NAR SAFETY OFFICER TRAINING PROGRAM

Introduction:

Model rocketry was created in the late 1950's as a means by which non-professional individuals could build and fly their own rocket powered models. The hobby was structured to safely pursue an activity that has a potential for personal injury and property damage. The use of manufactured motors to minimize the mixing and handling of propellants was a major factor in model rocketry's safety success. Safety procedures for the construction and operation of the models, based on aerospace industry practices, were another factor in this excellent safety record.

Hobby maturity and technology advancements permitted the use of more powerful motors and more sophisticated models. High power rocketry describes the step beyond model rocketry. Safety procedures for high power rocketry evolved from model rocketry. This document augments those safety procedures with practical guidance for individuals experienced in model rocketry and familiar with high power rocketry. The intent of this guidance is to assist individuals in performing safety officer functions on a high power rocket range. This guidance is based on experience, regulatory documents (e.g. FAA FAR Part 101), and codified practices (e.g. NFPA 1127). Note that regulatory or codified practices shall supercede guidance in this document if conflicts occur.

The primary safety officers are the Range Safety Officer (RSO) and the safety check-in officer. The RSO is responsible for safe operation of the rocketry range. The RSO shall have the final authority to approve or disapprove the launch of a vehicle. The safety check-in officer is responsible for verification of the vehicle flightworthiness. He will inspect the vehicles for structural integrity, systems condition (e.g. recovery system, motor restraint), motor certification, and dynamic properties (e.g. center of gravity, center of pressure).

Participants in this program will be required to complete tasks relevant to range safety. Individuals will share safety critical range positions with a mentor. Individuals performing mentored RSO or safety check-in functions must possess a high power certification (Levels 1, 2, or 3).

Mentors will be individuals who are both generally acknowledged to be competent in the safety critical roles and are currently certified to NAR level 2 or 3 (Proof of Tripoli certification is not adequate; Tripoli members must have a NAR Membership License showing their certification level). Mentors will observe and advise the participants while they apply suggested guidelines to real world situations.

The objective of this program is to educate NAR members by exposing them, with guidelines and mentors, to “real world” situations. These members, when acting as safety officers and instructing other NAR members, will increase the level of safety awareness at our launches to continue our legacy of safety in the rocketry hobby.

Requirements:

1.0 Specific Safety Check-in Officer Tasks Description

A) 20 check-ins required (Level 1 or 2)

B) A minimum of 6 models must be Level 2

C) 2 cluster model check-ins

D) 1 “staged” high power model check-in

E) 4 models w/ electronic recovery deployment systems check-ins

F) 3 post flight failure analyses

Requirements called out in C, D, and E above can be met at the same time as requirements in A and B

2.0 Range Safety Officer Tasks Description

A) 15 launches required (Level 1 or 2)

B) A minimum of 6 models must be Level 2 launches

C) 1 cluster model launch

D) 1 “staged” high power model launch

E) 2 model launches using electronic recovery deployment systems

F) 1 launch site evaluation required

Requirements called out in C, D, and E above can be met at the same time as requirements in A and B

Safety Check-in Officer Guidelines:

The items below offer guidance for the acceptance and rejection of models presented for inspection. In addition to the inspection, question the modeler about his model. Ask him if he has any worry areas and what, if anything, he has done to minimize that worry. Other questions may be directed towards specific features of the model. Ask if he has flown the model before with the installed motor and recovery system. If, for example, electronic recovery or staging are being attempted for the first time ask the modeler how he tested their operation prior to flight. If a lack of knowledge or skills is evident from the conversation then consider performing a more extensive inspection of the model.

Items A1 through A3 provide administrative guidance. Items A1 and A2 are necessary to assure compliance with Consumer Product Safety Commission (CPSC) and NFPA 1127 user requirements. Item A3 guidance is intended to assure compliance with the Federal Aviation Administration (FAA) Part 101 requirements.

A1) Is the modeler over 18? If not, the modeler cannot legally use high power motors, reloadable motors of any power class, or "G" motors. "G" motors and reloadable motors may be used if the individual is accompanied by a parent or legal guardian.

