National Aeronautics and Space Administration

# 2012–2013 NASA SLP

## Student Launch Projects

Note: For your convenience, this document identifies Web links when available. These links are correct as of this publishing; however, since Web links can be moved or disconnected at any time, we have also provided source information as available to assist you in locating the information.

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# Proposal/ Statement of Work

# Timeline for the NASA Student Launch Projects

(Dates are subject to change.)

## August 2012:

1 Request for Proposal (RFP) goes out to all teams.

31 One electronic copy of the completed proposal due to NASA Marshall Space Flight Center (MSFC).

**Send Electronic Copy to:**
edward.m.jeffries@nasa.gov
Jacobs ESTS Group

julie.d.clift@nasa.gov
NASA MSFC

## September 2012:

27 Schools notified of selection

## October 2012:

4 Team teleconference (tentative)

11 Preliminary Design Review (PDR) Question and Answer Session (tentative)

22 Web presence established for each team

29 PDR reports, presentation slides, and flysheet posted on the team Web site by 8:00 a.m. Central Time.

## November 2012:

7–16 PDR Presentations (tentative)

## December 2012:

3 Critical Design Review (CDR) Question and Answer Session (tentative)

## January 2013:

14 CDR reports, presentation slides, and flysheet posted on the team Web site by 8:00 a.m. Central Time.

23–Feb. 1 CDR Presentations (tentative)

## February 2013:

11 Flight Readiness Review (FRR) Question and Answer Session (tentative)

## March 2013:

18 FRR reports, presentation slides, and flysheet posted on the team Web site by 8:00 a.m. Central Time.

25-Apr 3 Flight Readiness Review Presentations *(tentative)*

## April 2013:

17 5:00 p.m.: All teams and team members arrive in Huntsville, AL
5:30 p.m.: Team Lead meeting
6:30 p.m.: Launch Readiness Reviews (LRR) begin

18-19 Welcome to MSFC/LRRs continue

20 Launch Day

21 Launch Day Rain Day

## May 2013:

6 Post-Launch Assessment Review (PLAR) posted on the team Web site by 8:00 a.m. Central Time.

17 Winning USLI team announced.

# Design, Development, and Launch of a Reusable Rocket and Science or Engineering Payload Statement of Work (SOW)

1. **Project Name:** NASA Student Launch Projects
   1.1.1 Project Components
      1.1.1. Student Launch Initiative (SLI)
      1.1.2. University Student Launch Initiative (USLI)

2. **Governing Office:** NASA Marshall Space Flight Center Academic Affairs Office

3. **Period of Performance:** Eight (8) calendar months.

4. **Introduction**
   4.1. The NASA Student Launch Projects (SLP) challenges middle, high school and college students to design, build and launch a reusable rocket to one mile above ground level while carrying a scientific or engineering payload. SLP is managed by NASA Marshall Space Flight Center's (MSFC) Academic Affairs Office and is comprised of two project elements: NASA Student Launch Initiative (SLI) for middle/high school teams and NASA University Student Launch Initiative (USLI) for community college and university teams.

   USLI is a competition where teams are scored on each element of the project. SLI is not a competition; however, teams must first place in the top of the Team America Rocketry Challenge or the Rockets for Schools competitions to be eligible to participate in SLI. Once qualifying at either of these competitions, the qualifying teams must send one educator or mentor to a NASA Advanced Rocketry Workshop (ARW) held during the summer.

   Any community college or university located in the U.S. is eligible to propose to participate in USLI. It is not required, but highly recommended that interested teams participate in the ARW.

   During the ARW, participants learn more about SLP expectations, NASA's mission and education goals and objectives, high-powered rocketry and rocketry safety. After successful completion of the ARW, each team is issued a Request for Proposal (RFP) to participate in SLP in the fall. A panel of NASA and NASA contractor engineers, scientists, and education specialists review the proposals and make a selection of new SLP teams.

   SLP is an 8-month, or academic year long, commitment requiring teams to submit a series of reports and reviews, develop a Web site, provide educational engagement in their local community, and provide a timeline, a budget and other requirements. The reports and reviews are similar to NASA's technical review process, requiring teams to complete a Preliminary Design Review (PDR), Critical Design Review (CDR), Flight Readiness Review (FRR) and Post-Launch Assessment Review (PLAR). In addition, teams must complete a Launch Readiness Review (LRR), or hardware and safety inspection, prior to launch in Huntsville, AL.

**The performance targets for the reusable launch vehicle and payload are:**

**1. Vehicle Requirements**

1.1. The vehicle shall deliver the science or engineering payload to, but not exceeding, an apogee altitude of 5,280 feet above ground level (AGL).

1.2. **(USLI Only)** The vehicle shall carry one commercially available, barometric altimeter for recording of the official altitude used in the competition scoring.

1.2.1. The official scoring altimeter shall report the official competition altitude via a series of beeps to be checked after the competition flight in Huntsville.

1.2.2. Teams may have additional altimeters to control vehicle electronics and payload experiments.

1.2.2.1. At the Launch Readiness Review, a NASA official shall be able to mark the altimeter which will be used for the official scoring.

1.2.2.2. At the launch field, a NASA official shall be able to obtain the altitude by listening to the audible beeps reported by the altimeter.

1.2.2.3. At the launch field, to aid in determination of the vehicle's apogee, all audible electronics, except for the official altitude-determining altimeter shall be capable of being turned off.

1.2.3. The following circumstances will warrant a score of zero for the altitude portion of the competition:

1.2.3.1. The official, marked altimeter is damaged and/or does not report an altitude via a series of beeps after the team's competition flight.

1.2.3.2. The team does not report to the NASA official designated to record the altitude with their official marked altimeter on the day of the launch.

1.2.3.3. The altimeter reports an apogee altitude over 5,600 feet AGL.

1.3. The launch vehicle shall remain subsonic from launch until landing.

1.4. The launch vehicle shall be designed to be recoverable and reusable. Reusable is defined as being able to be launched again on the same day without repairs or modifications.

1.5. The launch vehicle shall have a maximum of four (4) independent sections. An independent section is defined as a section that is either tethered to the main vehicle or is recovered separately from the main vehicle using its own parachute.

1.6. The launch vehicle shall be capable of being prepared for flight at the launch site within 2 hours, from the time the Federal Aviation Administration flight waiver opens.

1.7. The launch vehicle shall be capable of remaining in launch-ready configuration at the pad for a minimum of 1 hour without losing the functionality of any critical on-board component.

1.8. The vehicle shall be compatible with either an 8 feet long 1 in. rail (1010), or an 8 feet long 1.5 in. rail (1515), provided by the range.

1.9. The launch vehicle shall be capable of being launched by a standard 12 volt direct current firing system. The firing system will be provided by the Range Services Provider.

1.10. The launch vehicle shall require no external circuitry or special ground support equipment to initiate launch (other than what is provided by the range).

1.11. The launch vehicle shall use a commercially available solid motor propulsion system using ammonium perchlorate composite propellant (APCP) which is approved and certified by the National Association of Rocketry (NAR), Tripoli Rocketry Association (TRA), and/or the Canadian Association of Rocketry (CAR).

1.12. **(USLI Only)** The total impulse provided by a USLI launch vehicle shall not exceed 5,120 Newton-seconds (L-class). This total impulse constraint is applicable to a single stage or multiple stages.

1.13. **(SLI Only)** The total impulse provided by a SLI launch vehicle shall not exceed 2,560 Newton-seconds (K-class). This total impulse constraint is applicable to a single stage or multiple stages.

1.14. The amount of ballast, in the vehicle's final configuration that will be flown in Huntsville, shall be no more than 10% of the unballasted vehicle mass.

1.15. All teams shall successfully launch and recover their full scale rocket prior to FRR in its final flight configuration. However, the purpose of the full scale demonstration flight is to demonstrate the launch vehicle's stability, structural integrity, recovery systems, and the team's ability to prepare the launch vehicle for flight. The following criteria must be met during the full scale demonstration flight:
    1.15.1. The vehicle and recovery system shall have functioned as designed.
    1.15.2. The payload does not have to be flown during the full-scale test flight. The following requirements still apply:
        1.15.2.1. If the payload is not flown, mass simulators shall be used to simulate the payload mass.
            1.15.2.1.1. The mass simulators shall be located in the same approximate location on the rocket as the missing payload mass.
        1.15.2.2. If the payload changes the external surfaces of the rocket (such as with camera housings or external probes) or manages the total energy of the vehicle, those systems shall be active during the full scale demonstration flight.
        1.15.2.3. Unmanned aerial vehicles, and/or recovery systems that control the flight path of the vehicle, shall be flown as designed during the full scale demonstration flight.
    1.15.3. The full scale motor does not have to be flown during the full scale test flight. However, it is recommended that the full scale motor be used to demonstrate full flight readiness and altitude verification. If the full scale motor is not flown during the full scale flight, it is desired that the motor simulate, as closely as possible, the predicted maximum velocity and maximum acceleration of the competition flight.
    1.15.4. The vehicle shall be flown in its fully ballasted configuration during the full scale test flight. Fully ballasted refers to the same amount of ballast that will be flown during the official flight in Huntsville (Refer to requirement 1.14).
    1.15.5. The success of the full scale demonstration flight shall be documented on the flight certification form, by a Level 2 or Level 3 NAR/TRA observer, and shall be documented in the FRR package.
    1.15.6. After successfully completing the full-scale demonstration flight, the launch vehicle or any of its components shall not be modified without the concurrence of the NASA Range Safety Officer (RSO).

1.16. **(USLI Only)** The maximum amount teams may spend on the rocket and payload is $5000 total. The cost is for the competition rocket as it sits on the pad, including all purchased components. The fair market value of all donated items or materials shall be included in the cost analysis. The following items may be omitted from the total cost of the vehicle:
    - Shipping costs
    - Ground support equipment
    - Team labor costs

1.17. Vehicle Prohibitions
    1.17.1. The vehicle shall not utilize forward canards.
    1.17.2. The vehicle shall not utilize forward firing motors.
    1.17.3. The vehicle shall not utilize motors which expel titanium sponges (Sparky, Skidmark, MetalStorm, etc.)
    1.17.4. The vehicle shall not utilize hybrid motors.
    1.17.5 The vehicle shall not utilize a cluster of motors, either in a single stage or in multiple stages.

**2. Recovery System Requirements**

2.1. The launch vehicle shall stage the deployment of its recovery devices, where a drogue parachute is deployed at apogee and a main parachute is deployed at a much lower altitude. Tumble recovery or streamer recovery from apogee to main parachute deployment is also permissible, provided that kinetic energy during drogue-stage descent is reasonable, as deemed by the Range Safety Officer.

2.2. At landing, each independent sections of the launch vehicle (as described in requirement 1.5) shall have a maximum kinetic energy of 75 ft-lbf.

2.3. All independent sections of the launch vehicle shall be designed to land within 2,500 ft. of the launch pad, assuming a 15 mph wind.

2.4. The recovery system electrical circuits shall be completely independent of any payload electrical circuits.

2.5. The recovery system shall contain redundant, commercially available altimeters. The term “altimeters” includes both simple altimeters and more sophisticated flight computers.

2.6. Each altimeter shall be armed by a dedicated arming switch which is accessible from the exterior of the rocket airframe when the rocket is in the launch configuration on the launch pad.

2.7. Each altimeter shall have a dedicated power supply.

2.8. Each arming switch shall be capable of being locked in the ON position for launch.

2.9. Each arming switch shall be a maximum of six (6) feet above the base of the launch vehicle.

2.10. Removable shear pins shall be used for both the main parachute compartment and the drogue parachute compartment.

2.11. An electronic tracking device shall be installed in the launch vehicle and shall transmit the position of the tethered vehicle or any independent section to a ground receiver.
    2.11.1. Any rocket section, or payload component, which lands untethered to the launch vehicle shall also carry an active electronic tracking device.
    2.11.2. The electronic tracking device shall be fully functional during the official flight in Huntsville.
    2.11.3. Audible beepers may be used in conjunction with an electronic, transmitting device, but shall not replace the transmitting tracking device.

2.12. The recovery system electronics shall not be adversely affected by any other on-board electronic devices during flight (from launch until landing).
  2.12.1. The recovery system altimeters shall be physically located in a separate compartment within the vehicle from any other radio frequency transmitting device and/or magnetic wave producing device.
  2.12.2. The recovery system electronics shall be shielded from all onboard transmitting devices, to avoid inadvertent excitation of the recovery system electronics.
  2.12.3. The recovery system electronics shall be shielded from all onboard devices which may generate magnetic waves (such as generators, solenoid valves, and Tesla coils) to avoid inadvertent excitation of the recovery system.
  2.12.4. The recovery system electronics shall be shielded from any other onboard devices which may adversely affect the proper operation of the recovery system electronics.

2.13. The recovery system shall use commercially available low-current electric matches for ignition of ejection charges.

2.14. Recovery System Prohibitions
  2.14.1. Flashbulbs shall not be used for ignition of ejection charges.
  2.14.2. Rear ejection parachute designs shall not be utilized on the vehicle.

**3. Payload Requirements**

3.1. The launch vehicle shall carry a science or engineering payload following one of three options:
  3.1.1. Option 1(USLI and SLI): The engineering or science payload may be of the team's discretion, but shall be approved by NASA. NASA reserves the authority to require a team to modify or change a payload, as deemed necessary by the Review Panel, even after a proposal has been awarded.
  3.1.2. Option 2 (USLI only): NASA Student Launch Projects is partnering with the NASA Reduced Gravity Education Flight Program (RGEFP) to offer a chance for one team to fly a micro gravity payload on the reduced gravity aircraft. The team chosen to participate will be the team that has demonstrated the highest level of fidelity in meeting the following requirements:
    3.1.2.1. The team participating in SLP may be of any size, but the team during the RGEFP event is limited to 6 flyers (5 prime, 1 alternate) and 2 ground crew personnel. Team members shall be 18 years or older and US Citizens. Each flight crew member shall fly once.
    3.1.2.2. Student experiments shall be organized, designed, and operated by student team members alone.
    3.1.2.3. The payload shall be designed to fly on an SLP rocket, yet be scalable to fly on the RGEFP aircraft.
    3.1.2.4. Payloads shall not involve human test subjects or invertebrate animals.
    3.1.2.5. The payload shall be designed to fly twice on the reduced gravity aircraft.
    3.1.2.6. The payload on the RGEFP aircraft shall weigh no more than 300 pounds.
    3.1.2.7. The payload size limit on the RGEFP aircraft shall be no more than 24 in. by 60 in. by 60 in.
    3.1.2.8. Payload experiments that are free-floating (not secured to the aircraft) shall be no more than 50 pounds and 24 in. on any side.
    3.1.2.9. The selected team shall complete a medical questionnaire, flight program paperwork, Test Equipment Data Package six weeks prior to the flight, complete the Test Readiness Review, and spend 8 business days in Houston, Texas for flight week activities.

3.1.3. Option 3 (USLI Only): The Science Mission Directorate (SMD) at NASA Headquarters will provide a $2,780 sponsorship for up to six teams that choose to design a payload that demonstrates the highest level of fidelity in meeting the following requirements:

3.1.3.1. The payload shall gather data for studying the atmosphere during descent and after landing, including measurements of pressure, temperature, relative humidity, solar irradiance and ultraviolet radiation.

3.1.3.2. Measurements shall be made at least every 5 seconds during descent.

3.1.3.3. Measurements shall be made every 60 seconds after landing.

3.1.3.4. Surface data collection operations shall terminate 10 minutes after landing.

3.1.3.5. The payload shall take at least 2 pictures during descent and 3 after landing.

3.1.3.6. The payload shall remain in an orientation during descent and after landing such that the pictures taken portray the sky toward the top of the frame and the ground toward the bottom of the frame.

3.1.3.7. The data from the payload shall be stored onboard and transmitted wirelessly to the team's ground station at the time of completion of all surface operations.

3.1.3.8. Separation of payload components at apogee will be allowed, but not advised. Separating at apogee increases the risk of drifting outside the recovery area.

3.1.3.9. The payload shall carry a GPS tracking unit.

3.1.3.10. Minimum separation altitude shall be 2,500 feet AGL.

3.2. Data from the science or engineering payload shall be collected, analyzed, and reported by the team following the scientific method.

3.3. Unmanned aerial vehicle (UAV) payloads of any type shall be tethered to the vehicle with a remotely controlled release mechanism until the RSO has given the authority to release the UAV.

3.4. Any payload element which is jettisoned during the recovery phase, or after the launch vehicle lands, shall receive real-time RSO permission prior to initiating the jettison event.

3.5. The science or engineering payload shall be designed to be recoverable and reusable. Reusable is defined as being able to be launched again on the same day without repairs or modifications.

**4. General Requirements**

4.1. Each team shall use a launch and safety checklist. The final checklist shall be included in the FRR report and used during the Launch Readiness Review and launch day operations.

4.2. Students on the team shall do 100% on the project, including design, construction, written reports, presentations, and flight preparation with the exception of assembling the motors and handling black powder charges (to be done by the team's Level 2 or 3 mentor).

4.3. The team shall provide and maintain a project plan to include, but not limited to the following items: project milestones, budget and community support, checklists, personnel assigned, educational engagement events, and risks and mitigations.

4.4. Each team shall identify a "mentor" which is defined as an adult who is included as a team member, who will be supporting the team (or multiple teams) throughout the project year, and may or may not be affiliated with the school, institution, or organization. The mentor shall have been certified by the National Association of Rocketry (NAR) or Tripoli Rocketry Association (TRA) for the motor impulse of the launch vehicle, and the rocketeer shall have flown and successfully recovered (using electronic, staged recovery) a minimum of

15 flights in this or a higher impulse class, prior to PDR. The mentor is designated as the individual owner of the rocket for liability purposes and must travel with the team to the launch in Huntsville, AL. One travel stipend will be provided per mentor regardless of the number of teams he or she supports. The stipend will only be provided if the team passes FRR and the team attends launch week in April.

4.5. The team shall identify all team members (exception Foreign National team members—see item 4.6) attending launch week activities by the Critical Design Review (CDR). Team members shall include:
   4.5.1. Students actively engaged in the project throughout the entire year (minimum 12 years of age).
   4.5.2. One mentor (see requirement 4.4).
   4.5.3. No more than two adult educators.

