



45th SPACE WING

Launch Forecast FAQs

PROBABILITY OF VIOLATION (POV)

WHAT IS THE POV, AND WHAT DOES IT INCLUDE?

- The POV represents the probability that a Lightning Launch Commit Criteria (LLCC) or a user constraint will be violated **during the launch window**.
- 45th Weather Squadron Launch Weather Officers (LWOs) use a combination of meteorological and climatological data, weather models, local knowledge, and experience to forecast this probability.
- LWOs evaluate and report violations of these weather constraints during the countdown.
- Typical user constraints included in the POV are **surface winds, precipitation, and temperature**.

WHAT DOES THE POV **NOT** INCLUDE?

- **The POV includes most, but not all user constraints.**
- Some user constraints are highly variable and/or dependent on the exact mission characteristics. For these, the 45th Weather Squadron may report constraint violations or provide data to the launch provider, but it is the launch provider who makes the launch decision.
- Examples of typical user constraints not included in the POV are **upper level wind shear, solar activity, and recovery conditions (launch provider dependent)**.
- **The user constraints that are not included in the POV are noted on each Launch Mission Execution Forecast.**

POV Includes







- The LLCC (10 Rules)
- Mission specific user constraints, which may include:
 - » Surface winds
 - » Temperature
 - » Flight through precipitation

POV Does Not Include

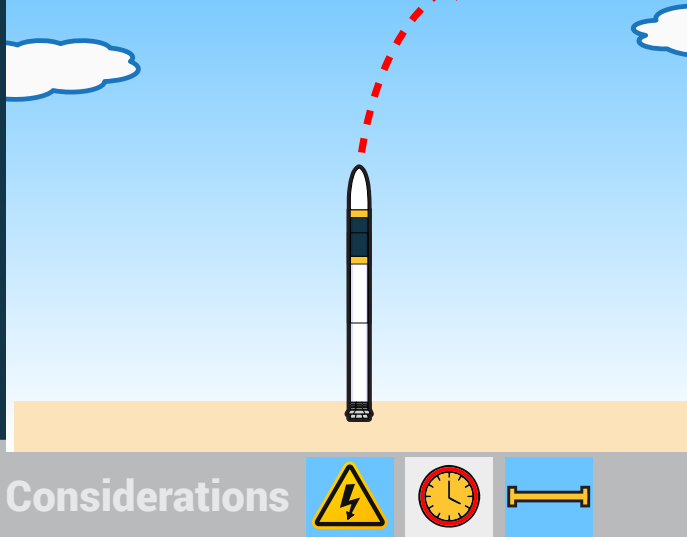
- Mission specific user constraints, which may include:
 - » Upper level wind shear
 - » Solar activity
 - » Recovery conditions

WHAT IS THE DIFFERENCE BETWEEN LIGHTNING LAUNCH COMMIT CRITERIA (LLCC) AND USER CONSTRAINTS?

- The **LLCC** consist of 10 rules that are **designed to avoid natural and rocket-triggered lightning strikes to in-flight rockets** (see pictures below). These are evaluated for **every launch**, regardless of the type of rocket or mission. A detailed description of the LLCC can be found at <https://standards.nasa.gov/standard/nasa/nasa-std-4010>.
- Launch Weather Officers must be **clear and convinced** that none of these criteria are violated in order to give the weather GO call for launch.
- **User constraints** are other weather criteria not defined in the LLCC, and are **different for each type of rocket**. They are established by the different launch providers.

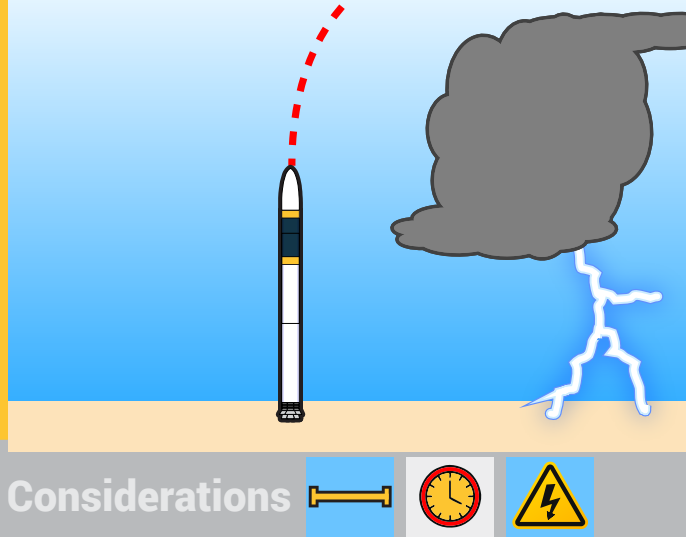
| | | | |
|--------|--|---|---|
| Legend |  Surface Electric Field |  Time |  Distance |
| |  Cloud Temperature |  Precipitation Intensity |  Rocket Velocity |