A2) Is the modeler certified to the power level being flown? Ask to see his membership card to verify the certification level. Make sure that the membership card is current. Note that some events will verify the certification level at registration. In that case, the person will have event identification showing the certification level. Individuals flying models meeting the following criteria will require high power certification:

a) Launches models containing multiple motors with a total installed impulse of 320.01 Newton-seconds or more, or

b) Launches models containing a single motor with a total installed impulse of 160.01 Newton-seconds or more, or

c) Launches rockets that weigh more than 53 ounces (1500 grams), or

d) Launches models powered by rocket motors not classified as model rocket motors per NFPA 1122, e.g.:

- Average thrust in excess of 80.0 Newtons
- Contains in excess of 2.2 ounces (62.5 grams) of propellant
- Hybrids

Note that some “F” and “G” motors fall into this category.

A3) Does the model fall within the FAA limitations? Models with less than 4 ounces of propellant and weighing less than 1 pound at launch do not require any additional interface with the FAA.

Models with 4 to 4.4 ounces of propellant or which weigh 1.0 to 3.3 pounds at launch require a notification to have been previously submitted to the FAA. Verify with the event director or RSO that the notification has been submitted prior to accepting these models. Models should be weighed prior to flight to verify that they fall within the weight limit. Motor data, typically available on certification lists, must be consulted to verify compliance with propellant limits.

Models containing in excess of 4.4 ounces of propellant or weighing over 3.3 pounds can only be flown with a FAA waiver. The waiver will specify a maximum altitude for flights. Verify with the event director or RSO that a waiver has been approved prior to accepting these models. Models must be weighed and motor propellant weight determined to verify that the model needs a waiver for legal flight. The performance of the model must be evaluated to determine compliance with the waiver altitude limit. Tables listing the motor type and model diameter may be available to indicate a minimum weight for the model. Models under the minimum weight must add ballast or reduce power to stay within waiver limits. Computer software may also be available on the field to estimate performance.

When estimating performance be conservative by using a lower value for the drag coefficient (C_D). Most airframes will have a C_D between 0.65 and 0.75. Use a C_D value between 0.45 and 0.50 for a conservative estimate of airframe performance.

Cluster combinations will not be addressed on most performance tables. A computer simulation will provide the best estimate of model performance. If a simulation prediction is not available then total the impulse of all motors and the average thrust of all motors. Use this number to identify a similar single motor model for comparison. If the model performance is within 15% of the waiver altitude limit do not permit it to fly without a higher fidelity prediction. Staged models have a similar issue. Since staged models will typically have less drag and higher performance than clustered models the method described above is less reliable. Use the method suggested for evaluating clusters but allow a larger margin for error; if the model is within 25% of the waiver altitude limit do not permit it to fly without a higher fidelity prediction.

Items A4 through A7 concern the rocket motor(s). The NAR safety code requires the use of certified rocket motors. Item A4 addresses this requirement. Items A5 and A6 are intended to verify the correctness of the motor choice and to identify potential safety hazards associated with the igniter. Item A7 addresses a potential hazard with some reloadable designs.

A4) Is the motor certified? Certification lists are available on the Internet or in publications from the certifying organizations. Verify the motor certification status by consulting the certification lists. Note that certification status may not extend to all delays within a motor type.

A5) Is the motor or motors adequate to safely fly the model? If available, consult the manufacturer's recommended liftoff weight. Model drag and weather conditions should be considered. High drag models (caused by basic model design, poor finish) will not go as high as streamlined models. Low average thrust motors in windy conditions allow more weathercocking of the model. The altitude may be limited due to weathercocking and the delay may be too long. Remember that motors with longer delays have lower recommended liftoff weights than the same motor with a shorter delay. If still in doubt, ask the modeler for his performance predictions and the prediction method for the model.

A6) Is the igniter a low current type? Flash bulbs and electric match current requirements are low enough that some launch systems my set them off with continuity power. Verify with the RSO or LCO whether the launch system is "flash bulb safe". Annotate flight cards if required to show the presence of a low current igniter.

A7) Ask the modeler if he is using the motor ejection charge. If he is, verify that he installed the black powder. Also, some motors rely on a tape disk to retain the powder in its cavity. Disks with dry adhesive or lubricant contamination on the forward face of the cavity may reduce the paper disk adhesion. Deceleration forces may cause the paper disk to come free and disperse the black powder. This will cause an ejection failure. It is suggested that the modeler backup the paper disk with masking tape around the edge to prevent it from coming free.