4.6. Foreign National (FN) team members shall be identified by the Preliminary Design Review (PDR) and may or may not have access to certain activities during launch week due to security restrictions. In addition, FN's may be separated from their team during these activities.

4.7. During test flights, teams shall abide by the rules and guidance of the local rocketry club's RSO. The allowance of certain vehicle configurations and/or payloads at the NASA SLP launch does not give explicit or implicit authority for teams to fly those certain vehicle configurations and/or payloads at local club launches. Teams should communicate their intentions to the local club's Prefect and RSO before attending any NAR or TRA launch.

4.8. The team shall engage a minimum of 100 middle school students or educators in educational, hands-on Science, Technology, Engineering, and Mathematics (STEM) projects by FRR.
   4.8.1. Comprehensive feedback on the activities and an educational engagement form shall be completed and submitted within two weeks after completion of an event. A sample of the educational engagement form can be found on page 31.

4.9. The team shall develop and host a Web site for documentation of all project components.
   4.9.1. Teams shall post, and make available for download, the required deliverables to the Web site by the due dates specified in the project timeline.

**At a minimum, the proposing team shall identify the following in a written proposal due to NASA MSFC by the dates specified in the project timeline.**

**General Information**

1. Name of school/organization, school or organization mailing address, and title of the project.

2. Name, title, and contact information for up to two adult educators.

3. Name and title of the individual who will take responsibility for implementation of the safety plan. (Safety Officer)

4. (USLI Only) Name, title, and contact information for the student team leader.

5. Approximate number of student participants who will be committed to the project and their proposed duties. Include an outline of the project organization that identifies the key managers (students and/or administrators) and the key technical personnel. Short resumes should be included in the report for these key positions. Only use first names for identifying team members; do not include surnames. (See requirement 4.5)

6. Name of the NAR/TRA section(s) the team is associating with for launch assistance, mentoring and reviewing.

**Facilities/Equipment**

1. Description of facilities and hours of accessibility, necessary personnel, equipment, and supplies that are required to design and build a rocket and payload.

2. Computer Equipment: Describe the type of computer equipment accessible to the team for communications, designing, building and hosting a team Web site, and document development to support design reviews. The team shall provide and maintain a Web presence where the status of the project will be posted, as well as a list of needed materials and/or expertise. The team will provide the capability to communicate via e-mail on a daily basis with the NASA SLP Project Office. The information technology identified could include computer hardware, computer-aided drafting (CAD) system capability, Internet access, and e-mail capability.

   The team shall provide additional computer equipment needed to perform WebEx video teleconferencing. Minimum requirements include the following:

   - Windows, Mac, Linux, Unix, or Solaris computer systems.
   - Broadband internet connection.
   - Speakerphone capabilities in close proximity to the computer. Cellular phones are not recommended for use as a speakerphone.
   - USB Webcam or analog video camera.
   - Personal name and contact information for WebEx/connectivity issues. Teams will not need to purchase their own WebEx seat.

3. Teams must implement the Architectural and Transportation Barriers Compliance Board Electronic and Information Technology (EIT) Accessibility Standards (36 CFR Part 1194) (http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&tpl=/ecfrbrowse/Title36/36cfr1194_main_02.tpl)

   Subpart B-Technical Standards (http://www.section508.gov/index.cfm?FuseAction=Content&ID=12):

   - 1194.21 Software applications and operating systems. (a-l)
   - 1194.22 Web-based intranet and internet information and applications. 16 rules (a-p)
   - 1194.26 Desktop and portable computers. (a-d)

**Safety**

The Federal Aviation Administration (FAA) [www.faa.gov] has specific laws governing the use of airspace. A demonstration of the understanding and intent to abide by the applicable federal laws (especially as related to the use of airspace at the launch sites and the use of combustible/ flammable material), safety codes, guidelines, and procedures for building, testing, and flying large model rockets is crucial. The procedures and safety regulations of the NAR [http://www.nar.org/safety.html] should be used for flight design and operations. The NAR/TRA mentor and Safety Officer shall oversee launch operations and motor handling.

1. Provide a written safety plan addressing the safety of the materials used, facilities involved, and person responsible, i.e., Safety Officer, for insuring that the plan is followed. A risk assessment should be done for all these aspects in addition to proposed mitigations. Identification of risks to the successful completion of the project should be included.

2. Provide a description of the procedures for NAR/TRA personnel to perform. Ensure the following:
   - Compliance with NAR high power safety code requirements [http://nar.org/NARhpsc.html].
   - Performance of all hazardous materials handling and hazardous operations.

3. Describe the plan for briefing students on hazard recognition and accident avoidance, and conducting pre-launch briefings.

4. Describe methods to include necessary caution statements in plans, procedures and other working documents.

   For example: Control of all hazardous materials (applicable MSDS: Materials Safety Data Sheets (MSDS) for your project must be included in your proposal under safety plan).

5. Each team shall provide a plan for complying with federal, state, and local laws regarding unmanned rocket launches and motor handling. Specifically, regarding the use of airspace, Federal Aviation Regulations 14 CFR, Subchapter F, Part 101, Subpart C; the handling and use of low-explosives (Ammonium Perchlorate Rocket Motors, APCP), Code of Federal Regulation 27 Part 55: Commerce in Explosives; and fire prevention, NFPA 1127 “Code for High Power Rocket Motors.”

6. Each school team shall provide a plan to possess the capability to purchase, store, transport, and use rocket motors.

7. A written statement that all team members understand and will abide by the following safety regulations:
   a. Range safety inspections of each rocket before it is flown. Each team shall comply with the determination of the safety inspection.
   b. The Range Safety Officer has the final say on all rocket safety issues. Therefore, the Range Safety Officer has the right to deny the launch of any rocket for safety reasons.
   **c. Any team that does not comply with the safety requirements will not be allowed to launch their rocket.**

**Technical Design**

1. A proposed and detailed approach to rocket and payload design.
   a. Include general vehicle dimensions, material selection and justification, and construction methods.
   b. Include projected recovery system design.
   c. Include projected motor type and size.
   d. Include projected science or engineering payload with hypothesis and/or stated goal for said payload. Include justification as to how the payload is appropriate for the level of students involved in the project. For returning teams, a similar payload can be proposed if the team is mostly new students who were not involved in the previous year’s work, but this needs to be shown. Otherwise, the team of returning students must propose a payload appropriate to a second or multiple years of expertise. An improvement of a previous year’s payload may be awarded, but justification must be given as to how the updated payload has technically evolved and matured. Keep in mind that veteran teams get no preference in the evaluation. All proposals must have the required level of detail and teams must not assume that review panel members remember what had been accomplished during the previous year. Repeat projects are discouraged.
      - (USLI RGEFP Only):
        - Address how you would scale up the payload to take full advantage of the space available on the microgravity flight.
        - Define the researchers’ interactions/procedures with their payload during the microgravity flight.
        - Identify any potential hazards or safety concerns and the associated mitigation plans.
   e. Address the requirements for the vehicle, recovery system, and payload.
   f. Address major technical challenges and solutions.

**Educational Engagement**

1. Include plans for engaging a minimum of 100 middle school educators or students in educational, hands-on STEM projects. Plans for obtaining comprehensive feedback shall be included.

**Project Plan**

1. Provide a detailed development schedule/timeline covering all aspects necessary to successfully complete the project.

2. Provide a detailed budget plan to cover all aspects necessary to successfully complete the project.

3. Provide a detailed funding plan.

4. Provide a written plan for soliciting additional "community support," which could include, but is not limited to, expertise needed, additional equipment/supplies, monetary donations, services (such as free shipping for launch vehicle components, if required, advertisement of the event, etc.), or partnering with industry or other public, private, or parochial schools.

5. Address major programmatic challenges and solutions.

6. Develop a clear plan for sustainability of the rocket project in the local area. This plan should include how to provide and maintain established partnerships and regularly engage successive classes of students in rocketry. It should also include partners (industry/community), recruitment of students, funding sustainability, and educational engagement.

Prior to award, all proposing entities may be required to brief NASA representatives. The time and the place for the briefings will be determined by the NASA MSFC Academic Affairs Office.

**Deliverables shall include:**

1. A reusable rocket and science or engineering payload ready for the official launch.

2. A scale model of the rocket design with a payload prototype. This model should be flown prior to the CDR. A report of the data from the flight and the model should be brought to the CDR.

3. Reports, PowerPoint presentations, and Milestone Review Flysheets due according to the provided timeline, and shall be posted on the team Web site by the due date. (Dates are tentative at this point. Final dates will be announced at the time of award.)

4. The team(s) shall have a Web presence no later than the date specified. The Web site shall be maintained/ updated throughout the period of performance.

5. Electronic copies of the Educational Engagement form(s) and comprehensive feedback pertaining to the implemented educational engagement activities shall be submitted prior to the FRR.

The team shall participate in a PDR, CDR, FRR, LRR, and PLAR. (Dates are tentative and subject to change.)

The PDR, CDR, FRR, and LRR will be presented to NASA at a time and/or location to be determined by NASA MSFC Academic Affairs Office.

**(SLI Only) Incremental funding of the project will be provided on the following criteria:**

1. $1,500 (new teams) or $750 (second-year teams) will be issued upon award of the contract and verification of team's Web presence.

2. $1,600 (new teams) or $1,400 (second-year teams) can be invoiced upon successful completion of the CDR.

3. $400 (new teams) or $200 (second-year teams) can be invoiced upon successful completion of the FRR.

4. $200 (new teams) or $100 (second-year teams) can be invoiced upon successful completion of the LRR and PLAR.

**Total SLI budget award of:**

$3,700 (new teams)
$2,450 (second-year teams)

**(USLI SMD Only) Incremental funding of the project will be provided on the following criteria:**

1. $780 will be issued upon award of the contract and verification of team's Web presence.

2. $1,400 can be invoiced upon successful completion of the CDR.

3. $400 can be invoiced upon successful completion of the FRR.

4. $200 can be invoiced upon successful completion of the LRR and PLAR.

**Total USLI SMD budget award of:**

$2,780

# Vehicle/Payload Criteria

# Preliminary Design Review (PDR)
## Vehicle and Payload Experiment Criteria

The PDR demonstrates that the overall preliminary design meets all requirements with acceptable risk and within the cost and schedule constraints and establishes the basis for proceeding with detailed design. It shows that the correct design options have been selected, interfaces have been identified, and verification methods have been described. Full baseline cost and schedules, as well as all risk assessment, management systems, and metrics, are presented.

The panel will be expecting a professional and polished report. Please use Arial, size 12 font for your PDR Report. It is advised to follow the order of sections as they appear below.

## Preliminary Design Review Report

### *I) Summary of PDR report (1 page maximum)*

**Team Summary**
- Team name and mailing address
- Location
- Name of mentor, NAR/TRA number and certification level

**Launch Vehicle Summary**
- Size and mass
- Motor choice
- Recovery system
- Milestone Review Flysheet

**Payload Summary**
- Payload title
- Summarize experiment

### *II) Changes made since Proposal (1-2 pages maximum)*

**Highlight all changes made since the proposal and the reason for those changes.**
- Changes made to vehicle criteria
- Changes made to payload criteria
- Changes made to project plan

### *III) Vehicle Criteria*

**Selection, Design, and Verification of Launch Vehicle**
- Include a mission statement, requirements, and mission success criteria.
- Review the design at a system level, going through each system's functional requirements (includes sketches of options, selection rationale, selected concept, and characteristics).
- Describe the subsystems that are required to accomplish the overall mission.
- Describe the performance characteristics for the system and subsystems and determine the evaluation and verification metrics.

- Describe the verification plan and its status. At a minimum, a table should be included that lists each requirement (in SOW), and for each requirement briefly describe the design feature that will satisfy that requirement and how that requirement will ultimately be verified (such as by inspection, analysis, and/or test).
- Define the risks and the plans for reducing the risks through analysis or testing for each system. A risk plot that clearly portrays the risk mitigation schedule is highly encouraged. Take all factors that might affect the project including risks associated with testing, delivery of parts, adequate personnel, school holidays, budget costs, etc. Demonstrate an understanding of all components needed to complete the project and how risks/delays impact the project.
- Demonstrate planning of manufacturing, verification, integration, and operations (include component testing, functional testing, or static testing).
- Describe the confidence and maturity of design.
- Include a dimensional drawing of entire assembly. The drawing set should include drawings of the entire launch vehicle, compartments within the launch vehicle (such as parachute bays, payload bays, and electronics bays), and significant structural design features of the launch vehicle (such as fins and bulkheads).
- Include electrical schematics for the recovery system.
- Include a Mass Statement. Discuss the estimated mass of the launch vehicle, its subsystems, and components. What is the basis of the mass estimate and how accurate is it? Discuss how much margin there is before the vehicle becomes too heavy to launch with the identified propulsion system. Are you holding any mass in reserve (i.e., are you planning for any mass growth as the design matures)? If so, how much? As a point of reference, a reasonable rule of thumb is that the mass of a new product will grow between 25 and 33% between PDR and the delivery of the final product.

**Recovery Subsystem**

- Demonstrate that analysis has begun to determine size for mass, attachment scheme, deployment process, and test results/plans with ejection charges and electronics.
- Discuss the major components of the recovery system (such as the parachutes, parachute harnesses, attachment hardware, and bulkheads), and verify that they will be robust enough to withstand the expected loads.

**Mission Performance Predictions**

- State mission performance criteria.
- Show flight profile simulations, altitude predictions with simulated vehicle data, component weights, and simulated motor thrust curve, and verify that they are robust enough to withstand the expected loads.
- Show stability margin, simulated Center of Pressure (CP)/Center of Gravity (CG) relationship and locations.
- Calculate the kinetic energy at landing for each independent and tethered section of the launch vehicle.
- Calculate the drift for each independent section of the launch vehicle from the launch pad for five different cases: no wind, 5-mph wind, 10-mph wind, 15-mph wind, and 20-mph wind.

**Interfaces and Integration**

- Describe payload integration plan with an understanding that the payload must be co-developed with the vehicle, be compatible with stresses placed on the vehicle, and integrate easily and simply.
- Describe the interfaces that are internal to the launch vehicle, such as between compartments and subsystems of the launch vehicle.
- Describe the interfaces between the launch vehicle and the ground (mechanical, electrical, and/or wireless/transmitting).
- Describe the interfaces between the launch vehicle and the ground launch system.

**Launch Operation Procedures**

- Develop a checklist of final assembly and launch procedures.

**Safety and Environment (Vehicle)**

- Identify a safety officer for your team.
- Provide a preliminary analysis of the failure modes of the proposed design of the rocket, payload integration, and launch operations, including proposed and completed mitigations.
- Provide a listing of personnel hazards and data demonstrating that safety hazards have been researched, such as material safety data sheets, operator's manuals, and NAR regulations, and that hazard mitigations have been addressed and enacted.
- Discuss any environmental concerns.

## *IV) Payload Criteria*

**Selection, Design, and Verification of Payload Experiment**

- Review the design at a system level, going through each system's functional requirements (includes sketches of options, selection rationale, selected concept, and characteristics).
- Describe the payload subsystems that are required to accomplish the payload objectives.
- Describe the performance characteristics for the system and subsystems and determine the evaluation and verification metrics.
- Describe the verification plan and its status. At a minimum, a table should be included that lists each payload requirement and for each requirement briefly describe the design feature that will satisfy that requirement and how that requirement will ultimately be verified (such as by inspection, analysis, and/or test).
- Describe preliminary integration plan.
- Determine the precision of instrumentation, repeatability of measurement, and recovery system.
- Include drawings and electrical schematics for the key elements of the payload.
- Discuss the key components of the payload and how they will work together to achieve the desired results for the experiment.

**Payload Concept Features and Definition**

- Creativity and originality
- Uniqueness or significance
- Suitable level of challenge

**Science Value**

- Describe payload objectives.
- State the payload success criteria.
- Describe the experimental logic, approach, and method of investigation.
- Describe test and measurement, variables, and controls.
- Show relevance of expected data and accuracy/error analysis.
- Describe the preliminary experiment process procedures.

**Safety and Environment (Payload)**

- Identify safety officer for your team.
- Provide a preliminary analysis of the failure modes of the proposed design of the rocket, payload integration, and launch operations, including proposed and completed mitigations.
- Provide a listing of personnel hazards and data demonstrating that safety hazards have been researched, such as material safety data sheets, operator's manuals, and NAR regulations, and that hazard mitigations have been addressed and enacted.
- Discuss any environmental concerns.

### *V) Project Plan*

**Show status of activities and schedule**

- Budget plan (in as much detail as possible)
- Funding plan
- Timeline (in as much detail as possible). GANTT charts are encouraged with a discussion of the critical path.
- Educational engagement plan and status

### *VI) Conclusion*

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# Preliminary Design Review Presentation

Please include the following in your presentation:

- Vehicle dimensions, materials, and justifications
- Static stability margin
- Plan for vehicle safety verification and testing
- Baseline motor selection and justification
- Thrust-to-weight ratio and rail exit velocity
- Launch vehicle verification and test plan overview
- Drawing/Discussion of each major component and subsystem, especially the recovery subsystem
- Baseline payload design
- Payload verification and test plan overview

The PDR will be presented to a panel that may be comprised of any combination of scientists, engineers, safety experts, education specialists, and industry partners. This review should be viewed as the opportunity to convince the NASA Review Panel that the preliminary design will meet all requirements, has a high probability of meeting the mission objectives, and can be safely constructed, tested, launched, and recovered. Upon successful completion of the PDR, the team is given the authority to proceed into the final design phase of the life cycle that will culminate in the Critical Design Review.

It is expected that the **students** deliver the report and answer all questions.

The presentation of the PDR shall be well prepared with a professional overall appearance. This includes, but is not limited to, the following: easy-to-see slides; appropriate placement of pictures, graphs, and videos; professional appearance of the presenters; speaking clearly and loudly; looking into the camera; referring to the slides, not reading them; and communicating to the panel in an appropriate and professional manner. The slides should use dark text on a light background.

# Critical Design Review (CDR)
## Vehicle and Payload Experiment Criteria

The CDR demonstrates that the maturity of the design is appropriate to support proceeding to full-scale fabrication, assembly, integration, and test and that the technical effort is on track to complete the flight and ground system development and mission operations in order to meet overall performance requirements within the identified cost and schedule constraints. Progress against management plans, budget, and schedule, as well as risk assessment, are presented. The CDR is a review of the final design of the launch vehicle and payload system. All analyses should be complete and some critical testing should be complete. The CDR Report and Presentation should be independent of the PDR Report and Presentation. However, the CDR Report and Presentation may have the same basic content and structure as the PDR documents, but with final design information that may or may not have changed since PDR. Although there may be discussion of subscale models, the CDR documents are to primarily discuss the final design of the full scale launch vehicle and subsystems.

