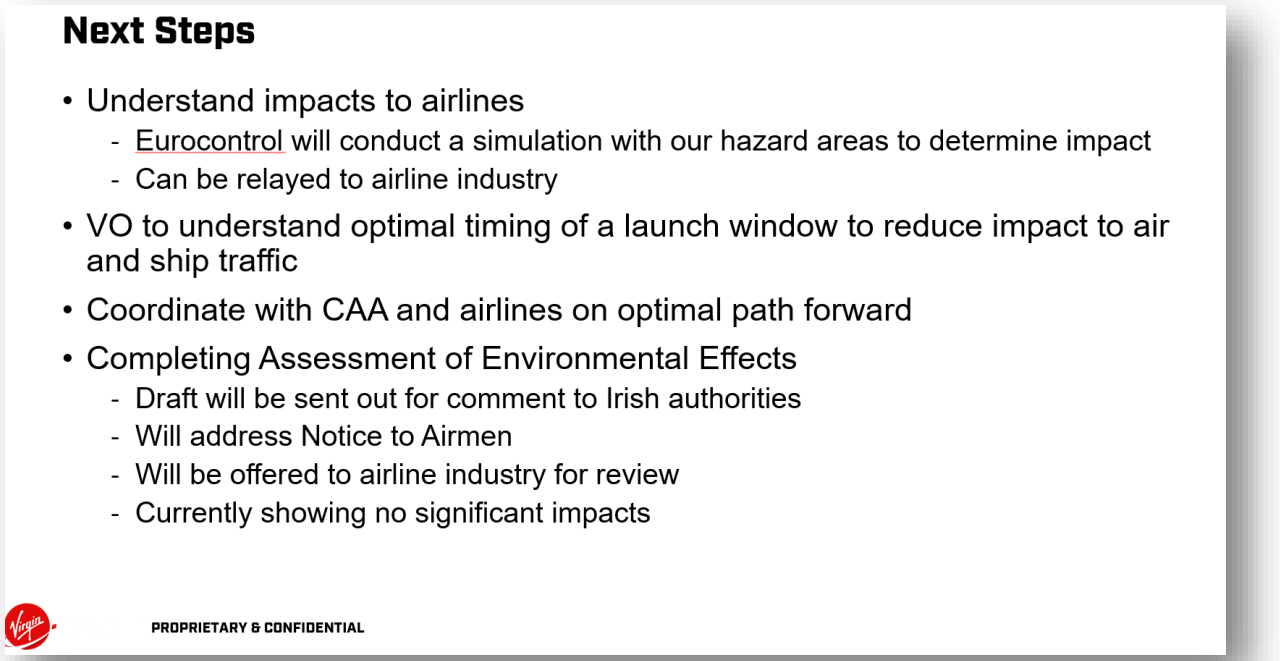

Notes:

- Eurocontrol would limit the aircraft from going through the hazard area
- AMC Airspace management cell
    - A message is sent the night before to the member countries
    - Published and fed to airline computers for flight planning routes
    - Airspace would not be available to flights
    - Updated utilization plan to reopen the airspace to everyone
- Lisboa Representative
    - Airspace management would add a no-fly zone
    - Activate the hazard area block for 2 hours
    - 10-15 minutes prior to launch deviate traffic to minimize any traffic flows
    - Flight path could have negative impact on Canary Island routes
    - ~40% traffic fly through the southern trajectory
    - Doable task but will take coordination
    - Very busy during summer and Autumn
- Eurocontrol – suggest completing a simulation in June to see what happens if using 2019 or 2018 data
    - Need the data of the areas (coordinates_
    - Send coordinates to Eurocontrol
    - To be run within the next month
    - Look to see what to do for rerouting
    - Very busy routes during the day and night
    - Tango routes would be impacted
- PSA
    - Heavy maritime traffic in the splashdown area off of Portugal
    - Need to have a discussion with maritime agency of Portugal

- Highway maritime corridors in the area
- They will talk to airspace and maritime, and defense (air force), civil protection
- PSA will start the internal meetings
- Portugal is already leading a launch system which will provide some precedent
- National regulatory authority to join in on the discussions
- Portugal will have everyone at the table to discuss and get back to VO
    - Meeting set for October 2021
- Involve ministry of foreign affairs
- First week of Oct., PSA is visiting UKSA
- National environment agency will want to review AEE

- Eurocontrol
    - Need to understand primary and backup dates and how weather could play an issue
    - Include Eurocontrol portal for informing other operators
    - Encouraged to provide information for EC network operations
    - No-Go decision point is fundamental
        - Airlines would have issues rerouting
- Actions
    - PSA to organize meeting in October internally
        - Organize a meeting with UKSA in the UK
        - PSA to get instructions from their government on how to proceed

[redacted]

Subject: FW: Meeting w/ [redacted] | Virgin Orbit
Location: Reunião do Microsoft Teams

Start: Wed 9/22/2021 8:00 AM
End: Wed 9/22/2021 9:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

-----Original Appointment-----
From: [redacted]
Sent: 10 September 2021 10:31
To: [redacted]
Subject: Meeting w/ [redacted] | Virgin Orbit
When: 22 September 2021 16:00-17:00 (UTC+00:00) Dublin, Edinburgh, Lisbon, London.
Where: Reunião do Microsoft Teams

Reunião do Microsoft Teams

Aderir pelo computador ou aplicação do telemóvel
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Nothing in this e-mail message amounts to a contractual or legal commitment on the part of EUROCONTROL, unless it is confirmed by appropriately signed hard copy.

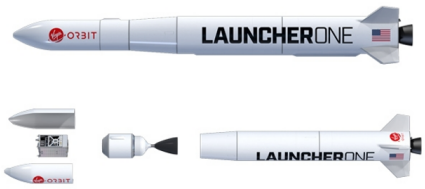
1

B.7.2 25-February-2022 Meeting Minutes

Attendees included Air Force, Airspace Management, Space Safety, and Eurocontrol

Overview

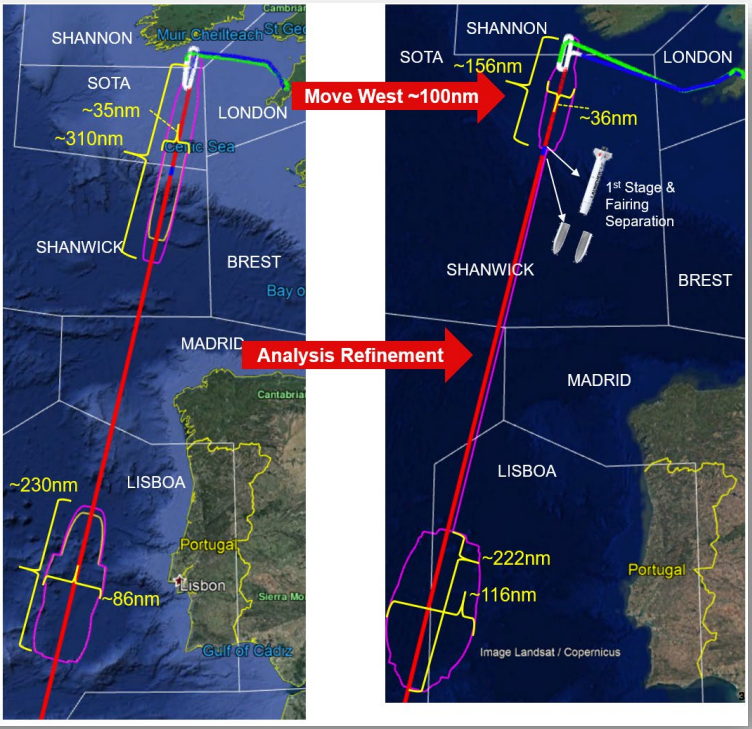
- VO will use LauncherOne (L1) to provide Low Earth Orbit (LEO) deployment service for small satellites from Cornwall Airport (NQY). Currently, L1 has a total payload capacity of 300 kilograms (kg) for Sun-Synchronous Orbit (SSO) and 500 kg for equatorial orbit. Subsequent versions of L1 will have increased capacity and range.
- VO uses an air-launched rocket system consisting of L1 and Cosmic Girl, a 747-400 equipped to carry and deploy L1 using a custom pylon mounted to the 747's existing, non-functioning, fifth engine underwing mount.
- The initial orbital parameters from Cornwall are an SSO mission with a southern Trajectory and a polar orbit with a northern trajectory.
- Currently projecting 1-2 launcher per year but could increase in the future



PROPRIETARY & CONFIDENTIAL

Southern Trajectory

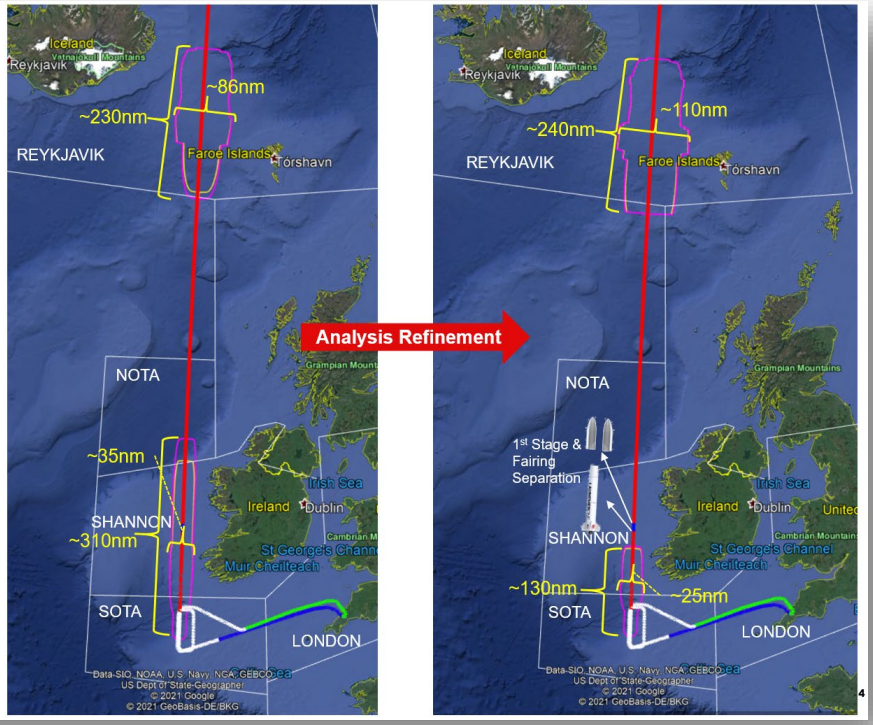
- SSO set for first flight in mid-July
  - Payload customer identified
- VO recently moved drop point ~100nm west to deconflict with Tango routes
- Limiting launch window to 1 hour
  - 30 minutes to drop
  - 30 minute for debris fall time
    - Refining analysis to decrease fall time
- Significant refinement of assumptions in analysis cut hazard area
- Coordinating with NATS, Eurocontrol, CAA, SPG, Portuguese Space Agency, IAA



PROPRIETARY & CONFIDENTIAL

Northern Trajectory

- Polar 88º orbit for a payload customer
- UKSA completed an MOU with Faroe Islands and Iceland to allow stage and fairing drop
- ACP in process
  - AIC/SUP publication 2-JUN-22



