# NATO STANDARD

# AXP-06

# NUCLEAR WEAPONS EFFECTS AND RESPONSES CASUALTY AND DAMAGE ASSESSMENT FOR EXERCISES

**Edition D Version 1**
**JANUARY 2016**

**NORTH ATLANTIC TREATY ORGANIZATION**

**ALLIED EXERCISE PUBLICATION**

**Published by the**
**NATO STANDARDIZATION OFFICE (NSO)**

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**NORTH ATLANTIC TREATY ORGANIZATION (NATO)**

**NATO STANDARDIZATION OFFICE (NSO)**

**NATO LETTER OF PROMULGATION**

18 January 2016

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# CHAPTER 1 INTRODUCTION

## 1.1. Purpose

This publication provides, for exercises and training ONLY, simplified nuclear casualty and damage data and procedures for use in making an assessment of the probable results of an enemy nuclear attack on friendly targets.

## 1.2. Scope

1. Ten representative weapon yields and a wide range of targets have been included in this publication for use by personnel of land, air and naval forces in a wide variety of situations.

2. The data and procedures in this publication have been kept as simple as possible in order to facilitate field use. While in some respects, the data in this publication are similar in appearance to data used by target analysts concerned with offensive weapons employment, these data are not suitable for such use and must not be used for weapon employment purposes.

## 1.3. Assumption

It is assumed that users of this publication are familiar with the effects of nuclear weapons and the contents of the reference documents listed int the covering STANAG.

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# CHAPTER 2 NUCLEAR WEAPONS

## 2.1. General

Employing nuclear weapons requires an understanding of their effects and target responses. Those effects of military interest that occur in the first minute are the initial effects. Those that occur after the first minute are residual effects. It may be hours or days before the consequences of some of these effects are known, and they may last for extended periods. AXP-06(D) provides summary descriptions of initial and residual effects from nuclear weapons and responses of personnel and equipment.

## 2.2. Nuclear Energy Partition

Nuclear explosions differ from conventional explosions in that both thermal and nuclear radiations are emitted as well **as blast. This energy, or yield, is measured in kilotons (KT), the energy released by 1,000 tons of TNT, or megatons (MT), the energy released by 1,000,000 tons of TNT**. Energy released by a nuclear weapon is typically in the form of X- rays, ultraviolet light, kinetic energy of debris, and nuclear radiation. At low altitudes, the X-rays and kinetic energy of the weapon debris heat the surrounding air to form a fireball and a shock wave. In the target area, most of the energy from a nuclear weapon detonation will appear as blast, thermal radiation and nuclear radiation.

## 2.3. Weapon Type

1. The partition of energy received by the target as blast, thermal radiation, and nuclear radiation depends primarily on whether the weapon uses fission or a combination of fission and fusion. Fission is the splitting of heavy atoms of uranium or plutonium. Fission produces neutrons, gamma rays, and radioactive fission products. Fusion is the combination of two light elements, typically hydrogen isotopes such as deuterium and tritium. Fusion produces neutrons as well as helium and hydrogen isotopes. Fusion is typically referred to as a thermonuclear process because it requires extremely high temperatures:

a. Fission Weapons. Approximately 80 percent of the energy released is initially in the form of X-rays and ultraviolet light with the remainder being nuclear radiation and kinetic energy of debris. For bursts in the atmosphere, the X-rays and debris heat the surrounding air to form a fireball and shock wave. At the target, slightly more than 50 percent of the energy may appear as blast, about 35 percent as thermal radiation, and the remaining 15 percent as nuclear radiation (5 percent initial and

10 percent residual). Some fission weapons may be referred to as a boosted fission weapon. A boosted fission weapon contains a small amount of fusion in order to provide additional neutrons to improve the efficiency, thus yield, of the fission process; and

b. Fission-Fusion Weapons. Fission-fusion weapons include thermonuclear and enhanced radiation (ER) weapons. The energy partition of a typical fission-fusion weapon is the same as for a fission weapon except there is less residual nuclear radiation per unit total yield. In an ER weapon, the neutrons produced by fusion are not intended to cause fission but rather to produce casualties or damage to a target. At the target, ER weapon energy typically divides into 30 percent blast, 20 percent thermal, and 50 percent nuclear radiation. Thus a 2 kiloton ER weapon will produce, approximately, the nuclear radiation of a 10 KT fission weapon and the blast and thermal radiation of a 1 KT fission device.