The panel will be expecting a professional and polished report. Please use Arial, size 12 font for your CDR Report. It is advised to follow the order of sections as they appear below.

## Critical Design Review Report

### *I) Summary of CDR report (1 page maximum)*

**Team Summary**
- Team name and mailing address
- Location
- Name of mentor, NAR/TRA number and certification level

**Launch Vehicle Summary**
- Size and mass
- Motor choice
- Recovery system
- Rail size
- Milestone Review Flysheet

**Payload Summary**
- Payload title
- Summarize experiment

### *II) Changes made since PDR (1-2 pages maximum)*

**Highlight all changes made since PDR and the reason for those changes.**
- Changes made to vehicle criteria
- Changes made to payload criteria
- Changes made to project plan

## *III) Vehicle Criteria*

**Design and Verification of Launch Vehicle**

Flight Reliability and Confidence

- Include mission statement, requirements, and mission success criteria
- Include major milestone schedule (project initiation, design, manufacturing, verification, operations, and major reviews)
- Review the design at a system level
    - Final drawings and specifications
    - Final analysis and model results, anchored to test data
    - Test description and results
    - Final motor selection
- Demonstrate that the design can meet all system level functional requirements. For each requirement, state the design feature that satisfies that requirement and how that requirement has been, or will be, verified.
- Specify approach to workmanship as it relates to mission success.
- Discuss planned additional component, functional, or static testing.
- Status and plans of remaining manufacturing and assembly.
- Discuss the integrity of design.
    - Suitability of shape and fin style for mission
    - Proper use of materials in fins, bulkheads, and structural elements
    - Proper assembly procedures, proper attachment and alignment of elements, solid connection points, and load paths
    - Sufficient motor mounting and retention
    - Status of verification
    - Drawings of the launch vehicle, subsystems, and major components
    - Include a Mass Statement. Discuss the estimated mass of the final design and its subsystems and components. Discuss the basis and accuracy of the mass estimate, the expected mass growth between CDR and the delivery of the final product, and the sensitivity of the launch vehicle to mass growth (e.g., How much mass margin there is before the vehicle becomes too heavy to launch on the selected propulsion system?).
- Discuss the safety and failure analysis.

**Subscale Flight Results**

- Include actual flight data from onboard computers, if available.
- Compare the predicted flight model to the actual flight data. Discuss the results.
- Discuss how the subscale flight data has impacted the design of the full-scale launch vehicle.

**Recovery Subsystem**

- Describe the parachute, harnesses, bulkheads, and attachment hardware.
- Discuss the electrical components and how they will work together to safely recover the launch vehicle.
- Include drawings/sketches, block diagrams, and electrical schematics.
- Discuss the kinetic energy at significant phases of the mission, especially at landing.
- Discuss test results.
- Discuss safety and failure analysis.

**Mission Performance Predictions**

- State the mission performance criteria.
- Show flight profile simulations, altitude predictions with final vehicle design, weights, and actual motor thrust curve.
- Show thoroughness and validity of analysis, drag assessment, and scale modeling results.
- Show stability margin and the actual CP and CG relationship and locations.

**Payload Integration**

Ease of integration

- Describe integration plan.
- Installation and removal, interface dimensions, and precision fit.
- Compatibility of elements.
- Simplicity of integration procedure.

**Launch concerns and operation procedures**

- Submit draft of final assembly and launch procedures.
- Recovery preparation.
- Motor preparation.
- Igniter installation.
- Setup on launcher.
- Troubleshooting.
- Postflight inspection.

**Safety and Environment (Vehicle)**

- Identify safety officer for your team.
- Update the preliminary analysis of the failure modes of the proposed design of the rocket and payload integration and launch operations, including proposed, and completed mitigations.
- Update the listing of personnel hazards and data demonstrating that safety hazards have been researched, such as material safety data sheets, operator's manuals, and NAR regulations, and that hazard mitigations have been addressed and enacted.
- Discuss any environmental concerns.

## *IV) Payload Criteria*

**Testing and Design of Payload Experiment**

- Review the design at a system level.
    - Drawings and specifications
    - Analysis results
    - Test results
    - Integrity of design
- Demonstrate that the design can meet all system-level functional requirements.
- Specify approach to workmanship as it relates to mission success.
- Discuss planned component testing, functional testing, or static testing.
- Status and plans of remaining manufacturing and assembly.
- Describe integration plan.
- Discuss the precision of instrumentation and repeatability of measurement.

- Discuss the payload electronics with special attention given to transmitters.
    - Drawings and schematics
    - Block diagrams
    - Batteries/power
    - Transmitter frequencies, wattage, and location
    - Test plans
- Provide a safety and failure analysis.

**Payload Concept Features and Definition**

- Creativity and originality
- Uniqueness or significance
- Suitable level of challenge

**Science Value**

- Describe payload objectives.
- State the payload success criteria.
- Describe the experimental logic, approach, and method of investigation.
- Describe test and measurement, variables, and controls.
- Show relevance of expected data and accuracy/error analysis.
- Describe the experiment process procedures.

**Safety and Environment (Payload)**

- Identify safety officer for your team.
- Update the preliminary analysis of the failure modes of the proposed design of the rocket and payload integration and launch operations, including proposed and completed mitigations.
- Update the listing of personnel hazards, and data demonstrating that safety hazards have been researched (such as material safety data sheets, operator's manuals, NAR regulations), and that hazard mitigations have been addressed and mitigated.
- Discuss any environmental concerns.

## *V) Project Plan*

**Show status of activities and schedule**

- Budget plan (in as much detail as possible)
- Funding plan
- Timeline (in as much detail as possible). GANTT charts are encouraged with a discussion of the critical path.
- Educational engagement plan and status

## *VI) Conclusion*

# Critical Design Review Presentation

Please include the following information in your presentation:

- Final launch vehicle dimensions
- Discuss key design features
- Final motor choice
- Rocket flight stability in static margin diagram
- Thrust-to-weight ratio and rail exit velocity
- Mass Statement and mass margin
- Parachute sizes, recovery harness type, size, and length, and descent rates
- Kinetic energy at key phases of the mission, especially landing
- Predicted drift from the launch pad with 5-, 10-, 15-, and 20-mph wind
- Test plans and procedures
- Scale model flight test
- Tests of the staged recovery system
- Final payload design overview
- Payload integration
- Interfaces (internal within the launch vehicle and external to the ground)
- Status of requirements verification

The CDR will be presented to a panel that may be comprised of any combination of scientists, engineers, safety experts, education specialists, and industry partners. The team is expected to present and defend the final design of the launch vehicle (including the payload), showing that design meets the mission objectives and requirements and that the design can be safety, constructed, tested, launched, and recovered. Upon successful completion of the CDR, the team is given the authority to proceed into the construction and verification phase of the life cycle which will culminate in a Flight Readiness Review.

It is expected that the **students** deliver the report and answer all questions.

The presentation of the CDR shall be well prepared with a professional overall appearance. This includes, but is not limited to, the following: easy-to-see slides; appropriate placement of pictures, graphs, and videos; professional appearance of the presenters; speaking clearly and loudly; looking into the camera; referring to the slides, not reading them; and communicating to the panel in an appropriate and professional manner. The slides should be made with dark text on a light background.

# Flight Readiness Review (FRR)
## Vehicle and Payload Experiment Criteria

The FRR examines tests, demonstrations, analyses, and audits that determine the overall system (all projects working together) readiness for a safe and successful flight/launch and for subsequent flight operations of the as-built rocket and payload system. It also ensures that all flight and ground hardware, software, personnel, and procedures are operationally ready.

The panel will be expecting a professional and polished report. Please use Arial, size-12 font for your FRR Report. It is advised to follow the order of sections as they appear below.

## Flight Readiness Review Report

### *I) Summary of FRR report (1 page maximum)*

**Team Summary**
- Team name and mailing address
- Location
- Name of mentor, NAR/TRA number and certification level

**Launch Vehicle Summary**
- Size and mass
- Final motor choice
- Recovery system
- Rail size
- Milestone Review Flysheet

**Payload Summary**
- Payload title
- Summarize experiment

### *II) Changes made since CDR (1-2 pages maximum)*

**Highlight all changes made since CDR and the reason for those changes**.
- Changes made to vehicle criteria
- Changes made to payload criteria
- Changes made to project plan

### *III) Vehicle Criteria*

**Design and Construction of Vehicle**
- Describe the design and construction of the launch vehicle, with special attention to the features that will enable the vehicle to be launched and recovered safely.
    - Structural elements (such as airframe, fins, bulkheads, attachment hardware, etc.).
    - Electrical elements (wiring, switches, battery retention, retention of avionics boards, etc.).
    - Drawings and schematics to describe the assembly of the vehicle.

- Discuss flight reliability confidence. Demonstrate that the design can meet mission success criteria. Discuss analysis, and component, functional, or static testing.
- Present test data and discuss analysis, and component, functional, or static testing of components and subsystems.
- Describe the workmanship that will enable mission success.
- Provide a safety and failure analysis, including a table with failure modes, causes, effects, and risk mitigations.
- Discuss full-scale launch test results. Present and discuss actual flight data. Compare and contrast flight data to the predictions from analysis and simulations.
- Provide a Mass Report and the basis for the reported masses.

**Recovery Subsystem**

- Describe and defend the robustness of as-built and as-tested recovery system.
    - Structural elements (such as bulkheads, harnesses, attachment hardware, etc.).
    - Electrical elements (such as altimeters/computers, switches, connectors).
    - Redundancy features.
    - Parachute sizes and descent rates
    - Drawings and schematics of the electrical and structural assemblies.
    - Rocket-locating transmitters with a discussion of frequency, wattage, and range.
    - Discuss the sensitivity of the recovery system to onboard devices that generate electromagnetic fields (such as transmitters). This topic should also be included in the Safety and Failure Analysis section.
- Suitable parachute size for mass, attachment scheme, deployment process, test results with ejection charge and electronics
- Safety and failure analysis. Include table with failure modes, causes, effects, and risk mitigations.

**Mission Performance Predictions**

- State mission performance criteria.
- Provide flight profile simulations, altitude predictions with real vehicle data, component weights, and actual motor thrust curve. Include real values with optimized design for altitude. Include sensitivities.
- Thoroughness and validity of analysis, drag assessment, and scale modeling results. Compare analyses and simulations to measured values from ground and/or flight tests. Discuss how the predictive analyses and simulation have been made more accurate by test and flight data.
- Provide stability margin, with actual CP and CG relationship and locations. Include dimensional moment diagram or derivation of values with points indicated on vehicle. Include sensitivities.
- Discuss the management of kinetic energy through the various phases of the mission, with special attention to landing.
- Discuss the altitude of the launch vehicle and the drift of each independent section of the launch vehicle for winds of 0-, 5-, 10-, 15-, and 20-mph.

**Verification (Vehicle)**

- For each requirement ( in SOW), describe how that requirement has been satisfied and by what method the requirement was verified. Note: Requirements are often satisfied by design features of a product, and requirements are usually verified by one or more of the following methods: analysis, inspection, and test.
- The verification statement for each requirement should include results of the analysis, inspection, and/or test which prove that the requirement has been properly verified.

**Safety and Environment (Vehicle)**

- Provide a safety and mission assurance analysis. Provide a Failure Modes and Effects Analysis (which can be as simple as a table of failure modes, causes, effects, and mitigations/controls put in place to minimize the occurrence or effect of the hazard or failure). Discuss likelihood and potential consequences for the top 5 to 10 failures (most likely to occur and/or worst consequences).
- As the program is moving into the operational phase of the Life Cycle, update the listing of personnel hazards, including data demonstrating that safety hazards that will still exist after FRR. Include a table which discusses the remaining hazards and the controls that have been put in place to minimize those safety hazards to the greatest extent possible.
- Discuss any environmental concerns that remain as the project moves into the operational phase of the life cycle.

**Payload Integration**

- Describe the integration of the payload into the launch vehicle.
- Demonstrate compatibility of elements and show fit at interface dimensions.
- Describe and justify payload-housing integrity.
- Demonstrate integration: show a diagram of components and assembly with documented process.

## *IV) Payload Criteria*

**Experiment Concept**

This concerns the quality of science. Give clear, concise, and descriptive explanations.

- Creativity and originality
- Uniqueness or significance

**Science Value**

- Describe science payload objectives in a concise and distinct manner.
- State the mission success criteria.
- Describe the experimental logic, scientific approach, and method of investigation.
- Explain how it is a meaningful test and measurement, and explain variables and controls.
- Discuss the relevance of expected data, along with an accuracy/error analysis, including tables and plots.
- Provide detailed experiment process procedures.

**Payload Design**

- Describe the design and construction of the payload and demonstrate that the design meets all mission requirements.
    - Structural elements (such as airframe, bulkheads, attachment hardware, etc.).
    - Electrical elements (wiring, switches, battery retention, retention of avionics boards, etc.).
    - Drawings and schematics to describe the design and assembly of the payload.
- Provide information regarding the precision of instrumentation and repeatability of measurement (include calibration with uncertainty).
- Provide flight performance predictions (flight values integrated with detailed experiment operations).
- Specify approach to workmanship as it relates to mission success.
- Discuss the test and verification program.

**Verification**

- For each payload requirement, describe how that requirement has been satisfied, and by what method the requirement was verified. Note: Requirements are often satisfied by design features, and requirements are usually verified by one or more of the following methods: analysis, inspection, and test.
- The verification statement for each payload requirement should include results of the analysis, inspection, and/or test which prove that the requirement has been properly verified.

**Safety and Environment (Payload)**

This will describe all concerns, research, and solutions to safety issues related to the payload.

- Provide a safety and mission assurance analysis. Provide a Failure Modes and Effects Analysis (which can be as simple as a table of failure modes, causes, effects, and mitigations/controls put in place to minimize the occurrence or effect of the hazard or failure). Discuss likelihood and potential consequences for the top 5 to 10 failures (most likely to occur and/or worst consequences).
- As the program is moving into the operational phase of the Life Cycle, update the listing of personnel hazards, including data demonstrating that safety hazards that will still exist after FRR. Include a table which discusses the remaining hazards and the controls that have been put in place to minimize those safety hazards to the greatest extent possible.
- Discuss any environmental concerns that still exist.

## *V) Launch Operations Procedures*

**Checklist**

Provide detailed procedure and check lists for the following (as a minimum).

- Recovery preparation
- Motor preparation
- Igniter installation
- Setup on launcher
- Launch procedure
- Troubleshooting
- Postflight inspection

**Safety and Quality Assurance**

Provide detailed safety procedures for each of the categories in the Launch Operations Procedures checklist. Include the following:

- Provide data demonstrating that risks are at acceptable levels.
- Provide risk assessment for the launch operations, including proposed and completed mitigations.
- Discuss environmental concerns.
- Identify individual that is responsible for maintaining safety, quality and procedures checklists.

## *VI) Project Plan*

**Show status of activities and schedule**

- Budget plan (in as much detail as possible)
- Funding plan
- Timeline (in as much detail as possible). GANTT charts are encouraged with a discussion of the critical path.
- Educational engagement plan and status

## *VII) Conclusion*

# Flight Readiness Review Presentation

Please include the following information in your presentation:

- Launch Vehicle design and dimensions
- Discuss key design features of the launch vehicle
- Motor description
- Rocket flight stability in static margin diagram
- Launch thrust-to-weight ratio and rail exit velocity
- Mass statement
- Parachute sizes and descent rates
- Kinetic energy at key phases of the mission, especially at landing
- Predicted altitude of the launch vehicle with a 5-, 10-, 15-, and 20-mph wind
- Predicted drift from the launch pad with a 5-, 10-, 15-, and 20-mph wind
- Test plans and procedures
- Full-scale flight test. Present and discuss the actual flight test data.
- Recovery system tests
- Summary of Requirements Verification (launch vehicle)
- Payload design and dimensions
- Key design features of the launch vehicle
- Payload integration
- Interfaces with ground systems
- Summary of requirements verification (payload)

The FRR will be presented to a panel that may be comprised of any combination of scientists, engineers, safety experts, education specialists, and industry partners. The team is expected to present and defend the as-built launch vehicle (including the payload), showing that the launch vehicle meets all requirements and mission objectives and that the design can be safely launched and recovered. Upon successful completion of the FRR, the team is given the authority to proceed into the Launch and Operational phases of the life cycle.

It is expected that the **students** deliver the report and answer all questions.

The presentation of the FRR shall be well prepared with a professional overall appearance. This includes, but is not limited to, the following: easy to see slides; appropriate placement of pictures, graphs, and videos; professional appearance of the presenters; speaking clearly and loudly; looking into the camera; referring to the slides, not reading them; and communicating to the panel in an appropriate and professional manner. The slides should be made with dark text on a light background.

# Launch Readiness Review (LRR)
## Vehicle and Payload Experiment Criteria

The Launch Readiness Review (LRR) will be held by NASA and the National Association of Rocketry (NAR), our launch services provider. These inspections are only open to team members and mentors. These names were submitted as part of your team list. All rockets/payload will undergo a detailed, deconstructive, hands-on inspection. Your team should bring all components of the rocket and payload except for the motor, black powder, and e-matches. Be able to present: anchored flight predictions, anchored drift predictions (15 mph crosswind), procedures and checklists, and Cp and Cg with loaded motor marked on the airframe. The rockets will be assessed for structural, electrical integrity, and safety features. At a minimum, all teams should have:

- An airframe prepared for flight with the exception of energetic materials.
- Data from the previous flight.
- A list of any flight anomalies that occurred on the previous full scale flight and the mitigation actions.
- A list of any changes to the airframe since the last flight.
- Flight simulations.
- Pre-flight check list and Fly Sheet.

A “punch list” will be generated for each team. Items identified on the punch list should be corrected and verified by NAR/NASA on Friday evening. Teams will not be assigned a time on Friday evening, but should come to the hotel to have these items approved. A flight card will be provided to teams, should be completed, and provided at the RSO booth on launch day.

