

2011-2012

# PSU USLI Safety Plan Presentation

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# Lab Safety

- If you aren't sure which tool to use or how to use it ask someone!
- A clean, organized lab is a safer environment.
- Secure loose clothing or jewelry before working.
- Do not work in the lab under the influence of drugs or alcohol.
- Always use necessary safety equipment.

# Learning Factory Safety

- First certification class will cover safety
- Learning Factory certification is a good thing
  - Particularly for Structures
- Always follow Learning Factory Safety Policy
  - Long pants, close-toed shoes, eye protection
- When in doubt ask a Learning Factory TA



# NAR HPR Safety Code\*

- Certification
- Materials
- Motors
- Ignition System
- Misfires
- Launch Safety
- Launcher
- Size
- Flight Safety
- Launch Site
- Launcher Location
- Recovery System
- Recovery Safety



\*The full NAR HPR Safety Code is located at the end of this presentation.

# Other Legal Entities

- The NAR (or TRA) governs rocketry as a whole, but specifically motor acquisition.
- The FAA governs airspace and high power launches need an FAA waiver or notice.
- NFPA Code 1127
- State and Local Laws
  - Launch site land owner

# Launch Safety

- The Range Safety Officer (RSO) has complete control over all rockets and whether they are launched
- Always obey instructions from launch officials.
- Be alert and aware of other flying rockets even as you are working.
- At our own launches, we will appoint launch officials (RSO, LCO, etc.)

