UK Civil Aviation Authority

Guidance to applicants on large rocket launch permissions under the Air Navigation Order

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Chapter 1

Introduction

1.1 This document provides guidance for applicants on large rocket launch permissions issued by the CAA under article 96 of the Air Navigation Order 2016 (ANO) as amended by the Air Navigation (Amendment) Order 2021

1.2 Large rockets are defined as having a total combined motor impulse of greater than 10,240 Newton-seconds that are not capable of exceeding the stratosphere (about 47km altitude). Therefore, rocket launches carried out under the ANO are sub orbital.

1.3 If your rocket is technically capable of exceeding the stratosphere it may still operate under an ANO permission provided that robust control measures are in place (for example a reduced fuel load) to ensure it remains within the stratosphere.

1.4 If your proposed launch rocket will reach a maximum altitude beyond the stratosphere you need to apply for a licence under the Space Industry Act 2018 (SIA).

1.5 Permissions granted under the ANO only allow for a single launch to take place.

1.6 You will need to send us a safety case and proof that you have insurance in place to cover your planned launch activity. To grant a permission we need to be satisfied that your safety case has:

- Identified the hazards and risks of your launch.
- Reduced the risks to As Low As Reasonably Practicable (ALARP) and that those risks are acceptable.

1.7 We grant ANO permissions for the flight of a large rocket and our assessment of any application focuses on the flight safety analysis linked to your safety case. You will still need to comply with the UK's existing health and safety legislation and regulations for ground safety.

What you will need to consider in your application

1.8 We strongly encourage you to speak to us before you apply to discuss your planned launch. This will help us to understand your proposed mission and timescales. We can also discuss the requirements you need to fulfil as part of your application.

1.9 You can book a pre-application meeting on our website.

1.10 Your safety case is a structured argument, backed up with evidence, which shows how your planned operation will be conducted safely. This document provides guidance on what information you need to submit as part of your safety case.

1.11 In addition to a launch permission, you may need to launch within segregated airspace. The UK has several established Danger Areas that may be able to accommodate a large rocket launch. If you are not using an existing Danger Area, you may need to apply for a Temporary Danger Area (TDA).

1.12 To apply for a TDA you must submit a DAP1916 (Statement of Need). The airspace change process for a TDA takes a minimum of six months so early submission of DAP1916 is recommended. Any large rocket permission will be conditional on airspace approval.

1.13 It's important to remember that applications for large rocket permissions and airspace changes are managed by separate teams who work together but who have different timelines.

Chapter 2
Application

Application process

2.1 The application process for a large rocket permission is broken down into the following steps:

Applicant

- Submit application

CAA space regulation team

- Initial screen
- Safety case assessment
- Final review
- Permission issue

2.2 You will need to complete our online application form (SRG2200), we ask you for information like your planned launch site, key people involved in the launch and details of your rocket and your planned flight, including:

- Planned apogee (maximum altitude) the rocket will be reaching.
- Launch azimuth (angle of the launch relative to true north).
- Inclination of your launch (relative to the ground).
- Technical particulars of the rocket.

2.3 Once we receive your application we will assign you a case manager, who will be your main point of contact throughout. The entire large rocket permission application process takes at least 16 weeks. During this time, we review your safety case, insurance plan and any other necessary arrangements. When your case manager has further questions for you, the 'clock' will stop on your application until you provide the information required.

2.4 Once we are satisfied that your safety case demonstrates that the risks to public safety and to property are ALARP, and that those risks are acceptable, and that you have adequate insurance in place for your proposed launch, we will produce your permission and conditions. Once granted, your case manager will send these to you.

2.5 Permissions only allow for a single launch, for repeat launches you will need to apply again for each one. Depending on the mission, it's possible that work from your previous application(s) may be used, but we advise that you speak to us as early as possible if you are planning multiple launches/applications.

Chapter 3

What you need to provide

Insurance plan

3.1 Rocket operators, as the persons whose activities could potentially cause harm, are considered the risk holders for their rocket launch and you are required to demonstrate that you have adequate insurance cover.