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# Post-Launch Assessment Review (PLAR)
## Vehicle and Payload Experiment Criteria

The PLAR is an assessment of system in-flight performance.

Your PLAR should include the following items at a minimum. Your PLAR should be about 4-15 pages in length.

- Team name
- Motor used
- Brief payload description
- Rocket height
- Rocket diameter
- Rocket mass
- Altitude reached (Feet)
- Vehicle Summary
- Data analysis & results of vehicle
- Payload summary
- Data analysis & results of payload
- Scientific value
- Visual data observed
- Lessons learned
- Summary of overall experience (what you attempted to do versus the results and how you felt your results were; how valuable you felt the experience was)
- Educational engagement summary
- Budget Summary

# Educational Engagement Form

Please complete and submit this form each time you host an educational engagement event.

Team name:_____

Date of event: _____

Location of event: _____

Grade level and number of participants:

Pre K-4 (1-9 years):_____

5-8 (10-13 years): _____

9-12 (14-18 years): _____

12+ (18+ years): _____

Educators: _____

Total: _____

Are the participants with a special group/organization (i.e., Girl Scouts, 4-H, school)? ___Y ___N

If yes, what group/organization? _____

Briefly describe your activities with this group: _____

_____

_____

_____

_____

_____

Did you conduct an evaluation of your educational engagement? If so, what were the results?

_____

_____

_____

_____


# NASA Project Life Cycle



Charles Pierce
Chief, Spacecraft Propulsion Systems Branch,
NASA - Marshall Space Flight Center

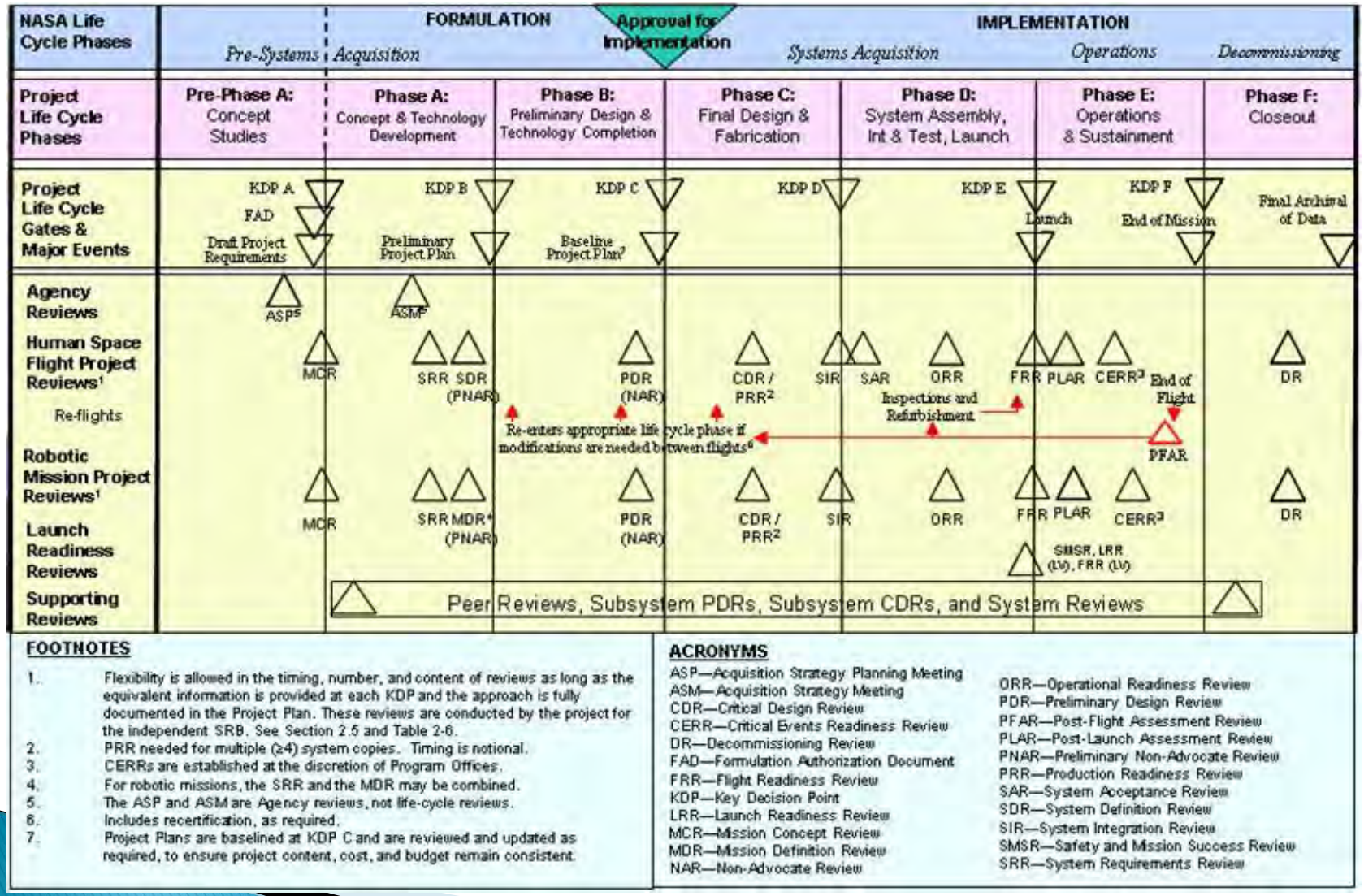
# Topics

- Purpose / Objective
- NASA Project Life Cycle (Typical)
- Preliminary Design Review
- Critical (Final) Design Review
- Flight Readiness Review
- Post Flight

# Purpose/Objectives of the NASA Project Life Cycle

- Plan for the design, build, verification, flight operations, and disposal of the desired system
- Maintain consistency between projects
- Set expectations for Project Managers, Scientists, & Engineers
  - Plans and Deliverables
  - Fidelity
  - Timing

# Typical NASA Project Life Cycle




**FOOTNOTES**

1. Flexibility is allowed in the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan. These reviews are conducted by the project for the independent SRB. See Section 2.5 and Table 2-6.
2. PRR needed for multiple (≥4) system copies. Timing is notional.
3. CERRs are established at the discretion of Program Offices.
4. For robotic missions, the SRR and the MDR may be combined.
5. The ASP and ASM are Agency reviews, not life-cycle reviews.
6. Includes recertification, as required.
7. Project Plans are baselined at KDP C and are reviewed and updated as required, to ensure project content, cost, and budget remain consistent.

**ACRONYMS**

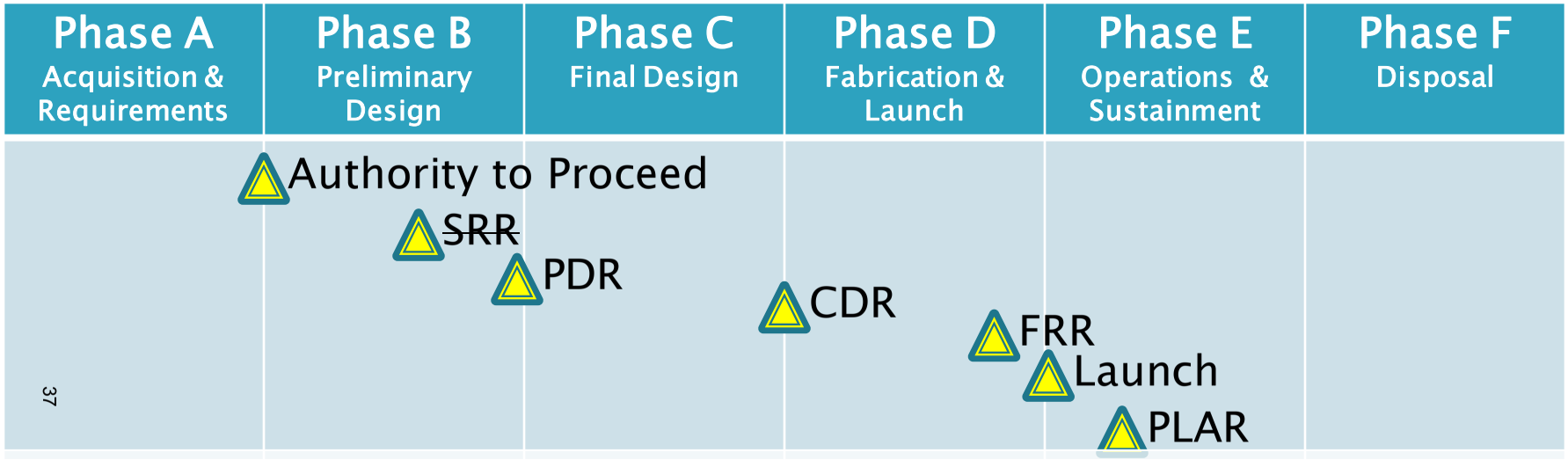
ASP—Acquisition Strategy Planning Meeting
ASM—Acquisition Strategy Meeting
CDR—Critical Design Review
CERR—Critical Events Readiness Review
DR—Decommissioning Review
FAD—Formulation Authorization Document
FRR—Flight Readiness Review
KDP—Key Decision Point
LRR—Launch Readiness Review
MCR—Mission Concept Review
MDR—Mission Definition Review
NAR—Non-Advocate Review
ORR—Operational Readiness Review
PDR—Preliminary Design Review
PFAR—Post-Flight Assessment Review
PLAR—Post-Launch Assessment Review
PNAR—Preliminary Non-Advocate Review
PRR—Production Readiness Review
SAR—System Acceptance Review
SDR—System Definition Review
SIR—System Integration Review
SMSR—Safety and Mission Success Review
SRR—System Requirements Review

Reference: NPR 7120.5D, Figure 2-4: "The NASA Project Life Cycle"



NASA Project Life Cycle, July 2012

# Student Launch Projects (SLP) Life Cycle




- ATP (Authority to Proceed) – Funding is applied to the contract/effort and work performance can begin
- SRR (System Requirements Review) – Top Level Requirements are converted into system requirements. System Requirements are reviewed and authority is given to proceed into Preliminary Design. The USLI/SLI Project skips this step. Note: This review is skipped for SLP, due to time constraints.
- PDR (Preliminary Design Review) – Preliminary Design is reviewed and authority is given to proceed into Final Design.
- CDR (Critical Design Review) – Final Design is reviewed and authority is given to proceed to build the system.
- FRR (Flight Readiness Review) – As-built design and test data are reviewed and authority is given for Launch.
- PLAR (Post Launch Assessment Report) - Summarize project (cradle to grave), discuss mission results and compare to expected results, document lessons learned.

# Preliminary Design Review (PDR)

- Objective
  - Prove the feasibility to build and launch the rocket/payload design.
  - Prove that all system requirements will be met.
  - Receive authority to proceed to the Final Design Phase
- Typical Products (Vehicle and Payload)
  - Preliminary Design Discussion
    - Drawings, sketches
    - Identification and discussion of components
    - Analyses (such as Vehicle Trajectory Predictions) and Simulation Results
    - Risks
    - Mass Statement and Mass Margin
  - Schedule from PDR to Launch (including design, build, test)
  - Cost/Budget Statement
  - Mission Profile (Concept of Operations)
  - Interfaces (within the system and external to the system)
  - Test and Verification Plan (for satisfying requirements)
  - Ground Support Equipment Designs/Identification
  - Safety Features

# Critical Design Review (CDR)

- Objective
  - Complete the final design of the rocket/payload system
  - Receive authority to proceed into Fabrication and Verification phase
    - In a perfect world, fabrication/procurement of the final system wouldn't begin until a successful completion of CDR.
    - Due to schedule constraints, however, it is often necessary to start procurements and fabrication prior to CDR.
    - Procurements and Fabrication that start prior to CDR add an extra risk to the Project because design issues may be discovered at CDR that impact procurements or fabrication.
- Typical Products (Vehicle and Payload)
  - PDR Deliverables (matured to reflect the final design)
  - Report and discuss completed tests
  - Procedures and Checklists

# Flight Readiness Review (FRR)

- Objective
  - Prove that the Rocket/Payload System has been fully built, tested, and verified to meet the system requirements
  - Prove that all system requirements have been, or will be, met
  - Receive authority to proceed to Launch
- Typical Products (Vehicle and Payload)
  - Schedule
  - Cost Statement
  - Design Overview
    - Key components
    - Key drawings and layouts
    - Trajectory and other key analyses
    - Key Safety Features
    - Mass Statement
    - Remaining Risks
  - Mission Profile
  - Presentation and analysis and models (use real test data)
  - System Requirements Verification
  - Ground Support Equipment
  - Procedures and Check Lists

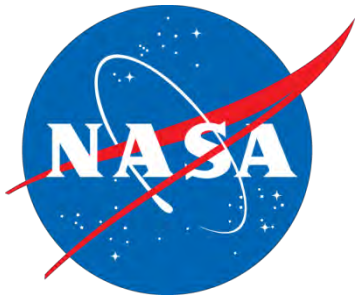
# Hardware Inspections (Hands on)

- Objective
  - To perform a hands-on final inspection of the rocket system, prior to launch
  - Performed by the operators of the Launch Range
- Process
  - Rockets deconstructed
    - Mechanical components pulled and twisted
    - Electronics and Wiring inspected (as much as possible)
    - Recovery System fully inspected
  - Questions asked
    - Arming, Activation, Execution Sequences
    - Rocket and Payload Functions
  - Launch Day Procedures reviewed
  - Questions Answered (anything about Launch Day or Range Operations)
  - Actions given to repair unsafe elements in the rocket system (if any are found)

- Note: This inspection is a Pre Range Safety Officer (RSO) inspection.
  - It occurs one day before launch and it purpose is to give the Student Teams an opportunity to correct hardware issues that could otherwise result in the denial of launch of their rocket.
  - A final RSO inspection will occur at the launch site (just like a normal NAR/TRA RSO Inspection at the launch site).

# Post Launch Assessment Report

- Summary of the Project
- Summary of the Vehicle and Payload
  - Especially note anything that changed after FRR
- Presentation of Vehicle and Payload Results
  - Comparison to predicted results
  - Discussion of anomalies
- Lessons Learned




**www.nasa.gov**

# Safety

# High Power Rocket Safety Code
## Provided by the National Association of Rocketry

1. **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.

2. **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.

3. **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.

4. **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.

5. **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.

6. **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.

7. **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.

8. **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.

9. **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.

10. **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.

11. **Launcher Location.** My launcher will be at least one half the minimum launch site dimension, or 1500 feet (whichever is greater) 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.

12. **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.

13. **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.

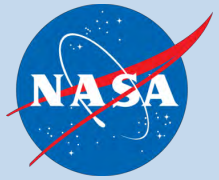
# Minimum Distance Table

| 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**

Revision of July 2008

Provided by the National Association of Rocketry (www.nar.org)




# Failures, Hazards and Risk

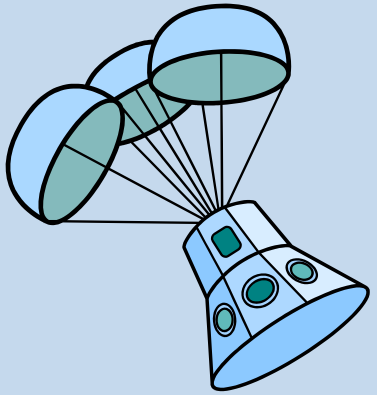
## How to Identify, Track and Mitigate

# Examples from Home

- Getting to work on time ("mission success")
  - **Risks**: weather, traffic jam, alarm doesn't ring
    - How do we plan for these risks?
  - **Failure**: the car doesn't start
    - How do we try to make sure that it will start?
  - **Hazard**: bad roads, other drivers, sudden changes in traffic flow
    - How do we plan for this and avoid problems?
- Getting to work on time means that we have recognized the risks, failure modes, and hazards, and have taken action to reduce their probability and impact.
- This same approach improves the probability of success for a project.