Status

- CAA Space Operator License resubmitted 9-FEB with updates to the Range license
  - Currently working the Range Assessment Questions
  - Submission included the Navigational Risk Assessment (NRA)
- NRA sent to MCA
- VO working continuously with Spaceport Cornwall on operations side and licensing
- Tight schedule to get licenses in place for a mid-July launch

Next Steps

- Next top priority is to work with Portuguese, IAA, and Irish Coastguard
- Eurocontrol to complete new assessment on airspace impact with updated southern trajectory
  - Sending exact launch time for accurate results
- Need to understand the priority for space launch in national airspace structure
  - Payload is partially military, possibly get state aircraft priority
- Coordinate with CAA, airlines, and MOD on optimal path forward
- Airspace agreements to be put in place
  - VO would like to include as many affected parties in one agreement as possible
  - Eurocontrol LOA in process
    - Looking into a real time telemetry feed to Eurocontrol for airspace integration
- Assessment of Environmental Effects version 2 has been completed with a finding of no significant impact
  - Document in Block B review
  - VO will be ready to respond to any public comments

PROPRIETARY & CONFIDENTIAL 6

Notes:

- [redacted] - Portugal Air Force
- [redacted] Space safety
- [redacted] – Portuguese Airspace Manager
- [redacted] – Portuguese Air Traffic Control
- [redacted] - Shanwick Control
- [redacted] – Portuguese Airforce with Air traffic control
- [redacted] - Air traffic management

- Eurocontrol to complete updated analysis by next week
- Virgin Orbit's operations will affect Santa Maria FIR
- Portuguese more detailed information on what happens in between the 2 hazard areas
- Is there a buffer on the hazard areas? Yes, VO adds 10nm around all sides
- Planning package
  - Less than 7 to 10 days is too short for any changes, need to increase timeline
- 30 day notice might not be enough
- 7 days is limit to have everything in place
  - Any changes after this could pose an issue
- Vo to do a final check on ceilings and shipping lanes for debris
- Share risk assessment with the Portuguese – Draft assessment sent
- Real time information on launch day is requested
  - Navy, civil protection, air traffic, etc
- Need to understand the vertical dimensions for 1st stage and fairing
  - VO responded that debris will be coming in vertical above FL600 to the ocean surface

[redacted]

Subject: Virgin Orbit
Location: Microsoft Teams Meeting

Start: Fri 2/25/2022 6:00 AM
End: Fri 2/25/2022 7:00 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

[redacted] ,

I hope this ok please let me know .

[redacted]

Microsoft Teams meeting

Join on your computer or mobile app
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Join with a video conferencing device
[redacted]
Alternate VTC instructions

Or call in (audio only)
[redacted]
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B.8 MOD/Qinetiq

B.8.1 08-December-2021 Meeting Minutes

Attendees: Qinetiq, MOD, Virgin Orbit

Notes:

- Overall discussion of airspace
- Effects of large TDAs discussed
    - Qinetiq conveyed concerns regarding rerouting of aircraft that may require routes through restricted areas due to Virgin Orbit launch
    - Even if TDAs do not overlap restricted areas, rerouting could affect availability

[redacted]

Subject: Virgin Orbit/Qinetiq Discussion
Location: Microsoft Teams Meeting

Start: Wed 12/8/2021 8:30 AM
End: Wed 12/8/2021 9:30 AM

Recurrence: (none)

Meeting Status: Meeting organizer

Organizer: [redacted]
Required [redacted]

Optional Attendees [redacted]

Hello,

Thank you for meeting with Virgin Orbit. This is to discuss Virgin Orbit's operations with respect to military danger zones.

Thank you,
[redacted]
Virgin Orbit

Join Microsoft Teams Meeting

Learn more about Teams

08-March-2022 Meeting Minutes
Attendees:

B.8.2 Correspondence

From: [redacted]
To:
Subject: RE: UC Virgin Orbit Operations
Date: Monday, November 22, 2021 3:16:37 AM
Attachments: image005.png
image004.png

[redacted]

Thank you for your email and I would like to take you up on your offer to discuss further. I provide airspace advice to a number of QinetiQ managed military ranges and MOD Hebrides (with associated airspace EG D701 complex) is the one that has the most interest in your project. The screen shot below shows how your planned flight path transits through the range (marked in red) and could potentially have an impact on our activity. I would like to understand more about the accuracy of the rocket in respect to following the planned flight path and the potential for the rocket to fall short or be 'cut-down' if there is a malfunction. Furthermore, how we might coordinate our mutual activity and whether the airspace is required to be sanitised of all other activity for a period leading up to the rocket launch until confirmation of it reaching its splash point. How that might be communicated to the Hebrides Range and what assurances you might need from us. I am sure the Hebrides Range trials staff will have more questions but if you and I can open the dialogue it will enable me to better inform them in the first instance.

My diary is a little full this week and I also have a period of leave however, I will be available from 1400 UTC Wed 8th Dec and any time thereafter that week and week beginning 13th Dec (but not PM 15th or 16th). I note from your signature block that you are in California and so am assuming an afternoon / evening time UTC is probably better with the 8 hour time difference, perhaps somewhere between 1600 UTC and 1900 UTC if that suits you? Naturally if you are over in the UK it will give us more options, my normal office hours are 0900 UTC – 1800 UTC. I can access MS Teams or Webex but not Skype.

I look forward to speaking to you and hearing more about the Virgin Orbit project.

Regards,

[redacted]

[redacted] Park, Coldharbour Lane
BRISTOL, BS16 1FJ, UK
[redacted]

From: [redacted]
Sent: Friday, 19 November 2021 17:42

To: [redacted]
Subject: Virgin Orbit Operations

Hi [redacted],

I received your contact information from [redacted] I am with Virgin Orbit in the US. We plan on conducting rocket flights from Spaceport Cornwall next year [redacted] mentioned that our flights may interfere with Danger Areas and I wanted to contact you for more information. I have attached an operations brief. If you have some time for a quick web meeting, I could explain further and we could discuss the impact. Please let me know if that would work for you.

Thank you,

[redacted]
4022 E CONANT STREET
LONG BEACH CA 90808
[redacted]
W VirginOrbit.com

From: [redacted]
To: [redacted]
Subject: RE: 2020331-DAATM_Comments_VO_Engagement
Date: Wednesday, May 4, 2022 4:37:00 PM
Attachments: 20220503_DAATM_VO_Response.pdf
image001.png
image003.png

[redacted],

Thank you and your team for taking the time to review Virgin Orbit's engagement document. Please find the responses attached. Feel free to reach out with any additional questions.

I have one additional note that I confirmed with NATS that NAT Tracks are active only until 19:00 (30W time) for Westbound, and they are activated eastbound at 02:00 till 08:00 (30W times).

Thank you,

[redacted]
4022 E CONANT STREET
LONG BEACH CA 90808
C [redacted]
W VirginOrbit.com

From: [redacted]
Sent: Tuesday, April 19, 2022 1:16 AM
To: [redacted]
Cc: [redacted]
Subject: 2020331-DAATM_Comments_VO_Engagement

Caution: This is an external email and may have suspicious subject or content. Please take caution when clicking links or opening attachments. When in doubt, contact [redacted]

[redacted]

Many thanks for sight of your 'CONOPS' for the 15 Jul launch from Cornwall. Attached are the observations from DAATM that I highlighted to our Space Directorate. I have included with the CAA, cc'd, and our own internal Space Directorate. I am sure they will have their own thoughts which will come separately as mine are slightly more in the tactical weeds than their more strategic overview I suspect.

From our perspective there are elements of the plan that may need clarifying; this though is probably because the detail is not included in the document and VO already have solutions in place for the things we have highlighted or are wrapped in your normal SOPs. I suspect this will be the case as I have been highlighting the majority of the items in the attached for the last 24 months in various fora and to most of the stakeholders in and out of VO.

Our main concerns are:

- Timelines
  - If 15 Jul is the target, the airspace promulgations through EuroControl is danger close..... 2 months from launch (L-2) so 15 May.
  - EuroControl have been proactive, autonomously, to feed the most likely airspace design into the system ahead of the AIC publication cycle, but based on a 15 Jul launch. This will allow the 'system' to inform airlines on time without any data inputting lag.
- Priority
  - MoD activity will take priority in the UK, including the use of 78 Sqn at Swanwick, currently. I highlight too the use of D063 for at least 2 training flights which will need some level of prioritisation.
  - We have asked various MoD stakeholders, vis Space Directorate, to apply some degree of priority towards this one-off launch, but this is outside DAATM sphere of influence.
- Airspace
  - Any impact on the southern danger areas has an impact on the northern danger areas which needs to be managed. There will need to be a balance between the SW airspace closures with the use of D702 so that we don't close the northern tracks too inadvertently.
  - There seems to be a lack of acknowledgement that it is not 'just' a 30 min closure of airspace – it needs to be longer in duration and will have in place for D+1 and D+2 for the reserve dates.
    - There may be a need to look in more detail on the exact timings for the racetrack reservation activation as it feels very tight and without any contingency for slippage or delays getting into the racetrack, and assumes one circuit is enough to be ready for launch.
- Diversion Plan/Emergency Plan

  - Just need some clarity on the diversion plan and criteria.
  - As BSD have confirmed as the Div (assuming CAA are content) for the 15 Jul launch plus 2 days, have they also agreed to or aware of the chance of the launch being delayed until after the summer, potentially Oct and so VO would I assume expect BSD to be available then too? The 15 Jul window was enabled by changing their flying programme; this may or may not be possible for a new date.

- DAATM is assuming use of BSC is being charged in accordance with JSP360; a deviation from JSP360 is possible but DAATM just need to be informed.
  - [redacted] will know what this document is so can offer his thoughts on how QQ are doing this.

The attached is not meant to sound negative but more aiming for open thinking to ensure all bases are covered. My team and I are very happy to chat about the attached thoughts. Everything is predicated on a single launch on 15 Jul 22 (+ 2 days contingency) and so there has been no work done on other dates, noting that delaying is slightly more complicated that merely cut and pasting the plan into a different time block, so any early indicators that timelines are changing would be hugely helpful.