# CHAPTER 3 EFFECTS

## 3.1. Blast

**Air Blast**. Peak overpressure and dynamic pressure (wind gust) from an airburst causes most of the materiel damage and a considerable fraction of the casualties. The magnitude of the air blast depends on the yield of the weapon, height of burst, and the distance from ground zero.

### 3.1.1. Pressures

Both overpressure and dynamic pressure vary with yield, with distance from the burst and with time at a fixed distance from the burst.

a. Overpressure. Intensely hot gasses at extremely high pressures within the fireball expand to cause a blast wave in the air, moving outward at high velocities, and rising in pressure above ambient conditions (overpressure). The peak overpressure occurs at the leading edge, or shock front, of the blast wave. The peak overpressure steadily decreases with distance from the source. The pressure behind the shock front forms the negative phase of the blast wave, or under pressure. Initially, the velocity of the shock front is many times the speed of sound. However, as the front moves outward, it slows to the speed of sound and ultimately dissipates. The duration of a blast wave, the time that the blast wave takes to pass a fixed point, increases with distance.

b. Dynamic Pressure. The force of the air accompanying the blast wave and the drag forces resulting from the associated winds are referred to as dynamic pressure. Dynamic pressure can cause damage by pushing or tumbling (translating) objects along the ground or by tearing targets apart.

### 3.1.2. Height of Burst (HOB) Influences

a. Airburst (AB). The highest blast wave pressures are obtainable from lower altitude bursts; thus, low AB's may be employed against blast-resistant materiel targets. However, the blast wave from an AB is reflected by the earth's surface, which reinforces the incident (initial) blast wave. The magnitude of this reinforcement depends on the HOB. Thus, for large area targets not blast-resistant, a high AB will likely provide adequate area coverage.

b. Surface Burst (SB). A SB produces less total air blast area coverage to most military targets than an AB because there is less reinforcement of the blast wave, and because some of the weapon's energy is dissipated creating a crater and generating ground shock.

c. Subsurface Burst (SSB). Except for very shallow SSB's, the air blast wave produced by buried bursts is weak compared to those from AB's and SB's. The amount of energy from SSB's going into air blast rather than crater formation and/or ground shock depends on the yield and depth of burst.

### 3.1.3. Modifying Influences

a. Weather. Rain and fog may attenuate the blast wave in the low-overpressure region.

b. Surface Conditions. Generally, smooth (ideal) surfaces such as thin layers of ice, snow, moist soil, and water do not modify the blast wave as a result of absorbed thermal energy. Overpressure is maximized for such surfaces. Conversely, non-ideal surfaces, thick, low, combustible vegetation, dry soils with sparse vegetation, and desert sand, absorb energy that creates a thermal layer. This layer corrupts the blast wave and results in greatly increased dynamic pressure or wind and less overpressure.

c. Terrain. Compared to pressures at the same distance on flat terrain, pressures are greater on the forward slopes of steep hills and lower on reverse slopes. However, line-of-sight shielding is not dependable because blast waves bend or diffract around obstacles, such as small hills or folds in the ground. Hills may decrease dynamic pressure and offer some local protection from flying debris. Forests, in general, do not significantly affect overpressure but do lessen dynamic pressure.

d. Urban Areas. Built-up areas are not expected to have a significant effect on the blast wave. Structures may provide some local shielding from flying debris. They can also increase pressures by channeling the blast wave.

### 3.1.4. Ground Shock and Cratering

When a nuclear weapon is detonated beneath, near, or on the surface, it forms a crater. This crater may be quite large depending on weapon yield, depth of burst, and soil characteristics. In rocky or cohesive soil, material thrown from the crater may range from a fraction of a pound to many tons. This ejected material poses a hazard to personnel, materiel, and structures. A portion of the burst energy is transmitted to the surrounding earth as a ground shock wave that travels radially outward through the earth. This ground shock wave attenuates much more rapidly than the air blast wave. Its actual attenuation depends heavily on the geology.

### 3.2. Thermal Radiation

Nuclear weapons detonated in the atmosphere emit thermal energy in two distinct pulses. The first pulse emits mostly x-ray and ultraviolet radiation and very little energy of the visible thermal type but heat the atmosphere to produce the second pulse. Approximately 20 percent of the total thermal energy is delivered by the time the second thermal pulse reaches its maximum intensity. The second pulse lasts nominally 10 times as long as it takes to reach its maximum intensity. It would be very difficult to take evasive action to prevent skin burns or flash blindness from bursts of less than a megaton in yield:

a. Characteristics. Within the atmosphere thermal radiation travels at the speed of light, travels in straight lines, and can be scattered, reflected, and easily absorbed (attenuated);

b. Modifying Influences:

(1) Weather. Any condition that significantly affects the visibility or the transparency of the air affects the transmission of thermal radiation, but clouds above the burst may reflect additional thermal radiation onto the target.

