
Appendix K
Missile Launch Safety and
Emergency Response

APPENDIX K

MISSILE LAUNCH SAFETY AND EMERGENCY RESPONSE

This appendix discusses in general terms the potential health and safety hazards associated with missile launch operations and the corresponding procedures that are in place to protect people and assets. The information herein focuses on the nature and control of the potential hazards and public risks associated with pre-launch, launch, and emergency response.

While range safety is location, facility, and mission-dependent, the Department of Defense (DoD) has established standards and protocols to eliminate or acceptably minimize potential health and safety risks/hazards. For missile operations, the safety offices coordinate efforts and standards through the Range Safety Group of the Range Commander's Council (RCC). Three key products of this group are the documents:

- RCC Standard 319, Flight Termination Systems Commonality Standard
- RCC Standard 321, Common Risk Criteria for National Test Ranges, Subtitle: Inert Debris
- RCC Standard 324, Global Positioning and Inertial Measurements Range Safety Tracking Systems Commonality Standard

The Pacific Missile Range Facility (PMRF) Range Safety Office is an active participant in the Range Safety Group, and the Range mandates specific policies that follow from these guidance documents in *PMRF Instruction 8020.16, Missile/Rocket Flight Safety Policy*.

Safety regulations are directed at preventing the occurrence of potentially hazardous accidents and minimizing or mitigating the consequences of hazardous events. This is accomplished by employing system safety concepts and risk assessment methodology to identify and resolve potential safety hazards.

The range safety process is predicated on risk avoidance, minimization of accident impacts, and protection of population centers. Risk values related to missile launch activities are categorized in two ways: probability of vehicle failure, including all possible failure modes that *could* lead to debris impact events, and the probabilities of the adverse consequences that could result from impact events. The consequence estimation is quantified by two key measures: the probability of individual casualty, defined as the probability of a person at a given location being injured, or the expected number of casualties (collective risk), defined as the average number of persons that may be injured in a launch (typically a very small number, such as a few injuries per million operations).

Range safety is accomplished by establishing:

- Requirements and procedures for storage and handling of propellants, explosives, radioactive materials, and toxics

- 1 • Evaluation of mission plans to assess risks and methods to reduce risk
- 2 • Performance and reliability requirements for flight termination systems on the vehicle
- 3 • A real-time tracking and control system at the range
- 4 • Mission rules that are sufficient to provide the necessary protection to people both on
- 5 and outside the boundaries of the launch facility

6
7 Procedures and analyses to protect the public can be generally divided into five aspects:

- 8 • Ground safety procedures—handling of propellants, ordnance, noise, hazardous
- 9 operations, toxics, etc.
- 10 • Pre-flight mission analysis—vehicle, trajectory, etc.
- 11 • Flight termination system verification
- 12 • In-flight safety actions
- 13 • Emergency response

14 15 **Ground Safety Procedures**

16 Procedures have been established to handle and store all materials (propellants, etc.) which
17 may be a hazard, control and monitor electromagnetic emissions, and govern transportation of
18 materials to and from a facility. Storage of propellants and explosives is controlled by quantity–
19 distance criteria. Failure modes and effects analyses are prepared when necessary for all
20 potentially hazardous activities and devices.

21 Accidents that occur before launch can result in on-pad explosions, potential destruction of the
22 vehicle, damage to facilities within range of the blast wave, and dispersion of debris in the
23 vicinity of the pad. The types of accidents depend upon the nature of the propellants. An
24 accident in handling storable hypergolic propellants could produce a toxic cloud, likely to move
25 as a plume and disperse beyond the boundaries of the facility. The risk to the public would then
26 depend upon the concentration of population in the path of this toxic plume and on the ability to
27 evacuate or protect the population at risk until the cloud is dispersed. It is obviously
28 advantageous if the winds generally blow away from populated areas. There are also specific
29 safety requirements and risks associated with ground support equipment. The design and use
30 of this equipment must incorporate safety considerations.

