

Vertical Flight Society

2020 eVTOL Infrastructure Workshop Series

Workshop #1 / Fire, Building & Electrical Code for Vertiports

Date: April 15, 2020

Question & Answer Session

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QUESTION

On the fire separation standards, is that for typical building materials only, or does it contemplate the much higher temperatures that eVTOL batteries burn at?

ANSWER

Dave – the legacy building materials tests for fire resistance ratings have never contemplated the time and intensity of heat / energy release in battery systems. The current 'source' for battery storage and energy storage is NFPA 855. That standard would likely be the building block for the actual battery storage and protection rules.

QUESTION

While "Vertiport" and "Vertistop" are not included in the IBC or IFC (International Building & Fire Code), the terms "Heliport" and "Helistop" are used. Is there a difference?

ANSWER

Dave – The emergence of EVTOL aircraft will likely usher in the terms Vertiport or Vertistop to differentiate these locations from the traditional liquid fuel Helistop / Heliport. The first step in this concept would be establishing a standard definition of both V-port & V-stop that will become the framework in the codes and regulations for identifying and differentiating these facilities.

QUESTION

So Vertiports would not be used for Helicopters? I assume the requirements to do a security and passenger screening still apply with a secure area? Also how do you handle luggage if eVTOL pax are connecting to airport?

ANSWER

Teresa – we would have to understand the design parameters of the existing heliport and the design eVTOL. With over 260 potential eVTOL designs in consideration, it is reasonable to consider that the weights and geometries of the design basis eVTOL would differ from the design basis helicopter.

Rex – Whether or not a heliport can be used as a vertiport or a vertiport can be used as a heliport has yet to be determined. Overall, it will depend on two things: A) Will the airspace be equivalent based on aircraft performance and B) Will the differences in fire code between the two be great enough to preclude interchangeability. Security will need to be accounted for but whether it will be equivalent to current part 121 air-carrier standards with TSA and airside restrictions has yet to be determined. Luggage will also

need to be considered but there will no doubt be significant size and weight restrictions.

QUESTION

How long is a fire code cycle?

ANSWER

Dave - Generally 3-5 years depending on the code or standard involved. The revision cycle however does not guarantee that a state or jurisdiction will adopt that edition anytime in the future. It is not an automatic process of new codes being adopted. There are review and revision periods by the jurisdiction which can extend the process. There is no surprise in the fact that the United States currently has jurisdictions which are still enforcing a 2000-2006 editions of the model codes. Many states and large metro cities work to keep on a review and adoption cycle that keeps things current, but it often lags 1-2 cycles behind the current published edition.

QUESTION

How should the aerospace industry be interacting with these regulatory bodies to start socializing these new technologies and update the regulatory language? How long would you foresee these processes taking?

ANSWER

NREL – We have been seeing significant collaboration through trade organizations, government agencies and related efforts on a worldwide and Federal level to understand this emerging market and help everyone be prepared. As the vehicles move from more regulated ground environments (airports) to less traditional locations, code development organizations become key contributors to assisting state and local agencies with guidance.

Rex – The Vertical Flight Society, in collaboration with numerous government and industry stake holders, is pushing these very conversations through conferences and workshops such as this as often as possible. As to a timeline, keep in mind that when the FAA conducts an Advisory and Rulemaking Committee (ARC) it generally can take up to 6 years to complete the rule making process and when they write an advisory circular such as the Heliport Design Guide it is upwards of 3 years.

QUESTION

How long does it typically take to publish fire codes for new technologies?

ANSWER

Dave – Model fire codes generally run on 3-5year revision cycles. That simply means that the authoring agency publishes on that interval. Whether or not a new technology 'gets in' the code is a function of the revision process when proposals are made and vetted by the various code development committees. There is no guarantee that any proposal ends up making its way into the final published code edition.

QUESTION

Will the fire protection rules for eVTOLs be easier/cheaper to fulfill compared to the requirements to a Heliport?

ANSWER

Dave – Once the code requirements are understood the cost model can be more accurately answered.

QUESTION

If an owner were to build a rooftop Vertistop designed for only EV use, what would prohibit a fueled air ship to land on that pad?

ANSWER

Dave – Speaking from the fire code perspective the design of the facility determines its permitted use. As if you designed it as an office building you couldn't start manufacturing explosives in it without first complying with the applicable codes to address the hazards. This is a regulatory issue between the codes and I also think in the overall facility approval from FAA or another agency. This concept is occurring regularly when an existing auto service station designed for liquid fueled cars starts taking in and working on alternative fueled vehicles. This change in fuel profile alters the risk and hazard so it would have to come into compliance with the applicable codes. Emergency landing during in-flight emergency is always an exception... any landing pad in a storm.

Rex – A yet to be determined argument as to how vertiports will be classified, e.g. public, private or commercial will impact this. If the site is classified as private prior permission required (PPR) then anyone landing at that facility must first have permission from the owner. That is not to say that it still could not happen.