(2) Terrain. Large hills, trees, and any opaque object or material such as camouflage net or tent canvas may provide some line-of-sight protection to a target element. Trucks, buildings, or even another person may protect an individual from thermal radiation. Foxholes provide increased protection. However, reflections off buildings or other objects may still cause injuries. Highly reflecting surfaces may reflect heat onto the target, intensifying the thermal radiation effect. Even the backs and sides of open foxholes will reflect thermal energy.

(3) Height of Burst. The amount of thermal radiation that a surface target receives from a nuclear burst of a given yield varies with the HOB. The maximum thermal effect at the target will usually be produced by an AB. A SB produces about one-half the amount of the thermal radiation that an AB produces because of the interaction of the fireball with the surface. No significant thermal radiation is received from a subsurface burst where the fireball is not visible.

### 3.3. Nuclear Radiation

Nuclear radiation consists of neutrons, alpha and beta particles, and electromagnetic energy in the form of x-rays and gamma rays. The principal types are neutrons and gamma rays. As the neutrons travel through the air, they lose energy in collisions with air molecules, producing (secondary) gamma rays. Radioactive products of fission are also produced in a nuclear explosion. The radioactive decay of these fission products starts immediately after the burst, producing alpha and beta particles, x-rays, and more gamma rays. Absorbed nuclear radiation is measured and expressed in the unit cGy (formerly the "RAD"). Dosimeters and other RADIAC meters may still be calibrated in RADs, but for practical military use they should be read directly in cGy. Nuclear radiation emitted in the first minute after the burst is initial radiation. The nuclear radiation emitted after the first minute is residual radiation:

a. Initial Radiation. Neutrons and gamma rays have a long range in air and are highly penetrating. They are the main cause of casualties. X-ray effects do not dominate in the lower regions of the atmosphere:

(1) Characteristics. Initial nuclear radiation travels at or near the speed of light; a portion is absorbed and/or scattered by material through which it passes; the atmosphere scatters it enough so that, at ranges of normal interest, some initial nuclear radiation comes from all directions, and it can penetrate and cause damage to materiel and personnel. The initial gamma rays received at a target consist of the prompt gamma rays from fission, secondary gamma rays from collisions of neutrons with air molecules and delayed gamma rays from fission products. The prompt neutron and gamma radiation is received at the target essentially within a millisecond; the secondary gammas arrive at the target over times longer than a second. Delayed gammas arrive over tens of seconds.

(2) Modifying Influences. For a given HOB, the gamma ray and neutron radiation received by a target at a given range from Ground Zero (GZ)[1] depends directly on the yield. However, other factors affect these quantities:

(a) Air Density. As the HOB or the temperature of the air increases, the air density decreases, and initial nuclear radiation travels farther.

(b) Terrain. Major terrain features between personnel and the burst such as large hills and forests may provide significant protection, depending on the HOB and type of forest. Minor irregularities such as ditches, gullies, and small folds in the ground may offer a little protection.

[1] Ground Zero (GZ): the point on the earth's surface directly above or below a nuclear detonation.

(c) Height of Burst. For surface and subsurface bursts, initial radiation is sharply attenuated by the surrounding ground.

(d) Target Elevation. A target above the terrain receives more radiation than one on the surface at the same distance from the burst.

(e) Shielding and Attenuation. People inside buildings, tanks, or foxholes will receive lower doses than they would in the open at the same distance from GZ. The ratio of the dose outside to the dose inside is called the protection factor. In actual operations, the protection factors for residual radiation should be determined from inside and outside dose rates measured in the field.

Protection Factor = Dose Outside/Dose Inside

b. Residual Radiation. Radiological hazards on and near the ground are caused by neutron- induced radiation, fallout, rainout, and base surge. Alpha and beta particles must come in direct contact with the skin or be inhaled or ingested to be of significance:

(1) Neutron-Induced Radiation. Radioactive materials are produced by neutron capture within a relatively small circular pattern hundreds of meters in radius around GZ. The distance to which a dose rate of 2 cGy/hour extends 1 hour after the burst encloses the significant area. For yields of 1 megaton or less, the maximum horizontal radius of this dose rate contour is about 2,000 meters.