31 In order to protect personnel and the public from these types of hazards, careful analysis is
32 performed. Each missile is evaluated for the toxic release hazard and explosive potential.
33 When appropriate, more detailed modeling of the transport of the toxic species is performed that
34 incorporates atmospheric effects, such as local winds and turbulence. Where needed, a region
35 may then be cleared of personnel. At PMRF, the amount of toxic substances is sufficiently
36 small that the public is highly unlikely to be exposed to unhealthful levels of toxic chemicals from
37 a missile accident. However, the range safety community has extensive experience with this
38 type of hazard due to the large amount of toxic chemicals aboard some large space lift vehicles.
39 When considering explosive potential, again each missile is evaluated for the hazard posed.
40 Specific action is then taken to protect personnel within the higher risk region, such as ensuring
41 that they are inside hardened structures (such as block houses) that will protect them from the
42 blast wave. Although large explosions can lead to effects relatively far from the launch pad, the

1 motors proposed at PMRF are small compared to the large space lift vehicles, and the
 2 possibility of injury to a person outside the Ground Hazard Area from a missile explosion is
 3 extremely remote.

4 **Pre-Flight Mission Analysis**

5 Minimization of the probability of terminating a “good” flight and simultaneous minimization of
 6 the potential of risk due to malfunctioning missile is accomplished through careful mission
 7 planning, preparation, and approval before launch. Planning is in two parts:

- 8 • Mission definition such that land overflights or other higher risk aspects of launch are
 9 avoided and/or minimized
- 10 • Development of data that support the real-time decision and implementation of active
 11 control and destruct activities

12
 13 Hazard potential exists for a missile in-flight because of the impact of falling debris (at speeds
 14 that can cause direct injury or damage buildings with occupants inside) and because of the
 15 potential for explosion upon impact of liquid and/or solid propellants. This potential hazard from
 16 propellants decreases with time into the flight because the quantities of on-board propellants
 17 decrease as they are consumed.

18 *Range Safety Planning*

19 The actual implementation of operational plans under launch conditions ultimately determines
 20 the actual risk exposure levels on and off site. Integral to the analysis are the constraints posed
 21 by the following:

- 22 • Launch area/range geometry and siting
- 23 • Nominal flight trajectories/profiles
- 24 • Launch/release points
- 25 • Impact limit lines, whether based on risk to population/facilities or balanced risk
 26 criteria
- 27 • Flight termination system and destruct criteria
- 28 • Wind/weather restrictions
- 29 • Instrumentation for ground tracking and sensing onboard the vehicle
- 30 • Essential support personnel requirements

31
 32 The Range Safety Office typically reviews and approves launch plans, imposes and implements
 33 destruct lines, and verifies that appropriate warnings areas have been published.

34 The launch (normal and failure) scenarios are modeled, and possible system failure modes are
 35 superimposed against the proposed nominal flight plan. The hazard to third parties is
 36 dependent on the vehicle configuration, flight path, launch location, weather, and many other
 37 factors.

1 A blast danger area around the missile on the launch pad and a launch danger area (typically a
2 circle centered on the pad with tangents extended along the launch trajectory) are prescribed for
3 each missile depending on its type, configuration, amount of propellants and their toxicity,
4 explosive blast wave potential, explosive fragment velocities anticipated in case of an accident,
5 typical weather conditions, and plume models of the launch area.

6 Each launch is evaluated based on:

- 7 • Range user data submission requirements from the hazard analysis viewpoint
- 8 • Launch vehicle analyses to determine all significant failure modes and their
9 corresponding probability of occurrence
- 10 • The vehicle trajectory, under significant failure mode conditions, which is analyzed to
11 derive the impact of probability density functions for intact, structurally failed, and
12 destructed options
- 13 • The vehicle casualty area based on anticipated (modeled) conditions at the time of
14 impact, based on the vulnerability of people, buildings, and vehicles to the hazards to
15 which they may be exposed
- 16 • Computed casualty expectations given the specific launch and mission profile,
17 population data near the range and along the ground track. Shelters may be
18 provided or evacuation procedures adopted, in addition to restricting the airspace
19 along the launch corridor and notifying the air and shipping communities to avoid
20 and/or minimize risks

