Managing Emergency Response
for Space Launch Operations

Safety has to be a key consideration for space launch services, which is why historically, launch operations have always been conducted in locations well away from spectators and operational staff. However, in the UK, where a number of new spaceports are currently seeking regulatory approval, the issue of Emergency Response and fire safety, is now the focus of increased attention. In this article, Chris Thain reviews the regulatory framework and legislation for the basics of fire safety and Emergency Response, which apply as much to Space Ports as to airports and similar facilities. The effective provision and management of on-site Emergency Response plans and resources, fire safety, fire prevention and asset protection are among the core responsibilities of UK Spaceport Launch Site Operators (LSO).

The UK is currently investing significant time and money in the development of its onshore space launch industry, with new laws and regulations enacted to enable a variety of commercial organisations to enter into this exciting new market. A critical part of the licensing requirement for LSO's is the preparation and approval of the Safety Case.

Regulated and licensed by the UK Space Agency, through the Safety Case, LSO licensees must satisfy the regulator that they have conducted a thorough assessment of risks to the health and safety of prescribed persons taking part in spaceflight activities and to have taken all reasonable steps to mitigate risks from spaceflight activities to the health, safety and property of other persons to 'as low as reasonably practicable' (ALARP) - (section 10(a) of the Space Industries Act and regulation 36(5). Thus, being able to demonstrate that operations are conducted at an ALARP level acceptable to the regulator is crucial to obtaining a launch site licence.

While the current space industry regulatory framework does not prescribe what the Emergency Response capabilities for each launch site must comprise, from a health and safety perspective, any risk identified through the risk assessment process must be mitigated in a manner that is both appropriate and proportionate.
In addition, the residual risks, even if the operator has met the ALARP test, must also be acceptable to the regulator, or the license will not be granted.

Primary and Secondary Space Legislation

Under the UK Space Industry Regulations enacted on 29th July 2021 as part of the Space Industry Act 2018 (SIA), LSO in the UK are required as a condition of the terms of their license to have an approved Emergency Response plan in place. Further guidance on duties for all licensees under the Space Industry Act 2018 are contained in the UK CAA's document CAP 2212 and CAP 2214.

While safety is always the paramount consideration, under Section 11 of the SIA, LSO are equally required to consider the environmental impacts of the spaceflight activities in an Assessment of Environmental Effects (AEE).

In turn, this assessment informs the level and type of Emergency Response (including the firefighting media (foam, dry powder, water etc.) to be employed) that the LSO will need on-site to satisfy the requirements of the regulator. LSO must also be aware of the requirements of the Civil Contingencies Act 2004 and be prepared to work with the Emergency Services and other multi-agency responders. This includes risk assessment, planning, and exercising for emergency incidents.

Horizontal v. Vertical Launch Sites

While each LSO is required to prepare an Emergency Response Plan (Regulation 165), the UK Space Agency is currently not being prescriptive about the Emergency Response services that will need to be in place for spaceflight activities to be conducted safely. The Emergency Response Plan for each LSO application will differ depending upon the mode of spaceflight activity that the launch site expects to undertake.

For Horizontal Launch Site Operators (HLSO), whose rockets and their payloads are propelled into sub-orbital or low earth orbits from carrier aircraft, such operations normally occur from existing aerodromes or airports.

These sites, comprising one or more runways, hanger buildings, air traffic control centres etc. operate under the regulatory authority of the UK Civil Aviation Authority (CAA) and are subject to established international safety and operational regulations and procedures, including the provision of on-site Aircraft Rescue and Fire Fighting (ARFF) services based upon the Category of the aerodrome and the size of and type of aircraft that utilise the facility.

ARFF services operate under International Civil Aviation Organisation (ICAO) regulations and standards which, under the UK CAA comprise CAP168 – Licensing of Aerodromes and CAP699 – Standards for the competence of rescue and firefighting services. The new CAP 2212 and CAP 2214, introduced as part of the Space Industry Regulations 2021 contains additional guidance pertinent to all LSO's

For Vertical Launch Site Operators (VLSO) however, no internationally recognised Emergency Response standards currently exist, although CAP 2212 section 5 does provide general guidance on the scope and purpose of the safety case. The UK Space Agency is leading on the development of operational requirements for vertical.

launch sites and is working closely with the CAA, LSO and industry specialists to define the Emergency Response services that may be required for such sites.

VLSO may also need to consider the installation of fire detection and alarm systems and fixed deluge firefighting systems around the launch platform and fuel storage areas, along with appropriate resources, assets and equipment for their mobile Emergency Response and firefighting crews.

It is important for both HLSO and VLSO to recognise that as commercial spaceflight operators, they cannot rely upon local authority fire and rescue services to provide stand-by Emergency Response cover for their spaceflight activities. They will need to risk assess their own activities and provide and maintain appropriate Emergency Response cover to suit their own circumstances and locations.