Yours Aye,

[redacted]
E1, Aviation House
Gatwick Airport South,
West Sussex, RH6 0YR
Landline:
[redacted]

B.9 NATS

B.9.1 02-September-2022 Meeting Minutes

Attendees: NATS, Virgin Orbit

Notes:

- Does FAA add a raised hazard area during the gap between launch and stage drop? – No, probabilities of failure are low between hazard areas and therefore additional blocks are not required
- Feedback from Oceanic and airlines should be sought in ACP

- Southern Trajectory
  - Operations in London, Shannon, and SOTA will make coordination more complex
  - Need to understand the separation distances between aircraft and the hazard areas
  - Airspace management will plan for the worst in this case
  - SOTA blocked by 1st stage
  - 800-900 flights in the area - depends on timing
    - Time of day very important for traffic patterns
  - Close to routes on the map
    - See how this overlaps the routes (ask for the routes) – get traffic analysis completed
    - 4-5 routes around the trajectory
    - See track set against routes
      - NATS to plot with safety buffers 30-60 miles
    - 40,000 movements are on the same trajectory, 60,000 are perpendicular
    - 8-9AM would be a really good time to pick for launch window
    - 60 mile buffer usually used with surface to unlimited (might be 30 miles)
    - Canary islands are very busy in winter
      - Varies day by day
    - There are better days of week for a launch
    - Coordinates at release, trajectory will be required by NATS to understand impacts
    - Stage drop is between Azores
    - Discuss LOAs with CAA, who do we need (need one with NATS, might be separate with Shannon, Brest, Madrid, Lisbon)
    - Single LOA might be used for all activities
      - Could do one for north and south trajectories
    - June has a lot of daylight at that time so later day might be better
    - Evening would allow further allowances
    - Money could be an issue with airlines that need to reroute around hazard areas
  - NATS is covered by the process
    - ACP would be sent to NATS
    - Feedback would be sent back
    - VO will need to show that we are working to reduce impacts
      - VO already looking at lowered AHAs, reduced launch windows, minimized impact, changed window time
    - The more proactive the better

- Tango Routes
  - If we can change trajectory slightly to the west we can show the reduced impact
- Skyvector.com is a good place to check routes
- T9 and T290
  - IARTA on the SPGs
  - Send NATS example LOA we currently have with FAA

  - Send coordinates of hazard areas
  - Can we tweak the southern trajectory to avoid routes?

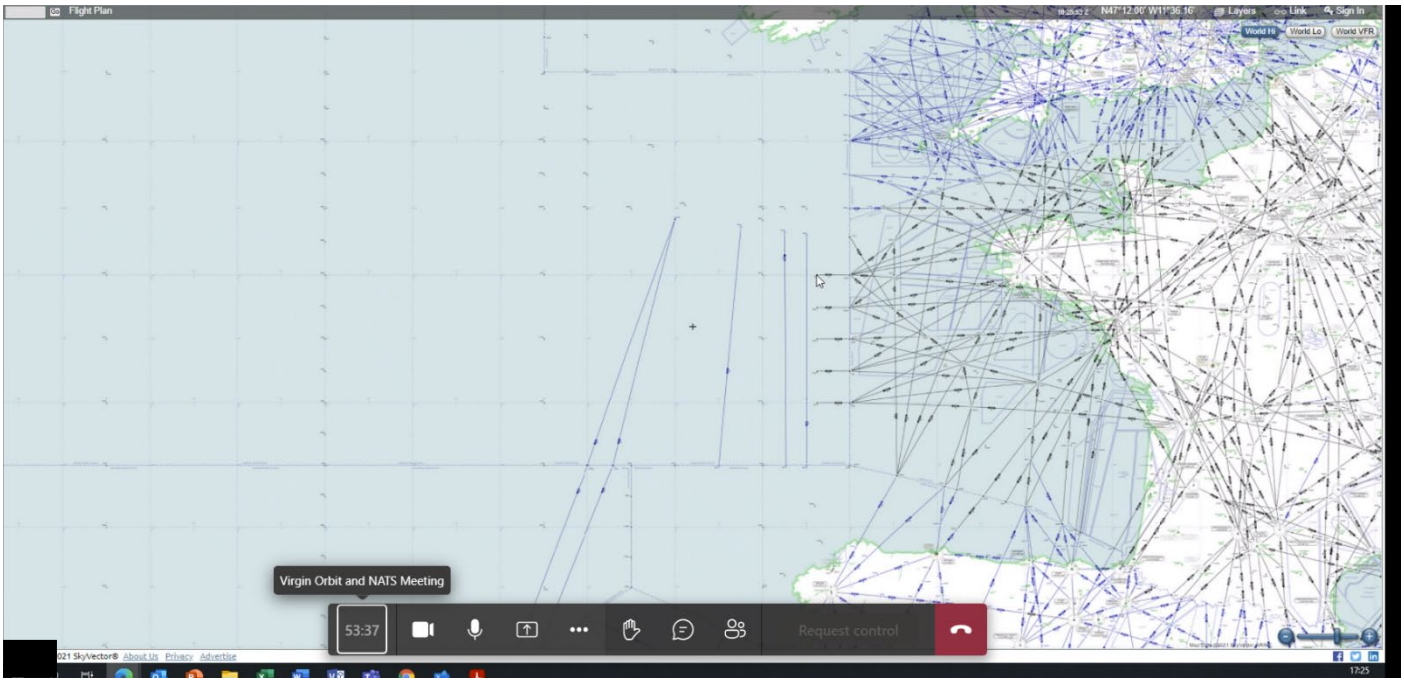

Figure 12 - Review of Tango Routes

[redacted]

Subject: Virgin Orbit and NATS Meeting
Location: Microsoft Teams Meeting

Start: Thu 9/2/2021 8:30 AM
End: Thu 9/2/2021 9:30 AM

Recurrence: (none)

Meeting Status: Accepted

Organizer: [redacted]

[EXTERNAL EMAIL]

Hi all,

Here is the invitation for tomorrows meeting between Virgin Orbit and NATS.
[redacted]

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting

Or call in (audio only)
[redacted]
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B.9.2 29-March-2021 Meeting Minutes

See Appendix 48B.5.1 for joint NATS/Eurocontrol/MOD meeting minutes

Appendix C: Earlier Versions of Engagement Material

Virgin Orbit has released 3 versions of the engagement material. These previous versions can be found below

C.1 15-September-2021 Version 1

See Attachment SMA-131 Version 1

Virgin Orbit Operations from Spaceport Cornwall
(Southern Trajectory)
SMA-131

Release Trac Ticket: 7220
Revision: 1.0
September 15, 2021

Virgin Orbit, LLC
4022 E. Conant Street
Long Beach, CA 90808

C.2 28-March-2022 Version 2.1

See attachment SMA-131 Version 2.1

Virgin Orbit Operations from Spaceport Cornwall
(Southern Trajectory)
SMA-131

Release Trac Ticket: 7580
Revision: 2.1
28-MAR-2022

Virgin Orbit, LLC
4022 E. Conant Street
Long Beach, CA 90808

C.3 **18-May-2022 Version 3.1**

This document

Appendix D: Virgin Orbit Traffic Analysis

Reproduced with permission from each participant

Virgin Orbit Traffic Analysis

Request by –

Collated by –

Collaborators –

Reviewers: Not Required

NATS

Prepared by:

NATS Private

NATS Private

Table of contents

Overview

Request Overview

Virgin Orbit have requested traffic analysis for four separate TDAs and a corridor South of the Canary Islands. To facilitate this first launch, collaborators agreed to provide the analysis in the report below. There is an expectation that this would normally be commissioned by the sponsor.

The request had the following requirements:

Collaborator comments in blue

Month of year to evaluate: October

Year to evaluate: 2019 if possible, else 2021

All collaborators have used data from October. Eurocontrol and IAA have included some dates within November.

Days of week to consider: Thursday, Friday, and Saturday.

If possible, Virgin Orbit would like to request all days of the week to be evaluated unless this is too burdensome. If all days are evaluated, this could be valuable data for Virgin Orbit to understand high traffic days to avoid.

Collaborators have varied approach to datasets used. Eurocontrol have included data for Thursday, Friday, and Saturday only. ANSPs have included data for all days of the week in October.

Time of day: Evaluation requested for 19:57 UTC – 01:57* UTC (*time would elapse into next day).

This range assumes a 2-hour TDA activation with 2 hours on each side of the window.

Observation windows:

Count of flights for each whole hour within the time of day, i.e., 19:57-20:56 UTC, 20:57-21:57 UTC, etc

Measurement:

Count of flights within the specified polygon in each hour

Eurocontrol have provided count of flights for all polygons. ANSPs have provided count of flights for the TDA within their area of responsibility. There will be a small number of aircraft that will be counted in more than one ANSP dataset due to aircraft crossing interface boundaries.

Report Overview

Whilst the data within this document has been collated by NATS, the information contained within this report is provided by multiple collaborators and any questions in relation to the data should be directed to the originator.

This report does not provide any guidance or supporting evidence related to actual flight delays or consequential schedule delays associated with crew limits, ETOPS, noise abatement rules, airport opening hours etc. Additionally, this report does not investigate the impact on adjacent airspace or service delivery through the first available Oceanic Entry Point North or South of the structure.

Each request has been individually assessed by Eurocontrol and one or more ANSPs. An overview of the average hourly loadings and range of values is provided for each request. Subsequent sections include individual ANSP/Eurocontrol supporting data and clarifications on logic, caveats, and assumptions (when available).

The impact of FBZs has not been included in any analysis. Only the coordinates provided for the TDAs by Virgin Orbit.

Eurocontrol have provided analytics for Request 1, 2 and 3, encompassing all TDA Elements and the portion of exposure south of TDA 4.

Enaire have provided analytics for Request 1 (for those flight impacting Madrid ACC Zone), Request 2 and Request 3 (for those flights affecting Canarias ACC zone).

NATS have provide analytics for Request 1 encompassing 'TDA Element 3' polygon.

IAA have provided analytics for Request 1 encompassing 'TDA Element 2' polygon. Additionally, IAA have provided a traffic assessment for TDA 1.

NAV Portugal have provided data for request 1, encompassing 'TDA 3 Element 3 & 4'. NAV Portugal have highlighted the exact polygon in their Supporting Data

Analysis

Request 1

3 Details of TDA Evaluation

3.1 Request 1

An evaluation is requested from the northern extent of TDA Element 2 to the southern element of TDA Element 4. This analysis will provide the full scope of closures. Please see Element design and coordinates in section 3.3.

Table 1 - Total TDA Coordinates

Latitude	Longitude
501640.36N	0104303.03W
504446.68N	0104742.04W
512419.80N	0103343.52W
512833.69N	0110625.08W
504915.24N	0111943.20W
502413.78N	0114154.24W
491209.65N	0120256.82W
424532.34N	0150015.26W
410655.27N	0152220.79W
390917.45N	0160503.49W
370858.18N	0163047.65W
364503.65N	0141126.56W
384435.31N	0133714.61W
404445.00N	0131114.86W
422121.89N	0123503.92W
490434.29N	0110859.26W

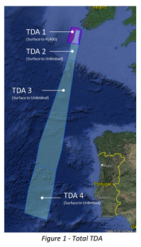
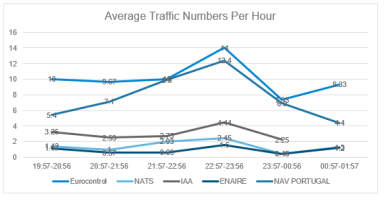


Figure 1 - Total TDA

Collaborators:

- Eurocontrol – TDA 2, 3 AND 4.
- NATS - TDA 3, affecting Shanwick region only, South of SOTA, North of 45N
- IAA – TDA 2
- Enaire – TDA 3, affecting Madrid ACC zone
- NAV Portugal – TDA 3 and 4



Range of values	19:57-20:56	20:57-21:56	21:57-22:56	22:57-23:56	23:57-00:56	00:57-01:57	Total
NATS	0-4	0-3	0-7	0-6	0-2	0-4	**2-14**
IAA	0-10	0-7	0-7	0-13	0-6	*	**6-32***
ENAIRE	0-3	0-4	0-2	0-6	0-2	0-2	**0-11**
NAV Portugal	2-14	2-15	2-22	5-20	1-14	1-8	**23-47**

*Does not include 00:57-01:57 – actual total expected to be higher.