22 *Launch Hazards*

23 Failures during the launch and ascent can be divided into two categories: propulsion and
24 guidance/control. In-flight destruct of the vehicle enables dispersion of propellants, thus
25 reducing the possibility of secondary explosions upon ground impact. The destruct systems on
26 vehicles having cryogenics are designed to minimize the mixing of the propellants, i.e., holes
27 are opened on the opposite ends of the fuel tanks. Solid rocket destruct systems usually
28 consist of linear shaped charges running along the length of the rocket, which open up the side
29 of the casing like a clam shell, causing an abrupt loss of pressure and thrust. They may,
30 however, produce many pieces of debris in the form of burning chunks of propellant and
31 fragments of the motor casing and engines.

32 Propulsion failures produce a loss of thrust and the inability of the vehicle to ascend.
33 Depending on its altitude and speed when thrust ceases, the vehicle can fall to the ground intact
34 or break up under aerodynamic stresses. The debris from these types of failures typically falls
35 on or very near the intended flight track. If the vehicle falls to the ground intact, the
36 consequences may be similar to those of an explosion on the ground. An explosion leads to a
37 blast wave, which can directly injure people or damage structures with people inside. If there is
38 potential for a significant explosion, a vehicle is destroyed during descent to prevent an impact
39 intact. An example of a propulsion failure is a solid-rocket motor burn-through. Solid rocket
40 motor failures can be due to a burn-through of the motor casing or damage or burn-through of
41 the motor nozzle. In a motor burn-through there is a loss of chamber pressure and an opening
42 is created in the side of the case, frequently resulting in structural breakup. The nozzle burn-
43 through may affect both the magnitude and the direction of thrust. There is no way to halt the

1 burning of a solid rocket once initiated. Hence, a solid rocket motor failure almost inevitably
2 puts the entire launch vehicle and mission at risk.

3 The Range Safety System (RSS) is critical in the case of guidance or control failures. The
4 purpose of the RSS is to destroy, halt, or neutralize the thrust of an errant vehicle before its
5 debris can be dispersed off-range and become capable of causing damage or loss of life.
6 Without a flight termination system, an errant missile could continue flying toward a population
7 center or other valuable asset. The debris could then injure people or cause considerable
8 damage. The destruct system generally is activated either on command or automatically soon
9 after the time of failure.

10 In addition to complete loss of control, three other early flight guidance and control failures have
11 been observed with launch vehicles over the life span of the space program: failure to pitch
12 over, pitching over but flying in the wrong direction (i.e., failure to roll before the pitchover
13 maneuver), and having the wrong trajectory programmed into the guidance computer. The
14 likelihood of these circumstances depends upon the type of guidance and control used during
15 the early portion of flight. The types are open or closed loop (i.e., no feedback corrections) and
16 programmer or guidance controlled. In the case of vehicles that use programming and open-
17 loop guidance during the first portion of flight, failure to roll and pitch is possible, although
18 relatively unlikely, based on historical flight data. If the vehicle fails to pitch over, it rises
19 vertically until it is destroyed. As it gains altitude, the destruct debris can spread over an
20 increasingly larger area. Consequently, most ranges watch for the pitchover, and if it does not
21 occur before a specified time, they destroy the vehicle before its debris pattern can pose
22 significant risk to structures and people outside the launch facility or the region anticipated to be
23 a hazard zone, where restrictions on airspace and ship traffic apply. Failure to halt the vehicle
24 within this time can produce a significant risk to those not associated with launch operations.

25 The potential for damage to ground sites from a launch vehicle generally decreases with time
26 into flight since fuel is consumed as the vehicle gains altitude. If it breaks up or is destroyed at
27 a higher altitude, the liquid fuels are more likely to be dispersed and lead to lower
28 concentrations on the ground. In addition, if there are solid propellants, they would have been
29 partially consumed during the flight period before the failure and would continue to burn in free
30 fall after the breakup.

31 *Risk Modeling*

32 The evaluation of launch associated hazards is based on range destruct criteria designed to
33 minimize risk exposure to on- and off-range population and facilities.

