

The Space Industries Act 2018

Consultation on Draft Guidance to the Regulator on Environmental Objectives relating to the exercise of its functions under this Act.

Response from the Institute of Acoustics

Introduction

The Institute of Acoustics (IOA) is the professional body for those working in the field of acoustics and noise management. Our members include consultants, academics and regulators. Our activities include working for the building industry, developers and local authorities in all matters associated with sound and noise management in the built and natural environment. This response has been compiled by members of the Institute and endorsed by its Governing body.

Background

The IOA welcomes the approach of setting environmental objectives for the spaceflight regulator and for providing guidance on those objectives.

The IOA response focuses on two aspects of the draft guidance, namely:

1. Noise – pages 15 – 20 of the draft guidance
2. The noise aspect of the Marine Environment

It can be seen that the Institute has various comments on these issues.

The IOA would be happy to liaise with officials in order to assist in developing the noise-related guidance over the coming months.

Noise

The consultation document asks two questions in relation to Noise. They are:

Q6 Is it clear from the guidance how the regulator should interpret the government's objective on noise? and

Q7 Do you have any comments on the specific guidance provided to the regulator on the objective related to noise? Please provide details.

The Institute's responses are:

Question 6	No
Question 7	Yes – please see below

Further Details

It is understood that the guidance is required to address the assessment of noise impacts from a new spaceport and the impact of space flights associated with the spaceport. Therefore, when providing guidance, it is convenient to divide the issues into 4 elements:

- Policy, Legislation and Guidance;
- Prediction;
- Assessment;
- Mitigation.

The Institute's comments below are set out under those headings.

Policy, Legislation and Guidance

Some of the information given in the draft guidance document really has no bearing on the issues to be addressed in the Assessment of Environmental Effects (AEE) of such a development. Such information includes:

- The reference to the Environmental Noise Directive, and presumably the associated transposing regulations. When considering the development of a new spaceport – this legislation has no bearing; and
- The Environmental Protection Act 1990 (EPA1990). This legislation would only potentially apply once the spaceport has been built and should a noise source at the spaceport, which falls under the terms of the EPA1990, be thought to be causing a statutory nuisance. Furthermore, noise from aircraft in flight are excluded from the ambit of this legislation and spacecraft could fall under the definition of an aircraft.

The overarching policy for noise management in England is set out in the Noise Policy Statement for England (NPSE), which is mentioned on page 16 of the guidance.

In terms of setting environmental objectives for the management of noise on people, the aims of the NPSE should become the Environmental Objectives set by the Secretary of State. These aims apply to all noise sources.

Following this approach would not only provide consistent noise management, but are familiar concepts with practitioners. The aims are:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*

- *where possible, contribute to the improvement of health and quality of life.*

The National Planning Policy Framework would also apply to the new spaceport. It includes the policy that states

Planning policies and decisions should contribute to and enhance the natural and local environment by:....

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of ...noise pollution;

This policy would also apply, and, therefore, should also be part of the Environmental Objectives.

The Planning Practice Guidance on Noise includes a Noise Exposure Hierarchy Table which provides assistance for implementing these policies. That table can be found here:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/820957/noise_exposure_hierarchy.pdf

Using these three documents provide the Environmental Objectives for the Regulator and the associated guidance for meeting them when developing a new spaceport.

As noted on page 16 of the draft guidance document, similar approaches to the management of noise can be found in the devolved administrations. Where appropriate, therefore, the guidance needs to be refined to reflect any detailed policy differences in Wales, Scotland and Northern Ireland.

Prediction

During the planning phase of any space related development there will be a need to predict noise from the scheme. Despite the increase of rocket launches in the past years and the commercialisation of their operations, little work has been published assessing the community noise impacts from rocket operations. However, before the community noise impact can be assessed and, if necessary, mitigation considered, noise prediction and modelling studies are needed to help better understand the potential noise exposures of the surrounding communities from rocket launches at spaceports.