Eurocontrol Supporting Data

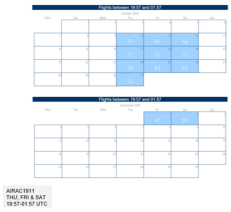
Objective:

- To assess and evaluate the impact of activation:
  - TDA LAUNCH_FAIRING
  - TDA RACETRACK
  - TDA 4 SOUTH
  - TDA CANARY TO END on civil traffic

Assumptions:

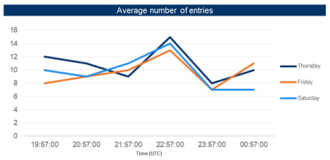
- TDA geometry as communicated on 02 August 2022
- Daily activation of 2 hours from 19:57 to 01:57 UTC
- Scope: Thursday, Friday and Saturday of AIRAC 1911 (as requested)

Number of flights crossing TDA LAUNCH_FAIRING



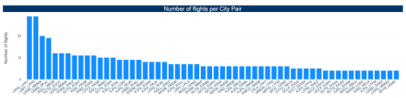
AIRAC1911
THU, FRI & SAT
19:57-01:57 UTC

Average traffic crossing TDA LAUNCH_FAIRING



Weekday	AVG Traffic	AVG Cross duration (s)	AVG Cross length (NM)
Thursday	64	1240.96	162.27
Friday	57	1417.70	187.42
Saturday	57	1290.41	172.62
Total	**59**	**1313.35**	**173.63**

▼ Image below presents the city pair with more than 3 flights crossing TDA LAUNCH_FAIRING



NATS Supporting Data

Date	Weekday	19:57-20:57	20:57-21:57	21:57-22:57	22:57-23:57	23:57-00:57	00:57-01:57	Total Unique Flights Impacted
1 - 2 Oct 19	Tue/Wed	3	1	3	2	0	0	6
2 - 3 Oct 19	Wed/Thu	1	0	0	0	1	2	4
3 - 4 Oct 19	Thu/Fri	1	0	0	2	1	0	4
4 - 5 Oct 19	Fri/Sat	2	2	6	6	0	1	12
5 - 6 Oct 19	Sat/Sun	4	1	2	3	0	4	13
6 - 7 Oct 19	Sun/Mon	1	1	0	1	0	2	5
7 - 8 Oct 19	Mon/Tue	1	0	2	0	0	0	3
8 - 9 Oct 19	Tue/Wed	0	2	3	6	1	1	11
9 - 10 Oct 19	Wed/Thu	0	0	2	1	0	1	4
10 - 11 Oct 19	Thu/Fri	1	0	0	1	0	3	5
11 - 12 Oct 19	Fri/Sat	1	1	1	3	2	2	7
12 - 13 Oct 19	Sat/Sun	3	1	2	2	0	1	8
13 - 14 Oct 19	Sun/Mon	0	0	2	3	0	1	5
14 - 15 Oct 19	Mon/Tue	0	3	3	5	0	1	11
15 - 16 Oct 19	Tue/Wed	2	1	2	1	0	2	8
16 - 17 Oct 19	Wed/Thu	1	1	3	6	0	1	10
17 - 18 Oct 19	Thu/Fri	4	3	2	4	1	2	14
18 - 19 Oct 19	Fri/Sat	2	2	1	2	1	2	8
19 - 20 Oct 19	Sat/Sun	2	3	4	6	1	0	14
20 - 21 Oct 19	Sun/Mon	2	1	3	4	0	2	12
21 - 22 Oct 19	Mon/Tue	1	2	7	4	0	3	12
22 - 23 Oct 19	Tue/Wed	2	1	5	6	1	1	11
23 - 24 Oct 19	Wed/Thu	1	0	4	0	1	2	8
24 - 25 Oct 19	Thu/Fri	0	0	1	0	0	1	2
25 - 26 Oct 19	Fri/Sat	0	0	0	2	1	1	3
26 - 27 Oct 19	Sat/Sun	2	0	1	2	1	0	6
27 - 28 Oct 19	Sun/Mon	2	3	3	2	0	0	6
28 - 29 Oct 19	Mon/Tue	0	0	0	1	0	1	2
29 - 30 Oct 19	Tue/Wed	1	0	0	0	1	2	4
30 - 31 Oct 19	Wed/Thu	2	0	0	1	1	2	5
31 Oct 19 - 1 Nov 19	Thu/Fri	2	1	1	0	0	0	4

NATS Methodology

To complete the request, the following steps were taken:

- ADSC data was extracted from the Business Intelligence Cloud for October 2019.
- ADSC position reports outside of Shanwick Airspace were removed.
- The remaining ADSC points were combined into flight legs with start/end times and latitude/longitude coordinates.
- Each flight leg was classified as to whether the leg would have crossed the Element 3 polygon at the specified time slots based on the start/end time of the leg and the start/end latitude/longitude coordinates.
- The total number of impacted flights was summed for each hourly time slot and the full slot and this was combined into the results table.

NATS Caveats

- Traffic flows and patterns between 2019 and 2022 will be different.
- No Flight Level filters were used.
- Knock on assumptions were not taken into consideration. For example, if flights must be rerouted into different airspaces.
- It is assumed that an aircraft flew in a straight line for its generated flight leg so that it could be captured crossing the polygon.
- As flight legs may have occurred over different time slots, the number of total distinct flights for the 6-hour time slot will be less than the sum of the flights impacted by each independent slot.

IAA Supporting Data

Date From	Date To	Day of Week	19:57 - 20:56	20:57 - 21:56	21:57 - 22:56	22:57 - 23:56	23:57 - 00:56	Total
01/10/2019	02/10/2019	Tues/Wed	5	3	3	10	0	21
02/10/2019	03/10/2019	Wed/Thur	2	3	2	3	1	11
03/10/2019	04/10/2019	Thur/Fri	5	3	2	5	0	15
04/10/2019	05/10/2019	Fri/Sat	5	4	3	4	2	18
05/10/2019	06/10/2019	Sat/Sun	7	5	5	5	5	27
06/10/2019	07/10/2019	Sun/Mon	1	1	4	11	1	18
07/10/2019	08/10/2019	Tues/Wed	5	5	6	4	3	23
08/10/2019	09/10/2019	Thur/Fri	1	1	0	3	1	6
09/10/2019	10/10/2019	Fri/Sat	5	2	1	4	3	15
10/10/2019	11/10/2019	Sat/Sun	10	5	7	6	4	32
11/10/2019	12/10/2019	Sun/Mon	2	4	4	8	3	21
12/10/2019	13/10/2019	Tues/Wed	3	4	6	3	2	18
13/10/2019	14/10/2019	Wed/Thur	2	0	3	4	0	9
14/10/2019	15/10/2019	Thur/Fri	2	2	1	2	1	8
15/10/2019	16/10/2019	Fri/Sat	3	1	2	8	2	16
16/10/2019	17/10/2019	Sat/Sun	6	0	4	1	6	17
17/10/2019	18/10/2019	Sun/Mon	3	5	2	7	1	18
18/10/2019	19/10/2019	Tues/Wed	3	4	1	4	2	14
19/10/2019	20/10/2019	Thur/Fri	2	2	3	2	2	11
20/10/2019	21/10/2019	Fri/Sat	4	0	1	1	0	6
21/10/2019	22/10/2019	Sat/Sun	2	2	2	1	1	8
22/10/2019	23/10/2019	Sun/Mon	3	1	0	3	1	8
23/10/2019	24/10/2019	Tues/Wed	2	0	3	1	2	8
24/10/2019	25/10/2019	Wed/Thur	8	7	3	2	5	25
25/10/2019	26/10/2019	Thur/Fri	2	1	4	13	5	25
26/10/2019	27/10/2019	Fri/Sat	2	3	3	7	3	18
27/10/2019	28/10/2019	Sat/Sun	0	2	1	6	3	12
28/10/2019	29/10/2019	Sun/Mon	2	0	1	3	1	7
29/10/2019	30/10/2019	Tues/Wed	0	3	3	5	3	14
30/10/2019	31/10/2019	Thur/Fri	1	2	5	2	0	10
31/10/2019	01/11/2019	Fri/Sat	3	4	4	7	3	21
01/11/2019	02/11/2019	Sat/Sun	0	1	3	2	3	9
02/11/2019	03/11/2019	Sun/Mon	6	2	2	7	4	21
03/11/2019	04/11/2019	Tues/Wed	2	4	2	3	4	15
04/11/2019	05/11/2019	Wed/Thur	4	4	1	2	4	15
05/11/2019	06/11/2019	Thur/Fri	4	1	2	1	0	8

ENAIRE Supporting Data

Date	19:57-20:57	20:57-21:57	21:57-22:57	22:57-23:57	23:57-00:57	00:57-01:57	Total
1-2 oct	2	1					3
2-3 oct			1	4		2	7
3-4 oct	2					1	3
4-5 oct				3	1	2	6
5-6 oct	2	1	2	1		1	7
6-7 oct		1		1		2	4
7-8 oct							0
8-9 oct	1		2	1			4
9-10 oct		2		2	1	1	6
10-11 oct	1		1	2	1		5
11-12 oct	2		1				3
12-13 oct	1	1	2	4	1		9
13-14 oct	1		2	3		1	7
14-15 oct	3		1	1			5
15-16 oct	1	1		1			3
16-17 oct				1		1	2
17-18 oct	2			1	1	1	5
18-19 oct	2						2
19-20 oct	1	1		3		1	6
20-21 oct	3		2	6			11
21-22 oct	2			2		1	5
22-23 oct		2			2	1	5
23-24 oct	3		1	2	1		7
24-25 oct		2	1	2	1	1	7
25-26 oct			1			1	2
26-27 oct	3	4		2	1		10
27-28 oct	2			3	1		6
28-29 oct			1	1	1		3
29-30 oct	1			2	1	1	5
30-31 oct		1	1				2

NAV Portugal Supporting Data

Virgin Orbit Traffic Analysis – Santa Maria (LPPO)

Prepared by Paulo Raposo

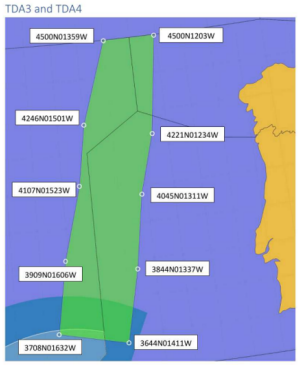
Traffic sample

As requested by Virgin Orbital, we considered the month of October 2019 and included the first two days of November to encompass the last Friday and Saturday of the period.

All days were considered, but Thursdays, Fridays and Saturdays were highlighted.

We considered the flights that flew in Santa Maria FIR and crossing the protected area boundaries for TDA3 and TDA4 combined at 45N or south (see picture below) between 1957 and 0157, with hourly time slots.

TDA3 and TDA4



Methodology

The traffic sample was obtained from our audit database files.

The last cleared profile (route points, including coordinates ana ATO) for each flight was used, ensuring that all flights were captured (including non-Datalink flights).

For each flight, we calculated the intersections of each route segment (great circles) with the lines that define the polygon specified above (also great circles) to obtain the entry and exit points on the TDA3+TDA4 (including coordinates and the time over the point).