34 Range safety reports, safety analysis reports, and other such probabilistic hazard analyses are
35 prepared by range users for each vehicle. An updated data package is provided for each
36 mission with key unique parameters, such as the flight paths and minor vehicle changes.

37 Modeling by the Range Safety Office computes risks based on estimating both the probabilities
38 and consequences of launch failures as a function of time into the mission. Input data includes
39 the mission profile, launch vehicle specifics, local weather conditions, and the surrounding
40 population distribution. In many cases, the Range works in advance with the user to optimize a
41 launch trajectory to risk minimize risk while meeting mission objectives. Destruct lines, which
42 will be implemented in real-time, are established during the risk evaluation process to confine

1 and/or minimize potential public risk of casualty or property damage. The debris impact
2 probabilities and consequences are then estimated for each launch considering the geographic
3 setting, normal jettisons, failure debris, and demographic data.

4 For all launches, the boosters, sustainers, and other expendable equipment are always
5 jettisoned and fall back to the Earth. Therefore, in planning a mission, care must be taken to
6 keep these objects from impacting on land, aircraft, and shipping lanes. These impact locations
7 are normally quite predictable, so risks can be avoided on a nominal mission.

8 Destruct lines are designed to protect the public from launch accident debris and are a key
9 result in the risk modeling. They are offset from populated areas to accommodate:

- 10 • Vehicle performance characteristics and wind effects
- 11 • The scatter of vehicle debris following an explosion
- 12 • The accuracy and safety-related tolerances of the vehicle tracking and monitoring
13 system
- 14 • The time delays between the impact point impingement on a destruct line and the
15 time at which flight termination actually takes place (i.e., human decision time lag)

16
17 By proper selection of destruct lines, the probability of debris impacting inhabited areas can be
18 reduced to extremely small levels.

19 The first step in modeling debris from failures is to understand the type of failures to which a
20 particular vehicle may be subject. Estimates for failure mode probabilities are typically based on
21 knowledge of a vehicle's critical systems and expert assessment of their reliability combined
22 with historical data, when available.

23 Then the response of the vehicle to each failure must be modeled. Simulation of the vehicle
24 systems and the resulting vehicle trajectory allow for understanding the effects of a failed
25 component. The modeling is very vehicle-specific until thrust is terminated (by direct result of
26 the failure, automatic on-board termination, flight safety action, or aerodynamic breakup). If the
27 vehicle breaks apart or is destroyed the resulting debris is then characterized by both
28 aerodynamic properties and properties that affect the consequences if it impacts a person or
29 object. There is inherent uncertainty in these parameters, which is included in the risk
30 modeling.

31 After thrust is terminated the debris from the accident propagates ballistically (the only forces
32 are drag, lift, and gravity). Debris that is very dense and has a high ballistic coefficient (β) is
33 less affected by the atmosphere and will tend to land closer to the vacuum instantaneous impact
34 point than lower ballistic coefficient pieces. High ballistic coefficients can be associated with
35 pumps, other compact metal equipment, etc. Panels or pieces of motor and rocket skin offer a
36 high drag relative to their mass (a low ballistic coefficient) and consequently slow down much
37 more rapidly in the atmosphere. After slowing down they tend to fall and drift with the wind. A
38 piece of debris with a very low ballistic coefficient ($\beta = 1$) is shown to stop its forward flight
39 almost immediately and drift to impact in the direction of the wind. Pieces having intermediate
40 value ballistic coefficients show a combination of effects. The uncertainties in the wind and

1 aerodynamics of the pieces are accounted for during this stage, resulting in a dispersion of
2 debris.