Surface Electric Fields Rule



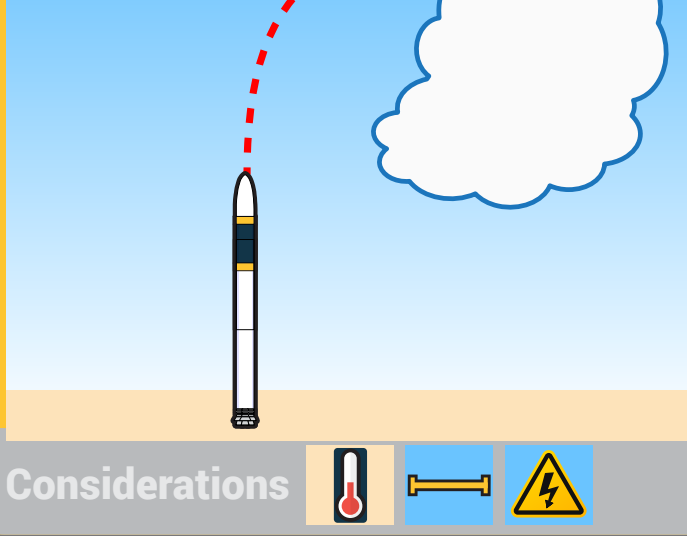
Considerations   

Lightning Rule



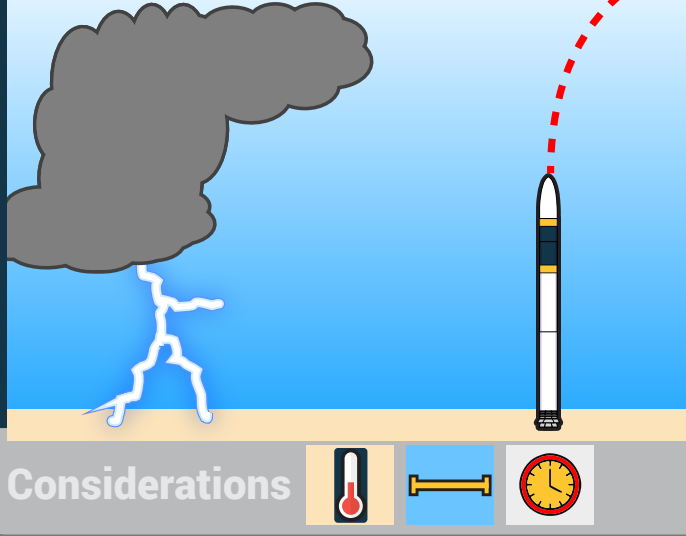
Considerations   

Cumulus Cloud Rule



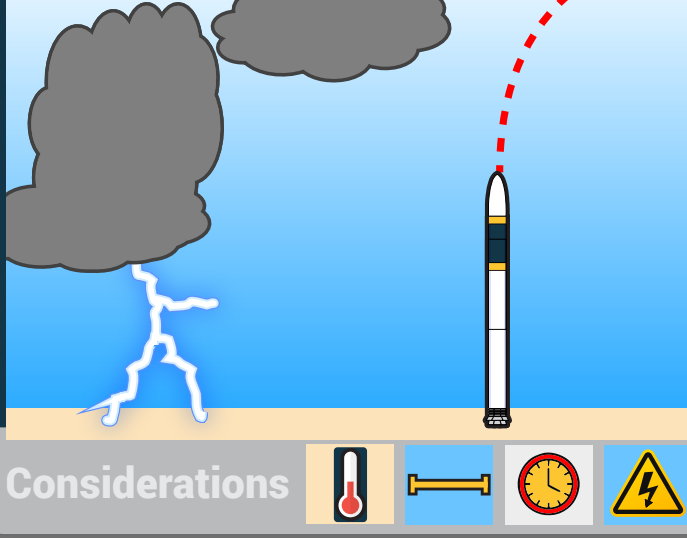
Considerations   

Attached Anvil Cloud Rule



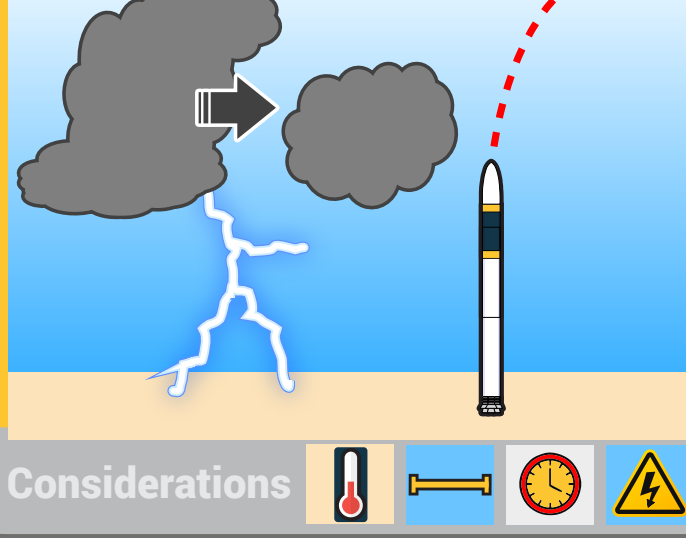
Considerations   

Detached Anvil Cloud Rule



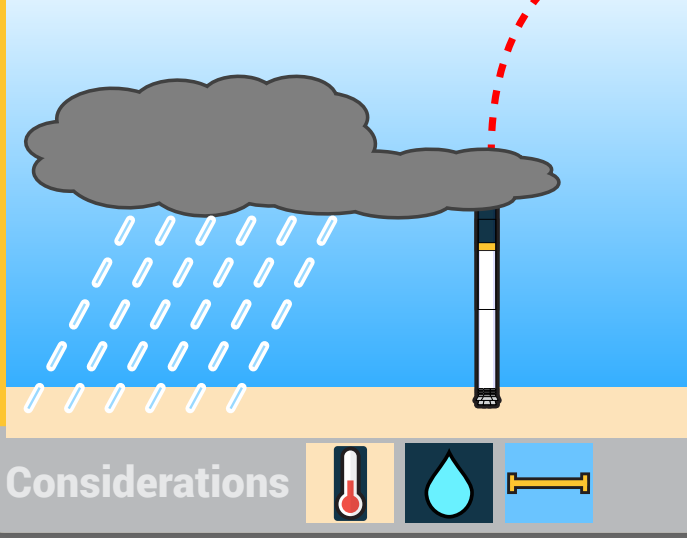
Considerations    

Debris Cloud Rule



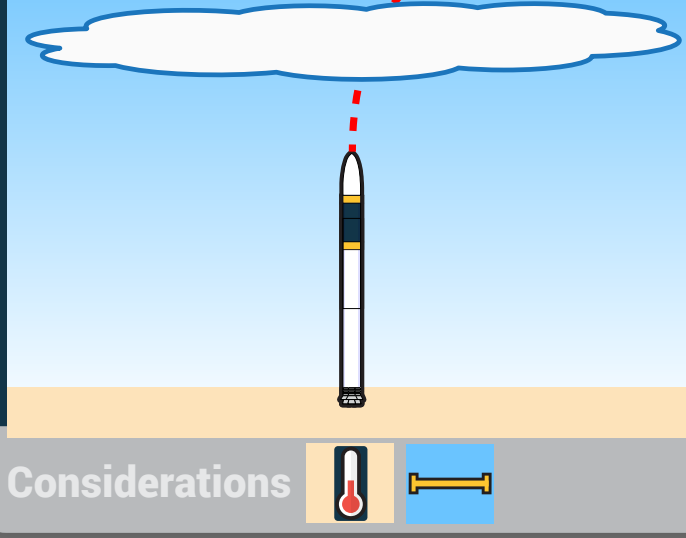
Considerations    

Disturbed Weather Rule



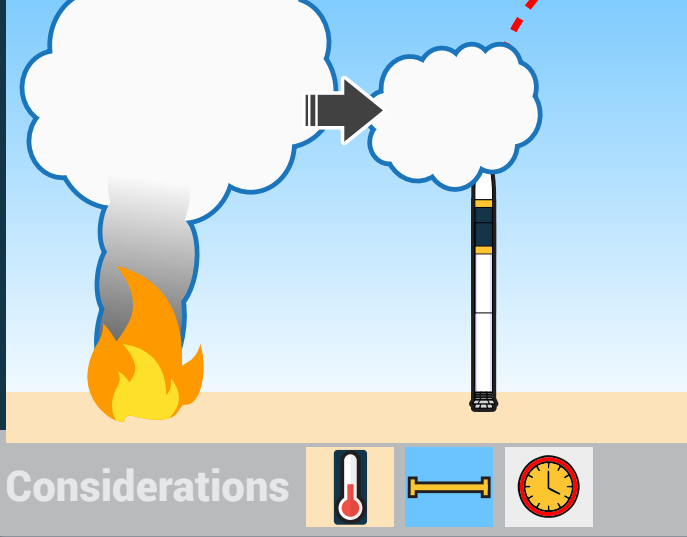