Items B1 through B8 cover the inspection of the basic model structure and recovery system. The check-in officer will need to handle the model during this phase of the inspection. Ask the model builder if there are any safety hazards, e.g. electronic systems, which may be activated while handling the model. The check-in officer needs to use his judgement when pulling and pushing on model parts; the effort needs to be sufficient to find marginal installations or construction but not so great as to damage a properly built model.

B1) Examine all "slip-fits", e.g. nosecone or payload shoulder, which are intended to separate in flight.

Turn the model nose down. It is unacceptable if the nosecone (or payload) can separate under their own weight. If it does, the nosecone (or payload) may "drag separate" just after motor burnout. Drag separation typically occurs at the highest velocity; the effect is often recovery system failure from excessive loads. A loose nose cone (or payload) can be tightened by the addition of tape to the shoulder.

Does the nosecone (or payload) slide free without excessive effort? A tight nosecone (or payload) can be caused by several problems. Paint overspray in the tube or on the shoulder may cause stickiness in the sliding area. A light sanding or a dusting with talcum powder can reduce the stickiness or remove the overspray. A burr may also form at the edge of the body tube. Again, a light sanding can correct the problem.

Check that the nosecone, if used as part of a payload section, is firmly installed. The object is to prevent loss of the nosecone and the payload contents in flight.

Consider the comment "it's flown before" with caution. Temperature and humidity affect the fit of airframe parts (parts swell or contract, finishes may soften in the heat). A smooth fit in an Arizona winter may become a test of muscle and patience in an Alabama summer.

B2) Examine the launch lugs. Are the launch lugs firmly attached to the model without evidence of cracking in the joints? Are the lugs adequately sized for the model?

Suggestions are 1/4" minimum for models up to 3.3 pounds; 3/8" to 1/2" lugs for models up to 20 pounds, 3/4' or larger lugs for models over 20 pounds. Single launch lugs should be at least 6 inches long and mounted at the model's CG. 2 lugs, each spaced a minimum of 2 body tube diameters from the CG are preferred. The separated lugs are preferred because they better resist rotation (from winds) of the model on the launch rod. Rotation of the model on the launch rod may cause binding during launch.

Check the lugs for paint buildup or burrs inside the lug(s). Paint or burrs may cause binding on the launch rod. A rolled sheet of sandpaper can be used to remove burrs or paint.

B3) Examine the fins. Are the fins mounted parallel to the roll axis of the model? Attempt to wiggle the fins at their tips. There should be no movement and minimal deflection. If the fins deflect is the fin material appropriate for the model? Models powered by H, I, or J motors should use 1/8" plywood or fiberglass at a minimum. Higher powered models and high aspect ratio fins (large fin span versus fin chord) require additional strength to resist launch loads and possible flutter problems. Laminated or built-up fins should be checked for delaminations. Bubbles may indicate delaminations. Tapping the fin with a heavy coin (e.g. half-dollar) will give a "dead" thud if a delamination is present. Examine the fin roots for cracks; minor "hairline" cracks may be acceptable if the fins are not loose or if the fins are mounted using "through the wall" construction. Check the fins for warpage; their should be little, if any, warpage.

B4) Examine the engine installation. Verify, if possible, that the engine is what the flight card indicates. If in doubt, ask that the engine be removed from the model. Pull on the motor to make sure it is firmly restrained in the model. If the motor is friction fitted then it should not move when strongly pulled. A positive means of engine retention, e.g. motor clip, bolted washers, is preferred. Verify that the motor cannot deflect the retention device and then eject. A wrap of tape around motor clip(s) to restrain the them against the motor is suggested.

B5) Can the motor "fly through" the model? Push on the nozzle end of the motor. The motor should not move forward in its mount nor should the mount move within the model. Try to determine the type and quantity of adhesive used in construction. Any evidence of "hot melt" adhesives should make the model suspect. Motor mounts should typically be mounted with epoxy adhesives with a sufficient quantity to form fillets at the centering ring to body tube joints.

B6) Is the model stable? Find the CG (center of gravity) of the flight ready model (motors installed, recovery system packed) by finding the model balance point. Where is the CG relative to the leading edge of the fins? On a single staged model with only a rear set of fins the CG should typically be forward of the forward root edge of the fins.