QUESTION

Some UAM vehicles could be hybrid, would this require both liquid fuel code and electrical yet to be written code.

ANSWER

Dave – The actual fuels present in the aircraft and at the facility would dictate which codes apply. Any installation would have to address the hazards which would normally be present. There is no resolution at this time for ‘what if’ someone lands a liquid fuel aircraft at an EVTOL facility. Aside from in-flight emergencies the introduction of a different fuel / different hazard would need to comply with the applicable codes.

QUESTION

What amp/volt power supply will be required for recharging eVTOL aircraft? What will be required to refit an existing building to comply with code?

ANSWER

NREL – Q1: The size of battery and desired charge rate for that battery determines how much energy must be delivered for the vehicle. The General Aviation Manufacturer’s Association (GAMA) is attempting to work with various industry partners, to standardize plug design, charging rates, and other elements relevant to various sizes of vehicles. The vehicle manufacturers choose much of the architecture and are somewhat following the automotive and heavy vehicle industry pathway towards standardization.

Teresa – Retrofits of an existing space may require building a room to house the LiOn batteries. It would probably be classified as a hazardous space and be required adhere to separation of space rules. That could require tearing up the floors, walls, and ceiling to install vertical and horizontal fire rated assemblies.

QUESTION

So, are you saying that the code official will most likely want to comply with both liquid-fueled hazards in addition to EV hazards?

ANSWER

Dave – At present the code official is working with codes that only regulate liquid fuels and hazards. With eVTOL facilities the hazards are different and will need their regulations developed into the code. Theoretically, any facility would only have to comply with the regulations for the hazards presents. If an exclusive eVTOL facility, then there is no application for liquid hazards protection. Only if the facility accommodated both liquid and electric aircraft would both sets of code requirements have to be applied. Think of it like motor vehicle fuel dispensing: we have codes which cover liquid fuels, hydrogen, CNG/LNG, and LPG fuels. Any given fuel dispensing location only complies with the fuels it intends to dispense. This concept would also apply to eVTOL facilities.

QUESTION

With existing regulations available for liquid fueled VTOL vehicles, will an electric VTOL vehicle (including rooftop charging needs) be notably safer? Will there be a learning curve associated with eVTOL-based regulations in which we see a decrease in safety, initially?

ANSWER

Dave – Actual fire testing and modeling of risk & hazards will help us answer the questions about what is necessary for the 'safe' ways and means to implement the VTOL concept.

Rex – In looking forward to the electrification of the aviation industry we can look back to the automotive industry for guidance. The National Fire Protection Association (NFPA), in collaboration with manufactures, has conducted significant testing to create the [Alternative Fuel Vehicles Safety Training for Emergency Responders](#). You can expect to see that same type of testing done for the aviation industry to help reduce the learning curve.

QUESTION

In our case our vehicles are eVTOL (electric hydrogen). In this can we assume that hydrogen refueling, and safety codes and provisioning will need to be addressed.

ANSWER

Dave – Within the NFPA standards structure all things hydrogen are regulated by NFPA 2. It would fall within the scope of NFPA 2 and their assembled experts to incorporate the hydrogen related elements of an eVTOL operation. The fire and building codes would still apply within their scope of the operation.

QUESTION

Is hydrogen refueling being investigated?

ANSWER

NREL under Department of Energy and partner funding has an active Hydrogen research program that includes production, storage and delivery in what is believed to be a one of a kind energy laboratory, the [Energy Systems Integration Facility \(ESIF\)](#) and our larger scale Flatirons Campus. The labs are national resources and available for industry partnership to advance technology. We are aware of other vehicle programs that are performing their own independent efforts in this area and there is research regarding

storing energy via hydrogen production when excess utility capacity is available.

QUESTION

Is there anything be done to support ehVTOL's? (eh - electric hydrogen).

ANSWER

NREL – It is assumed that manufacturers will continue to wish to advance this concept, working to reduce weight, cost, and increase energy density of systems. Generation, storage and delivery of hydrogen efficiently are areas that continue to need research to meet current industry needs.

QUESTION

What are your thoughts on Gravity Storage (Energy Vault - Tower of Power) and alignment of eVTOL infrastructure?

ANSWER

NREL – Two factors related to energy storage to consider in this type of decision are the means to create and capture energy, and the speed of transfer desired. Gravity storage could include crane and block systems, pumped hydro, etc. These are very stable storage methods, meaning once the energy is stored, it does not degrade. The space required could be significant depending on design. The speed of transfer should be evaluated as I am not aware of large volume transfer potential of these systems, however it may exist.

QUESTION

Are you working to this conceptual initiatives from personal/company level or are you part of an industries (eVTOL OEM, policy maker, architects) and policy maker partnership? It is not clear to me how you are financing all of these; do you have specific R&I funds devoted to these studies? I am sure this will become the reality in a decade or so, but how are you getting resources right now to keep it going in the meantime?