3 For each debris piece that may impact, the consequence is then modeled. Impacting launch
4 vehicle fragments can be divided into four categories:

- 5 • Inert pieces of vehicle structure,
- 6 • Pieces of solid propellant (some of which may burn up during free fall),
- 7 • Vehicle structures which contain propellant (solid or liquid) that may continue to burn
8 after landing (but are non-explosive), and
- 9 • Fragments which contain propellant and which can explode upon impact

10

11 The consequence of a single fragment impact is quantified by the “casualty area.” The casualty
12 area of an impacting fragment is the area about the fragment impact point within which a person
13 would become a casualty. Casualties may result from a direct hit, from a bouncing fragment,
14 from a collapsing structure resulting from an impact on a building or other shelter, from the
15 overpressure pulse created by an explosive fragment, from a fire or toxic cloud produced by the
16 fragment or some combination thereof. The hazard area is increased if a fragment has any
17 significant horizontal velocity component at impact which could result in bouncing or other
18 horizontal motion near ground level. Casualty area is also affected by the sheltering of people
19 by structures. Usually structures protect people from debris, but a very large impact may also
20 cause portions of a building to collapse, and the people inside are then also hazarded by the
21 debris from the structure. From a consequence standpoint, the pieces having a higher ballistic
22 coefficient impact at a higher velocity (and usually have larger mass) so can cause more severe
23 injuries and more damage.

24 The regions or areas exposed to accident hazards must be identified and the vulnerability to
25 debris quantified. This is called population modeling. A population model includes the location
26 and number of groups of people as well as the types of structures they are in.

27 The final step is the computation of risk, both individual probability of casualty and collective
28 expectation of casualty. This calculation incorporates the debris dispersion, the consequence
29 determination, and the population model.

30 *Safety Criteria*

31 Acceptable risk criteria at PMRF are based on the guidance of RCC 321-02, and are currently
32 as follows (per mission):

33 For mission essential personnel and assets,

- 34 • Probability of casualty for each individual must be less than 3 in 1 million (3×10^{-6}),
- 35 • Total expectation of casualty must be less than 300 in 1 million (3×10^{-4}),
- 36 • Probability of impact upon each aircraft with a 1 gram or greater piece of debris must
37 be less than 1 in 1 million (1×10^{-6}), and

- 1 • Probability of impact upon each ship of debris with greater than 11 foot-pounds force
2 (ft-lbf) of energy must be less than 10 in 1 million (1×10^{-5}).
3

4 For the general public,

- 5 • Probability of casualty for each individual must be less than 1 in 10 million
6 (1×10^{-7}),
7 • Total expectation of casualty must be less than 30 in 1 million (3×10^{-5}),
8 • Probability of impact upon each aircraft with a 1 gram or greater piece of debris must
9 be less than 1 in 10 million (1×10^{-7}), and
10 • Probability of impact on each ship of debris with greater than 11 ft-lbf of energy must
11 be less than 1 in 1 million (1×10^{-6}).
12

13 *Aircraft and Ship Clearance Procedures*

14 The criteria above are used to determine clearance area for aircraft and ships. Larger warning
15 areas are also published that include the entire region where a hazard may exist.

16 For aircraft, clearance and warning areas are distributed through the Airmen's Information
17 System and the Notice to Airmen (NOTAM) System. The Airmen's Information System consists
18 of civil aeronautical charts and publications, such as airport/facility directories, published and
19 distributed by the Federal Aviation Administration, National Aeronautical Charting Office. The
20 aeronautical charts and the airport/facility directories contain more permanent data and are the
21 main sources to notify airmen of changes in or to the National Airspace System.

22 The NOTAM System is a telecommunication system designed to distribute unanticipated or
23 temporary changes in the National Airspace System, or until aeronautical charts and other
24 publications can be amended. This information is distributed in the Notice to Airmen
25 Publication. The Notice to Airmen Publication is divided into four parts: (1) NOTAMs expected
26 to be in effect on the date of publication, (2) revisions to Minimum En Route Instrument Flight
27 Rules Altitudes and Changeover Points, (3) international—flight prohibitions, potential hostile
28 situations, foreign notices, and oceanic airspace notices, (4) special notices and graphics such
29 as military training areas, large scale sporting events, air shows, and airport specific information
30 – Special Traffic Management Programs. Notices in Sections 1 and 2 are submitted through the
31 National Flight Data Center, ATA-110. Notices in sections 3 and 4 are submitted and processed
32 through Air Traffic Publications, ATA-10. Air Traffic Publications, ATA-10 issues the Notice to
33 Airmen Publication every 28 days.