Canards, wings, forward swept fins, and strakes will require the CG to be further forward. Multi-staged models must be evaluated for each stage. Ask the modeler to show the CP (center of pressure) location on the model (and less each stage for a staged model). Request to see the calculations if in doubt. The CG must be a least one body tube diameter forward of the CP in each flight phase. Note that a subscale model may, in most cases, also be flown to show stability of the full size model.

Hybrid powered models must also be examined carefully for stability. Unlike most solid fueled models the CG of a hybrid model may actually move aft during flight. The rearward CG shift may destabilize the model. To be conservative, determine

the CG of a hybrid model with the solid fuel component in place but without the oxidizer loaded.

B7) If the model appears neglected or of marginal construction or the builder does not display good knowledge of model practices ask to inspect the recovery system. Pull on the shock cord several times. The shock cord must not be cracked, cut, frayed, or burnt. Discoloration from ejection operation is typically not a problem. Make sure that the shock cord is securely mounted in the model. Make sure any knots in the recovery system will not loosen or slip. Recovery system hardware, including screw eyes and swivels, needs to be strong enough for recovery loads, mounted to solid structure as necessary, and all fasteners are tight. Inspect “quick links” to verify that they are not likely to pull apart under recover loads. Is parachute protection from the ejection charge adequate and nonflammable? Verify that the parachute is undamaged including no loose suspension lines and no tears or burns which may spread during recovery. Is non-flammable, bio-degradable (no fiberglass) wadding being used?

B8) Does the booster section have a vent hole? Typically, a 1/8 to 3/16 inch hole is drilled in the booster section just behind the nosecone or payload shoulder area. This hole is intended to vent the rocket internal pressure to the outside. It is recommended practice on high performance (high altitude) models because it prevents the internal pressure from prematurely separating the nosecone or payload section.

Items C1 through C4 concern check-in items peculiar to cluster models.

C1) If the model is a cluster look for any open holes between the motor mounting tubes. Are the holes sealed to prevent ejection charge gases from venting out?

C2) If black powder and composite motors are mixed in a cluster are the composite motors the first to be ignited? Composite motors are harder to ignite than black powder. The model must not separate from the ignition system before the composite motors are ignited.

C3) Are the motor igniters for the cluster wired in parallel (not in series)? Check for shorts which may prevent igniter function.

C4) Are the igniters "matched"? Igniters having different current requirements may not light at the same time. Igniters that light quickly may ignite their rocket motors prior to ignition of other motors in the cluster. The model may leave the pad before all the motors are started.

Items D1 through D6 concern the use of radio control equipment.

D1) If radio control is used for flight functions, is the operating frequency in the 27, 50, 53, or 72 megahertz bands? 72 megahertz radios using the "old" 2 color flag system for frequency identification are not legal. 75 megahertz frequencies may not be used for flight functions. Note that 27 megahertz usage, while legal, is discouraged due to the possible interference from citizen band (CB) radios.

D2) If using 50 or 53 megahertz does the operator have a valid Technician or higher (General, Extra, Advanced) ham license in his possession?

D3) Did the operator range check his equipment? A range check is performed by collapsing the transmitter antenna and walking away from the model while an observer watches the function of one of the radio controlled channels. Modern receivers will generally operate without glitches or loss of control between 75 and 100 feet from the transmitter.

D4) Does the operator have authorization to use the frequency? "Clothespin" frequency control and/or radio impound may be used to prevent unauthorized frequency use. Find out from the event director or RSO what the frequency control procedures are.

D5) Is the radio (transmitter) compliant with AMA narrow band guidelines? Older radios will have gold stickers on the radio. All radios built since 1991 will comply with the narrow band requirement even if they do not have gold stickers.

D6) Are receiver antennas protected from breakage (not flopping freely, do they have strain relief)?

Items E1 through E4 concern the use of electronic systems for parachute or staging operations. Item E4 addresses problems peculiar to the use of mercury switches. Although generally obsolete and unreliable, less sophisticated modelers may still attempt to use a mercury switch for staging.

E1) Ask if electronics are used in the model (e.g. for parachute deployment, staging). Examine the electronics for items that may dislodge (e.g. motor igniters) or break during flight. Are heavy items, e.g. batteries, adequately supported to prevent coming loose from "g" loads.

How did the modeler verify the functionality of his electronics? When was the last time the electronics were checked? Are the batteries fresh? If the recovery is altimeter based, has the modeler verified its operation, e.g. in a bell jar with a vacuum pump?

