



**DEPARTMENT OF THE NAVY**

PACIFIC MISSILE RANGE FACILITY  
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IN REPLY REFER TO:

PMRFINST 8020.5C  
N3R/FB:rca

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PACIFIC MISSILE RANGE FACILITY INSTRUCTION 8020.5C

From: Commanding Officer, Pacific Missile Range Facility

Subj: EXPLOSIVE SAFETY CRITERIA (ESA) FOR RANGE USER ORDNANCE  
OPERATIONS

Ref: (a) NAVSEA OP 5, Vol. I  
(b) NAVSEA OP 3565 Vol. II  
(c) MIL-STD-882 D  
(d) RCC Standard 319  
(e) PMRFINST 8023.2G

Encl: (1) ESA Information Requirements

1. Purpose. To provide guidance and procedures governing explosive safety criteria for range ordnance operations at the Pacific Missile Range Facility (PMRF).

2. Cancellation. PMRFINST 8020.5B

3. Scope. This instruction applies to PMRF, all tenant activities and all range users conducting ordnance operations, surface launching, and loading or unloading explosives on aircraft. This instruction emphasizes the requirements of references (a) through (e) and is limited to the ground phase ordnance evolutions. Procedures for in-flight safety are contained elsewhere in the Range Safety Manual.

4. Background. The hazards associated with ordnance handling are well documented, and lessons learned are often at great expense. Potential hazards of ordnance handling include fire, blast fragmentation, toxicity, and radiation. Every reasonable precaution must be taken in planning and executing operations involving explosives to preclude injury to personnel and damage to property.

5. Responsibilities.

a. The Launch/Ordnance Officer (LOO) shall:

(1) Conduct a detailed analysis of proposals submitted concerning missiles or explosives and their proposed operations on the Range. Range users shall submit all information listed in enclosure (1) for new ordnance systems to the Launch Ordnance Office. The analysis shall consider fire, blast, sound, toxicity, radiation and other effects that may constitute a hazard to

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personnel or facilities. After determination of an acceptable analysis, an Explosive Safety Approval (ESA) shall be issued.

- (2) Establish procedures for surveillance and control of traffic within the hazard areas.
- (3) Review and approve the design of facilities in which ordnance will be handled to ensure safety protections meet requirements of reference (a).
- (4) Provide Launch Control Officers (LCO) and Pad Safety Officers (PSO) for launch operations.
- (5) Assume responsibility for and control of all emergency facilities, equipment, and personnel required in the event of a hazardous situation resulting from missile land impact.
- (6) Provide positive control of requisition, receipt, issue, transport, expenditure and storage of all explosive ordnance items at PMRF.
- (7) Ensure personnel who handle ordnance are trained and meet requirements of reference (a) for non-nuclear certification and qualification.
- (8) Investigate surface launching failures, incidents, and accidents.

6. Explosive Safety Criteria. The PMRF LOO shall review programs that require ordnance or will affect ordnance operations at PMRF. He shall be included in the early planning of such programs to maintain PMRF explosive safety requirements. The following criteria will normally apply:

a. Transportation, handling and storage of ordnance shall be in accordance with reference (e).

b. Preparation, assembly, arming, and initiating of ordnance shall be in accordance with approved procedures:

(1) Where ordnance is an in-service weapon or target system, published checklists (Naval Air Weapons Center, Naval Surface Weapons Center, or other Department of Defense component) will normally be used.

(2) For unique ordnance systems or systems undergoing test and evaluation, procedures and/or checklists generated by the Range user and approved under the ESA review process will be used.

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c. As a general guide, ordnance systems are required to incorporate the following features:

(1) Each firing system shall have a provision for a positive "hold" condition for direct interruption of power flow between the power source and initiator. The arming switch shall be under direct and positive control of the PSO or LCO for enabling or disabling the firing circuit when required. Where such switching is performed electrically, the circuit shall be failsafe in design, i.e., the application of power is required for an "armed" condition and the removal of power ensures a "safe" condition. In surface-launched missiles, the arming station shall be capable of being locked in the SAFE position. It shall be located so that should ignition take place at the time of final arming, injury to personnel shall not occur. Each launching system shall have a minimum of two firing train interrupting mechanisms: safe and arm devices, arm/disarm devices, safe/arm plugs, switches, relays, etc.