34 For ship protection, clearance and warning areas are provided to the Coast Guard. The Coast
35 Guard District is responsible for developing and issuing Local Notices to Mariners (NTMs).
36 Local Notices to Mariners are developed from information received from Coast Guard field units,
37 the General Public, U.S. Army Corps of Engineers, U.S. Merchant Fleet, National Oceanic and
38 Atmospheric Administration, National Ocean Service, and other sources, concerning the
39 establishment of, changes to, and deficiencies in aids to navigation and any other information
40 pertaining to the safety of the waterways within each Coast Guard District. This information
41 includes: reports of channel conditions, obstructions, hazards to navigation, dangers,
42 anchorages, restricted areas, regattas, information on bridges such as proposed construction or
43 modification, the establishment or removal of drill rigs and vessels, and similar items.

1 **Range Safety System Validation**

2 In order for mission rules such as destruct limits to be implemented, the range safety system
3 must work, especially the flight termination system. For tracking (position and velocity data),
4 multiple reliable, independent sources are required for each vehicle. Extensive effort is applied
5 to the validation of the flight termination system. PMRF Instruction 8020.16 includes specific
6 appendices for both tracking systems and for flight termination systems.

7 Tracking systems include both ground based systems (i.e., radar) and on-board systems (i.e.,
8 global positioning systems). Radar systems have been used extensively at PMRF for many
9 years, and have very high reliability, having successfully tracked many vehicles. Radar tracking
10 can either be performed to track a beacon on-board the vehicle or in skin-track mode. On-board
11 data is sent to the ground through telemetry. On-board systems typically have very high
12 accuracy. The standards in *RCC Standard 324, Global Positioning and Inertial Measurements*
13 *Range Safety Tracking Systems Commonality Standard* provide guidance and specifications for
14 testing of these systems to ensure their reliability.

15 A flight termination system consists of several components. The ground unit contains a
16 transmitter, which can send simple tones on a mission-specific radio frequency. On the vehicle
17 there is a radio receiver and a termination system. The termination system may either be a
18 non-destructive thrust-termination action or a destruct charge that breaks apart the vehicle. The
19 choice of the system depends on mission, vehicle, and safety constraints. This system must
20 have high reliability, and numerous tests are performed on each flight termination system unit to
21 ensure that it will work throughout all conceivable missile flight environments. *RCC Standard*
22 *319, Flight Termination Systems Commonality Standard* provides guidance and specifications
23 for testing of these systems to ensure their reliability.

24 **In-flight Safety Actions**

25 In real-time, the impact points of debris are computed based on the current position and velocity
26 of the vehicle. The impact points are based on telemetry and/or radar data of the vehicle
27 position and velocity. These are displayed to the Missile Flight Safety Officer (MFSO), who
28 monitors them relative to prescribed destruct lines. If the vehicle encroaches upon these lines,
29 a destruct decision is made or withheld according to clearly formulated destruct criteria. A
30 backup system during early flight is visual observation, where an observer watches the vehicle
31 through a "skyscreen" with pre-determined boundaries. The observer advises the MFSO
32 through handheld radio whether the missile is within the acceptable flight corridor.

33 Early in the flight the (predicted) instantaneous impact point advances slowly. As the vehicle
34 altitude, velocity, and acceleration increase, the instantaneous impact point change rate also
35 increases from zero to several miles per second. It is the instantaneous impact point that the
36 Range Safety Officer usually observes during a launch. Prior to launch a map with lines
37 indicates the limits of excursion, which, when exceeded, would dictate a command signal to
38 terminate flight.

39 Generally, the on-board destruct system is not activated early in flight (during the first few
40 seconds or so) until the failed vehicle clears the launch. This is intended to protect valuable
41 launch assets. Debris from such accidents will land within the Ground Hazard Area.

1 **Emergency Response**

2 PMRF has an Emergency Response Plan that defines the initial response requirements and
3 procedures to be implemented in the event that a missile malfunction and/or flight termination
4 occurs during flight activities. The following paragraphs present a general description of the
5 emergency response process.