ANSWER

NREL – The US DOE National laboratory systems are primarily government owned non-profit contractor operated facilities intended to help US industries bridge the research gap that exists between concept development and industry adoption. Current work in this area has been funded by various Federal agencies, and industry partners that wish to utilize the unique capabilities of the labs to advance the industry. Foundational research is primarily funded by the Department of Energy for public use. We have heard that

private industry is investing heavily in this space to advance their concepts.

QUESTION

How do you get a budget for these studies in your companies?

ANSWER

NREL – The US DOE National laboratory systems are primarily government owned, non-profit contractor operated facilities intended to help US industries bridge the research gap that exists between concept development and industry adoption. The unique capabilities of our people and facilities are available through Federal grants, direct partnership and other agreements. Novel concepts and gaps in research are identified with partner organizations, and efforts are then considered for funding through various programs, public and private.

QUESTION

Is it anticipated that ALL Vertistop facilities will have recharging capabilities? Or will they be similar to helistops vs heliports where fueling only occurs at certain facilities?

ANSWER

Rex – In considering the difference between the terms ‘Heliport’ and ‘Helistop’ as it would potentially relate to ‘Vertiport’ and ‘Vertistop’ there are two schools of thought. The first being federal and the second being municipal. In regard to federal oversight, the FAA does not distinguish between a heliport and a helistop as far as the standards being used, they are identical. The federal documentation, i.e. the Airport Master Record only refers to heliports. The term helistop does not appear on the FAA Form 5010. At the municipality level however, they delineate the difference in the following way. A heliport will have refueling capability, will have a hangar for storage of the aircraft and maintenance will be conducted on site. A helistop will have none of these. This then dictates what code criteria will then apply which is of course interpreted by the municipalities Authority Having Jurisdiction (AHJ).

QUESTION

Within the urban areas in my realm of influence, I’ve talked to our power provider. When we get to MW needs, there are fewer optimal areas able to provide such power without significant upgrades to underground infrastructure. Is there a planning template for energy demands associated with varying sizes of vertiports?

ANSWER

NREL – MW level evaluation is currently occurring on the Heavy Truck industry and NREL is actively pursuing partnerships on this for aviation. The Department of Energy has significant resources related to ground vehicle adoption at: <https://www.energy.gov/eere/vehicles/reports-and-publications> to inform potential pathways. NREL experience has shown that one method of potentially reducing infrastructure costs for advanced energy loads on legacy systems is to move generation and storage closer to the use area, and/or shift demand to off peak times. NASA in 2018 funded a study that looked at energy delivery concerns and indicated cost for distribution and transmission level upgrades could be significant depending on the site.

QUESTION

When basing a Vertistop or Vertiport off of existing FAA ACs, or the rescinded FAA AC, is there a document in existence to help understand risks associated with reducing TLOF, FATO, and other dimensions? This would help inform a privately developed and funded facility

ANSWER

Rex – The heliport design guide is based on several research documents that were published in the 80's and 90's that were designed to identify and mitigate known risks associated with heliport design and development. These include but are not limited to the following documents:

- [DOT/FAA/DS-88/12](#) Minimum Required Heliport Airspace Under Visual Flight Rules
- [DOT/FAA/RD-90/4](#) Heliport VFR Airspace Design Based on Helicopter Performance
- [DOT/FAA/RD-90/9](#) Analysis of Helicopter Accident Risk Exposure Near Heliports, Airports and Unimproved Sites
- [DOT/FAA/RD-91/1](#) Composite Profiles of Helicopter Mishaps at Heliports and Airports
- [DOT/FAA/RD-93/17](#) Safe Heliports Through Design and Planning
- [DOT/FAA/RD-94/41](#) VFR Heliport Obstacle – Rich Environments: Test and Evaluation

QUESTION

At what point will a dedicated Fire & Rescue (ARFF) service become a requirement for a Vertiport as per ICAO Doc 9137 Regulations?

ANSWER

Rex – Yet to be determined.

QUESTION

If you want to build a Vertistop today, could it be done by building a helistop under the current codes and then use it for EV? The codes already have requirements for helistops and for battery charging systems. The only new issue is the battery in the EV itself.

ANSWER

Dave – A lot of the answer to that question will rely on the local officials who you will be approaching and asking them how they would view your approach since we understand that the current fire code requirements would be prescribing protective methods which would be of little to no use or effectiveness to an EVTOL aircraft. It's an unconventional approach to bring an emerging technology into current codes and your success should not be construed as actual fire protection or safety.

Rex – Most municipalities utilize a "Conditional Use Permit" process for things such as heliports. Within these permitting processes there are generally stipulations as to what type of aircraft and what type of operations are permitted. Anything different than what is permitted would then fall into a variance or acceptance, which are generally accomplished on a case by case basis and can be a very big hurdle to overcome. This is why the Vertical Flight Society is working so hard to help facilitate the development of eVTOL infrastructure regulations and code sooner rather than later.

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- **Address Additional Questions To:** infrastructure@vtol.org
 - **Or Visit:** www.vtol.org/infrastructure