(2) Wiring to all electro-explosive devices (EEDs) shall be of minimum length and maximum separation from other wiring. All ignition circuitry shall be continuously shielded from the power source with the shield grounded only at the device end. Any grounding of the firing circuit leads shall be done at one point only. Ungrounded firing circuit leads shall be connected to ground through static bleed resistors. The use of single wire firing circuits using common grounding (i.e., chassis) as a return will not be permitted.

(3) All safety critical ordnance circuitry shall be completely shielded and interconnecting cabling shall utilize twisted, shielded pairs with an insulating cover. Complete physical and electrical isolation of the battery or other power sources from safety critical EED firing circuitry shall be provided. Both terminals of the power source shall remain isolated from the EED leads until the proper time in the arming sequence. Consideration shall be given during missile design to preclude the possibility of initiating leads inadvertently touching other electrical leads or connections.

(4) Initiators that are in series shall not have significantly different functioning times.

(5) When the initiators are in parallel and perform independent functions or have significantly different ignition times, their ignition circuitry shall include a protective device, which prevents the shorting of either circuit by the ignition of the first.

(6) Missile configuration shall be such that there will not be any possibility of inadvertent contact with a terminal or pin energized with electrical power when installing any ordnance component. Connectors used in EED firing circuits for mating during missile/rocket buildup shall be designed to preclude mis-mating.

(7) Systems which employ Exploding Bridge Wires (EBWs) shall have a dual bleed system for the capacitor charge and a positive means for interrupting the capacitor charging circuit and the trigger circuit. There must be a capability for monitoring the capacitor charge status from the launch control center, preferably at the LCO console.

(8) Connectors on EED leads and cable assemblies should be pre-assembled with proper grounding and shielding and tested for continuity and isolation before installation in a missile. Sharp edges, which could damage wiring, should be removed and holes for cable access should be provided with protection to prevent damage to insulation or shielding. No soldering (hot work) will be permitted on any circuit while explosives are connected.

(9) System power shall not be applied until the latest practical time as provided in the approved launch procedures.

(10) Internal firing systems for ordnance to be initiated after launch will:

(a) Conform to paragraphs (6c (1) through 6c (8)) of this instruction.

(b) Preferably have a system that is armed after first motion or by a remotely controlled Safe/Arm device. If this is not practical, approval will be a function of the reliability of the first stage ignition system and will be contingent upon the missile being committed to fire once the firing system is armed.

(c) Pull-away, acceleration, or pressure-type arming devices must be installed so they will not operate as a result of vibration, launcher movement, or other normal motion.

d. Procedural Requirements. All procedures shall incorporate the following steps or be performed under the applicable conditions:

(1) All radio frequency (RF) radiating devices aboard the launch vehicle or launch platforms shall be OFF when explosive work is being performed. Any other restrictions of RF sources shall be in accordance with reference (e).

(2) Firing system check-out shall be performed prior to any ordnance operation. The check-out shall verify the proper functioning of all safety provisions in the system.

(3) No-voltage checks shall be made prior to electrical connection of the ordnance to a firing control circuit. They will:

(a) Be performed as part of the system check-out and prior to the point in the countdown where ordnance items are connected.

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(b) Be performed by personnel qualified to assess their results. These checks will be performed in the presence of, and to the satisfaction of personnel making the subsequent ordnance connection. Explosive components will not be connected to any circuit which causes a meter deflection during the no-voltage test.

(c) Require a review of the sensitivity of all initiators whose circuits are to be tested to ensure the sensitivity of the meter is adequate. In general, the meter will have a minimum sensitivity of 20,000 ohms per volt, a minimum voltage scale of 2.5 volts, and a minimum current scale of 100 microamperes.

(d) Be made between all initiator wires and between all wires and ground.

(4) Continuity tests on circuits containing electrical initiators will be performed only under direct supervision of a qualified PSO and under conditions where no hazard would exist if ignition were to occur. The maximum current permitted will be determined by the sensitivity of the device under test, and test equipment shall be verified not to exceed this current prior to each use.

(5) Final arming of a firing system shall be at the latest practical time.