# Risk Definition

- The combination of the probability of an undesired event and the consequences, impact, or severity of the event.
- Risk assessment includes
  - What can go wrong
  - How likely is it to occur
  - What the consequences are
- Risk Mitigation is
  - Application of methods to lessen the probability and/or impact of the undesired event



# Examples of Risk

- Planned design will be over budget
- Key personnel will leave the program
- Unavailability of equipment when needed to support schedule
- Students have many other demands on time and do not have time to finish the project
- Parts unavailability
- Mishaps
- Communication issues
- Bad weather on launch day

# Risk Management

- "Risk management is a continuous process that
  - identifies risks;
  - analyzes their impact and prioritizes them;
  - develops and carries out plans for risk mitigation or acceptance;
  - tracks risks and the implementation of mitigation plans;
  - supports informed, timely, and effective decisions to control risks and mitigation plans;
  - and assures that risk information is communicated and documented.
  - Risk management is driven by established success criteria and is performed by the whole team"
  - (from NASA Program and Project Management Processes and Requirements)

# Examples of Tables to Include in PDR, CDR, FRR

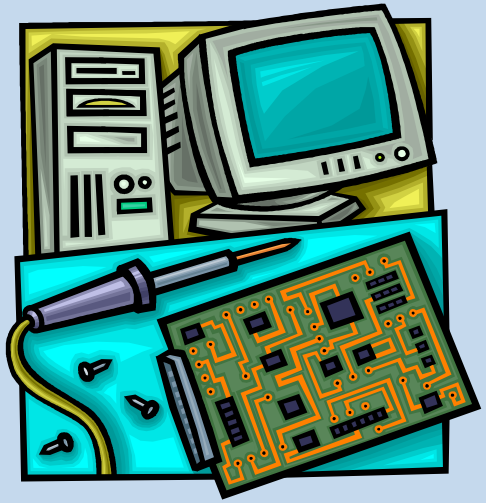
| Risk | Probability | Impact | Mitigation |
|---|---|---|---|
| Project falls behind schedule due to multiple demands on time | Highly probable | Late delivery of PDR, CDR, FRR; incomplete project | Create a schedule with margin for problems, track progress; divide work among team |
| Parts are unavailable | Probability is low | Last minute design changes | Have design options and multiple sources; finalize design and order parts early |
| Key personnel leave project | Probability is low | Extra work for members; late delivery; incomplete project | Have primary and backup assignments; document activities; communicate |
| Project is over budget | Highly probable | Last minute design changes for cost cutting; incomplete project | Track progress; have multiple funding sources |

# Failures

- During the rocket design process, each component and system should be analyzed for failure modes:
  - How can it fail
  - What are the consequences of the failure
  - How can the failure be prevented
- This includes system integration and ground support equipment, as well as the rocket and payload
- Document the analysis and update as necessary

# Failure Examples

- Parachutes fail to deploy
- Failure to ignite
- Unstable flight
- Failure to collect data
- Power loss

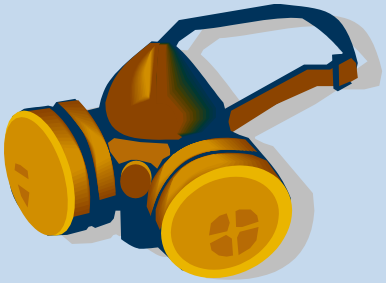


# Examples of Tables to Include in PDR, CDR, FRR

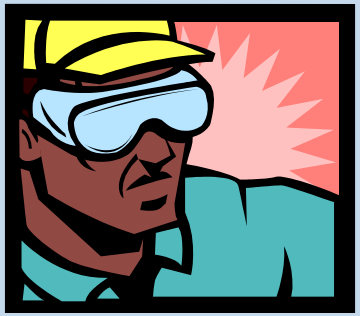
**Failure Modes and Effects Analysis of Propulsion System**

*Propulsion Team: Daniel Chhitt, Jason Back*

| *Function* | *Potential Failure Mode* | *Potential Effects of Failure* | *Failure Prevention* |
|---|---|---|---|
| 1 | Propellant fails to ignite. | Total mission failure, rocket does not take off. | Proper ignition system setup. |
| 2 | Propellant ignites but extinguishes before desired burn time. | Rocket may not reach desired height, payload failure. | Proper motor and propellant inspection and testing. |
| 3 | Motor mounting fails and motor launches through the rocket. | Possible destruction of all systems; avionics, recovery, payload | Proper motor mounting structure and load testing of mounting structure. |
| 4 | Propellant ignites but causes a catastrophic explosion. | Possible destruction of all systems; avionics, recovery, payload, structure. | Proper motor and propellant inspection and testing. |
| 5 | Propellant ignites but burns through motor casing. | Severe loss of stability, possible destruction of all systems. | Proper testing of motor casing and propellant. |
| 6 | Motor casing becomes detached during flight. | Rocket may not reach desired height, motor becomes a projectile. | Proper testing and mounting of motor casing to the structure. |



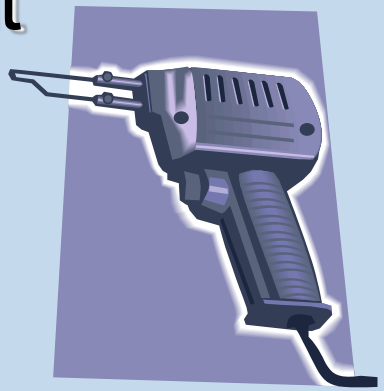
# Hazards



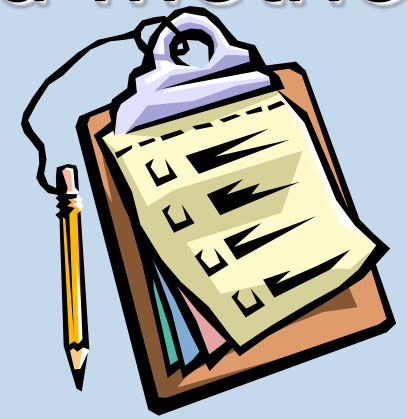
- The project can be done safely and successfully, but a few hazards must be clearly recognized, understood, and mitigated.
- Safety of the students is NASA's first priority and must never be compromised.
- There are many resources available to help with this concern.

# Hazard Examples

- Adhesives, solvents, and paint
- Black Powder and solid propellant
- Use of Tools
- Launch site failures
- Pressurized/cold hybrid systems
- Other hazards associated with a particular design



# Safety Resources and Methods



- NAR Safety Codes and Mentors
- NAR certifications and training
- Material Safety Data Sheets
- Operators Manuals
- Development and adherence to assembly and launch procedures
- Equipment, such as goggles, gloves, sturdy shoes, hard hats, cotton clothing, fire extinguishers
- Environment, such as good ventilation, restricting cell phones around electric matches
- Planning and communication; designate someone responsible to look at activities from a safety perspective
- Use the buddy system

# Examples of Tables to Include in PDR, CDR, FRR

| Hazard | Effect of Hazard | Mitigation |
|---|---|---|
| Chemicals in paint, solvent, adhesive | Possible respiratory and skin irritation | Read MSDS for precautions; wear gloves; have good ventilation |
| Ignition of black powder or other pyrotechnic or explosive compounds | Fire, damage to equipment, personal injury | Follow safety rules; wear cotton clothing; do not smoke or have other static or spark producing items in the area |
| Use of power tools | Cuts or other injuries, damage to equipment, flying debris | Follow manufacturer's safety instructions; wear goggles; do not operate without supervision |
| Misfire, hangfire on launch pad | Rocket may not be safe to approach | Write procedures to plan for this contingency and follow; be patient and wait; consult with experts |

# Mission Success

- Mission Success is the result of attention to detail, and a thorough, honest assessment of risks, failure modes and hazards.
- Failure is often the best teacher, so plan to test as much as possible.
- Teamwork and communication are essential for a successful project.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# Understanding MSDS's



By: Jeff Mitchell
MSFC Environmental Health

# What is an MSDS?

- A Material Safety Data Sheet (MSDS) is a document produced by a manufacturer of a particular chemical and is intended to give a comprehensive overview of how to safely work with or handle this chemical

# What is an MSDS?

- MSDS's do not have a standard format, but they are all required to have certain information per OSHA 29 CFR 1910.1200
- Manufacturers of chemicals fulfill the requirements of this OSHA standard in different ways

# Required data for MSDS's

- Identity of hazardous chemical
- Chemical and common names
- Physical and chemical characteristics
- Physical hazards
- Health hazards
- Routes of entry
- Exposure limits

# Required data for MSDS's (Cont.)

- Carcinogenicity
- Procedures for safe handling and use
- Control measures
- Emergency and First-aid procedures
- Date of last MSDS update
- Manufacturer's name, address, and phone number

# Important Agencies

- ACGIH
  - The American Conference of Governmental Industrial Hygienist develop and publish occupational exposure limits for many chemicals, these limits are called TLV's (Threshold Limit Values)

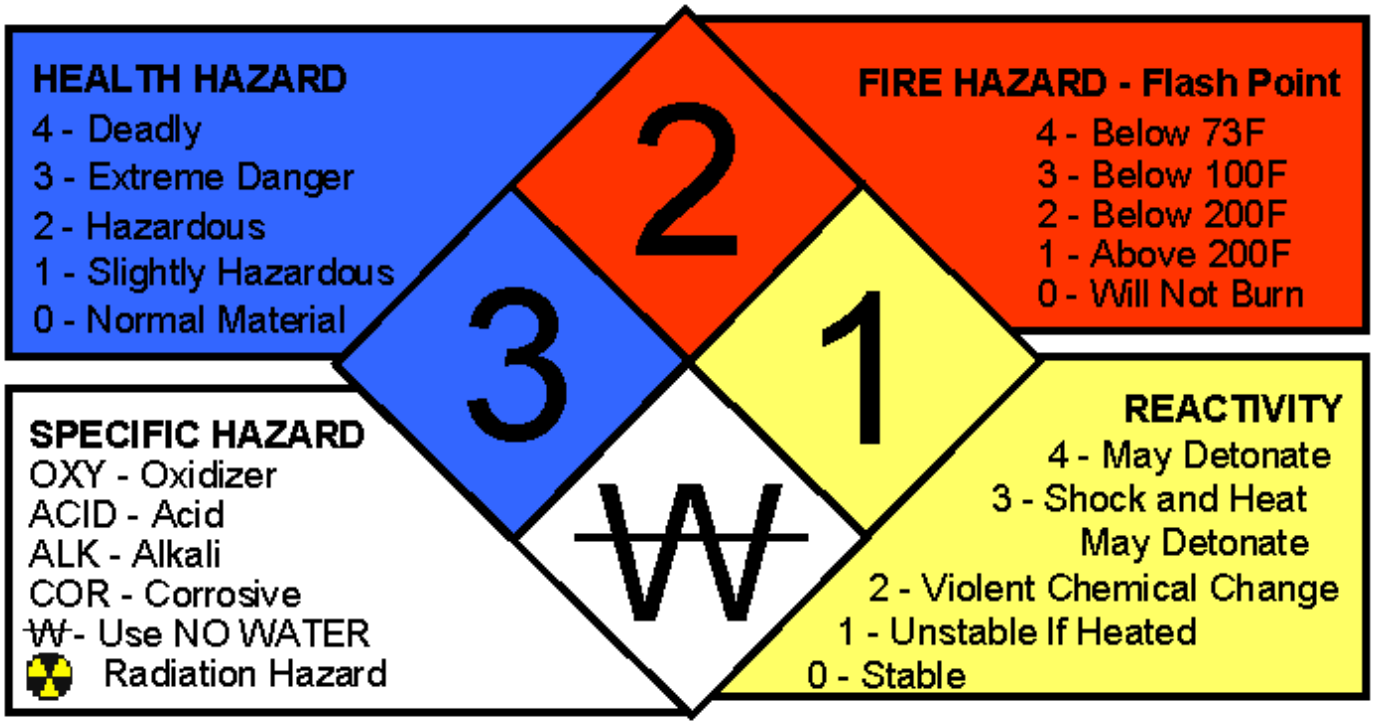
# Important Agencies (Cont.)

- ANSI
  - The American National Standards Institute is a private organization that identifies industrial and public national consensus standards that relate to safe design and performance of equipment and practices

# Important Agencies (Cont.)

- NFPA
  - The National Fire Protection Association, among other things, established a rating system used on many labels of hazardous chemicals called the NFPA Diamond
  - The NFPA Diamond gives concise information on the Health hazard, Flammability hazard, Reactivity hazard, and Special precautions
  - An example of the NFPA Diamond is on the next slide

# NFPA Diamond



# Important Agencies (Cont.)

- NIOSH
  - The National Institute of Occupational Safety and Health is an agency of the Public Health Service that tests and certifies respiratory and air sampling devices.  It also investigates incidents and researches occupational safety

# Important Agencies (Cont.)

- OSHA
  - The Occupational Safety and Health Administration is a Federal Agency with the mission to make sure that the safety and health concerns of all American workers are being met

# Exposure Limits

- Occupational exposure limits are set by different agencies
- Occupational exposure limits are designed to reflect a safe level of exposure
- Personnel exposure above the exposure limits is not considered safe

# Exposure Limits (Cont.)

- OSHA calls their exposure limits, PEL's, which stands for Permissible Exposure Limit
  - OSHA PEL's rarely change
- ACGIH, establishes TLV's, which stands for Threshold Limit Values
  - ACGIH TLV's are updated annually

# Exposure Limits (Cont.)

- A Ceiling limit (noted by C) is a concentration that shall never be exceeded at any time
- An IDLH atmosphere is one where the concentration of a chemical is high enough that it may be Immediately Dangerous to Life and Health

# Exposure Limits (Cont.)

- A STEL, is a Short Term Exposure Limit and is used to reflect a 15 minute exposure time
- A TWA, is a Time Weighted Average and is used to reflect an 8 hour exposure time

# Chemical and Physical Properties

- Boiling Point
  - The temperature at which the chemical changes from liquid phase to vapor phase
- Melting Point
  - The temperature at which the chemical changes from solid phase to liquid phase
- Vapor Pressure
  - The pressure of a vapor in equilibrium with its non-vapor phases. Most often the term is used to describe a liquid's tendency to evaporate
- Vapor Density
  - This is used to help determine if the vapor will rise or fall in air
- Viscosity
  - It is commonly perceived as "thickness", or resistance to pouring. A higher viscosity equals a thicker liquid

# Chemical and Physical Properties (Cont.)

- Specific Gravity
  - This is used to help determine if the liquid will float or sink in water
- Solubility
  - This is the amount of a solute that will dissolve in a specific solvent under given conditions
- Odor threshold
  - The lowest concentration at which most people may smell the chemical
- Flash point
  - The lowest temperature at which the chemical can form an ignitable mixture with air
- Upper (UEL) and lower explosive limits (LEL)
  - At concentrations in air below the LEL there is not enough fuel to continue an explosion; at concentrations above the UEL the fuel has displaced so much air that there is not enough oxygen to begin a reaction

# Things you should learn from MSDS's

- Is this chemical hazardous?
  - Read the Health Hazard section
- What will happen if I am exposed?
  - There is usually a section called Symptoms of Exposure under Health Hazard
- What should I do if I am overexposed?
  - Read Emergency and First-aid procedures
- How can I protect myself from exposure?
  - Read Routes of Entry, Procedures for safe handling and use, and Control measures

# Take your time!

- Since MSDS's don't have a standard format, what you are seeking may not be in the first place you look
- Study your MSDS's before there is a problem so you aren't rushed
- Read the entire MSDS, because information in one location may compliment information in another

# The following slides are an abbreviated version of a real MSDS



Study it and become more familiar with this chemical

# MSDS: METHYL ETHYL KETONE

Abbreviated MSDS

## SECTION 1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
1-800-635-0064 OR
1-510-895-1313

Manufacturer name and phone #

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 78-93-3
RTECS NUMBER: EL6475000
EU NUMBER (EINECS):
201-159-0
EU INDEX NUMBER:
606-002-00-3

SUBSTANCE: METHYL ETHYL KETONE

TRADE NAMES/SYNONYMS:
BUTANONE; 2-BUTANONE; ETHYL METHYL KETONE; METHYL ACETONE; 3-BUTANONE; MEK; SCOTCH-GRIP ® BRAND SOLVENT #3 (3M); STOP, SHIELD, PEEL REDUCER (PYRAMID PLASTICS, INC.); STABOND C-THINNER (STABOND CORP.); OATEY CLEANER (OATEY COMPANY); RCRA U159; UN1193; STCC 4909243; C4H8O; OHS14460

Last revision

CHEMICAL FAMILY:
Ketones, aliphatic

CREATION DATE: Sep 28 1984
REVISION DATE: Mar 30 1997

## SECTION 2. COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT: METHYL ETHYL KETONE
CAS NUMBER: 78-93-3
PERCENTAGE: 100

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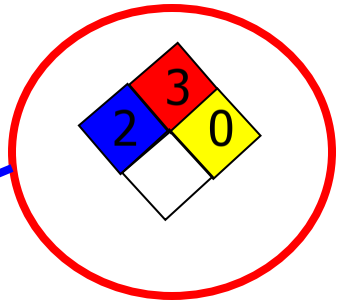
## SECTION 3. HAZARDS IDENTIFICATION

NFPA RATINGS (SCALE 0-4): Health=2 Fire=3 Reactivity=0




Good info for labeling containers

EMERGENCY OVERVIEW:
COLOR: colorless
PHYSICAL FORM: liquid
ODOR: minty, sweet odor
MAJOR HEALTH HAZARDS: respiratory tract irritation, skin irritation, eye irritation, central nervous system depression
PHYSICAL HAZARDS: Flammable liquid and vapor. Vapor may cause flash fire

POTENTIAL HEALTH EFFECTS:

What happens when exposed?

INHALATION:

SHORT TERM EXPOSURE: irritation, nausea, vomiting, difficulty breathing,

SKIN CONTACT:

SHORT TERM EXPOSURE: irritation

LONG TERM EXPOSURE: same as effects reported in short term exposure

EYE CONTACT…

INGESTION…

CARCINOGEN STATUS:

OSHA: N

NTP: N

IARC: N

Does it cause cancer?

---

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## SECTION 4. FIRST AID MEASURES

INHALATION…

SKIN CONTACT…

EYE CONTACT…

INGESTION…

What should you do if exposed?