E2) Does the modeler expose himself to accidental discharge during arming/disarming the electronics? Do the electronics indicate whether or not they are armed?

E3) Does the modeler have a checklist or reminder to arm the system prior to flight and disarm the system upon landing?

E4) Does the model use mercury switches to initiate staging. Mercury switches rely on the deceleration after motor burnout to activate the upper stage. Some motors have a gradual thrust decay that will not provide a sufficiently "sharp" deceleration to activate the mercury switch. In this case the model will arc over in flight prior to upper stage ignition.

Verify that the modeler has chosen an motor with a "sharp" thrust decay. Verify that the modeler has some means by which to deactivate the system in the event of a flight failure or aborted launch.

Mercury is toxic. Most mercury switches use a relatively fragile glass envelope to contain the metal. The envelope can be made more rugged by shrinking a piece of heat shrink tubing over the switch and sealing the ends with epoxy.

Items F1 and F2 concern the launch pads. Modelers will occasionally use their own launch pads to support their models. Verifying the below items during check-in removes a potential burden from the RSO.

F1) If tower launchers are used verify that the model cannot "escape" from between the rails.

F2) Verify that modeler supplied launchers have blast deflectors to prevent exhaust impingement on the ground.

The safety check-in officer has no obligation to allow models to fly. If, in his best judgement, a model is unsafe then it shall not pass through check-in. If technical doubts are present then the safety check-in officer should consult with the range safety officer. Modeler's excuses, including long drives and event entry expenses should not compromise the safety check-in officer's decisions.

Range Safety Officer Guidelines:

Items G1 through G16 concern the basic range setup and facilities. The RSO should review the range setup prior to the start of launch activities to identify potential safety issues. The RSO also needs to be familiar with the location of safety equipment, e.g. fire extinguishers, first aid kit, and telephone.

G1) Is a means of measuring wind speed or getting weather reports available?

G2) Do all launch pads have blast deflectors to prevent exhaust impingement onto the ground? Do launch pads restrict travel of the launch rod to prevent angles greater than 20 degrees from the vertical? Are launch rods securely fastened to the launch pad to prevent lofting of the launch rod with the rocket? Are the launch rods unbent and clean to minimize the likelihood of a rocket binding on the pad?

Do the launch pad numbers match the numbers on the launch controller. Mismatches may allow confusion regarding which pad is active and cause the launch of the wrong model.

Are launch pad numbers visible from all directions? Visibility allows individuals to determine if they are near "hot" pads if they are approaching from outlying areas.

G3) Does launch equipment have sufficient current output to light igniters with large current demands? Clusters are a concern because multiple igniters in parallel will draw more current than single igniters.

G4) Is the launch controller "flashbulb safe"? Some igniters, e.g. flashbulbs and electric matches, have very low current requirements for ignition. Launch equipment, which is not flashbulb safe, will ignite these igniters with the continuity current flow. Continuity currents of 10 milli-amperes or less are generally considered flashbulb safe. This is a general guideline because there are no specified "no-fire" currents for flashbulbs. If a question exists about the safety of the launch control equipment a representative igniter (without motor) should be tested for the possibility of accidental ignition.

G5) Is the ground cleared of all flammable materials around the launch pad? If not, have provisions been made to water down the area to prevent fire? Launch areas will have to be periodically re-watered to compensate for evaporation. Minimum clear distances are 50 feet for "H" through "J" motors, 75 feet for "K" motors, 100 feet for "L" motors, and 125 feet for "M" through "O" motors.

G6) Are launch pads located away from personnel per the distances specified in the safety codes? Are barriers, e.g. flag lines, in place to prevent entry into launch areas? Is pad access planned to minimize personnel crossing launch control wiring or approaching other "hot" pads.

G7) Will the model trajectory cause models to land in spectator or non-participant areas? Remember that fin stabilized rockets will weathercock into the wind. Consider the trajectory possibilities for models which have recovery failures and those that drift in the wind after recovery. Where possible, locate spectator, preparation, and parking areas away from the likely impact points for recovery failures.

G8) Is fire fighting equipment available? Water is the preferred fire fighting agent for grass fires. An A:B:C: dry chemical extinguisher should also be available to fight electrical or fuel fires (e.g. gasoline from a generator). Does a fire fighting plan exist? At a minimum, all personnel on the range should be told to stop whatever preparations or launch activity they are doing and assist in containing a range fire.