(6) An ordnance system which does not activate when initiation is attempted shall be considered a HANGFIRE unless it can be positively verified that the firing system failed to apply the appropriate initiation, in which case a MISFIRE may be declared.

(a) A launch indication, such as first motion (lift off) signal, canister release signal, etc., must be provided to the Range for LCO verification that the missile or rocket system has left the launch platform. The signal will also be used to process queuing of radars for missile tracking.

(b) In the event of a HANGFIRE, the firing system shall be placed in the SAFE position, and personnel shall remain CLEAR of the launch site for a minimum of 30 minutes. If any internal batteries capable of initiating onboard ordnance have been activated prior to the HANGFIRE, the wait period should extend 30 minutes beyond the expected or measured depletion of battery power. All procedures used will be based on the assumption that the ordnance might ignite at any moment. After the wait period the ordnance is assumed to be stable, and appropriate safing, downloading and/or disposal procedures may be accomplished.

(c) In the event of a MISFIRE, if the fault can be determined and remedied, initiation may be attempted again, or the ordnance may be safed, downloaded, and/or disposed of as desired without a wait period.

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7. Operational Requirements. The LOO shall designate the following operational personnel:

a. A Launch Control Officer (LCO) for each surface launch operation conducted in areas under control of the Commanding Officer. The LCO will be the senior operational supervisor assigned to the launch operation and shall:

(1) Have complete responsibility and authority for safety of the test area being used and safe conduct of the tests and he will:

(a) Be present during each firing.

(b) Be thoroughly briefed before firing time, and have the opportunity to conduct or participate in planning.

(c) Have the Standard Operating Procedure (SOP) and supplemental documentation available at the site and ensure that they are followed.

(d) Coordinate operations in the firing area.

(e) Have control of the number of personnel in the firing area and the conditions under which they are permitted in the firing area.

(f) Be responsible for all energetic material in the firing area and the conditions under which they are permitted in the firing area.

(g) Be responsible for setup of all energetic material in the firing site.

(h) Determine when it is safe to connect the firing line to the initiating device.

(i) Be responsible for the firing.

(j) Follow safety procedures established by the SOP and supplemental documentation when dud, misfires, and malfunctioned ordnance are present in the test area.

(2) Be the interface with the Operations Conductor (OC) and Range Facilities Control Officer (RFCO).

(3) Control personnel and vehicular traffic in the Ground Hazard Area (GHA).

(4) Transmit a "HOLD FIRE" order to the fire control system if ground safety criteria are not met.

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(5) Have a copy of the current Launch Procedure, which provides applicable countdown information, pad safety criteria, and emergency procedures.

(6) Resolve operational/safety conflicts during the countdown.

(7) Assume responsibility in the event of a missile disaster in the GHA and control emergency actions.

b. A Pad Safety Officer (PSO) will be responsible to the LCO for each hazardous operation conducted. Hazardous operations shall not commence unless a PMRF PSO is present. The PSO shall:

(1) Ensure the operation is conducted in accordance with PMRF safety criteria, and the Range User's plan and procedures have been approved by the LOO.

(2) Suspend operations if unsafe practices or conditions exist.

(3) Make the final determination that the launch pad is safe for the hazardous operation.

(4) Verify required safety equipment is at the proper location and in operating condition.

(5) Monitor the following types of work and report the results to the LCO:

(a) Installation, testing, or transfer of ordnance items.

(b) Installation and check-out of destruct system equipment installed in the missile. A representative from Flight Safety may be required to monitor certain phases of these operations.

(c) Elevation of the launcher and confirmation of launcher settings.

c. A Safety Monitor to ensure all ordnance procedures in Ordnance Assembly Buildings are performed in accordance with Ordnance SOP-LO-004 and PMRF safety criteria.

#### 8. Hazard Areas.

a. The LCO will determine pre-launch hazard areas for ordnance items launched from operating areas in accordance with Range Safety Operational Plans (RSOPs) and Range Safety Approvals (RSAs).

b. The Range User may propose hazard areas in connection with the User's operations. Range User submissions of such proposals shall include the technical basis utilized in determining the proposed hazard areas.

c. An ambulance and firefighting equipment and personnel will be on call and under control of the PSO or LCO whenever ordnance work is being performed.

d. Access for emergency vehicles shall be kept clear at all times.

e. Privately owned automobiles, including contractor vehicles, shall be removed from ground hazard areas during CAUTION and DANGER periods. A CAUTION period is when a hazardous condition exists and the risk level does not preclude the exposure of personnel. Personnel not associated with the mission may be allowed in the area only at the discretion of the CO. A DANGER period is when a hazardous condition exists and the risk level is sufficiently high to preclude the exposure of personnel. Only Mission Essential personnel are permitted near the vehicle at the approval of the CO.