---

## SECTION 5. FIRE FIGHTING MEASURES

## SECTION 6. ACCIDENTAL RELEASE MEASURES

AIR RELEASE:
Reduce vapors with water spray
SOIL RELEASE:
Dig holding area such as lagoon, pond or pit for containment. Absorb with…

---

## SECTION 7. HANDLING AND STORAGE

Store and handle in accordance …

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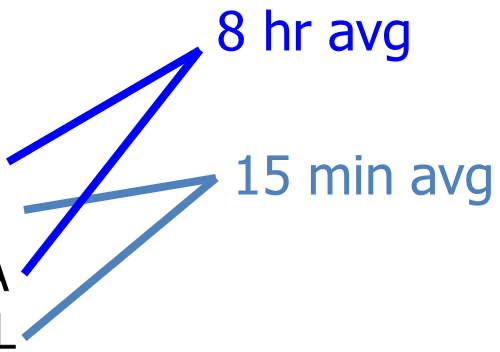
## SECTION 8. EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
METHYL ETHYL KETONE:

METHYL ETHYL KETONE:
200 ppm (590 mg/m3) OSHA TWA
300 ppm (885 mg/m3) OSHA STEL
200 ppm (590 mg/m3) ACGIH TWA
300 ppm (885 mg/m3) ACGIH STEL



# SECTION 9. PHYSICAL AND CHEMICAL PROPERTIES

COLOR: colorless
PHYSICAL FORM: liquid
ODOR: minty, sweet odor
MOLECULAR WEIGHT: 72.12
MOLECULAR FORMULA: C-H3-C-H2-C-O-C-H3
BOILING POINT: 176 F (80 C)
FREEZING POINT: -123 F (-86 C)
VAPOR PRESSURE: 100 mmHg @ 25 C
VAPOR DENSITY (air = 1): 2.5
SPECIFIC GRAVITY (water = 1): 0.8054
WATER SOLUBILITY: 27.5%
PH: No data available
VOLATILITY: No data available
ODOR THRESHOLD: 0.25-10 ppm
EVAPORATION RATE: 2.7 (ether = 1)
VISCOSITY: 0.40 cP @25 C
SOLVENT SOLUBILITY: alcohol, ether, benzene, acetone, oils, solvents

MYTH: if it smells bad it is harmful, if it smells good it is safe

MEK vapor is heavier than air

MEK liquid will float on stagnant water

Not very soluble in water

Will likely smell MEK before being overexposed

Goes to vapor easy

SECTION 10. STABILITY AND REACTIVITY

SECTION 11. TOXICOLOGICAL INFORMATION

SECTION 12. ECOLOGICAL INFORMATION

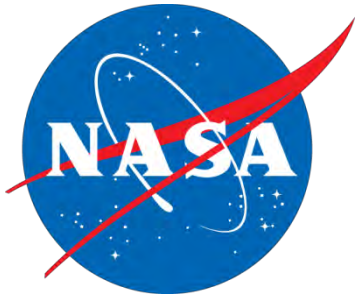
SECTION 13. DISPOSAL CONSIDERATIONS

SECTION 14. TRANSPORT INFORMATION

SECTION 15. REGULATORY INFORMATION

SECTION 16. OTHER INFORMATION

MSDS's have an abundance of information useful in many different aspects




**www.nasa.gov**

# Awards

# USLI Competition Awards

| Award: | Award Description: | Determined by: | When awarded: |
|---|---|---|---|
| **Vehicle Design Award** | Awarded to the team with the most creative and innovative overall vehicle design for their intended payload while still maximizing safety and efficiency. | USLI panel | Launch Day |
| **Payload Design Award** | Awarded to the team with the most creative and innovative payload design while maximizing safety and science value. | USLI panel | Launch Day |
| **SMD Payload Design Award** | Awarded to the team with the most creative and innovative reduced gravity payload design while maximizing safety and science value. | USLI panel | Launch Day |
| **Project Review (CDR/FRR) Award** | Awarded to the team that is viewed to have the best combination of written reviews and formal presentations | USLI panel | Launch Day |
| **Educational Engagement Award** | Awarded to the team that is determined to have best inspired the study of rocketry and other science, technology, engineering, and math (STEM) related topics in their community. This team not only presented a high number of activities to a large number of people, but also delivered quality activities to a wide range of audiences. | USLI panel | Launch Day |
| **Web Design Award** | Awarded to the team that has the best, most efficient Web site with all documentation posted on time. | USLI panel | Launch Day |
| **Altitude Award** | Awarded to the team that achieves the best altitude score according to the scoring rubric and listed requirements. | USLI panel | Launch Day |
| **Best Looking Rocket** | Awarded to the team that is judged by their peers to have the “Best Looking Rocket” | Peers | Launch Day |
| **Best Team Spirit Award** | Awarded to the team that is judged by their peers to display the “Best Team Spirit” on launch day. | Peers | Launch Day |
| **Rookie Award** | Awarded to the top overall rookie team using the same criteria as the Overall Winner Award. (Only given if the overall winner is not a rookie team). | USLI panel | May 17, 2013 |
| **Overall Winner** | Awarded to the top overall team. Design reviews, outreach, Web site, safety, and a successful flight will all factor into the Overall Winner. | USLI panel | May 17, 2013 |

# Procurement and Finances

# Procurement and Finances

In order to receive the NASA Student Launch Projects grant upon award, there are several important steps to take.

*Prior to awards, you can go ahead and do the following:

1. DUNS Number:
   The DUNS number is: Data Universal Numbering System.
   Go to: https://eupdate.dnb.com/requestoptions/government/ccrreg/
   Use Web site registration or contact by phone to receive a DUNS number within 48 hours.
   On the D&B Web site, it will ask for a Primary SIC: Standard Industrial Classification Code. The SIC code for Elementary and Secondary Schools is 8211. It will also ask for a primary contact (principal) and the number of employees.

2. Cage Code: (Takes about 1 hour to complete.)
   Cage Code Web site: https://www.bpn.gov/ccr/

3. “Offerer Representations and Certifications”:
   You will need the DUNS number and your MPIN to fill out the Reps and Certs form. The MPIN is a 9-digit code containing at least one alpha character and one number, created by you in your CCR record
   The Reps and Certs Web site: www.bpn.gov/orca.

4. Payment Information Form
   This form must be submitted as soon as award is granted. This will allow for direct deposit of funds after each invoice is submitted.

*If your school or organization is selected to participate in the NASA Student Launch Projects, look closely at the following forms:

a. Consideration and Payment sheet
   This sheet will show the payment break-down. Note that anytime the words “Contractor” or “Offerer” appears, this is referring to YOU or the SCHOOL. Invoices should be sent upon completion of each mile-stone.

b. Delivery Schedule will provide due dates.

c. Solicitation Contract/Order for Commercial Items
   This page will contain contact information for contract questions (located in boxes 9 and 16) and financial questions (located in box 18a). Box 4 “Order Number” is your reference number for all communications with Office of Procurement and Office of Finance. Invoices should be submitted to the address in box 18a.

# Information Needed to Register (Cage Code)

* Items are mandatory

## General Information

* **Data Universal Numbering System (D-U-N-S) Number:** The Data Universal Numbering System (D-U-N-S) Number is a unique nine-character identification number provided by the commercial company Dun & Bradstreet (D&B). Call D&B at 1-866-705-5711 or access their Web site at http://ccr.dnb.com/ccr/pages/CCRSearch.jsp if you do not have a D-U-N-S Number. The process to request a D-U-N-S Number via phone takes about 10 minutes and is free of charge. Internet requests are fulfilled within 24 hours. Once a D-U-N-S Number has been issued, it will be available for use in CCR within 24 hours.

You must have a different nine-digit D-U-N-S Number for each physical location or different address in your company as well as each legal division that may be co-located. When entering your D-U-N-S Number, enter only the numbers; do not include dashes. As a result of obtaining a D-U-N-S Number, you might be included on D&B's marketing list that is sold to other companies. If you do not want your name or company name included on this marketing list, D&B has asked that you contact them anytime at the same numbers noted above to request they be removed.

**D-U-N-S +4:** The use of D-U-N-S+4 Numbers to identify vendors is limited to identifying different CCR records for the same vendor at the same physical location. For example, a vendor could have two records for themselves at the same physical location to identify two separate bank accounts. (Vendors wishing to register their subsidiaries and other entities should ensure that each additional location obtains a separate D-U-N-S Number from Dun & Bradstreet at 1-866-705-5711.)

**CAGE Code:** The Commercial and Government Entity (CAGE) Code is a five-character ID number used extensively within the federal government. Vendors with a U.S. address may submit the application without a CAGE Code if they do not have one. If your application does not contain a CAGE Code, one will be assigned to you. The CCR registration process will also verify existing CAGE Codes for all applicants. To speed up the process, make every effort to use a current CAGE Code in your application. You must have a separate CAGE Code for each physical location and separate division at the same physical location. Each separate CCR registration must have its own CAGE Code. If you think you have a CAGE Code, search the DLIS CAGE Web at http://www.dlis.dla.mil/cage_welcome.asp.

Note: Vendors located outside of the U.S. are required to include an NCAGE Code on the registration, or it will be considered incomplete.

* Legal Business Name and Doing Business As (DBA): Enter the legal name by which you are incorporated and pay taxes. If you commonly use another name, such as a franchise or licensee name, then include that in the DBA space below the Legal Business Name. Your legal business name as entered on the CCR registration MUST match the legal business name at Dun & Bradstreet. If the information does not match, your registration may be rejected during processing. Do not type "same" or "as shown above" in the DBA field.

* US Federal TIN: The Tax Identification Number (TIN) is the nine-digit number which is either an Employer Identification Number (EIN) assigned by the Internal Revenue Service (IRS) (http:www.irs.gov/businesses/small/article/0,,id=104331,00.html) or Social Security Number (SSN) assigned by the Social Security Administration (SSA) (http:/www.ssa.gov/replace_sscard.html).

If you do not know your TIN/EIN, contact the IRS at 1-866-255-0654 (Option 2). If you operate as an individual sole proprietorship, you may use your Social Security Number if you do not have a TIN/EIN. If you are located outside the United States and do not pay employees within the U.S., you are not required to provide a TIN. When entering your TIN (EIN or SSN) on the Web site enter only the numbers; do not include the dashes (Example: 123456789 not 123-45-6789)

Note: Authority: 31 U.S.C. 7701 (c) (3) Principal Purpose(s). The TIN may be used by the Federal Government to collect and report on delinquent amounts arising out of the offer's relationship with the Federal Government.

Note: As of October 30, 2005, all TINs will be validated by the IRS. You will not be allowed to have an active CCR registration without a validated TIN. The TIN matching process is a joint effort between the General Services Administration (GSA), Department of Defense (DOD), and the IRS to improve the quality of data in government acquisition systems. A notice has gone out to CCR registrants informing them of the IRS validation in CCR registration.

*In order to complete your CCR registration and qualify as a vendor eligible to bid for federal government contracts or apply for federal grants, the TIN and Taxpayer Name combination you provide in CCR must match exactly to the TIN and Taxpayer Name used in federal tax matters.*

It will take one to two business days to validate new and updated records prior to becoming active in CCR.

**Division Name and Number:** If you do business as a division of a larger company, use this space to indicate the proper name for your division. If a number identifier commonly distinguishes your division, enter that in the division number field. Otherwise, leave blank.
**Company URL:** If applicable, provide your company's homepage URL. Both upper and lower cases are acceptable.

* **Physical Street Address 1:** PO Box and c/o may not be used in this space. You must include a valid street address where your business is located. If you use a PO Box for correspondence, this may be included in the space allocated for "mailing address." Your street address, as entered on the CCR registration, MUST match the street address assigned to your D&B D-U-NS Number. If the information does not match, your registration may be rejected during processing. You may not register a branch of the business with the branch address and the headquarters D-U-N-S Number.

**Physical Street Address 2:** Use this space to continue your physical street address, if needed.

* **City, State, Zip:** The nine-digit zip code is mandatory. When entering the nine-digit zip code on the Web, enter numbers only; do not include the dash. (Example: 123456789 not 12345-6789)
* **Country:** Choose the appropriate country code abbreviation from the list provided.
* **Mailing Address Information:** If you are unable to receive mail at your physical address, enter a proper mailing address here. A Post Office Box is permissible. Any address used here will receive all CCR correspondence. If the Point of Contact is in a different location than the legal business address and wishes to receive the mail directly, please enter the appropriate address here.
* **Date Business Started:** Enter the date your business was started in its present form. This may be used to distinguish you from others with similar names. When entering the information on the Web site, you must enter as mm/dd/yyyy. (Example: 01/01/1995)
* **Fiscal Year End Close Date:** Enter the day on which you close your fiscal year. For example, if you use the calendar year, enter 12/31. When entering the information on the Web site, you must enter as mm/dd.

* **Average Number of Employees:** Be sure to provide accurate information about the number of employees for your business, as this value is part of determining your business size classification. The calculation must include the employees of all affiliates, not just your individual branch. For more information, see http://www.sba.gov/size.

* **Annual Revenue:** Be sure to provide accurate information about the three-year average annual revenue for your business, as this value is part of determining your business size classification. The calculation must include the revenue of *all affiliates*, not just your individual branch. For more information, see http://www.sba.gov/size. Annual revenue cannot be zero; you must enter a number. When entering revenue in the Web site, enter numbers only, no dollar signs or commas.

**Company Security Level:** If applicable, choose the correct level of security for the facility.

**Highest Employee Security Level:** If applicable, choose the security level of the employee with the highest employee security level at that facility.




# Frequently Asked Questions (FAQ)

**Who can see my records?**

ORCA records are considered public information. Anyone with access to the Internet, that knows your DUNS number, can search the archives to view an ORCA record.

**What is ORCA?**

Please refer to the Acquisition.gov website for an explanation. http://www.acquisition.gov/faqs_whatis.cfm

**Why was ORCA created?**

Prior to ORCA, vendors were required to submit Reps and Certs for each individual large purchase contract award. Now, using ORCA, a contractor can enter their Reps and Certs information once for use on all Federal contracts. This site not only benefits the contractor by allowing them to maintain an accurate and complete record but also the Contracting Officer as they can view every record, including archives, with the click of a mouse.

**Who needs to register in ORCA?**

You must be registered in ORCA if the solicitation you are responding to requires that you have an active registration in CCR.

**What is the difference between CCR and ORCA and why must I register in both systems?**

Central Contractor Registration (CCR) is the primary vendor database for the U.S. Federal Government. Since October 1, 2003, it is federally mandated that any business wishing to do business with the federal government under a FAR-based contract must be registered in CCR before being awarded a contract. In addition, vendors must maintain their CCR records annually.

Online Representations and Certifications Application (ORCA) replaces most of the paper based Representations and Certifications (Reps and Certs) in Section K of solicitations with an Internet application. FAR 52.204-8 mandates the use of ORCA on or after January 1, 2005.

CCR and ORCA are complimentary systems. ORCA reuses data pulled from CCR and pre-populates many of the required Representations and Certifications. Then, the vendor completes the remaining Reps and Certs with the understanding that with each solicitation they are certifying to current, accurate and complete information.

**Where do I register?**

ORCA is an on-line system that is located on the Internet. The ORCA site can be found by going to http://www.bpn.gov and clicking on "Online Reps and Certs Application" on the left side of the screen. If you do not have access to the Internet or feel you need extra Internet help please contact the Procurement Technical Assistance Center (PTAC) (www.dla.mil/db/procurem.htm) closest to you.

**What information will I need to complete my ORCA registration?**

Two items are needed prior to registration; (1) An active record in CCR, (2) An MPIN from that active CCR record. Visit www.ccr.gov to complete these tasks if you haven't already. More information about the questions asked in ORCA can be found in the ORCA Handbook.

**What is an MPIN?**

Please refer to the Acquisition.gov website for an explanation. http://www.acquisition.gov/faqs_whatis.cfm

**Why is there a questionnaire?**

The questionnaire is to help you gather information you need for the clauses. The questionnaire is not the official version. Be sure to read the clauses carefully.

**How often do I fill out the questionnaire?**

You need to update ORCA at least once a year. You can update or change your Reps and Certs information whenever necessary and the 365 day clock will start over from the day of change.

**Why does it say "See Section K" beside the NAICS codes and what does that mean?**

When it says "See Section K" beside your NAICS code, that means you have identified NAICS codes with exceptions and there are multiple criteria to determine size standard. SBA cannot pass to ORCA the information of a determination of small business classification for the NAICS codes with exceptions. Therefore, you must provide the contracting officer in writing a response to Section K of the solicitation with the provision number, NAICS code, small business classification, and a short explanation.

**Why is no signature required when I submit my Reps and Certs?**

Formal certification of ORCA data occurs when a vendor signs a solicitation. At that time a vendor is certifying that data in ORCA is current, accurate, and complete.

**Where can the SF 330 Part II be submitted electronically?**

The SF 330 Part II has been incorporated into the Online Representations and Certifications Application (ORCA). The ORCA link can be found at http://www.bpn.gov.

**Why was the SF 330 Part II incorporated in to ORCA?**

To ease the burden on vendors, the government determined that the qualifications of A-E firms could be easily submitted via an electronic method. ORCA was chosen as the place to collect and store the 330 Part II information. Now a vendor can enter ORCA at any time and supply both their reps and certs and 330 Part II information. Since the site is available 24/7 the vendor can enter, update or change any of their information with the click of a mouse. If there is no change to the information posted, a company record remains active for 365 days. When a change is made, that record is archived and the current record becomes activated and the expiration date is reset for another 365 days. This reduces time spent and paper collected by both the government and the vendor.

**Do I have to register my SF 330 Part II information in ORCA?**

Submission of the SF 330 Part II through ORCA is voluntary.

**On ORCA, I don't see a direct link to the SF 330 Part II information. Where do I add my information?**

Question number 24 on the ORCA questionnaire collects all SF 330 information. However, you must fill out all the other answers on the questionnaire, not just #24

**Do I have to answer all the Reps and Certs questions or just provide SF330 Part II information?**

Yes, you must answer all the Reps and Certs in order to provide any SF330 Part II information.

## 52.212-3 Offeror Representations and Certifications—Commercial Items.

As prescribed in 12.301(b)(2), insert the following provision:

OFFEROR REPRESENTATIONS AND CERTIFICATIONS—COMMERCIAL ITEMS (MAY 2011)

An offeror shall complete only paragraph (b) of this provision if the offeror has completed the annual representations and certifications electronically at http://orca.bpn.gov. If an offeror has not completed the annual representations and certifications electronically at the ORCA website, the offeror shall complete only paragraphs (c) through (o) of this provision.

(a) *Definitions*. As used in this provision—

"Economically disadvantaged women-owned small business (EDWOSB) concern" means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States and who are economically disadvantaged in accordance with 13 CFR part 127. It automatically qualifies as a women-owned small business eligible under the WOSB Program.

"Forced or indentured child labor" means all work or service—

(1) Exacted from any person under the age of 18 under the menace of any penalty for its nonperformance and for which the worker does not offer himself voluntarily; or

(2) Performed by any person under the age of 18 pursuant to a contract the enforcement of which can be accomplished by process or penalties.

"Inverted domestic corporation", as used in this section, means a foreign incorporated entity which is treated as an inverted domestic corporation under 6 U.S.C. 395(b), *i.e.*, a corporation that used to be incorporated in the United States, or used to be a partnership in the United States, but now is incorporated in a foreign country, or is a subsidiary whose parent corporation is incorporated in a foreign country, that meets the criteria specified in 6 U.S.C. 395(b), applied in accordance with the rules and definitions of 6 U.S.C. 395(c). An inverted domestic corporation as herein defined does not meet the definition of an inverted domestic corporation as defined by the Internal Revenue Code at 26 U.S.C. 7874.

"Manufactured end product" means any end product in Federal Supply Classes (FSC) 1000-9999, except—

(1) FSC 5510, Lumber and Related Basic Wood Materials;

(2) Federal Supply Group (FSG) 87, Agricultural Supplies;

(3) FSG 88, Live Animals;

(4) FSG 89, Food and Related Consumables;

(5) FSC 9410, Crude Grades of Plant Materials;

(6) FSC 9430, Miscellaneous Crude Animal Products, Inedible;

(7) FSC 9440, Miscellaneous Crude Agricultural and Forestry Products;

(8) FSC 9610, Ores;

(9) FSC 9620, Minerals, Natural and Synthetic; and

(10) FSC 9630, Additive Metal Materials.

"Place of manufacture" means the place where an end product is assembled out of components, or otherwise made or processed from raw materials into the finished product that is to be provided to the Government. If a product is disassembled and reassembled, the place of reassembly is not the place of manufacture.