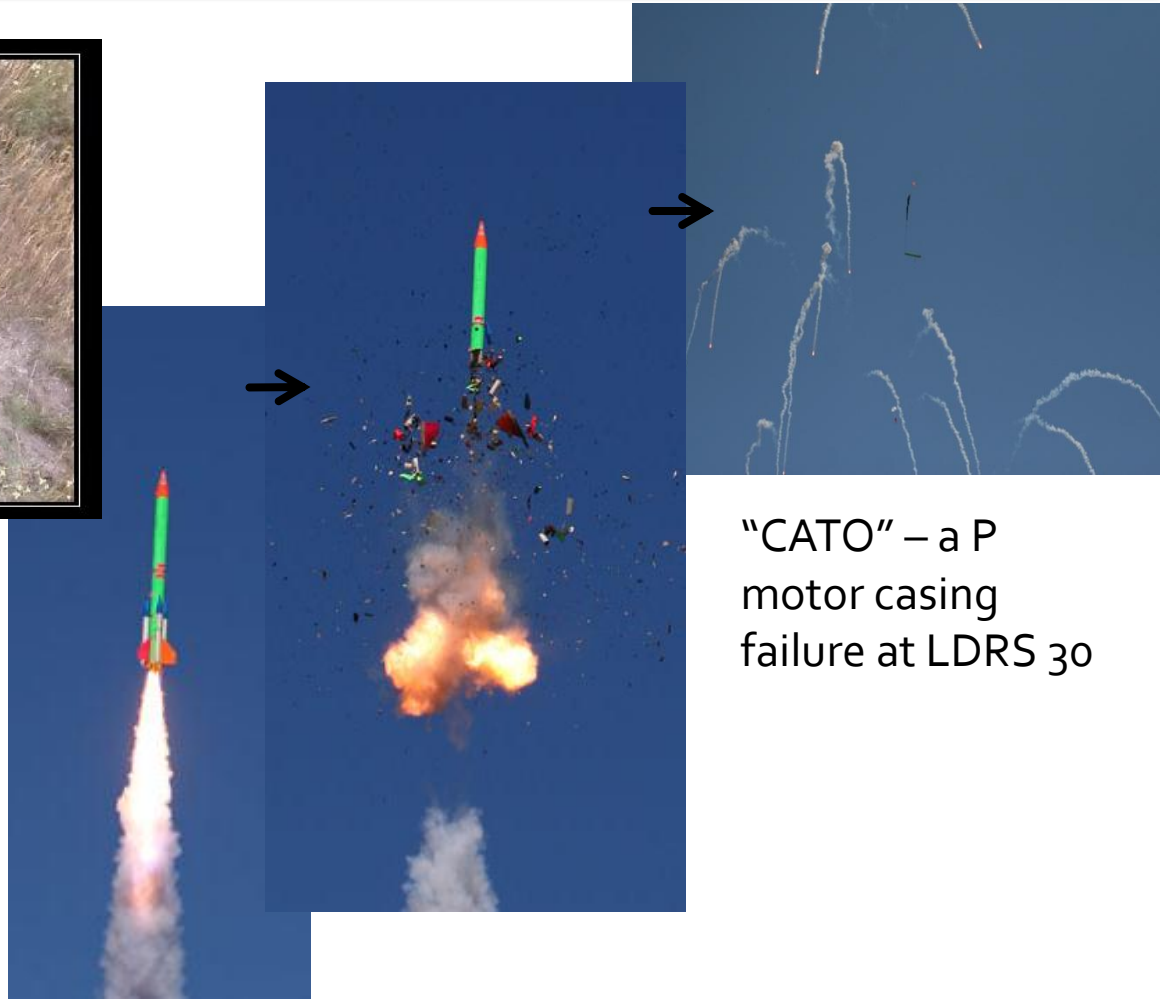
# The Importance of Launch Safety



"Core Sample"



Flight of an unstable rocket



"CATO" – a P motor casing failure at LDRS 30



# A sense of scale:

Powered by (1) P motor  
(which CATO'ed) and (4)  
L motors

Our ~40# 6" diameter 11'  
tall USLI rocket was  
powered by (1) L motor

The P motor class has up  
to 16x the impulse of an L



# Hazards

- Hazards are identifiable dangers that must be mitigated.
- Common hazards for USLI will be tool use, epoxy, solder, black powder, ammonium perchlorate composite propellant (APCP).
- New hazards will arise as the project design matures.

# Mitigation-Dealing with Hazards

Just some of the potential hazards and appropriate mitigations

| Material        | Hazard              | Mitigation  |
|-----------------|---------------------|---|
| APCP            | Accidental Ignition | Proper storage, Certified members handle material |
| Epoxy           | Skin Irritation     | Wear gloves                                       |
| Solder          | Inhalation, Burns   | Functioning equipment, Dedicated solder station   |
| Fiberglass Dust | Inhalation          | Use mask while sanding/cutting fiberglass         |
| Black Powder    | Accidental Ignition | Proper storage, handle in small quantities        |

# Sleep

- Continuously working and becoming sleep deprived should be avoided.
- Lack of sleep will prevent you from functioning safely and with the attention that is needed at a launch.
- Drivers should be fully rested and/or should rotate driving with others.
- One passenger should remain awake to assist the driver.

# Risks and Failure

- Many risks can be prevented or reduced but there is always a chance for failure to occur.
- Our methods and designs must account for possible failure and prevent or lessen its ability to do harm.
- For example, standing the necessary distance away from the rocket at launch so a CATO will not hurt anyone.

# Conclusions

- Rocketry has a very good record of safety, this is because rocketeers take safety seriously.
- However rocketry suffers from an image of danger, so to prove our safety we must demonstrate that we follow sound safety rules.
- Use common sense.