6 Initial response to any areas impacted by flight hardware shall be to secure and render safe the
7 area for follow-on recovery and restoration activities. All areas affected by ground impact of
8 flight hardware shall be cleared of all recoverable debris and environmentally restored. The
9 recovery of launch hardware shall be accomplished in a manner consistent with each launch
10 location's requirements as set forth in applicable environmental documentation and conditions
11 specified by the appropriate land owner.

12 In the event of a flight termination or malfunction, Flight Safety would immediately determine the
13 projected impact area(s) for all debris and flight hardware. The Emergency Response
14 Coordinator would be notified, and the Emergency Response Plan would be initiated.

15 An initial assessment team would be immediately dispatched to the predicted impact area(s) to
16 assess the situation.

17 Key elements of information to be obtained by the initial assessment team include:

- 18 • Exact impact location(s)
- 19 • Extent and condition of impact location(s)
- 20 • Personnel injuries
- 21 • Indications of fires and/or hazardous materials releases
- 22 • Extent of property damage

23
24 Results would be reported back to the Emergency Response Coordinator as expeditiously as
25 possible. Based on this assessment, the Emergency Response Coordinator would call up and
26 dispatch to the impact site(s) the appropriate elements of a contingency team.

27 The Contingency Team would be designated by the Emergency Response Coordinator and
28 would consist of those elements determined to be required, based on the initial assessment.
29 Elements that may be included on the Contingency Team may include, depending on the
30 situation, communications, logistics, public affairs, staff judge advocate, security, health and
31 safety, Explosive Ordnance Disposal, recovery, fire safety, and civilian agency personnel.

32 The initial priorities for the Contingency Team are the following:

- 33 • Emergency rescue and/or emergency medical treatment
- 34 • Establish site security
- 35 • Contain, control, and extinguish fires
- 36 • Confine hazardous materials

1 All elements of the Contingency Team would be under the control of an On Scene Incident
2 Coordinator, designated by the Emergency Response Coordinator. The On Scene Incident
3 Coordinator would retain on-scene control of all initial response elements until initial response
4 operations are complete and recovery and site restoration activities commence.

5 The highest priorities during any emergency response operation are the rescue of injured or
6 trapped personnel and the control of any fires produced by a launch or impact event. Rescue of
7 injured and trapped personnel is of the highest priority. Responsibility for emergency rescue is
8 shared among all initial response personnel but most especially by the first-on-scene security
9 personnel and the fire response units (military or civilian). Rescues should be attempted using
10 appropriate safety equipment and protective clothing (i.e., respirators, protective clothing, etc.,
11 as necessary). Since rescue may require entry into the impact area, care should be taken to
12 avoid hazards associated with hazardous debris or fires. Under no circumstances shall rescue
13 personnel unnecessarily endanger themselves during rescue activities. Rescue personnel
14 should *never* require rescue by other response personnel.

15 Emergency response operations are complete once all impact sites have been secured, rescue
16 operations are completed, any fires have been extinguished, and initial site reconnaissance has
17 been performed. Recovery and site restoration activities can then be initiated. Using the results
18 of the initial site reconnaissance, plans would be developed for the recovery of all debris and the
19 restoration of the site(s) to natural conditions.

20 Additional post-launch recovery and restoration areas may be determined by the launch
21 operator before and throughout mission-specific operations. The recovery of launch hardware
22 would be accomplished in a manner consistent with the launch site procedures, and
23 requirements set forth in applicable environmental documentation and conditions specified in
24 agreements with appropriate land owners.