The totals were obtained by summing the number of flights for each time slot and for the full requested period.

Comments

The results (see below) are expressed in number of flights.

The number of unique flights for the total time is less than the sum of the count of flights for each individual time slot, as one single flight might span over 2 or more slots.

Since January 2020 the flights using the Tango routes have pretty much stopped flying in LPPO due to the Datalink Mandate, this fact might skew the results, as around 200 flights on this situation were detected in this analysis.

This sample does not include flights that did not enter LPPO.

Traffic Sample example

777634/IBE6253, LEMD to KJFK
403722N0064323W:2019-10-01/15:35:11
410000N0150000W:2019-10-01/16:25:39 **Entry in LPPO**
420000N0200000W:2019-10-01/16:57:33
430000N0300000W:2019-10-01/18:00:48
430000N0400000W:2019-10-01/19:06:56 **Exit from LPPO**
430000N0500000W:2019-10-01/20:09:32
420000N0600000W:2019-10-01/21:12:16
410700N0670000W:2019-10-01/21:54:14
420237N0702536W:2019-10-01/22:16:16

Calculated

ENTRY TDA	2019-10-01/16:14:07	405758N0130607W
EXIT TDA	2019-10-01/16:28:12	410516N0152339W

As the entry and exit times from the TDA are outside the requested interval, this particular flight was not considered on the results table.

DATE	WEEKDAY	19H57	20H57	21H57	22H57	23H57	00H57	UNIQUE
01/10/2019	1	3	14	14	15	7	4	39
02/10/2019	2	5	8	11	16	11	6	43
03/10/2019	3	8	7	8	9	6	5	29
04/10/2019	4	4	11	15	19	10	2	43
05/10/2019	5	12	14	15	16	3	3	44
06/10/2019	6	2	15	18	16	9	5	43
07/10/2019	0	14	9	14	15	7	7	44
08/10/2019	1	5	5	7	18	8	3	33
09/10/2019	2	3	5	7	14	9	8	37
10/10/2019	3	5	7	12	20	5	3	38
11/10/2019	4	9	11	15	13	7	5	41
12/10/2019	5	8	7	8	9	6	3	33
13/10/2019	6	4	6	14	12	6	3	34
14/10/2019	0	10	3	8	14	4	7	38
15/10/2019	1	6	7	10	17	4	4	35
16/10/2019	2	4	3	7	11	14	5	35
17/10/2019	3	4	7	10	14	1	5	29
18/10/2019	4	4	5	9	5	6	4	25
19/10/2019	5	5	4	7	11	1	2	25
20/10/2019	6	6	3	9	14	6	3	34
21/10/2019	0	4	4	8	10	4	3	28
22/10/2019	1	4	5	8	10	3	2	24
23/10/2019	2	4	5	6	12	13	1	31
24/10/2019	3	2	8	9	14	9	7	33
25/10/2019	4	3	15	22	16	8	7	47
26/10/2019	5	9	7	13	16	9	3	36
27/10/2019	6	2	4	10	9	5	3	24
28/10/2019	0	3	2	2	6	9	8	24
29/10/2019	1	5	2	5	7	9	4	23
30/10/2019	2	5	7	4	4	6	3	23
31/10/2019	3	7	9	6	9	9	3	30
01/11/2019	4	2	4	4	9	9	6	30
02/11/2019	5	6	8	10	10	5	7	33
03/11/2019	6	6	9	12	11	8	5	34
	AVERAGE	5,4	7,1	9,9	12,4	6,9	4,4	33,6
	TOTAL	183	240	337	421	236	149	1142

Request 2

3.2 Request 2

An evaluation is requested from the southern extent of TDA Element 4 to the Canary Islands (shown in green, Figure 2). This is not a TDA but will help CAA evaluate impacts south of the proposed TDA.

Table 2 - South of TDA 4 Coordinates

Latitude	Longitude
274035.39N	0182500.43W
272309.44N	0170023.71W
364503.65N	0141126.56W
370858.18N	0163047.65W

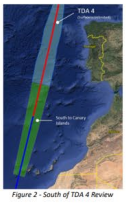
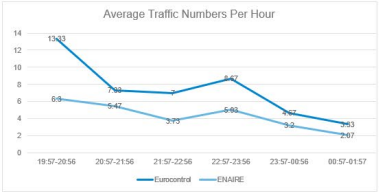


Figure 2 - South of TDA 4 Review

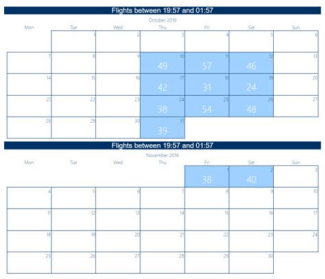
Collaborators:

- Eurocontrol
- Enaire –affecting Canarias ACC zone



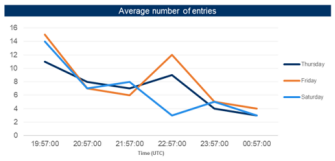
Eurocontrol Supporting Data

Number of flights crossing TDA4SOUTH



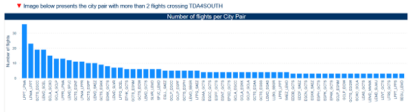
Virgin Orbit Traffic Analysis

Average traffic crossing TDA4SOUTH



Weekday	AVG Traffic	AVG Cross duration (s)	AVG Cross length (NM)
Thursday	42	1476.26	171.74
Friday	45	1691.69	198.63
Saturday	40	1522.61	180.20
Total	**42**	**1567.37**	**183.94**

▼ Image below presents the city pair with more than 2 flights crossing TDA4SOUTH



Virgin Orbit Traffic Analysis

ENAIRE Supporting Data

Date	19:57-20:57	20:57-21:57	21:57-22:57	22:57-23:57	23:57-00:57	00:57-01:57	Total
1-2 oct	8	9	4	10	4	2	37
2-3 oct	7	4	4	3	6	4	28
3-4 oct	9	6	1	6	3	5	30
4-5 oct	9	7	4	5	4		29
5-6 oct	10	8	4	12	5	1	40
6-7 oct	11	15	4	9	9	3	51
7-8 oct	4	6	4	3	7		24
8-9 oct	4	8	3	4	5	1	25
9-10 oct	4	5	4	11	2	2	28
10-11 oct	7	5	5	14	2	2	35
11-12 oct	9	6	4	13	4		36
12-13 oct	10	12	7	2	1	3	35
13-14 oct	6	6	2	1	4	1	20
14-15 oct	3	3	3	10	4	5	28
15-16 oct	6	7	3	3	3	3	25
16-17 oct	2	4	5	5	2	2	20
17-18 oct	7	7	4	1	1		20
18-19 oct	6	4	2	4	2	1	19
19-20 oct	5			2	2	2	11
20-21 oct	3	1	3	6	2	4	19
21-22 oct	1	3	1	6	1	1	13
22-23 oct	2	5	3	3	3		16
23-24 oct	5	2	5	3	2		17
24-25 oct	6	4	7	4	4	3	28
25-26 oct	12	9	3	6	6	5	41
26-27 oct	7	7	9	1	1	3	28
27-28 oct	8	3	4	1	3	4	23
28-29 oct	3	2	4		1	1	11
29-30 oct	8	4	3	3	2	2	22
30-31 oct	7	2	3		1	2	15

Virgin Orbit Traffic Analysis

Request 3

3.3 Request 3

An evaluation is requested from the Canary Islands to termination of the flight corridor. This also is not a TDA but CAA will be interested in the exposure of aircraft outside of the TDA.

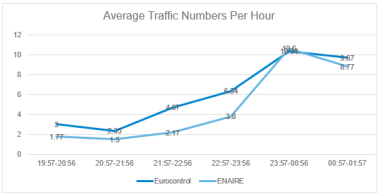
Table 3 - Canary to End

Latitude	Longitude
095606.66N	0221214.95W
093844.81N	0203832.27W
272309.44N	0170023.71W
274035.39N	0182500.43W

Figure 3 - Canary Islands to Flight Corridor End

Collaborators:

- Eurocontrol – **Datasets have limitations for West Africa**
- Enaire –affecting Canarias ACC zone



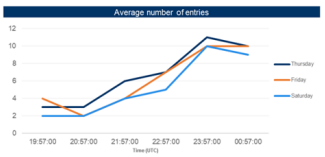
Virgin Orbit Traffic Analysis

Eurocontrol Supporting Data

Number of flights crossing TDACNR

Virgin Orbit Traffic Analysis

Average traffic crossing TDACNR



Weekday	AVG Traffic	AVG Cross duration (s)	AVG Cross length (NM)
Thursday	37	1398.34	185.00
Friday	37	1381.72	181.64
Saturday	32	1378.05	179.82
Total	**35**	**1386.42**	**182.26**

▼ Image below presents the city pair with more than 2 flights crossing TDACNR

Virgin Orbit Traffic Analysis

ENAIRE Supporting Data

Date	19:57-20:57	20:57-21:57	21:57-22:57	22:57-23:57	23:57-00:57	00:57-01:57	Total
1-2 oct	2		3	4	12	4	25
2-3 oct	2	2	3	2	15	9	33
3-4 oct	1		3	4	14	12	34
4-5 oct	3	1	3	4	11	8	30
5-6 oct	1	2	2	5	9	9	28
6-7 oct	2	2	2	4	13	3	26
7-8 oct	1		3	5	10	11	30
8-9 oct	1	1		1	14	9	26
9-10 oct	1	2	1	5	7	8	24
10-11 oct	2	2	1	2	6	6	19
11-12 oct	4	1	1	4	5	4	19
12-13 oct		3	3	1	13	12	32
13-14 oct	2	1	5	4	13	13	38
14-15 oct	2		3	3	8	10	26
15-16 oct	1	1	1		4	3	10
16-17 oct	2	1	4	4	4	11	26
17-18 oct		2	4	7	12	10	35
18-19 oct	3	2	3	4	11	10	33
19-20 oct		2	3	6	11	10	32
20-21 oct	2	2	2	10	18	10	44
21-22 oct	2	1	1	8	13	9	34
22-23 oct	2	1	1	4	15	10	33
23-24 oct	2	5	3	3	16	8	37
24-25 oct	1	3	2	6	12	11	35
25-26 oct	3	1	3	4	9	4	24
26-27 oct	2		2		11	15	30
27-28 oct	2	2	1	3	8	6	22
28-29 oct	1	2	1	2	9	7	22
29-30 oct	3	2		2	7	13	27
30-31 oct	3	1	1	3	8	8	24

Request 3.4 Expected Output

3.4 Expected Output

Virgin Orbit requests an output as shown below (if possible):

EXAMPLE OUTPUT

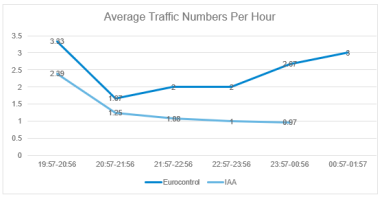
Time	Request 1 region	Request 2 region	Request 3 region
19:57-20:56UTC	15	5	6
20:57-21:56UTC	7	4	3
21:57-22:56UTC	6	5	2

Due to varying ANSP datasets, the table below takes account **for Eurocontol data only**. Additional validation from ANSP sources can be found earlier in this report.