Considerations   

Thick Cloud Rule



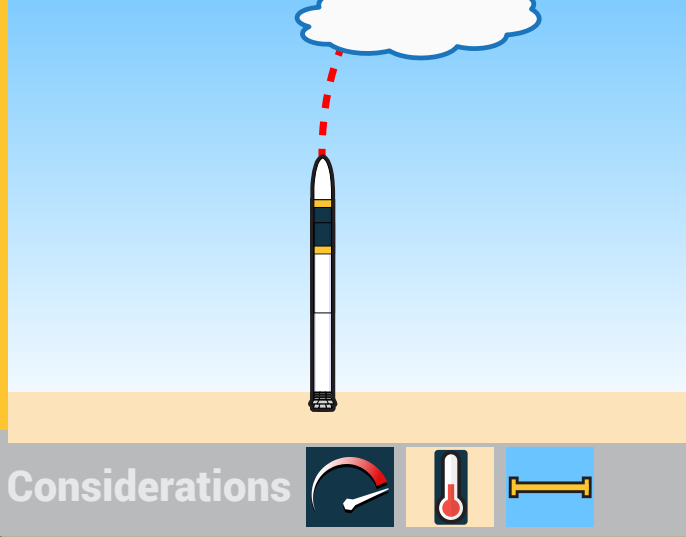
Considerations  

Smoke Plume Rule



Considerations   

Triboelectrification Rule

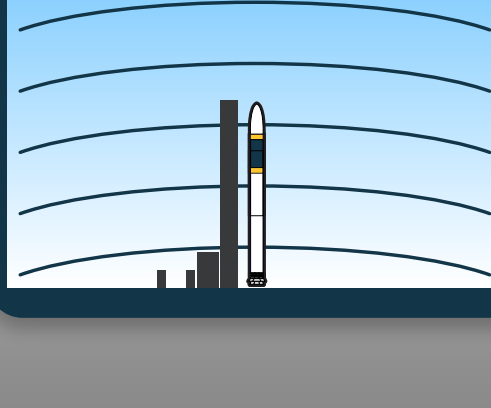


Considerations   

WHAT IS THE DIFFERENCE BETWEEN NATURAL LIGHTNING AND ROCKET-TRIGGERED LIGHTNING?

- If you live in Florida, you are probably familiar with **natural lightning**. Natural lightning is a giant spark of electricity that is caused from the build up of opposite charged particles in towering thunderstorm clouds.
- **Rocket-triggered lightning** is also a giant spark of electricity, but does not form naturally in our atmosphere. It only occurs when a large rocket flies through a strong enough atmospheric electric field.
- The electric field needed to induce rocket-triggered lightning is much lower than for natural lightning. **A cloud that is not producing natural lightning could still cause rocket-triggered lightning.**
- Either type of lightning could cause serious damage to the rocket and endanger public safety.

Undisturbed Field



Disturbed State



Triggered State