25 The launch site operator is responsible for planning, performance, and control of launch
26 activities. This includes:

- 27 • Using results of analysis provided by Flight Safety to determine flight hardware
28 impact zones which fully encompass the areas designated in the analysis
- 29 • Ensuring that appropriate agreements with all affected landowners are in place and
30 adequately address recovery requirements
- 31 • Coordinating with local civilian authorities concerning recovery requirements
- 32 • Providing recovery plans to applicable agencies/personnel in accordance with
33 current launch site policies
- 34 • Establishing appropriate travel routes (ground/air) prior to launch activities to outline
35 access into recovery areas
- 36 • Perform visual inspections and obtain radar data to insure expeditious recovery of
37 the missile
- 38 • Ensure complete recovery of missile hardware

39
40

1 The recovery team is responsible for the recovery of all missile debris and restoration of impact
2 areas to their natural condition. Recovery personnel would have overall responsibility for
3 controlling recovery and restoration operations. Air units composed of helicopters and support
4 equipment would transport recovery personnel to road-inaccessible impact sites. Air support
5 equipment would also transport the missile components out of all land and near-shore impact
6 sites and perform quality assurance inspections or sweeps to ensure proper recovery
7 procedures.

8 Each launch location is subject to all Federal and State regulations involving waste/material
9 handling and disposal, endangered species, and historical resource preservation.
10 Implementation of these regulations may require the assistance of civilian agencies and law
11 enforcement authorities during recovery and restoration operations. Civilian assistance would
12 be requested by each launch location in accordance with existing agreements.

13 The following is a list of personnel, equipment, transportation, and operational requirements that
14 typically would be necessary to perform recovery activities.

15 *Personnel*

- 16 • Helicopter pilots
- 17 • Helicopter co-pilots
- 18 • Helicopter crew chief
- 19 • Explosive Ordnance Disposal personnel (two)
- 20 • Recovery personnel
- 21 • Project representative
- 22 • Owner representative (if required by controlling agent)
- 23 • Environmental representative (if required by controlling agent)

24
25 *Roadblocks*

26 Roadblocks shall be utilized to limit unauthorized access into recovery areas that include
27 locations in the vicinity of public roadways or thoroughfares. The Recovery Team Coordinator
28 would designate appropriate roadblock locations on roads leading into recovery areas.
29 Roadblocks would be coordinated by the launch site security personnel, augmented as needed
30 by local law enforcement personnel. At each roadblock positive communication would be
31 established and maintained with the Recovery Team Coordinator and other security
32 personnel/roadblocks. This communication would occur using either landlines (telephones),
33 cellular telephone, or military radio systems.

34 Certain critical response personnel, such as ambulance/medical or fire response units, shall be
35 permitted to pass through "active" roadblocks in the performance of their duties.

36 *Debris Recovery*

37 Personnel would arrive at impact site by appropriate mode. Recovery transportation vehicles
38 would remain at the nearest accessible road. Explosive Ordnance Disposal members of the

1 recovery team would be the first on scene and would be responsible for the identification,
2 handling, control, and rendering safe of minor detonating charges and other minor hazardous
3 debris. Other responsibilities include:

- 4 • Providing initial impact site control to prevent exposure for recovery personnel
5 (Security personnel would assume this role as impact zone access controls are
6 eased.)
- 7 • Maintaining area safety and rendering safe potential explosive materials
- 8 • Conducting initial impact site assessments for the identification of debris and the
9 determination of recovery equipment requirements
- 10 • Assisting in dismantling of launch hardware prior to recovery and transport
11 operations

12
13 Recovery personnel would then handle the next phase of the recovery including:

- 14 • Collect small missile parts
- 15 • Dismantle larger pieces into manageable sections
- 16 • Transport recovered parts by helicopter to recovery vehicles waiting at accessible
17 roads

18
19 *Environmental Restoration*

20 Recovery operations would be coordinated with the Environmental Office at each launch site. If
21 deemed necessary, an archaeologist and biologist would accompany Explosive Ordnance
22 Disposal personnel during the initial site assessment to determine if cultural or sensitive
23 biological resources are present at the impact site. These resource specialists would assist in
24 the determination of recovery equipment requirements and recovery transport routes.

25 All recovery and restoration activities would be carried out in accordance with Memorandums of
26 Agreement signed by appropriate State and Federal agencies and other potentially affected
27 organizations. Impacted areas would be restored to a natural condition in accordance with land-
28 owners' agreements and agency requirements.

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