3.2 As a guideline, the minimum amount of insurance cover required for a large rocket launch under the ANO is £5 million. This amount may be higher or lower depending on the risks posed by the launch. If lower, you will need to justify why your level of cover is adequate.

3.3 You will need to show that you have taken steps to ensure that this level of cover is sufficient given the potential consequences of an accident during or because of the launch.

3.4 To make a convincing argument that your insurance cover is adequate you should demonstrate that:

a) Through the safety case, you have identified the risks to public safety and property arising from your proposed activities and have reduced those risks to as low as reasonably practicable.

b) You have assessed the level of third-party liability insurance cover required to meet the residual risks.

The level of cover provided must take account of:

- The range of potential accidents.
- The people/property that could be affected.

c) You have insurance cover in place from a UK, EU, or US insurance provider.

If cover is not in place at the time your application is submitted, you should provide evidence of engagement with insurers and/or other parties on insurance proposals for such arrangements.

d) You can provide evidence that this cover is in place. We recognise that certified copies of insurance policies may not be available at the time of the application, but evidence must be provided before activities covered by the permission take place.

Safety case

3.5 Your safety case is how you demonstrate that you understand the risks to people and their property arising from your planned launch and how you will manage those risks to as low as reasonably practicable. In it, you should show that you have:

- identified the hazards from the proposed launch activity,
- assessed the resulting risks to people and property,
- considered measures to prevent or mitigate those risks and
- taken steps to manage those risks so that they are ALARP.

3.6 You do not need to include preparations for launch in your safety case as they are not part of the ANO permission, but you will need to comply with UK health and safety legislation which is regulated by the Health and Safety Executive (HSE).

3.7 We will review your safety case to assess whether you have made a compelling argument, supported by relevant evidence, to show that you have taken the necessary steps to manage the risks to ALARP and that the residual risks to the public and their property are acceptable.

Hazard identification

3.8 As a minimum you should identify hazards in the following categories:

- **Hazards to those on land**
  This is specifically third parties (including people, property, and animals) who are on the land and not involved in the launch of the rocket.
- **Hazards at sea**
  This covers maritime users and vessels that might be present in the area that the rocket will be launched in or flying over.
- **Hazards in the air**
  This covers all users of the airspace through which the rocket will fly from launch to recovery, including commercial, military, and private aviation and other aerial vehicles.

3.9 To effectively identify the hazards of your rocket flight, you will need to:

- Identify the conditions under which a hazardous event can occur (such as weather, temperatures, or humidity).
- Identify what could cause or contribute to a hazard.

3.10 You will need to classify the risk associated with the hazards or hazardous scenarios based on the likelihood of it occurring, and the consequence if it does occur so that you can determine appropriate risk controls.

Risk controls

3.11 You should provide information on your risk controls. As a minimum this should include:

- Information on how you plan to monitor any region of land, maritime areas, or airspace necessary to ensure the number and location of the members of the public are consistent with the inputs used for your flight safety analysis in your safety case.
- Information on how you will contain your rocket to your identified airspace, as well as any land or maritime areas that airspace is over.

3.12 You should provide a detailed communications plan, along with procedures during countdown, launch, flight, and (if appropriate) recovery. This information should include:

- Identification of each interface needed to support the pre-launch, launch, flight, and recovery operations of the rocket.
- The necessary authority of personnel to issue commands.
- How you will communicate with personnel, so that they have direct access to real-time safety-critical information required for issuing hold/resume, go/no go, and abort decisions and commands.

Flight safety analysis

3.13 You will need to perform a flight safety analysis on your rocket, to understand its behaviour during both successful flight and failure. Testing the potential impact of your rocket is fundamental to understanding the size of the hazard area needed.

3.14 The results of your flight safety analysis should be used to identify and implement appropriate risk controls, for example setting wind limits, adjusting the launch trajectory, or using a wind-weighting safety system.

3.15 The outcomes of your flight safety analysis should be clearly set out and linked to your safety case. It is important to use the flight safety analysis to draw meaningful conclusions about the hazards, the overall risk, and the effectiveness of risk controls.

Factors the flight safety analysis must consider

3.16 Your flight safety analysis requires suitable trajectory analysis for the proposed flight, which must account for applicable launch settings parameters (such as launch azimuth and inclination).