Time	Request 1 region	Request 2 region	Request 3 region
19:57-20:56	10	13.33	3
20:57-21:56	9.67	7.33	2.33
21:57-22:56	10	7	4.67
22:57-23:56	14	8.67	6.34
23:57-00:56	7.33	4.67	10.34
00:57-01:57	9.33	3.33	9.67

Additional Analysis

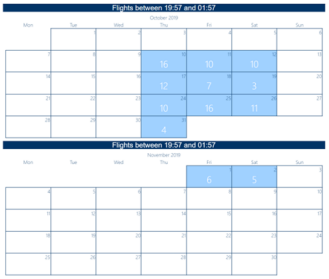
Both Eurocontrol and IAA have provided analysis for the Racetrack TDA 1 as below:



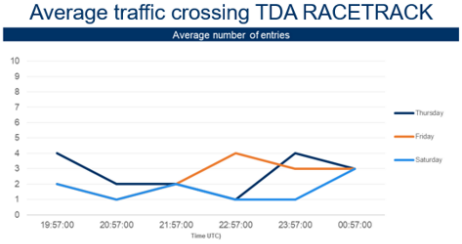
Discrepancies may be associated with Eurocontrol analysis focussing on Thursday/Friday/Saturday. IAA includes all days of week.

Eurocontrol Supporting Data

Number of flights crossing TDA RACETRACK



Average traffic crossing TDA RACETRACK



Weekday	AVG Traffic	AVG Cross duration (s)	AVG Cross length (NM)
Thursday	11	316.07	46.39
Friday	10	271.97	39.95
Saturday	7	302.38	44.69
Total	**9**	**296.83**	**43.66**

▼ Image below presents flights crossing TDA RACETRACK and grouped by city pair

IAA Supporting Data

Date From	Date To	Day of Week	19:57 - 20:56	20:57 - 21:56	21:57 - 22:56	22:57 - 23:56	23:57 - 00:56	Total
01/10/2019	02/10/2019	Tues/Wed	5	2	3	1	0	11
02/10/2019	03/10/2019	Wed/Thur	2	1	0	0	0	3
03/10/2019	04/10/2019	Thur/Fri	3	1	0	1	1	6
04/10/2019	05/10/2019	Fri/Sat	2	3	1	1	2	9
05/10/2019	06/10/2019	Sat/Sun	5	4	1	1	0	11
06/10/2019	07/10/2019	Sun/Mon	1	0	1	2	0	4
07/10/2019	08/10/2019	Tues/Wed	2	0	1	1	1	5
08/10/2019	09/10/2019	Thur/Fri	1	0	0	0	0	1
09/10/2019	10/10/2019	Fri/Sat	5	1	0	2	3	11
10/10/2019	11/10/2019	Sat/Sun	5	3	1	1	2	12
11/10/2019	12/10/2019	Sun/Mon	1	1	0	2	1	5
12/10/2019	13/10/2019	Tues/Wed	3	2	4	0	0	9
13/10/2019	14/10/2019	Wed/Thur	2	1	0	1	1	5
14/10/2019	15/10/2019	Thur/Fri	1	0	0	0	0	1
15/10/2019	16/10/2019	Fri/Sat	1	1	1	2	1	6
16/10/2019	17/10/2019	Sat/Sun	2	0	2	1	4	9
17/10/2019	18/10/2019	Sun/Mon	3	2	1	1	1	8
18/10/2019	19/10/2019	Tues/Wed	3	1	0	0	1	5
19/10/2019	20/10/2019	Thur/Fri	0	1	1	1	2	5
20/10/2019	21/10/2019	Fri/Sat	3	1	0	0	0	4
21/10/2019	22/10/2019	Sat/Sun	4	1	1	0	1	7
22/10/2019	23/10/2019	Sun/Mon	3	1	0	1	0	5
23/10/2019	24/10/2019	Tues/Wed	4	1	1	0	0	6
24/10/2019	25/10/2019	Wed/Thur	5	2	2	0	4	13
25/10/2019	26/10/2019	Thur/Fri	2	0	2	5	1	10
26/10/2019	27/10/2019	Fri/Sat	1	1	3	2	0	7
27/10/2019	28/10/2019	Sat/Sun	0	1	0	3	2	6
28/10/2019	29/10/2019	Sun/Mon	1	3	2	1	0	7
29/10/2019	30/10/2019	Tues/Wed	1	1	2	3	1	8
30/10/2019	31/10/2019	Thur/Fri	2	2	4	0	0	8
31/10/2019	01/11/2019	Fri/Sat	1	1	2	0	0	4
01/11/2019	02/11/2019	Sat/Sun	3	0	2	0	0	5
02/11/2019	03/11/2019	Sun/Mon	1	1	1	2	1	6
03/11/2019	04/11/2019	Tues/Wed	1	2	0	1	1	5
04/11/2019	05/11/2019	Wed/Thur	5	3	0	0	4	12
05/11/2019	06/11/2019	Thur/Fri	2	0	0	0	0	2

Appendix E: Preliminary Airspace Analysis

Traffic analysis was completed by Eurocontrol using the preliminary proposed TDAs. Traffic data was taken from July 2019 at peak air traffic levels to offer a conservative approach. Details are shown below. This study was revised with a better understanding of requirements and TDA structures. The updated study is shown in Section 8.