G9) Are battery terminals protected from accidental shorts, which can cause a fire or battery explosion? If used, are 110 VAC supplies protected to prevent electrical shock (e.g. ground fault interrupter). Extension cord connections should be raised above wet grass. The use of 110 VAC power should be suspended in the event of rain.

G10) Is a first aid kit available? Are emergency telephone numbers for fire and ambulance easily available? Is a phone nearby to call for assistance?

G11) How are participants and spectators made aware of an incoming model? Public address announcements work but consider a siren or air horn as a heads up signal.

Some ranges use a broadcast band FM transmitter to allow reception of countdowns and range head information. Consider setting up inexpensive FM radios at the edges of the range area to make announcements more audible in those areas.

G12) Is smoking controlled? Safety codes prohibit smoking with 50 feet of launch and preparation areas. Be aware of other flammable materials on the site where smoking may be a hazard. Are "butt" cans available to prevent discards of lit smoking materials on the ground?

G13) If applicable, is the FAA waiver activated? Is a copy of the waiver available on the launch range? Do all participants know the waiver limits? Is a contact point and method (e.g. cellular phone) available to the FAA in the event of a problem?

G14) Does the RSO have a means of clearly and consistently communicating with the launch control officer (LCO)? The communications must be clear to allow coordination of pad access and launch permission.

G15) Are binoculars available to allow the RSO to better assess the safety of a airborne rocket?

G16) Where are models with electronic systems prepared/armed for flight? Is there a preparation/arming area positioned and/or isolated from event participants to minimize exposure in case of inadvertent activation of an upper stage or recovery system? Radio emissions can cause inadvertent electronic system activation. Are any controls in place for the use of radio transmitters around electronic staging or recovery systems?

Items H1 through H7 concern activities immediately prior to the launch of a rocket. The RSO should be constantly scanning the launch pad areas for personnel and skies for aircraft.

H1) Is the launch angle within 20 degrees of the vertical?

H2) Is the model stable on the launch pad? Verify that the model is not twisting around its launch lug in a manner that may cause binding on the launch pad. Verify that the model and launch rod are not “whipping” around in the wind. This may be indicative of too small a launch rod diameter. Does the launch rod look adequately

long for the model on the launch pad? How close is the upper launch lug to the end of the rod? Many 1/4 inch launch rods are at least 4 feet long; many 1/2 inch launch rods are at least 6 feet long.

H3) Are winds within safety code requirements (no greater than 20 miles per hour)? Staged models and models with large fin areas may weathercock significantly into the wind; consider the possible trajectories of such models before launch.

H4) Are spectators or modelers within the safe distance of the launch pad? Make sure that adjacent launch pad preparations are not too close to the active launch pad. Hold the launch until people are clear of the pads.

H5) Are the skies clear of aircraft? Ask for assistance from other launch participants to scan for aircraft. Has the tower or other FAA facility been notified of the launch if required by the waiver conditions?

H6) Is the model being launched a hybrid? Hybrid motors are more sensitive to ambient temperatures than solid rocket motors. Cold temperatures will significantly reduce performance as compared to a solid rocket motor. Consider giving launch priority to hybrid powered models because of their environmental sensitivity.

H7) Are required model electronics armed for flight? Are there any “Remove Before Flight” streamers hanging from the model? Does the modeler need to arm his electronics manually prior to launch; ask if he has done so? Are all umbilical and lanyard connections attached (or detached) as required for model operation?

Items J1 through J5 concern observations of the flight. The RSO should observe the model’s operation at least until the recovery system has fully operated and the rocket’s safe descent is verified. Even after verifying the rocket’s safe descent it should be periodically observed to ensure that its touchdown is not a threat to personnel or property.

J1) Are models penetrating the cloud cover? If models are penetrating the cloud cover there is a hazard to aircraft (and a violation of most FAA waivers). Identify the altitude where the cloud cover exists and modify the allowable power and weight requirements to prevent cloud penetration.

J2) Are models trajectories taking the models over spectator or parking areas? Adjust pad angles to prevent models from entering these areas.

J3) Remember that staged models will have multiple pieces requiring recovery. Observe all pieces to verify that their recovery systems have deployed. Warn range personnel if incoming parts are a hazard.