“Restricted business operations” means business operations in Sudan that include power production activities, mineral extraction activities, oil-related activities, or the production of military equipment, as those terms are defined in the Sudan Accountability and Divestment Act of 2007 (Pub. L. 110-174). Restricted business operations do not include business operations that the person (as that term is defined in Section 2 of the Sudan Accountability and Divestment Act of 2007) conducting the business can demonstrate—

(1) Are conducted under contract directly and exclusively with the regional government of southern Sudan;

(2) Are conducted pursuant to specific authorization from the Office of Foreign Assets Control in the Department of the Treasury, or are expressly exempted under Federal law from the requirement to be conducted under such authorization;

(3) Consist of providing goods or services to marginalized populations of Sudan;

(4) Consist of providing goods or services to an internationally recognized peacekeeping force or humanitarian organization;

(5) Consist of providing goods or services that are used only to promote health or education; or

(6) Have been voluntarily suspended.

“Service-disabled veteran-owned small business concern”—

(1) Means a small business concern—

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a service-disabled veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

“Small business concern” means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and size standards in this solicitation.

“Subsidiary” means an entity in which more than 50 percent of the entity is owned—

(1) Directly by a parent corporation; or

(2) Through another subsidiary of a parent corporation.

“Veteran-owned small business concern” means a small business concern—

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

“Women-owned business concern” means a concern which is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

“Women-owned small business concern” means a small business concern—

(1) That is at least 51 percent owned by one or more women; or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

"Women-owned small business (WOSB) concern eligible under the WOSB Program" (in accordance with 13 CFR part 127), means a small business concern that is at least 51 percent directly and unconditionally owned by, and the management and daily business operations of which are controlled by, one or more women who are citizens of the United States.

(b)

(1) *Annual Representations and Certifications*. Any changes provided by the offeror in paragraph (b)(2) of this provision do not automatically change the representations and certifications posted on the Online Representations and Certifications Application (ORCA) website.

(2) The offeror has completed the annual representations and certifications electronically via the ORCA website at http://orca.bpn.gov. After reviewing the ORCA database information, the offeror verifies by submission of this offer that the representations and certifications currently posted electronically at FAR 52.212-3, Offeror Representations and Certifications—Commercial Items, have been entered or updated in the last 12 months, are current, accurate, complete, and applicable to this solicitation (including the business size standard applicable to the NAICS code referenced for this solicitation), as of the date of this offer and are incorporated in this offer by reference (see FAR 4.1201), except for paragraphs _____.

[*Offeror to identify the applicable paragraphs at (c) through (o) of this provision that the offeror has completed for the purposes of this solicitation only, if any.*

*These amended representation(s) and/or certification(s) are also incorporated in this offer and are current, accurate, and complete as of the date of this offer.*

*Any changes provided by the offeror are applicable to this solicitation only, and do not result in an update to the representations and certifications posted on ORCA*.]

(c) Offerors must complete the following representations when the resulting contract will be performed in the United States or its outlying areas. Check all that apply.

(1) *Small business concern*. The offeror represents as part of its offer that it ❑ is, ❑ is not a small business concern.

(2) *Veteran-owned small business concern*. [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision*.] The offeror represents as part of its offer that it ❑ is, ❑ is not a veteran-owned small business concern.

(3) *Service-disabled veteran-owned small business concern*. [*Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (c)(2) of this provision*.] The offeror represents as part of its offer that it ❑ is, ❑ is not a service-disabled veteran-owned small business concern.

(4) *Small disadvantaged business concern*. [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision*.] The offeror represents, for general statistical purposes, that it ❑ is, ❑ is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(5) *Women-owned small business concern*. [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision*.] The offeror represents that it ❑ is, ❑ is not a women-owned small business concern.

(6) WOSB concern eligible under the WOSB Program. *[Complete only if the offeror represented itself as a women-owned small business concern in paragraph (c)(5) of this provision.]* The offeror represents that—

(i) It ❑ is,❑ is not a WOSB concern eligible under the WOSB Program, has provided all the required documents to the WOSB Repository, and no change in circumstances or adverse decisions have been issued that affects its eligibility; and

(ii) It ❑ is, ❑ is not a joint venture that complies with the requirements of 13 CFR part 127, and the representation in paragraph (c)(6)(i) of this provision is accurate in reference to the WOSB concern or concerns that are participating in the joint venture. [*The offeror shall enter the name or names of the WOSB concern or concerns that are participating in the joint venture:* _____.] Each WOSB concern participating in the joint venture shall submit a separate signed copy of the WOSB representation.

(7) Economically disadvantaged women-owned small business (EDWOSB) concern. [*Complete only if the offeror represented itself as a WOSB concern eligible under the WOSB Program in (c)(6) of this provision.*] The offeror represents that—

(i) It ❑ is, ❑ is not an EDWOSB concern eligible under the WOSB Program, has provided all the required documents to the WOSB Repository, and no change in circumstances or adverse decisions have been issued that affects its eligibility; and

(ii) It ❑ is, ❑ is not a joint venture that complies with the requirements of 13 CFR part 127, and the representation in paragraph (c)(7)(i) of this provision is accurate in reference to the EDWOSB concern or concerns that are participating in the joint venture. The offeror shall enter the name or names of the EDWOSB concern or concerns that are participating in the joint venture: _____. Each EDWOSB concern participating in the joint venture shall submit a separate signed copy of the EDWOSB representation.

**Note:** Complete paragraphs (c)(8) and (c)(9) only if this solicitation is expected to exceed the simplified acquisition threshold.

(8) *Women-owned business concern (other than small business concern).* [*Complete only if the offeror is a women-owned business concern and did not represent itself as a small business concern in paragraph (c)(1) of this provision.*] The offeror represents that it ❑ is a women-owned business concern.

(9) *Tie bid priority for labor surplus area concerns*. If this is an invitation for bid, small business offerors may identify the labor surplus areas in which costs to be incurred on account of manufacturing or production (by offeror or first-tier subcontractors) amount to more than 50 percent of the contract price:_____

(10) [*Complete only if the solicitation contains the clause at FAR 52.219-23, Notice of Price Evaluation Adjustment for Small Disadvantaged Business Concerns, or FAR 52.219-25, Small Disadvantaged Business Participation Program—Disadvantaged Status and Reporting, and the offeror desires a benefit based on its disadvantaged status.*]

(i) *General.* The offeror represents that either—

(A) It ❑ is, ❑ is not certified by the Small Business Administration as a small disadvantaged business concern and identified, on the date of this representation, as a certified small disadvantaged business concern in the CCR Dynamic Small Business Search database maintained by the Small Business Administration, and that no material change in disadvantaged ownership and control has occurred since its certification, and, where the concern is owned by one or more individuals claiming disadvantaged status, the net worth of each individual upon whom the certification is based does not exceed $750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); or

(B) It ❑ has, ❑ has not submitted a completed application to the Small Business Administration or a Private Certifier to be certified as a small disadvantaged business concern in accordance with 13 CFR 124, Subpart B, and a decision on that application is pending, and that no material change in disadvantaged ownership and control has occurred since its application was submitted.

(ii) ❑ *Joint Ventures under the Price Evaluation Adjustment for Small Disadvantaged Business Concerns.* The offeror represents, as part of its offer, that it is a joint venture that complies with the requirements in 13 CFR 124.1002(f) and that the representation in paragraph (c)(10)(i) of this provision is accurate for the small disadvantaged business concern that is participating in the joint venture. [*The*

*offeror shall enter the name of the small disadvantaged business concern that is participating in the joint venture:* _____.]

(11) *HUBZone small business concern*. [*Complete only if the offeror represented itself as a small business concern in paragraph (c)(1) of this provision*.] The offeror represents, as part of its offer, that—

(i) It ❑ is, ❑ is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material changes in ownership and control, principal office, or HUBZone employee percentage have occurred since it was certified in accordance with 13 CFR Part 126; and

(ii) It ❑ is, ❑ is not a HUBZone joint venture that complies with the requirements of 13 CFR Part 126, and the representation in paragraph (c)(11)(i) of this provision is accurate for each HUBZone small business concern participating in the HUBZone joint venture. [The offeror shall enter the names of each of the HUBZone small business concerns participating in the HUBZone joint venture: _____.] Each HUBZone small business concern participating in the HUBZone joint venture shall submit a separate signed copy of the HUBZone representation.

(d) Representations required to implement provisions of Executive Order 11246—

(1) Previous contracts and compliance. The offeror represents that—

(i) It ❑ has, ❑ has not participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation; and

(ii) It ❑ has, ❑ has not filed all required compliance reports.

(2) *Affirmative Action Compliance*. The offeror represents that—

(i) It ❑ has developed and has on file, ❑ has not developed and does not have on file, at each establishment, affirmative action programs required by rules and regulations of the Secretary of Labor (41 cfr parts 60-1 and 60-2), or

(ii) It ❑ has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(e) *Certification Regarding Payments to Influence Federal Transactions (*31 U.S.C. 1352*)*. (Applies only if the contract is expected to exceed $150,000.) By submission of its offer, the offeror certifies to the best of its knowledge and belief that no Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress or an employee of a Member of Congress on his or her behalf in connection with the award of any resultant contract. If any registrants under the Lobbying Disclosure Act of 1995 have made a lobbying contact on behalf of the offeror with respect to this contract, the offeror shall complete and submit, with its offer, OMB Standard Form LLL, Disclosure of Lobbying Activities, to provide the name of the registrants. The offeror need not report regularly employed officers or employees of the offeror to whom payments of reasonable compensation were made.

(f) *Buy American Act Certificate*. (Applies only if the clause at Federal Acquisition Regulation (FAR) 52.225-1, Buy American Act—Supplies, is included in this solicitation.)

(1) The offeror certifies that each end product, except those listed in paragraph (f)(2) of this provision, is a domestic end product and that for other than COTS items, the offeror has considered components of unknown origin to have been mined, produced, or manufactured outside the United States. The offeror shall list as foreign end products those end products manufactured in the United States that do not qualify as domestic end products, *i.e.*, an end product that is not a COTS item and does not meet the component test in paragraph (2) of the definition of “domestic end product.” The terms “commercially available off-the-shelf (COTS) item” “component,” “domestic end product,” “end product,” “foreign end product,” and “United States” are defined in the clause of this solicitation entitled “Buy American Act—Supplies.”

(2) Foreign End Products:

| Line Item No. | Country of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

[*List as necessary*]

(3) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25.

(g)(1) *Buy American Act—Free Trade Agreements—Israeli Trade Act Certificate*. (Applies only if the clause at FAR 52.225-3, Buy American Act—Free Trade Agreements—Israeli Trade Act, is included in this solicitation.)

(i) The offeror certifies that each end product, except those listed in paragraph (g)(1)(ii) or (g)(1)(iii) of this provision, is a domestic end product and that for other than COTS items, the offeror has considered components of unknown origin to have been mined, produced, or manufactured outside the United States. The terms "Bahrainian, Moroccan, Omani, or Peruvian end product," "commercially available off-the-shelf (COTS) item," "component," "domestic end product," "end product," "foreign end product," "Free Trade Agreement country," "Free Trade Agreement country end product," "Israeli end product," and "United States" are defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements–Israeli Trade Act."

(ii) The offeror certifies that the following supplies are Free Trade Agreement country end products (other than Bahrainian, Moroccan, Omani, or Peruvian end products) or Israeli end products as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act":

Free Trade Agreement Country End Products (Other than Bahrainian, Moroccan, Omani, or Peruvian End Products) or Israeli End Products:

| Line Item No. | Country of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

[*List as necessary*]

(iii) The offeror shall list those supplies that are foreign end products (other than those listed in paragraph (g)(1)(ii) of this provision) as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act." The offeror shall list as other foreign end products those end products manufactured in the United States that do not qualify as domestic end products, *i.e.*, an end product that is not a COTS item and does not meet the component test in paragraph (2) of the definition of "domestic end product."

Other Foreign End Products:

| Line Item No. | Country of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

[*List as necessary*]

(iv) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25.

(2) *Buy American Act—Free Trade Agreements—Israeli Trade Act Certificate, Alternate I*. If Alternate I to the clause at FAR 52.225-3 is included in this solicitation, substitute the following paragraph (g)(1)(ii) for paragraph (g)(1)(ii) of the basic provision:

(g)(1)(ii) The offeror certifies that the following supplies are Canadian end products as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act":

Canadian End Products:

| Line Item No. |
|---|
| _____ |
| _____ |
| _____ |

[*List as necessary*]

(3) *Buy American Act—Free Trade Agreements—Israeli Trade Act Certificate, Alternate II*. If Alternate II to the clause at FAR 52.225-3 is included in this solicitation, substitute the following paragraph (g)(1)(ii) for paragraph (g)(1)(ii) of the basic provision:

(g)(1)(ii) The offeror certifies that the following supplies are Canadian end products or Israeli end products as defined in the clause of this solicitation entitled "Buy American Act—Free Trade Agreements—Israeli Trade Act":

Canadian or Israeli End Products:

| Line Item No. | Country of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

[*List as necessary*]

(4) *Trade Agreements Certificate*. (Applies only if the clause at FAR 52.225-5, Trade Agreements, is included in this solicitation.)

(i) The offeror certifies that each end product, except those listed in paragraph (g)(4)(ii) of this provision, is a U.S.-made or designated country end product, as defined in the clause of this solicitation entitled "Trade Agreements."

(ii) The offeror shall list as other end products those end products that are not U.S.-made or designated country end products.

Other End Products:

| Line Item No. | Country of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

[*List as necessary*]

(iii) The Government will evaluate offers in accordance with the policies and procedures of FAR Part 25. For line items covered by the WTO GPA, the Government will evaluate offers of U.S.-made

or designated country end products without regard to the restrictions of the Buy American Act. The Government will consider for award only offers of U.S.-made or designated country end products unless the Contracting Officer determines that there are no offers for such products or that the offers for such products are insufficient to fulfill the requirements of the solicitation.

(h) *Certification Regarding Responsibility Matters (Executive Order 12689*). (Applies only if the contract value is expected to exceed the simplified acquisition threshold.) The offeror certifies, to the best of its knowledge and belief, that the offeror and/or any of its principals—

(1) ❑ Are, ❑ are not presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(2) ❑ Have, ❑ have not, within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a Federal, state or local government contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, violating Federal criminal tax laws, or receiving stolen property;

(3) ❑ Are, ❑ are not presently indicted for, or otherwise criminally or civilly charged by a Government entity with, commission of any of these offenses enumerated in paragraph (h)(2) of this clause; and

(4) ❑ Have, ❑ have not, within a three-year period preceding this offer, been notified of any delinquent Federal taxes in an amount that exceeds $3,000 for which the liability remains unsatisfied.

(i) Taxes are considered delinquent if both of the following criteria apply:

(A) *The tax liability is finally determined*. The liability is finally determined if it has been assessed. A liability is not finally determined if there is a pending administrative or judicial challenge. In the case of a judicial challenge to the liability, the liability is not finally determined until all judicial appeal rights have been exhausted.

(B) *The taxpayer is delinquent in making payment*. A taxpayer is delinquent if the taxpayer has failed to pay the tax liability when full payment was due and required. A taxpayer is not delinquent in cases where enforced collection action is precluded.

(ii) *Examples*.

(A) The taxpayer has received a statutory notice of deficiency, under I.R.C. §6212, which entitles the taxpayer to seek Tax Court review of a proposed tax deficiency. This is not a delinquent tax because it is not a final tax liability. Should the taxpayer seek Tax Court review, this will not be a final tax liability until the taxpayer has exercised all judicial appeal rights.

(B) The IRS has filed a notice of Federal tax lien with respect to an assessed tax liability, and the taxpayer has been issued a notice under I.R.C. §6320 entitling the taxpayer to request a hearing with the IRS Office of Appeals contesting the lien filing, and to further appeal to the Tax Court if the IRS determines to sustain the lien filing. In the course of the hearing, the taxpayer is entitled to contest the underlying tax liability because the taxpayer has had no prior opportunity to contest the liability. This is not a delinquent tax because it is not a final tax liability. Should the taxpayer seek tax court review, this will not be a final tax liability until the taxpayer has exercised all judicial appeal rights.

(C) The taxpayer has entered into an installment agreement pursuant to I.R.C. §6159. The taxpayer is making timely payments and is in full compliance with the agreement terms. The taxpayer is not delinquent because the taxpayer is not currently required to make full payment.

(D) The taxpayer has filed for bankruptcy protection. The taxpayer is not delinquent because enforced collection action is stayed under 11 U.S.C. §362 (the Bankruptcy Code).

(i) Certification Regarding Knowledge of Child Labor for *Listed End Products (Executive Order 13126)*. [*The Contracting Officer must list in paragraph (i)(1) any end products being acquired under this solicitation that are included in the List of Products Requiring Contractor Certification as to Forced or Indentured Child Labor, unless excluded at* 22.1503*(b)*.]

(1) *Listed end products*.

| Listed End Product | Listed Countries of Origin |
|---|---|
| _____ | _____ |
| _____ | _____ |

(2) *Certification*. [*If the Contracting Officer has identified end products and countries of origin in paragraph (i)(1) of this provision, then the offeror must certify to either (i)(2)(i) or (i)(2)(ii) by checking the appropriate block*.]

[ ] (i) The offeror will not supply any end product listed in paragraph (i)(1) of this provision that was mined, produced, or manufactured in the corresponding country as listed for that product.

[ ] (ii) The offeror may supply an end product listed in paragraph (i)(1) of this provision that was mined, produced, or manufactured in the corresponding country as listed for that product. The offeror certifies that it has made a good faith effort to determine whether forced or indentured child labor was used to mine, produce, or manufacture any such end product furnished under this contract. On the basis of those efforts, the offeror certifies that it is not aware of any such use of child labor.

(j) *Place of manufacture.* (Does not apply unless the solicitation is predominantly for the acquisition of manufactured end products.) For statistical purposes only, the offeror shall indicate whether the place of manufacture of the end products it expects to provide in response to this solicitation is predominantly—

(1) ❑ In the United States (Check this box if the total anticipated price of offered end products manufactured in the United States exceeds the total anticipated price of offered end products manufactured outside the United States); or

(2) ❑ Outside the United States.