An area that may require more detailed consideration by each LSO involves the unusual risks associated with different types of rocket propellant fuels and hazardous chemicals that may be used in space flight activities. The storage, transfer and fuelling of rockets with highly reactive or explosive fuels coupled with the potential release of highly toxic gases and poisonous products of combustion from these fuels in the event of a launch site fire will require specialist knowledge and training for emergency responders.

Other diverse risks specific to spaceport LSO include the potential numbers and proximity of any tourists that wish to witness the launch site activities and the potential for environmental harm from fire if the launch site is situated in or around peat moorland.

On-site Emergency Response Provision

Under the Space Industry Regulations 2021 (Pt 9, c.8 – 154.1), a spaceport licensee must ensure that rescue and firefighting personnel, facilities and equipment are provided at the spaceport in a timely manner.

The cost of maintaining and operating an on-site Rescue and Fire Fighting Service (RFFS) or for airports, an Aircraft Rescue and Fire Fighting (ARFF) service, in order to fully meet the compliance and operational license requirements for commercial spaceflight activities will need to be carefully considered by the LSO within its planning and budgeting process.

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Failure to fully comply with and maintain Emergency Response services to defined standards or agreed levels will prevent the LSO from gaining or keeping its license to operate and, in the event of an incident, potentially expose the LSO to serious financial liability and significant reputational risk. Insurers will of course demand that any identified risk is minimised and mitigated before they provide insurance cover for the site and its operations. Notwithstanding the availability of local or municipal resources to react in the event of an emergency or serious incident, the on-site RFFS, which will provide the vital 'First Response' to any incident, is generally a choice between two main options; an 'employed' service or an 'outsourced' service.

While some VLSO may elect to invest in their own Fire and Rescue Services, or for HLSO contract with the existing Airport ARFF service, which normally includes the provision of a dedicated Fire Station(s), skilled personnel, response vehicles and life-saving equipment, others will need to consider outsourced or sub-contracted service providers, to enable them to meet their operational needs in a more cost effective and compliant manner.

So, what are the factors that will influence the decision to outsource the Emergency Response function and how should LSO choose between these options?

Managing Risk and Maintaining Compliance

The requirement and resources for an on-site fire and rescue service will be determined chiefly by the type of activity that the LSO is involved in at each site or facility, the

assessment of the risks associated with the processes or activities that occur on-site and the impact that any emergency incident may have on the business, its employees and on the surrounding communities.

The decision to outsource may be driven by purely financial or economic motives as LSO seek to reduce costs and enhance their commercial competitiveness or by other strategic and tactical factors.

Ultimately, the motivation for investment in an on-site fire and rescue resource is like an insurance policy which is rooted in the avoidance of loss, which can be organisational, financial, reputational and/or personal in nature and in a need to ensure the on-going stability, security, and resilience of the launch facility.

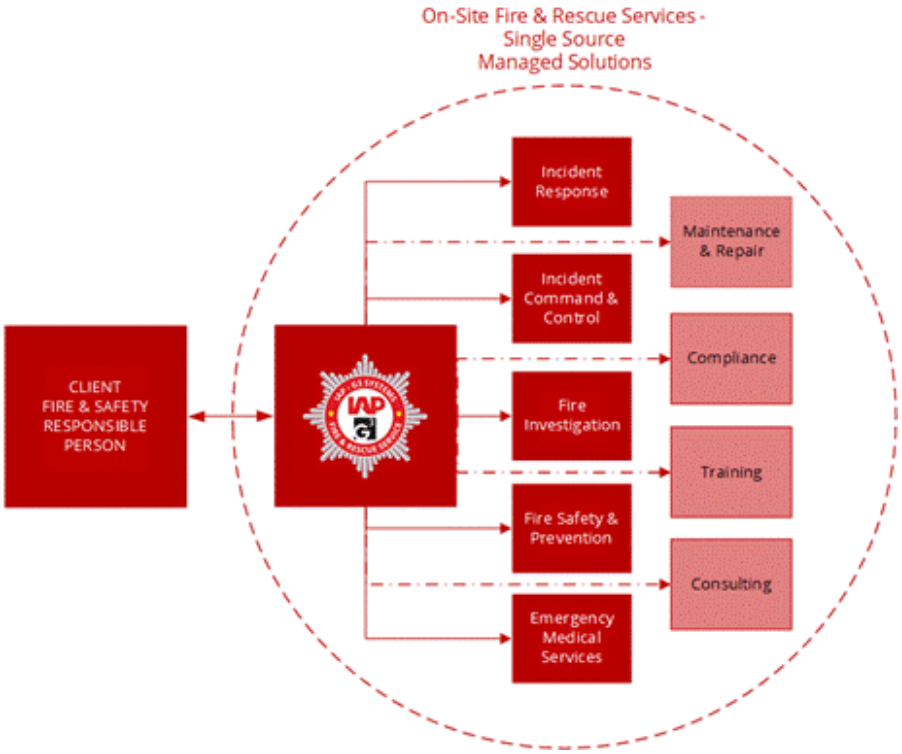
Regulatory compliance, business continuity reassurance and client 'peace of mind' are the benefits of such an investment, but as with any insurance policy, it is sincerely hoped that the Fire and Rescue Service will never need to be called upon in a real-life emergency situation.