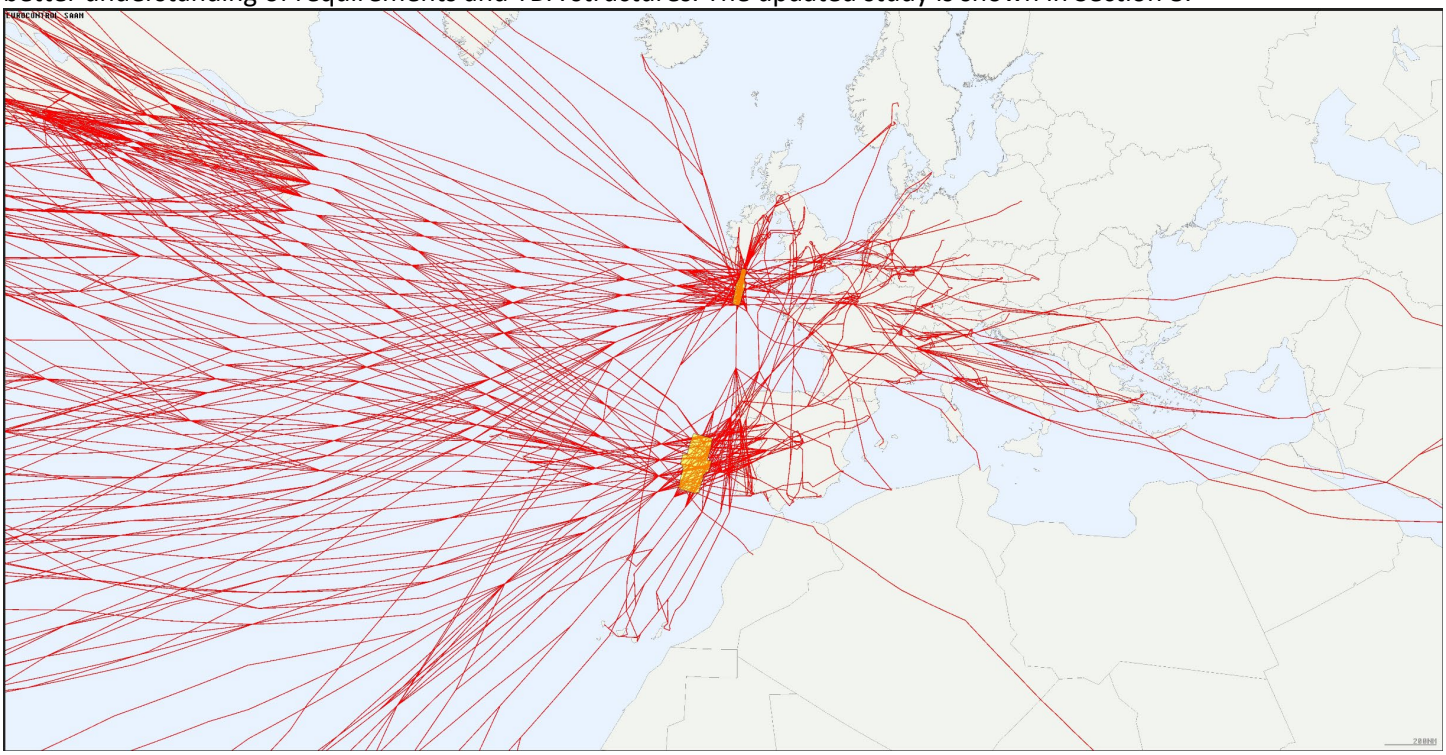


Figure 13 - Combined Traffic Data

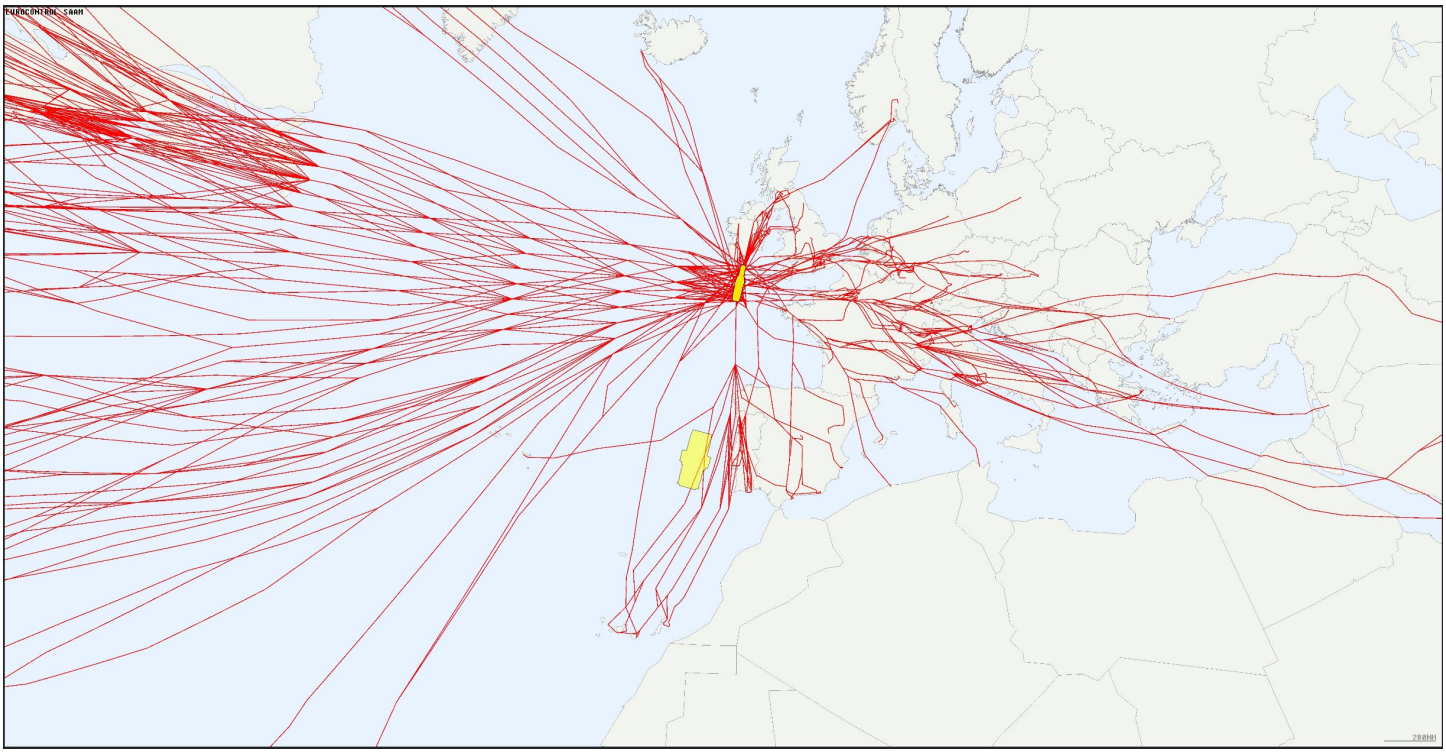


Figure 14 - Traffic at Rocket Drop TDA

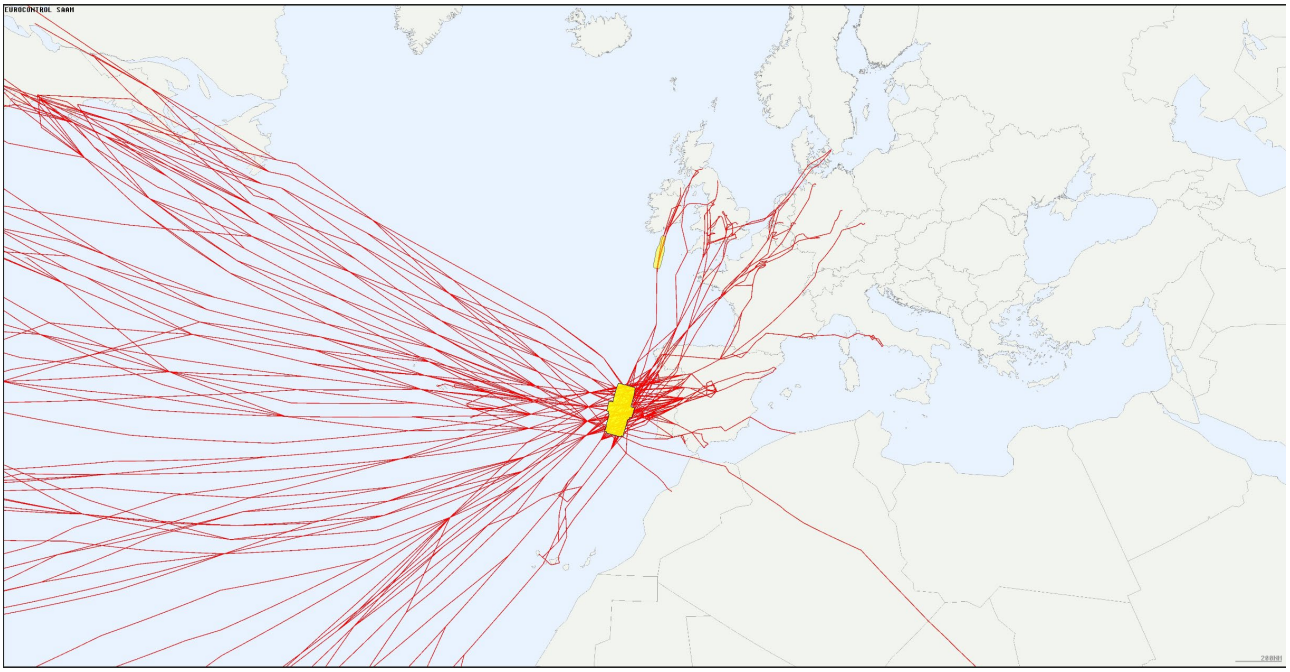


Figure 15 - Traffic at S1/Fairing Splashdown TDA

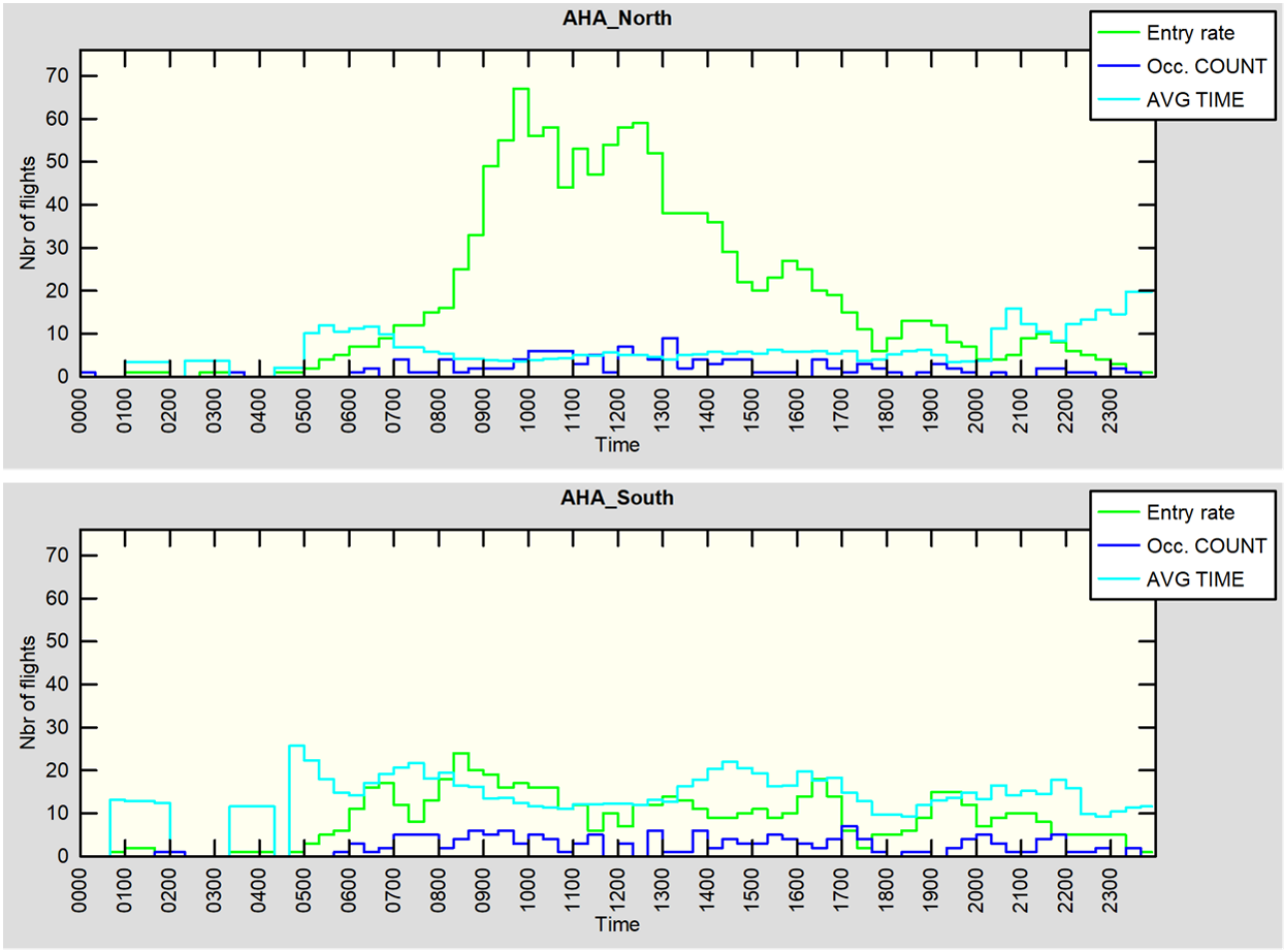


Figure 16 - Rates of Aircraft Transit Through TDAs

Appendix F: Virgin Orbit Airspace Analysis Request

F.4 Purpose

The purpose of this document is to request an air traffic analysis related to a specific airspace structure for a period in October. The returned analysis will give understanding to impacts on airlines and how Temporary Danger Area (TDA) structures may be released as the rocket progresses on its trajectory.

F.5 Scope

Virgin Orbit has created 4 TDA elements for a Captive Carry 747-400 flight and a rocket launch. The air traffic analysis is requested to cover all 4 TDAs using historical data (where possible, Aireon space based ADS-B data) that can be translated to the following future timeline:

- Month of year to evaluate: **October**
- Year to evaluate: **2019 if possible, else 2021**
- Days of week to consider: **Thursday, Friday, and Saturday**. If possible, Virgin Orbit would like to request **all days** of the week to be evaluated unless this is too burdensome. If all days are evaluated, this could be valuable data for Virgin Orbit to understand high traffic days to avoid.
- Time of day: Evaluation requested for **19:57 UTC – 01:57* UTC** (*time would elapse into next day). This range assumes a 2 hour TDA activation with 2 hours on each side of the window.
- Observation windows: count of flights for each whole hour within the time of day, i.e. 19:57-20:56 UTC, 20:57-21:57 UTC, etc
    - Measurement: count of flights within the specified polygon in each hour
- Output is requested by **02-AUG-2022** to meet CAA timelines

F.6 Details of TDA Evaluation

F.6.1 Request 1

An evaluation is requested from the northern extent of TDA Element 2 to the southern element of TDA Element 4. This analysis will provide the full scope of closures. Please see Element design and coordinates in section G.6.3.

Table 2 - Total TDA Coordinates

Latitude	Longitude
501640.36N	0104303.03W
504446.68N	0104742.04W
512419.80N	0103343.52W
512833.69N	0110625.08W
504915.24N	0111943.20W
502413.78N	0114154.24W
491209.65N	0120256.82W
424532.34N	0150015.26W
410655.27N	0152220.79W
390917.45N	0160503.49W
370858.18N	0163047.65W
364503.65N	0141126.56W
384435.31N	0133714.61W
404445.00N	0131114.86W
422121.89N	0123503.92W
490434.29N	0110859.26W

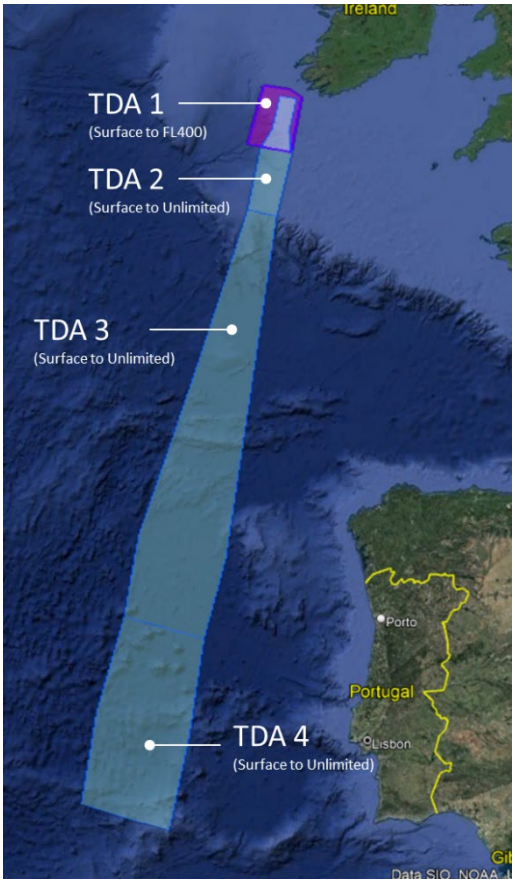


Figure 17 - Total TDA

F.6.2 Request 2

An evaluation is requested from the southern extent of TDA Element 4 to the Canary Islands (shown in green, Figure 2). This is not a TDA but will help CAA evaluate impacts south of the proposed TDA.