J4) Models with electronic recovery systems may have multiple deployment events. A drogue parachute may be deployed at apogee and a main parachute may be deployed at some preset distance above the ground. Observe the model to verify that all planned recovery events occur. Warn range personnel not to handle a model that has not completed all planned deployment events because live charges and armed electronics may present a hazard. Only the model builder or people familiar with the rocket’s systems should handle a model with electronic deployment after a flight.

J5) Is there a common thread to any flight failures, e.g. a particular modeler, model, or motor? Notify the check-in officer to prevent potential problems from reaching the launch pad.

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The range safety officer has no obligation to allow models to fly. If, in his best judgement, a model is unsafe then it shall not be permitted to fly. The range safety officer's decisions may not be appealed. The range safety officer may consult with other technically competent individuals prior to making a decision. Modeler's excuses, including long drives and event entry expenses, should not compromise the range safety officer's decisions.

Training Documentation:

The following pages will document your progress in completing the safety officer training. Print your name and NAR number at the top of each page. Volunteer to assist in the safety check-in officer and range safety positions at the launches. You may have to coordinate with range officials prior to the launch to have a mentor assigned or to schedule a range shift. Opportunities to perform training in the range safety officer or safety check-in officer positions may be accepted in any order; there are no requirements to complete training in one position prior to training in the other position.

Have your mentor sign the training blocks as each requirement is met. The same mentor is not required for each training step. There is no time limit to complete the safety officer training; proceed at your own pace and as training opportunities occur. It is suggested that attendance at the larger regional meets or national events will provide the greatest exposure to different model types and different mentoring techniques. The variety of models and volume of flights at these events can improve the quality of the training experience and expedite completion of the training process.

Level 1 certified high power modelers, may perform the safety check-in officer or RSO duties on a NAR Level 2 or Level 3 high power range after completing this training program. The Level 1 modelers will be required to complete the Level 2 high power certification written exam to perform those duties. They may credit the accomplishment of this exam towards Level 2 certification. The Level 2 exam question pool and tests may be requested from the address listed below.

Upon completion of the training requirements make a copy for your own records. Forward the completed forms (only those pages with mentor signatures) to Stephen Lubliner at 9968 E. Domenic Lane, Tucson, AZ 85730. Your NAR headquarters records will annotated to indicate completion of the safety officer training program. A revised sporting license will be issued to show completion of the training program. Questions and comments on this program can be answered by a letter to the above address, via email at 103056.621@compuserve.com , or via telephone at 520-296-1689.

Training Record for: _____ NAR No.: _____

Street: _____ City: _____ ZIP: _____

Day Phone: (_____)_____ Evening Phone: (_____)_____

Email Address: _____ High Power Cert. Level: _____

Individuals signing in the spaces below certify that the individual being trained has performed the required activity and demonstrates an understanding of the information provided to perform the task.

SAFETY CHECK-IN OFFICER TASKS

Level 1 or Level 2 model check-ins: Each of the following items may be signed off after completing the check-in of Level 1 ("I", "J") or Level 2 ("J", "K", "L") powered models. Note the number of models checked in under the guidance of each mentor. Use as many lines, 1 through 7, as required to document 14 check-ins. Information listed above as items A1 through A7, B1 through B8, and F1 through F2 provides guidance for these tasks.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

4) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

5) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

6) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

7) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models checked in: _____

Level 2 model check-ins: Each of the following items may be signed off after completing the check-in of a Level 2 ("J", "K", "L") powered model. Information listed above as items A1 through A7, B1 through B8, and F1 through F2 provides guidance for these tasks.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

4) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

5) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

6) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Cluster model check-ins: Each of the following items may be signed off after completing the check-in of a clustered (2 or more motors in the same stage) model. Information listed above as items C1 through C4 provides guidance for these tasks. Each of these items may be signed off at the same time as any above item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Training Record for: _____ NAR No.: _____

Staged model check-in: The following item may be signed off as completed after completing the check-in of a multi-staged model. Information listed above as items B6, and E1 through E4 provides additional guidance for this task. This item may be signed off at the same time as any other item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Models with electronic deployment/staging systems check-ins: Each of the following items may be signed off after completing the check-in of a model containing electronic staging or recovery systems. Information listed above as items D1 through D6 and E1 through E4 provides additional guidance for these tasks. Each of these items may be signed off at the same time as any other item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

4) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Failed flight review: Each of the following items may be signed off after completing the review of a failed flight (not including misfires). An attempt to identify the failure cause and the appropriate corrective action will be made. Was there a fault in the check-in process that allowed the failed model to fly?