(k) *Certificates regarding exemptions from the application of the Service Contract Act.* (Certification by the offeror as to its compliance with respect to the contract also constitutes its certification as to compliance by its subcontractor if it subcontracts out the exempt services.) [*The contracting officer is to check a box to indicate if paragraph (k)(1) or (k)(2) applies.*]

[ ] (1) Maintenance, calibration, or repair of certain equipment as described in FAR 22.1003-4(c)(1). The offeror ❑ does ❑ does not certify that—

(i) The items of equipment to be serviced under this contract are used regularly for other than Governmental purposes and are sold or traded by the offeror (or subcontractor in the case of an exempt subcontract) in substantial quantities to the general public in the course of normal business operations;

(ii) The services will be furnished at prices which are, or are based on, established catalog or market prices (see FAR 22.1003-4(c)(2)(ii)) for the maintenance, calibration, or repair of such equipment; and

(iii) The compensation (wage and fringe benefits) plan for all service employees performing work under the contract will be the same as that used for these employees and equivalent employees servicing the same equipment of commercial customers.

[ ] (2) Certain services as described in FAR 22.1003-4(d)(1). The offeror ❑ does ❑ does not certify that—

(i) The services under the contract are offered and sold regularly to non-Governmental customers, and are provided by the offeror (or subcontractor in the case of an exempt subcontract) to the general public in substantial quantities in the course of normal business operations;

(ii) The contract services will be furnished at prices that are, or are based on, established catalog or market prices (see FAR 22.1003-4(d)(2)(iii));

(iii) Each service employee who will perform the services under the contract will spend only a small portion of his or her time (a monthly average of less than 20 percent of the available hours on an annualized basis, or less than 20 percent of available hours during the contract period if the contract period is less than a month) servicing the Government contract; and

(iv) The compensation (wage and fringe benefits) plan for all service employees performing work under the contract is the same as that used for these employees and equivalent employees servicing commercial customers.

(3) If paragraph (k)(1) or (k)(2) of this clause applies—

(i) If the offeror does not certify to the conditions in paragraph (k)(1) or (k)(2) and the Contracting Officer did not attach a Service Contract Act wage determination to the solicitation, the offeror shall notify the Contracting Officer as soon as possible; and

(ii) The Contracting Officer may not make an award to the offeror if the offeror fails to execute the certification in paragraph (k)(1) or (k)(2) of this clause or to contact the Contracting Officer as required in paragraph (k)(3)(i) of this clause.

(l) *Taxpayer Identification Number (TIN) (*26 U.S.C. 6109, *31 U.S.C. 7701)*. (Not applicable if the offeror is required to provide this information to a central contractor registration database to be eligible for award.)

(1) All offerors must submit the information required in paragraphs (l)(3) through (l)(5) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the Internal Revenue Service (IRS).

(2) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(3) *Taxpayer Identification Number (TIN)*.

❏ TIN: _____.

❏ TIN has been applied for.

❏ TIN is not required because:

❏ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

❏ Offeror is an agency or instrumentality of a foreign government;

❏ Offeror is an agency or instrumentality of the Federal Government.

(4) *Type of organization*.

❏ Sole proprietorship;

❏ Partnership;

❏ Corporate entity (not tax-exempt);

❏ Corporate entity (tax-exempt);

❏ Government entity (Federal, State, or local);

❏ Foreign government;

❏ International organization per 26 CFR 1.6049-4;

❏ Other _____.

(5) *Common parent*.

❑ Offeror is not owned or controlled by a common parent;

❑ Name and TIN of common parent:

Name _____.

TIN _____.

(m) *Restricted business operations in Sudan*. By submission of its offer, the offeror certifies that the offeror does not conduct any restricted business operations in Sudan.

(n) Prohibition on Contracting with Inverted Domestic Corporations.

(1) *Relation to Internal Revenue Code*. An inverted domestic corporation as herein defined does not meet the definition of an inverted domestic corporation as defined by the Internal Revenue Code 25 U.S.C. 7874.

(2) *Representation*. By submission of its offer, the offeror represents that—

(i) It is not an inverted domestic corporation; and

(ii) It is not a subsidiary of an inverted domestic corporation.

(o) Sanctioned activities relating to Iran.

(1) Unless a waiver is granted or an exception applies as provided in paragraph (o)(2) of this provision, by submission of its offer, the offeror certifies that the offeror, or any person owned or controlled by the offeror, does not engage in any activities for which sanctions may be imposed under section 5 of the Iran Sanctions Act of 1996.

(2) The certification requirement of paragraph (o)(1) of this provision does not apply if—

(i) This solicitation includes a trade agreements certification (*e.g.*, 52.212-3(g) or a comparable agency provision); and

(ii) The offeror has certified that all the offered products to be supplied are designated country end products.

(End of provision)

*Alternate I (Apr 2011).* As prescribed in 12.301(b)(2), add the following paragraph (c)(12) to the basic provision:

(12) (Complete if the offeror has represented itself as disadvantaged in paragraph (c)(4) or (c)(10) of this provision.)

[*The offeror shall check the category in which its ownership falls*]:

____ Black American.

____ Hispanic American.

____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

____ Individual/concern, other than one of the preceding.

*Alternate II (Apr 2011).* As prescribed in 12.301(b)(2), add the following paragraph (c)(10)(iii) to the basic provision:

(iii) *Address.* The offeror represents that its address ❑ is, ❑ is not in a region for which a small disadvantaged business procurement mechanism is authorized and its address has not changed since its certification as a small disadvantaged business concern or submission of its application for certification. The list of authorized small disadvantaged business procurement mechanisms and regions is posted at http://www.arnet.gov/References/sdbadjustments.htm. The offeror shall use the list in effect on the date of this solicitation. "Address," as used in this provision, means the address of the offeror as listed on the Small Business Administration's register of small disadvantaged business concerns or the address on the completed application that the concern has submitted to the Small Business Administration or a Private Certifier in accordance with 13 CFR Part 124, subpart B. For joint ventures, "address" refers to the address of the small disadvantaged business concern that is participating in the joint venture.

# Consideration and Payment

The Contractor shall be paid as follows. Acceptance as used herein is defined as the successful completion of required tasks and deliverables for the period covered.

| Payment | Milestone | Amount |
|---|---|---|
| 1 | Upon Award and Verification of Web presence | $1,500<br>($700)<br>[$780] |
| 2 | Successful completion of CDR | $1,600<br>($1,400)<br>[$1,400] |
| 3 | Successful completion of FRR | $400<br>($200)<br>[$400] |
| 4 | Successful completion of LRR and PLAR | $200<br>($100)<br>[$200] |
| **Total** | | **$3,700<br>($2,450)<br>[$2,780]** |

( ) denotes amounts payable to second year SLI teams.
[ ] denotes amounts payable to USLI SMD teams.

Invoices furnished by the contractor shall be submitted in triplicate to:

NASA Shared Services Center (NSSC)
Financial Management Division (FMD)- Accounts Payable
BLDG 1111, C. Road
Stennis Space Center, MS 39529
Email: NSSC-AccountsPayable@nasa.gov
Fax: 866-209-5414

OR

Electronic invoices may be submitted to:

NSSC-AccountsPayable@nasa.gov

An information copy shall be furnished to the following:

George C. Marshall Space Flight Center
Procurement Office, Attn: PS20 (Contract Specialist TBD)
Marshall Space Flight Center, AL 35812

Also send electronically to julie.d.clift@nasa.gov and edward.m.jeffries@nasa.gov

(End of clause)

# Delivery Schedule

The Contractor shall deliver the items required to be furnished by the contract as follows:

| Item No. | Description | Qty | Delivery Date | Email Address |
|---|---|---|---|---|
| 1 | Establish a Web presence | 1 | October 2012 | julie.d.clift@nasa.gov |
| 2 | Reports | 3 | November 2012<br>January 2013<br>March 2013 | same as above |
| 3 | Reusable rocket and science payload | 1 | April 2013 | same as above |
| 4 | PLAR | 1 | May 2013 | same as above |

(End of clause)

**SOLICITATION/CONTRACT/ORDER FOR COMMERCIAL ITEMS**
***OFFEROR TO COMPLETE BLOCKS 12, 17, 23, 24, & 30***

| 1. REQUISITION NUMBER | PAGE 1 OF |
|---|---|

| 2. CONTRACT NO. | 3. AWARD/EFFECTIVE DATE | 4. ORDER NUMBER | 5. SOLICITATION NUMBER | 6. SOLICITATION ISSUE DATE |
|---|---|---|---|---|
| | | | | |

| 7. FOR SOLICITATION INFORMATION CALL: | a. NAME | b. TELEPHONE NUMBER *(No collect calls)* | 8. OFFER DUE DATE/ LOCAL TIME |
|---|---|---|---|
| | | | |

| 9. ISSUED BY | CODE | 10. THIS ACQUISITION IS |
|---|---|---|
| | | ☐ UNRESTRICTED OR ☐ SET ASIDE: _____ % FOR:<br>☐ SMALL BUSINESS ☐ EMERGING SMALL BUSINESS<br>NAICS:<br>☐ HUBZONE SMALL BUSINESS<br>SIZE STANDARD:<br>☐ SERVICE-DISABLED VETERAN-OWNED SMALL BUSINESS ☐ 8 (A) |

| 11. DELIVERY FOR FOB DESTINATION UNLESS BLOCK IS MARKED | 12. DISCOUNT TERMS | 13a. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700) | 13b. RATING<br>14. METHOD OF SOLICITATION |
|---|---|---|---|
| ☐ SEE SCHEDULE | | | ☐ RFQ ☐ IFB ☐ RFP |

| 15. DELIVER TO | CODE | 16. ADMINISTERED BY | CODE |
|---|---|---|---|
| | | | |

| 17a. CONTRACTOR/ OFFEROR | CODE | FACILITY CODE | 18a. PAYMENT WILL BE MADE BY | CODE |
|---|---|---|---|---|
| TELEPHONE NO. | | | | |

| 17b. ☐ CHECK IF REMITTANCE IS DIFFERENT AND PUT SUCH ADDRESS IN OFFER | 18b. SUBMIT INVOICES TO ADDRESS SHOWN IN BLOCK 18a UNLESS BLOCK BELOW IS CHECKED ☐ SEE ADDENDUM |
|---|---|

| 19. ITEM NO. | 20. SCHEDULE OF SUPPLIES/SERVICES | 21. QUANTITY | 22. UNIT | 23. UNIT PRICE | 24. AMOUNT |
|---|---|---|---|---|---|
| | *(Use Reverse and/or Attach Additional Sheets as Necessary)* | | | | |

| 25. ACCOUNTING AND APPROPRIATION DATA | 26. TOTAL AWARD AMOUNT *(For Govt. Use Only)* |
|---|---|
| | |

☐ 27a. SOLICITATION INCORPORATES BY REFERENCE FAR 52.212-1, 52.212-4. FAR 52.212-3 AND 52.212-5 ARE ATTACHED. ADDENDA ☐ ARE ☐ ARE NOT ATTACHED

☐ 27b. CONTRACT/PURCHASE ORDER INCORPORATES BY REFERENCE FAR 52.212-4. FAR 52.212-5 IS ATTACHED. ADDENDA ☐ ARE ☐ ARE NOT ATTACHED

| ☐ 28. CONTRACTOR IS REQUIRED TO SIGN THIS DOCUMENT AND RETURN _____ COPIES TO ISSUING OFFICE. CONTRACTOR AGREES TO FURNISH AND DELIVER ALL ITEMS SET FORTH OR OTHERWISE IDENTIFIED ABOVE AND ON ANY ADDITIONAL SHEETS SUBJECT TO THE TERMS AND CONDITIONS SPECIFIED | ☐ 29. AWARD OF CONTRACT: REF. _____ OFFER DATED _____. YOUR OFFER ON SOLICITATION (BLOCK 5), INCLUDING ANY ADDITIONS OR CHANGES WHICH ARE SET FORTH HEREIN, IS ACCEPTED AS TO ITEMS: |
|---|---|

| 30a. SIGNATURE OF OFFEROR/CONTRACTOR | 31a. UNITED STATES OF AMERICA *(SIGNATURE OF CONTRACTING OFFICER)* |
|---|---|
| | |

| 30b. NAME AND TITLE OF SIGNER *(Type or print)* | 30c. DATE SIGNED | 31b. NAME OF CONTRACTING OFFICER *(Type or print)* | 31c. DATE SIGNED |
|---|---|---|---|
| | | | |

AUTHORIZED FOR LOCAL REPRODUCTION
PREVIOUS EDITION IS NOT USABLE

**STANDARD FORM 1449** (REV. 3/2005)
Prescribed by GSA - FAR (48 CFR) 53.212

| 19.<br>ITEM NO. | 20.<br>SCHEDULE OF SUPPLIES/SERVICES | 21.<br>QUANTITY | 22.<br>UNIT | 23.<br>UNIT PRICE | 24.<br>AMOUNT |
|---|---|---|---|---|---|
| | | | | | |

32a. QUANTITY IN COLUMN 21 HAS BEEN

☐ RECEIVED ☐ INSPECTED ☐ ACCEPTED, AND CONFORMS TO THE CONTRACT, EXCEPT AS NOTED: _____

| 32b. SIGNATURE OF AUTHORIZED GOVERNMENT REPRESENTATIVE | 32c. DATE | 32d. PRINTED NAME AND TITLE OF AUTHORIZED GOVERNMENT REPRESENTATIVE |
|---|---|---|
| | | |

| 32e. MAILING ADDRESS OF AUTHORIZED GOVERNMENT REPRESENTATIVE | 32f. TELPHONE NUMBER OF AUTHORZED GOVERNMENT REPRESENTATIVE<br><br>32g. E-MAIL OF AUTHORIZED GOVERNMENT REPRESENTATIVE |
|---|---|
| | |

| 33. SHIP NUMBER<br>☐ PARTIAL ☐ FINAL | 34. VOUCHER NUMBER | 35. AMOUNT VERIFIED CORRECT FOR | 36. PAYMENT<br>☐ COMPLETE ☐ PARTIAL ☐ FINAL | 37. CHECK NUMBER |
|---|---|---|---|---|
| | | | | |

| 38. S/R ACCOUNT NO. | 39. S/R VOUCHER NUMBER | 40. PAID BY |
|---|---|---|
| | | |

| 41a. I CERTIFY THIS ACCOUNT IS CORRECT AND PROPER FOR PAYMENT | | 42a. RECEIVED BY *(Print)* | |
|---|---|---|---|
| 41b. SIGNATURE AND TITLE OF CERTIFYING OFFICER | 41c. DATE | 42b. RECEIVED AT *(Location)* | |
| | | 42c. DATE REC'D *(YY/MM/DD)* | 42d. TOTAL CONTAINERS |

**STANDARD FORM 1449** (REV. 3/2005) **BACK**

OMB No. 1510-0056

# ACH VENDOR/MISCELLANEOUS PAYMENT ENROLLMENT FORM

This form is used for Automated Clearing House (ACH) payments with an addendum record that contains payment-related information processed through the Vendor Express Program. Recipients of these payments should bring this information to the attention of their financial institution when presenting this form for completion. See reverse for additional instructions.

## PRIVACY ACT STATEMENT

The following information is provided to comply with the Privacy Act of 1974 (P.L. 93-579). All information collected on this form is required under the provisions of 31 U.S.C. 3322 and 31 CFR 210. This information will be used by the Treasury Department to transmit payment data, by electronic means to vendor's financial institution. Failure to provide the requested information may delay or prevent the receipt of payments through the Automated Clearing House Payment System.

## AGENCY INFORMATION

| | | |
|---|---|---|
| FEDERAL PROGRAM AGENCY | | |
| AGENCY IDENTIFIER: | AGENCY LOCATION CODE (ALC): | ACH FORMAT: ☐ CCD+ ☐ CTX |
| ADDRESS: | | |
| | | |
| CONTACT PERSON NAME: | | TELEPHONE NUMBER: ( ) |
| ADDITIONAL INFORMATION: | | |

## PAYEE/COMPANY INFORMATION

| | |
|---|---|
| NAME | SSN NO. OR TAXPAYER ID NO. |
| ADDRESS | |
| | |
| CONTACT PERSON NAME: | TELEPHONE NUMBER: ( ) |

## FINANCIAL INSTITUTION INFORMATION

| | |
|---|---|
| NAME: | |
| ADDRESS: | |
| | |
| ACH COORDINATOR NAME: | TELEPHONE NUMBER: ( ) |
| NINE-DIGIT ROUTING TRANSIT NUMBER: ___ ___ ___ ___ ___ ___ ___ ___ ___ | |
| DEPOSITOR ACCOUNT TITLE: | |
| DEPOSITOR ACCOUNT NUMBER: | LOCKBOX NUMBER: |
| TYPE OF ACCOUNT: ☐ CHECKING ☐ SAVINGS ☐ LOCKBOX | |
| SIGNATURE AND TITLE OF AUTHORIZED OFFICIAL: (Could be the same as ACH Coordinator) | TELEPHONE NUMBER: ( ) |

## Instructions for Completing SF 3881 Form

Make three copies of form after completing. Copy 1 is the Agency Copy; copy 2 is the Payee/Company Copy; and copy 3 is the Financial Institution Copy.

1. Agency Information Section - Federal agency prints or types the name and address of the Federal program agency originating the vendor/miscellaneous payment, agency identifier, agency location code, contact person name and telephone number of the agency. Also, the appropriate box for ACH format is checked.

2. Payee/Company Information Section - Payee prints or types the name of the payee/company and address that will receive ACH vendor/miscellaneous payments, social security or taxpayer ID number, and contact person name and telephone number of the payee/company. Payee also verifies depositor account number, account title, and type of account entered by your financial institution in the Financial Institution Information Section.

3. Financial Institution Information Section - Financial institution prints or types the name and address of the payee/company's financial institution who will receive the ACH payment, ACH coordinator name and telephone number, nine-digit routing transit number, depositor (payee/company) account title and account number. Also, the box for type of account is checked, and the signature, title, and telephone number of the appropriate financial institution official are included.

## Burden Estimate Statement

The estimated average burden associated with this collection of information is 15 minutes per respondent or recordkeeper, depending on individual circumstances. Comments concerning the accuracy of this burden estimate and suggestions for reducing this burden should be directed to the Financial Management Service, Facilities Management Division, Property and Supply Branch, Room B-101, 3700 East West Highway, Hyattsville, MD 20782 and the Office of Management and Budget, Paperwork Reduction Project (1510-0056), Washington, DC 20503.

National Aeronautics and Space Administration

**George C. Marshall Space Flight Center**
Huntsville, AL 35812
www.nasa.gov/marshall

**www.nasa.gov**

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