Table 3 - South of TDA 4 Coordinates

Latitude	Longitude
274035.39N	0182500.43W
272309.44N	0170023.71W
364503.65N	0141126.56W
370858.18N	0163047.65W

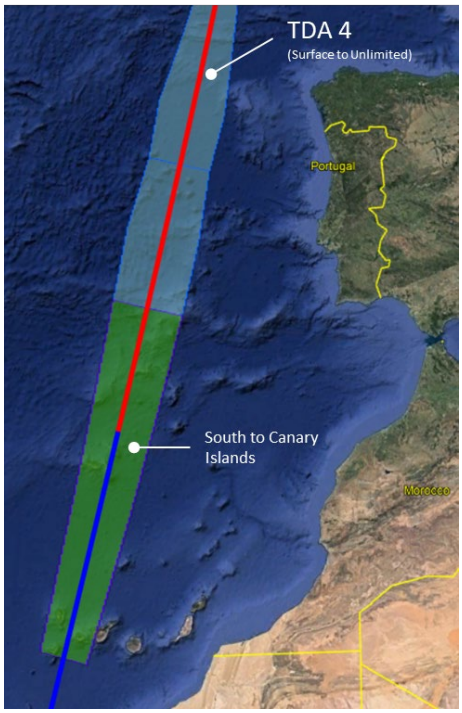


Figure 18 - South of TDA 4 Review

F.6.3 Request 3

An evaluation is requested from the Canary Islands to termination of the flight corridor. This also is not a TDA but CAA will be interested in the exposure of aircraft outside of the TDA.

Table 4 - Canary to End

Latitude	Longitude
095606.66N	0221214.95W
093844.81N	0203832.27W
272309.44N	0170023.71W
274035.39N	0182500.43W

Figure 19 - Canary Islands to Flight Corridor End

F.6.4 Expected Output

Virgin Orbit requests an output as shown below (if possible):

EXAMPLE OUTPUT

Time	Request 1 region	Request 2 region	Request 3 region
19:57-20:56UTC	15	5	6
20:57-21:56UTC	7	4	3
21:57-22:56UTC	6	5	2

F.7 TDA Coordinates of Each Element

F.7.1 TDA Element 1

Table 5 - Element 1 Coordinates

Latitude	Longitude
514132.99N	0113752.58W
513604.93N	0104652.46W
512633.74N	0102355.76W
502009.88N	0104324.56W
503058.39N	0120549.16W

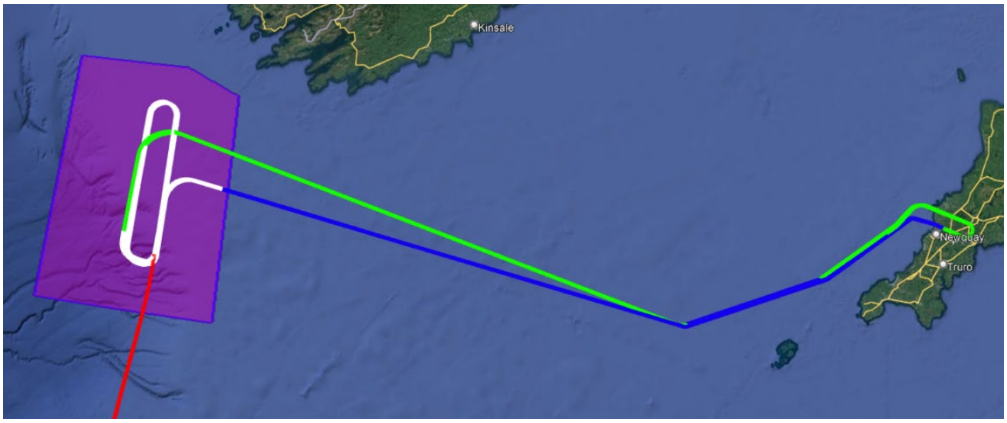


Figure 20 - TDA Element 1

F.7.2 TDA Element 2

Table 6 - Element 2 Coordinates

Latitude	Longitude
490434.29N	0110859.26W
501640.36N	0104303.03W
504446.68N	0104742.04W
512419.80N	0103343.52W
512833.69N	0110625.08W
504915.24N	0111943.20W
502413.78N	0114154.24W
491209.65N	0120256.82W

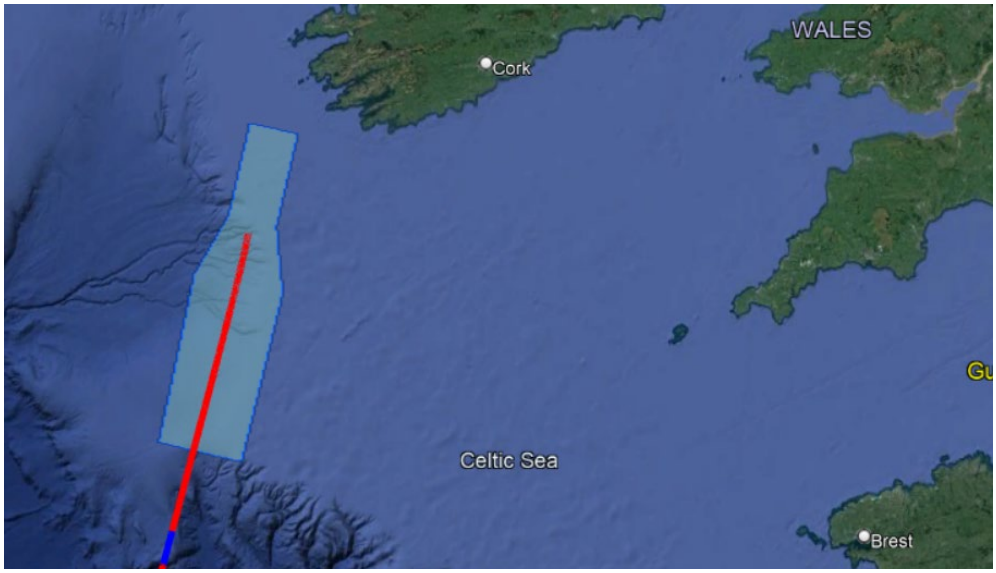


Figure 21 - TDA Element 2

F.7.3 TDA Element 3

Table 7 - Element 3 Coordinates

Latitude	Longitude
410655.27N	0152220.79W
424532.34N	0150015.26W
491209.65N	0120256.82W
490434.29N	0110859.26W
422121.89N	0123503.92W
404445.00N	0131114.86W

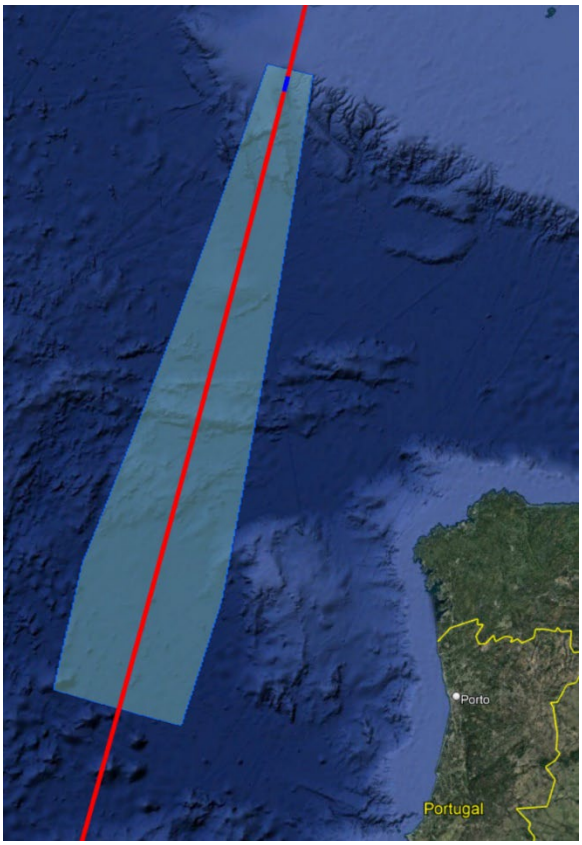


Figure 22 - TDA Element 3

F.7.4 TDA Element 4

Table 8 - Element 4 Coordinates

Latitude	Longitude
410655.27N	0152220.79W
390917.45N	0160503.49W
370858.18N	0163047.65W
364503.65N	0141126.56W
384435.31N	0133714.61W
404445.00N	0131114.86W

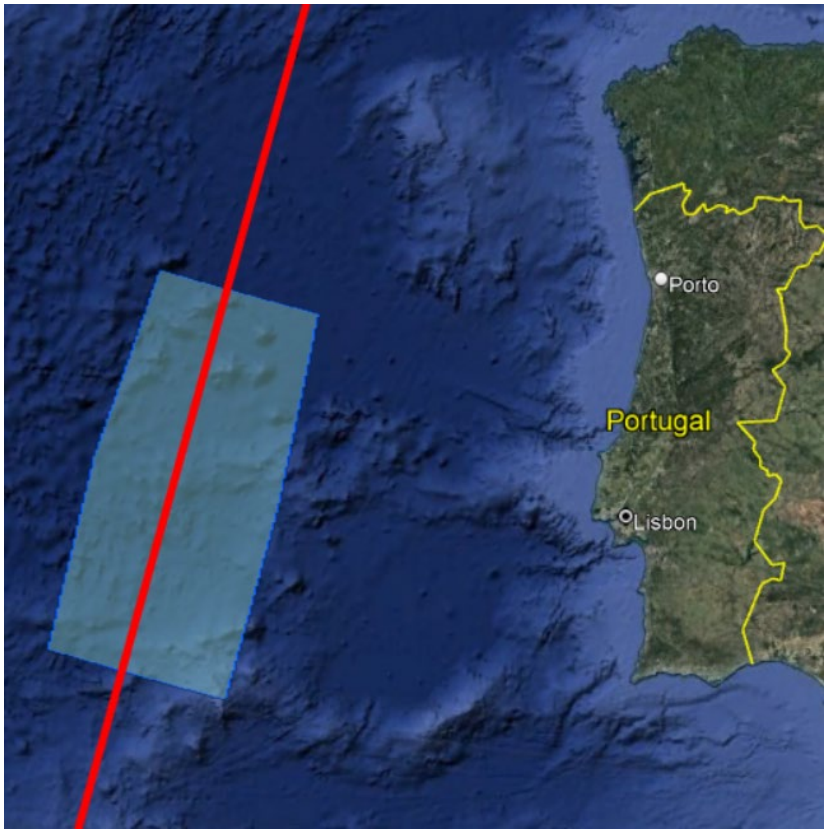


Figure 23 - TDA Element 4