(2) Fallout. Fallout is usually found in a large, elongated pattern around and outward from GZ. Soil swept into the radioactive debris cloud from a near-surface, surface, or subsurface burst combines with the radioactive debris and creates a radioactive hazard when it falls to the ground. Fallout will occur whenever the nuclear fireball touches the ground. The heavier fallout particles start reaching the area around GZ shortly after a burst. The lighter particles reach the ground farther downwind at later times. The greatest fallout intensity is usually close to GZ. However, winds, precipitation, or unusual terrain features may create high-intensity hot spots and low-intensity areas. Changes in wind direction can subject some locations to long periods of fallout. Craters caused by surface and (shallow) subsurface bursts will be contaminated by neutron-induced radiation and residual radioactive fission products.

(3) Fallout Safe Height of Burst (FSHOB). No military significant fallout will occur for a burst at or above the FSHOB. It is computed by one of the equations below in which W stands for safety[2] yield in kilotons.

W < 100 kT; FSHOB = 30 ($W^{1/3}$)(meters) or W > 100 kT; FSHOB = 55 ($W^{1/3}$)(meters)

(4) Rainout. Rainout consists of radioactive debris in the atmosphere brought down by precipitation. Rainout may be more concentrated than fallout, and it may or may not cover GZ.

(5) Base Surge. When a subsurface burst occurs, a dust and debris cloud called the base surge is formed at the surface of the earth around the debris stem. Radioactive dust and soil particles in the base surge cloud settle out and generally produce contamination in a circular pattern around GZ. The extent of contamination depends upon the depth of burst, soil type, and local wind conditions. Contamination from the base surge is not normally distinguished from main cloud fallout.

(6) Common Characteristics. Neutron-induced radiation, fallout, base surge, and rainout persist for relatively long periods and decontamination is difficult and the extent of the affected area is difficult to predict. The size, shape, and location of fallout areas depend on wind patterns and speed. The size and intensity of the radiation areas caused by the neutron-induced radiation and base surge depend heavily on soil composition and depth of burst. The size of the rainout area and the intensity of the radiation depend on the relative locations of the precipitation centre and the debris cloud. They also depend on the time between the burst and the precipitation. The most significant residual radiation from these areas is gamma radiation.

(7) HOB Influence. The extent of the hazards resulting from radioactivity on the ground depends primarily on the HOB. When a nuclear weapon is detonated at a height that precludes damage or casualties to ground targets neither induced radiation nor fallout of tactical significance occur. When a nuclear weapon produces damage or casualties on the ground, but the burst is above the minimum FSHOB, only neutron-induced radiation occurs. When a surface or near-surface burst is employed, neutron-induced radiation, base surge, and fallout result. The fallout pattern can be expected to overlap and overshadow the entire induced radiation and base surge patterns. Subsurface bursts produce induced radiation, base surge, and fallout in and around the

[2] Safety in this context is defined has the HOB aimed at precluding significant fallout. Safety yield can be assumed to be 10% greater than the nominal yield of the weapon.

crater. If the proper atmospheric conditions exist, rainout may occur for any HOB.

c. Electromagnetic Pulse (EMP), System Generated EMP (SGEMP), Transient Radiation Effects on Electronics (TREE), Nuclear Blackout. EMP and Nuclear Blackout are produced when initial nuclear radiation interacts with the atmosphere; SGEMP and TREE result from interaction directly with a system. EMP, SGEMP and TREE can cause electronic failure or upset. Nuclear Blackout can interrupt Command, Control Communication, Computer, Intelligence, Surveillance and Reconnaissance (C4ISR) transmission and reception for many minutes:

(1) Electromagnetic Pulse. When initial nuclear radiation (prompt neutrons and gamma rays) interacts with the atmosphere, large electromagnetic fields are created on or near the ground. Ground-based equipment is effected by an EMP (called High- altitude EMP (HEMP)) for a HOB greater than 45 km. HEMP can cover thousands of square kilometers on the ground. For HOBs below 25 to 45 km, EMP observed near or on the ground (called low-altitude EMP) increases as the HOB increases. This EMP (often called Source-region EMP (SREMP)) is very large (covering tens of square kilometers) and complicated within and near the fireball. SREMP intensity reduces rapidly at personnel safety distances from the fireball and mimics HEMP characteristics.