not actually a core function of the organisation itself.

Fire crews must be skilled, qualified, and experienced and must train continually to maintain their competence. Skills fade is a very real and recognised phenomenon, and a lack of training is not something you wish to suddenly become aware of when responding to an emergency situation.

Outsourcing the firefighting and rescue service provision enables each LSO to focus on their core business while delegating essential but non-core elements to external specialist providers. This releases internal resources that can be put to more effective use for other purposes, leading to greater overall efficiency and competitiveness.

Certainly, during the initial stages of UK spaceport development, relatively infrequent space launches mean that the cost of an emergency service provision may seem quite high. This cost will of course be amortised as the increasing frequency of launches makes the overall provision more cost effective.



Recruiting, training, resourcing, and supporting an employed on-site fire and rescue service can be a relatively expensive operational cost for the LSO.

The day-to-day management of an employed Fire, Rescue and Safety service can sap the LSO managers of time and energy that, while imperative to the safe, legal and ultimately the profitable operation of the facility, is

One way to offset the early costs of the Emergency Response service is for LSO's to collaborate to share these costs. Collaborative working is a hallmark of the UK space industry and given that UK space launches will need to be deconflicted from a timing and location perspective, there is little reason why two or more LSO's could not contract to share an Emergency Response provision, thus saving money and mitigating their insurance liability

while also maintaining their regulatory compliance.

The question to be asked is, could an outsourced service provider deliver the required functions, tasks, and regulatory responsibilities, maintain and improve launch site safety, respond effectively to any emergency incident and add value to the organisation, at a more cost-effective rate than directly employing and maintaining an on-site team?

When properly executed, outsourcing the on-site Fire and Rescue Service can have a defining impact on the company's revenue recognition and can deliver improved business continuity and resilience as well as significant savings through lower operational and labour costs.

Specialist Knowledge, Skills, and Expertise

Realistically, launch site licensees cannot be experts in every business function, process, or discipline; it is simply uneconomic to cover all of the required specialist and technical roles in-house. By utilising an outsourced service provider for its Emergency Response requirements, the LSO can leverage a global knowledge base and resource, accessing world class capabilities, expertise, technical skills, and experience, at an economic level.

Managed FRS service providers often have access to a wider, more highly skilled, and diverse talent pool than the client themselves and will already have in place the requisite interview and selection processes designed to select only the strongest, most appropriately qualified and experienced staff.

Training and competence management will reflect global best practice, with space industry and launch site-specific risks recognised, evaluated, and reflected in the ongoing training provided to the FRS staff members.

Shared experiences coupled with specialist skills, learning and best working practices also enable the outsourced service provider to add value and resilience to and further reduce risk within the client's operation.

Shared Responsibilities and Liabilities

Although the LSO must retain its duty of care to operate in a safe and environmentally responsible manner, delegating Fire and Rescue Service responsibilities to external providers can release companies of day-to-day management functions that are difficult to administer and control, while still realizing the inherent benefit the FRS provides and crucially maintaining operational compliance and certification.

As specialists in their field, outsourced FRS service providers generally are much better at deciding how to cost effectively avoid risk in their areas of expertise without compromising safety and response than perhaps a fully employed on-site team might be. This is because their incentive to deliver a high level of service and to maintain their professional reputation and credibility while remaining profitable is potentially stronger for the outsourced provider. If, unfortunately, something does go wrong, a further consideration may be that the responsibility and possible consequential contractual liability could well be shared in whole or in part with the Service Provider, rather than being wholly carried by the contracting client themselves.

Making the Right Choice

The decision to resource the Fire and Rescue Service for a Space Port launch site cannot be made lightly. A thorough and detailed examination of the associated risks, costs and benefits must be investigated during preparation for the licensing process and as part of the site's comprehensive safety case construction.

partner organisation is essential. Taking account of both the hard and soft response and delivery factors for each individual launch site is critically important.

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G3 Systems Ltd. is a wholly owned subsidiary of IAP Worldwide Services Inc. – a global provider of services to government and commercial customers.

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