It would be helpful if these studies were required to produce outputs in formats that build on and can be integrated with existing aviation noise data, e.g., airport noise contours. This would particularly be the case if spaceports might be developed at existing airports or airfields as well as where new sites are proposed.

Spacecraft noise has characteristics that make it different in how the sound propagates compared with other noise sources e.g., the distance at which the sound waves transitions from relative low rates of decay to more rapid decline can be longer than for other sources. Consequently, many of the established methods for predicting noise propagation are not as accurate as they may be for other sources.

Some of the approved spaceports in the USA have followed empirically derived NASA noise prediction methods for evaluating the acoustics, vibration and blast environment when selecting the location of a potential spaceport. However, these methods are dated and do not take into account the new types of spacecraft designs and take off methods that are to be found. With recent technological advancements, the concept of horizontal launch vehicles is quickly becoming a new category of spacecraft. Although various noise prediction models have been developed and used for spaceports, there is no single unified approved method.

Consequently, the IOA suggests that the guidance also requires that the Scoping for any Environmental Statement (or equivalent where the EIA regulations may not apply), for a spaceport should include a comprehensive review of available models and methods for prediction of space travel related noise and a detailed explanation of the reasons for using a preferred chosen method.

Furthermore, the guidance should encourage sensitivity tests using, where available, alternative methods but based on the same inputs as used for the preferred method, so that the uncertainty of the prediction work can be understood.

The IOA agree with the draft documents' advice that relying solely on the $L_{eq,T}$ noise metric time averaged over long periods to predict and assess impacts is not the most appropriate method to use.

In addition, indicators including the following are also recommended:

- The maximum noise level in a noise event i.e., launch or recovery of an individual spacecraft e.g., L_{Amax}
- The overall noise energy in a noise event e.g., the SEL (the Single Event Level) and $L_{Aeq,T}$ (the total noise energy over the event period, T)
- The degree to which the noise event exceeds the typical prevailing sound levels at receptors.
- The frequency content of the noise event and the prominence of any dominant frequencies compared to the prevailing sound.
- The onset time of the noise i.e., how quickly the sound level goes from relatively low level to maximum and vice versa.
- Assessing the likely effects of the above acoustic impact data by contextualising it in terms of factors including the number, duration and timing of noise events per day, week, month and year.

CAP 1766 *Emerging Aircraft Technologies and their potential noise impacts* indicates that the CAA's Environmental Research and Consultancy Department (ERCD) has been playing a part in the work of the International Civil Aviation Organisation developing noise standards for supersonic aircraft, and the IOA suggest that ERCD could provide noise emission levels for the prediction of noise from spaceports in the UK.

Assessment

The draft guidance mentions the World Health Organisation (WHO) guidelines. Whilst the WHO guidelines provide a useful body of knowledge on the likely health effects of noise, the spaceport guidance should avoid implying the WHO guidelines can be used as set standards to be achieved. Any such standards or thresholds to be used should be set by national or local

authorities taking account of the local and national context in order to achieve the relevant policy requirements.

The consultation documents also refer to a WHO guideline for L_{Amax} levels to avoid hearing damage. The IOA believe it would be more consistent to refer to the Control of Noise at Work Regulations 2005 which quote a lower exposure action value of a peak sound pressure of 135 dB (C-weighted).

As mentioned earlier, the noise from spacecraft can be quite different from other sources. It is usually intermittent but can last for up to several minutes when it happens. It also can occur at extremely high source sound levels, meaning it can propagate over long distances and affect a wide area. It often contains a strong low frequency element, including Infrasound (see below), which leads to enhanced propagation, triggers different annoyance and sleep disturbance responses to noise without such features, and can have indirect effects such as causing resonant vibration in light weight structures and building elements. Consequently, reliance on the advice and recommendations of standards and guidance that are appropriate for sounds without such content, such as, BS 8233 and the WHO Guidelines, may not be appropriate.