# NAR HPR Safety Code (1/3)

- **Certification.** I will only fly high power rockets or possess high power rocket motors that are within the scope of my user certification and required licensing.
- **Materials.** I will use only lightweight materials such as paper, wood, rubber, plastic, fiberglass, or when necessary ductile metal, for the construction of my rocket.
- **Motors.** I will use only certified, commercially made rocket motors, and will not tamper with these motors or use them for any purposes except those recommended by the manufacturer. I will not allow smoking, open flames, nor heat sources within 25 feet of these motors.
- **Ignition System.** I will launch my rockets with an electrical launch system, and with electrical motor igniters that are installed in the motor only after my rocket is at the launch pad or in a designated prepping area. My launch system will have a safety interlock that is in series with the launch switch that is not installed until my rocket is ready for launch, and will use a launch switch that returns to the "off" position when released. If my rocket has onboard ignition systems for motors or recovery devices, these will have safety interlocks that interrupt the current path until the rocket is at the launch pad.
- **Misfires.** If my rocket does not launch when I press the button of my electrical launch system, I will remove the launcher's safety interlock or disconnect its battery, and will wait 60 seconds after the last launch attempt before allowing anyone to approach the rocket.
- **Launch Safety.** I will use a 5-second countdown before launch. I will ensure that no person is closer to the launch pad than allowed by the accompanying Minimum Distance Table, and that a means is available to warn participants and spectators in the event of a problem. I will check the stability of my rocket before flight and will not fly it if it cannot be determined to be stable.
- **Launcher.** I will launch my rocket from a stable device that provides rigid guidance until the rocket has attained a speed that ensures a stable flight, and that is pointed to within 20 degrees of vertical. If the wind speed exceeds 5 miles per hour I will use a launcher length that permits the rocket to attain a safe velocity before separation from the launcher. I will use a blast deflector to prevent the motor's exhaust from hitting the ground. I will ensure that dry grass is cleared around each launch pad in accordance with the accompanying Minimum Distance table, and will increase this distance by a factor of 1.5 if the rocket motor being launched uses titanium sponge in the propellant.

# NAR HPR Safety Code (2/3)

- **Size.** My rocket will not contain any combination of motors that total more than 40,960 N-sec (9208 pound-seconds) of total impulse. My rocket will not weigh more at liftoff than one-third of the certified average thrust of the high power rocket motor(s) intended to be ignited at launch.
- **Flight Safety.** I will not launch my rocket at targets, into clouds, near airplanes, nor on trajectories that take it directly over the heads of spectators or beyond the boundaries of the launch site, and will not put any flammable or explosive payload in my rocket. I will not launch my rockets if wind speeds exceed 20 miles per hour. I will comply with Federal Aviation Administration airspace regulations when flying, and will ensure that my rocket will not exceed any applicable altitude limit in effect at that launch site.
- **Launch Site.** I will launch my rocket outdoors, in an open area where trees, power lines, buildings, and persons not involved in the launch do not present a hazard, and that is at least as large on its smallest dimension as one-half of the maximum altitude to which rockets are allowed to be flown at that site or 1500 feet, whichever is greater.
- **Launcher Location.** My launcher will be 1500 feet from any inhabited building or from any public highway on which traffic flow exceeds 10 vehicles per hour, not including traffic flow related to the launch. It will also be no closer than the appropriate Minimum Personnel Distance from the accompanying table from any boundary of the launch site.
- **Recovery System.** I will use a recovery system such as a parachute in my rocket so that all parts of my rocket return safely and undamaged and can be flown again, and I will use only flame-resistant or fireproof recovery system wadding in my rocket.
- **Recovery Safety.** I will not attempt to recover my rocket from power lines, tall trees, or other dangerous places, fly it under conditions where it is likely to recover in spectator areas or outside the launch site, nor attempt to catch it as it approaches the ground.



# NAR HPR Safety Code (3/3)

| MINIMUM DISTANCE TABLE                   |                                  |  |                                  |   |
|--|----------------------------------|--|----------------------------------|---|
| Installed Total Impulse (Newton-Seconds) | Equivalent High Power Motor Type | Minimum Diameter of Cleared Area (ft.) | Minimum Personnel Distance (ft.) | Minimum Personnel Distance (Complex Rocket) (ft.) |
| 0 -- 320.00                              | H or smaller                     | 50                                     | 100                              | 200   |
| 320.01 -- 640.00                         | I                                | 50                                     | 100                              | 200   |
| 640.01 -- 1,280.00                       | J                                | 50                                     | 100                              | 200   |
| 1,280.01 -- 2,560.00                     | K                                | 75                                     | 200                              | 300   |
| 2,560.01 -- 5,120.00                     | L                                | 100                                    | 300                              | 500   |
| 5,120.01 -- 10,240.00                    | M                                | 125                                    | 500                              | 1000  |
| 10,240.01 -- 20,480.00                   | N                                | 125                                    | 1000                             | 1500  |
| 20,480.01 -- 40,960.00                   | O                                | 125                                    | 1500                             | 2000  |

**Note: A Complex rocket is one that is multi-staged or that is propelled by two or more rocket motors**