(2) System-Generated Electromagnetic Pulse. The gamma rays and, in some instances, X rays from a nuclear burst may interact with materials in systems and produce free electrons and electrical currents that generate an electromagnetic pulse in the system itself. For low-altitude bursts, SGEMP occurs in the source region at the same time as EMP. Intense electric fields may be generated when free electrons are emitted into system enclosures and cavities.

(3) Transient Radiation Effects on Electronics (TREE). At distances from a burst where personnel will survive initial radiation effects, neutron and gamma radiation can still damage materiel. The term "transient" indicates that the radiation is short lived. The effects on materiel, however, can be either temporary or permanent. Semiconductors and other electronic components are especially sensitive to TREE.

(4) Nuclear Blackout. Radiation from a nuclear burst will produce large disturbances and ionized dust clouds in the atmosphere. When the path of radio transmission is through these burst-affected regions, radio waves can be disrupted or totally blacked out. Blackout depends on the HOB, the yield, condition of the atmosphere, and the frequency of

the radio waves. Radio waves travelling through the nuclear fireball are refracted (bent), partially or totally absorbed, or scattered, thus reducing signal strength at the receiver. Under certain conditions, refraction can cause defocusing of a radio wave beam or even beam splitting.

## 3.4. Special Considerations

### 3.4.1. Extremely Cold Environments

Ice, snow, high winds, and low temperatures can alter nuclear weapon effects:

a. Blast. At temperatures of about -45$^{o}$ C (-49$^{o}$F), air blast damage radii for materiel targets such as tanks, artillery, and military vehicles can increase by as much as 20 percent. This increase may be partially offset by ideal reflecting surfaces such as the ice and snow, which reduce the dynamic pressures. Cratering in ice and frozen soil is similar to cratering in solid rock; however, the crater size would probably be larger than that in rock. Several feet of snow over the soil will reduce crater dimensions. Blast may interfere with movement over frozen waterways and, in the spring, cause a spring break-up. Blast may also cause avalanches in mountainous areas.

b. Thermal Radiation. When surfaces are covered with snow and ice and atmospheric conditions are clear, the minimum safe distances for unwarned, exposed personnel must be increased by 30 percent. Additionally, unwarned personnel will suffer flash blindness, particularly at night. Conversely, heavy clothing in extremely cold environments may help protect personnel from thermal effects. In addition, the cold temperatures and surface frost reduce thermal effects to most materials.

### 3.4.2. Hot Environments

Weapons effects do not vary as much in hot and tropical environments as in extremely cold environments. However, wearing less clothing and have more skin exposed increases susceptibility to thermal burns.

# CHAPTER 4 RESPONSES

## 4.1. Response to Blast

Air blast, cratering, ground shock, and indirect effects can damage materiel and injure personnel:

a. Air Blast. A large part of the destruction caused by a nuclear explosion is due to blast effects. Objects within the path of the blast wave are subjected to severe, sharp increases in atmospheric pressure and to extraordinarily severe transient winds. Most buildings, with the exception of reinforced or blast-resistant structures, will suffer moderate to severe damage when subjected to overpressures of only 35.5 kilopascals (kPa) (0.35 Atmospheres of Pressure (Atm). The velocity of the accompanying blast wind may exceed several hundred km/hr. Most materiel targets are drag- or wind-sensitive. The range for blast effects increases significantly with the explosive yield of the weapon. In a typical air burst, these values of overpressure and wind velocity noted above will prevail at a range of 0.7 km for 1 kiloton (Kt) yield; 3.2 km for 100Kt; and 15.0 km for 10 Mt:

(1) Materiel Damage. Air blast may damage equipment by diffraction loading and drag loading. Diffraction loading refers to overpressure that crushes or tears off components. Drag loading refers to dynamic pressure that overturns, tumbles, or translates the equipment. Induced shock caused by these phenomena may damage internal components such as radios mounted in combat vehicles. Most military equipment is drag-sensitive and, hence, damaged primarily by the dynamic pressures from the passing blast wave. Parked aircraft, structures, and forests are damaged by a combination of overpressures and dynamic pressures. Aircraft Plexiglas windows are particularly vulnerable to overpressure. Pressure sensitive mines may be detonated by overpressure. Tables 1 through 6 provide radii to moderate and severe blast damage for a variety of structures, transportation systems and military systems for notional weapon types.