Infrasound is noise energy at or below 20 Hz. At normally encountered environmental levels infrasound is not audible to most people. But spacecraft can produce very high levels of sound, including at infrasonic frequencies that may be so high they can become audible relatively near to the source. Whilst the risk of significant adverse effects from infrasound is small, it is worthwhile noting that it is a perennial issue which is often misunderstood and/or misused in regard to various forms of development, and that addressing the issue early in the development of policy may help avoid protracted and polarised debate and opposition, which might delay or distract from achieving policy aims.

The consultation document correctly notes that noise could impact both humans and wildlife, including domesticated animals and livestock. There is little UK specific guidance on assessing the effect of noise levels on animals, and it may be helpful for the regulator or another body (e.g., CAA or ICCAN) to suggest any internationally available material that might be used.

Finally, on page 17 there was an inconsistency in the metrics used. The IOA propose that the wording should say

To avoid and minimise the risk of structural damage, the maximum noise levels (LZ_{max}) should never exceed 110 dB.

The IOA recommend that the advice should include a statement that,

where possible the maximum noise level should be mitigated to less than 90 dB LZ_{maz} to minimise the risk of induced resonant vibration in lightweight structures and building elements e.g., windows.

It is also recommended that it is made clear that these values relate to a location outside the potentially affected properties.

Mitigation

The hierarchy of noise controls shown in Figure 1 is not recognised as a mitigation hierarchy for environmental noise management. Furthermore, it is arguably not correct in its details.

Instead, with regards to when the spacecraft are in the sky or about to take-off, the IOA suggests that the ICAO Balanced Approach should be mentioned, i.e.:

- noise at source;

- land use planning;
- operating procedures; and
- operating restrictions.

The consultation document notes that due to impacts on civil aircraft operations and for meteorological reasons, operators may prefer to launch at night. It is very well recognised, however, that the potential impact of noise at night on human health can be great.

Given that the draft guidance notes that noise from spaceflight activities is anticipated to be one of the biggest environmental concerns for both the impacts on human and wildlife receptors, the IOA would suggest that spaceports should be located sympathetically with civil aviation flight paths so that there is no need to operate at night.

There is a strong case for the Regulator to state that there should be no night operations as a specific operational restriction for planned spaceport operations.

Noise - Conclusion

The IOA are of the view that the aims and objectives of existing noise policy and guidance suitably account for spacecraft related noise. However, standards and guidance commonly used in the UK for other noise sources are only partly suitable for spaceport related noise.

Therefore, it is suggested that the government should commission a study to collate and review evidence on the effects of space travel related noise. This could then inform development of suitable guidelines and standards incorporating Government policy aims and objectives which seek to balance the negative effects of noise with the positive economic and social benefits of development.

The Noise Aspect of the Marine Environment

The consultation document asks two questions in relation to Noise. They are:

Q6 Is it clear from the guidance how the regulator should interpret the government's objective on the marine environment? and

Q7 Do you have any comments on the specific guidance provided to the regulator on the objective related to the marine environment? Please provide details.

The Institute's responses are:

Question 6	No
Question 7	Yes – please see below

Further Details

The draft guidance provided to the regulator on the marine environment is vague. It makes many suggestions for top level strategy, but does not consider actually what should be done or how to do it. Currently, the regulatory basis for protecting the noise environment in the oceans is ill-defined. This guidance has the opportunity of taking the lead in beginning to define good practice.

The potential noise impact of developing and running the infrastructure is reasonably well understood, based on other similar developments, but the impact of the space vehicles is novel and will obviously need investigating and mitigation strategies developed. In particular shock waves due to sonic booms and their likely depth penetration must be characterised. Previous measurements on Concorde should provide helpful examples.

Before assessing any noise impact, however, the current noise environment in affected areas must be established, both due to natural sources and due to anthropogenic noise. Also required would be an assessment of the species present in the area under consideration (including possibly human divers) and their sensitivity to noise disturbance.

Finally, the potential for debris falling from space vehicles and impacting marine life on or near the surface, oil rigs, and other offshore installations would require assessment.

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