3.17 This should be performed with appropriate simulation packages and be capable of demonstrating the scope and scale of the proposed operations (for example the maximum apogee, maximum energy trajectory and flight envelope under uncertainty).

3.18 Your trajectory analysis will need to consider uncertainty in parameters throughout all stages of the launch (including stage separation or deployment of parachutes) such as:

- Flight characteristics (elevation and azimuth).
- Rocket performance (thrust).
- Physical properties (mass, aerodynamic properties, thrust offset and so on).
- Wind, both the variability and uncertainty:
  - Variability accounts for a range of known conditions at the time of launch, such as the acceptable wind speed and direction envelope defined by the operator.
  - Uncertainty in wind conditions should also be considered in analysis, (there will be some uncertainty between the forecast conditions and the actual conditions at launch).

3.19 The extent to which wind at various altitudes will affect the launch will depend on operational parameters such as the altitude of the flight, the wind conditions on the day of launch, the number of stages, recovery systems and the aerodynamics and stability of the rocket.

3.20 You should consider the level of detail/fidelity of trajectory analysis carefully. Six-degree-of-freedom models are required to accurately predict the trajectories of weathervaning rockets and rockets with significant angular momentum.

3.21 A careful use of assumptions and three-degree-of-freedom models may be appropriate, but your safety case should contain a strong argument why this is appropriate for your planned flight.

Simulation analysis

3.22 You should describe the method chosen for handling uncertainty in the flight safety analysis. This may include a Monte Carlo analysis, a worst-case scenario analysis, or sensitivity analysis.

3.23 When you provide simulation analysis and results, we will need the following information, including any related assumptions:

- Physical characteristics including mass, centre of mass, moment of inertia or similar.

- Any uncertainties in the model (physical or aerodynamic).
- Propulsion models (including thrust and mass flow rate profiles).
- Aerodynamics model with a description of the definition of any aerodynamic coefficients used.
- Description of changes to flight profiles during flight (such as changes in motion during different stages of the flight).
- If a Monte Carlo analysis (or similar) is used, a list of parameters, and their assumed distributions.
- The predicted effect of weather on the flight of the rocket (preferably using a wind-weighting system).

Demonstrating ALARP

3.24 Your safety case must include a written demonstration of how you have managed the risk to people and property to as low as reasonably practicable. In simple terms, this means showing that throughout the development of the project you have asked yourself the following questions:

1. What more can we do to reduce the risk?

This is often done as part of the hazard identification process by systematically brainstorming further risk reduction measures.

2. Why are we not doing it?

You will need to evaluate the potential risk reduction measures and consider:

- Are they practical (does the technology exist)?
- Do they simply transfer risk rather than reduce it?

3.25 Cost benefit analysis can help make an informed choice between risk reduction options.

3.26 Proposed risk reduction measures must be implemented if the sacrifice (in money, time, trouble) is not grossly disproportionate to the risk. What counts as grossly disproportionate is a judgement but the higher the risk, the more effort, time, and sacrifice is needed to reduce the risk.

Chapter 4

Permissions and next steps

4.1 Our role is to ensure that you conduct your rocket launches in a way that protects the public and their property and this includes monitoring sub orbital launch activities.

4.2 Any permission we grant will include conditions with which you must comply. To show compliance, you may need to send us information for example, details of any tests or rehearsals you conduct or a post launch report. We may also choose to carry out inspections of your sites before and after any launch.

Conditions

4.3 A condition is a statement or requirement that you must comply with, either pre-launch, in flight or post-launch or all such times.

4.4 These may include general conditions related to launches, such as:

- Making and keeping records of key events during countdown on the day of launch.
- Notifying us of the date and time your launch took place and when it concluded.
- Providing a comparison of your pre-flight predictions versus actual flight results.
- Assessing how effective your safety measures were, or if any incidents happened before, during or after your flight.

4.5 We may also include conditions that are specific to your planned activity.

Next steps

If you need to make amendments to your permission after issue (for example changing the planned launch window or flight characteristics of your rocket) you will need to contact us to discuss how these changes can be made.

This may result in a new permission being issued and may involve additional review depending on the scale of the changes.