9. Personnel in Hazard Areas.

a. Operational procedures shall be designated to minimize the number of persons in hazard areas. Roadblocks will be set to control access to hazard areas. Surveillance sweeps will be made to ensure nonessential personnel are removed prior to commencement of the DANGER period.

b. Directors, Heads of Offices, and Range Users having personnel whose assigned duties require them to remain inside the ground hazard area during a missile firing operation will submit certification to the LOO for approval prior to the operation.

c. Essential personnel authorized to remain in the GHA during a missile firing operation shall:

(1) Occupy only those buildings in the GHA approved for their occupancy.

(2) Proceed to or remain in these buildings when appropriate warnings are passed by assigned Safety Officers.

(3) Comply with safety instructions and warnings passed over the launch complex or launch area announcing systems.

d. All nonessential personnel shall be out of GHAs prior to commencement of the DANGER period.

10. Protective Clothing.

a. All personnel working at launch pads or assembly buildings will wear approved safety equipment (hard hats, long pants, safety shoes, hearing and eye protection, static-dissipative clothing) appropriate to the type of operation being performed.



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b. Personnel engaged in installing, removing, arming, or disarming pyrotechnics will wear face shields or protective goggles equipped with safety lenses of adequate light shade type.

c. When working with liquid propellant chemicals, all personnel shall wear specific Personnel Protective Equipment (PPE) in accordance with manufacturer's recommendation as per the chemical being used. These PPE are required when personnel exposure to the chemical cannot be mitigated.



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Lists, 1, 4 & 5

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**EXPLOSIVE SAFETY APPROVAL (ESA) INFORMATION REQUIREMENTS**

1. General description of vehicle, to include drawings, all physical data and location of all ordnance items.
2. Procedures for Assembly, Disassembly, Handling, Upload and Download.
3. Proposed launching procedures to include any special safety precautions.
4. Checkout of missile systems procedures.
5. Misfire/Hang fire procedures.
6. Complete schematics of firing circuits from power supply to ordnance items. (Include interlocks safeties, and inhibits that prevent premature initiation). Provide narrative for each ordnance initiation train.
7. List and description of all ordnance items including resistance and maximum safe no fire.
8. Description of all RF devices to be used in relation to missile, rocket(s), or aircraft used to launch missile/rockets(s). Specifically:
  - a. Average output power and/or peak power, pulse repetition rate, and pulse width.
  - b. Antenna gain or type and size, dimension, and polarization.
  - c. Transmission band or frequency.
  - d. Antenna locations (diagram).
  - e. Antenna Pattern and polarization.
9. Description and schematic of special test equipment (e.g. meters).
10. Description of proposed launcher and handling equipment (include schematics and required interfaces).
11. Certification of personnel handling ordnance.
12. System Safety Analysis.

Enclosure (1)

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**EXPLOSIVE SAFETY APPROVAL (ESA) INFORMATION REQUIREMENTS  
(continued)**

13. Hazardous Material Data Requirements. Specifically:

- a. A list of all hazardous materials.
- b. A Material Safety Data Sheet (MSDS) for each hazardous material.
  - (1) A description of any detection equipment, if available.
  - (2) A list of decontamination and disposal procedures.
  - (3) A description of PPE to be used with any hazardous material.

14. Pressurized systems

- a. List of all pressure system components (i.e. valves, regulators, hoses, tubes, vessels, gages, etc.) with Maximum Allowable Working Pressure (MAWP), safety factors or design burst pressure, if available, material fabrication.
- b. Maximum operating pressure at operating temperatures.
- c. Identify all pressure sources, operating pressure and temperature and flow rates.
- d. All relief valve pressure settings and flow rates.
- e. Pressure ranges of all transducer and regulators.
- f. Flow path through all the components.
- g. Drawing of system that shows physical layout and dimension.