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Training Record for: _____ NAR No.: _____

Individuals signing in the spaces below certify that the individual being trained has performed the required activity and demonstrates an understanding of the information provided to perform the task.

RANGE SAFETY OFFICER TASKS

Level 1 or Level 2 range safety review: Each of the following items may be signed off after completing the pre-launch and flight range safety review for Level 1 ("I", "J") or Level 2 ("J", "K", "L") powered models. Note the number of models checked in under the guidance of each mentor. Use as many lines, 1 through 5, as required to document 9 check-ins. Information listed above as items H1 through H7, and J1 through J5 provides guidance for these tasks.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models launched: _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models launched: _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models launched: _____

4) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models launched: _____

5) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Number of models launched: _____

Level 2 range safety review: Each of the following items may be signed off after completing the pre-launch and flight range safety review for a Level 2 ("J", "K", "L") powered model. Information listed above as items H1 through H7, and J1 through J5 provides guidance for these tasks.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

3) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

4) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

5) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

6) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Clustered model range safety review: The following item may be signed off as completed after completing the pre-launch and flight safety review for a clustered model. Information listed above as items H1 through H7, and J1 through J5 provides guidance for this task. This item may be signed off at the same time as any other item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Staged model range safety review: The following item may be signed off as completed after completing the pre-launch and flight safety review for a staged model. Information listed above as items H1 through H7, and J1 through J5 provides guidance for this task. This item may be signed off at the same time as any other item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Models with electronic deployment/staging systems range safety review: Each of the following items may be signed off after completing the pre-launch and flight safety review of a model containing electronic staging or recovery systems. Information listed above as items H1 through H7 and J1 through J5 provides additional guidance for these tasks. Each of these items may be signed off at the same time as any other item as long as the requirements for each item are met.

1) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

2) Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____

Training Record for: _____ NAR No.: _____

LAUNCH SITE EVALUATION

Complete the launch site evaluation items listed below. It is preferred that the evaluation be performed prior to the start of the day's launch activity to avoid interference with model launches. Discuss "No" answers with the mentor to determine why a "No" answer is acceptable. Refer to guidelines G1 through G16 above for additional information.

Item #	Description	Yes	No
G1	Is a means of measuring wind speed or getting weather reports available?		
G2	Do all launch pads have blast defectors? Do launch pads restrict the launch angle to less than 20 degrees? Are launch rods securely fastened to the launch pads?		
G3	Does launch equipment have sufficient current output for high current ignition requirements (e.g. clusters)?		
G4	Is the launch equipment "flashbulb safe"?		
G5	Is the ground cleared of flammable materials around the launch pad? Are provisions made to water down the area to prevent fire?		
G6	Are launch pads located away from personnel per the distances specified in the safety codes?		
G6	Are barriers in place to prevent unauthorized entry into the launch areas? Is pad access planned to minimize launch personnel from crossing launch control wiring or approaching "hot" pads?		
G7	Will the model trajectories cause them to land in spectator or non-participant areas?		
G8	Is fire fighting equipment available?		
G9	Are battery terminals protected from accidental shorts? Are 110 VAC supplies protected to prevent electrical shock?		
G10	Is a first aid kit available? Are emergency telephone numbers for fire and ambulance easily available? Is a phone nearby to call for assistance?		
G11	How are participants and spectators made aware of an incoming model?		
G12	Is smoking controlled? Are "butt" cans available to prevent discards of lit smoking materials on the ground?		
G13	If applicable, is the FAA waiver activated? Is a copy of the waiver available on the launch range? Do all participants know the waiver limits? Is a contact point and method available to the FAA in the event of a problem?		
G14	Does the RSO have a means of clearly and consistently communicating with the launch control officer?		
G15	Are binoculars available to allow the RSO to better assess the safety of an airborne rocket?		
G16	Is an electronics preparation/arming area provided to minimize the danger from an inadvertent activation of an upper stage or recovery system?		

Mentor's Name, NAR No. (printed): _____

Cert. Level: _____ Date: _____ Location (City, State): _____