(2) Personnel Injury. Very high overpressure is required to cause immediate deaths, provided no translational motion occurs. Lower overpressures may cause severe internal injuries, especially to lungs and abdominal organs. Eardrum rupture, which is painful but not

necessarily disabling, may result from still lower overpressures. Personnel in field fortifications such as shelters and foxholes can become casualties at lower incident overpressures than personnel in the open because the blast pressure can build up from multiple reflections inside such enclosures. Injuries from the above effects are called primary blast injuries. Tables 7 through 13 provide radii to effect for personnel in the open and in a variety of structure types. These radii reflect the combined effects of radiation, blast and thermal exposure, one of which will dominate casualty production, depending on the weapon yield. Radii to effect are given for a number of notional weapon types.

(a) Personnel in the open can also be injured by being picked up and thrown by dynamic pressure (translation). Personnel translated by blast winds may be injured by tumbling or by impact with solid surfaces. Translational casualty criteria are evaluated on a mix of translational injuries consisting of 75 percent of injuries caused by decelerative tumbling and 25 percent of injuries caused by solid impact. The third source of blast injuries that are considered are missiling injuries, that is, injuries caused by objects hitting personnel. Blast personnel safety criteria for exposed personnel are typically the maximum of the above three discussed blast casualty mechanisms. Blast casualty criteria for exposed personnel are the maxima of the first two mechanisms. Table 7 provides the range to effect in meters for exposed personnel.

b. <u>Cratering and Ground Shock</u>. Depending on terrain, cratering may be the primary mechanism for producing obstacles to movement. It may also be used to damage structural targets. Crater debris fall to earth over a significant area, causing injuries and damaging equipment and structures. For long periods of time after the detonation, residual radiation in and around the crater may be a significant hazard to personnel attempting to breach the obstacle. Ground shock can damage structural targets, but it is a primary damage mechanism only for underground targets. Cratering and/or ground shock can destroy bridges and underground targets; and

c. <u>Indirect Effects</u>. The blast wave can turn debris, stones, and sand into missiles, which may cause casualties. Sand and dust may limit visibility and movement in the target area for tens of minutes. They may also affect electromagnetic transmissions for a short time. Buildings and fortifications that collapse also damage materiel and injure personnel. These casualties can be estimated from the damage done to the structures. Rubble in built-up areas and trees blown down by air blast often extend far beyond the primary target area and may block avenues of approach or hinder the military mission. Cratering can prevent or impede military movements.

### 4.2. Response to Thermal Radiation

Essentially all of the thermal radiation absorbed by a target element is immediately converted to heat. It may cause injury or damage, and it may ignite combustible materials. Since significant amounts of thermal energy may be reflected from a target, the amount absorbed may be only a small fraction of the incident thermal energy:

a. Personnel. Personnel may be vulnerable to thermal radiation, which causes two general categories of injury: Burns and blindness:

(1) Burns. Thermal burns produced directly by absorbing the thermal energy are flash burns. Those produced indirectly by fires that the thermal energy ignited are flame burns. Personnel safety criteria developed for thermal radiation exposures are based upon thermal radiation being transmitted to bare skin or through battlefield uniforms in sufficient intensity to cause skin burns. Flame burns occur from burning clothes or other nearby materials. Table 14 provides radii at which second degree burns may be expected for personnel in the open, wearing battle dress uniform and battle dress over garment, for a number of notional weapon types.

(2) Blindness. The flash of light produced by a nuclear explosion may be many times brighter than the sun. The temporary loss of vision from this bright flash, called flash blindness, may occur even if the fireball is not in direct view. Retinal burns, which are permanent, may occur. Eye damage can be produced farther from the burst than skin burns can be. Sufficient thermal energy arrives so quickly that reflex actions to protect the eyes, such as blinking, give only limited protection, if any at all.

b. Environment:

(1) Forest Fires. Thermal radiation may start forest fires depending on the mixture of dry and green fuels, tree canopy, seasonal and recent weather, wind, relative humidity, and topography. Thermal radiation normally does not ignite green fuels (living branches, green grass, and other living foliage). However, burning dry fuels (surface litter, fallen branches, dead leaves, and dry grass) can ignite the green fuels. The tree canopy may smoke and char but ordinarily will not sustain ignition. The tree canopy can protect the dry fuel on the surface.

(2) Urban Fires. In cities, direct thermal radiation can ignite flammable articles. In addition, the blast wave can start fires by upsetting stoves,

causing electrical short circuits, or breaking gas lines. Persons in burning buildings may become burn casualties. Shelter persons may die of asphyxiation after surviving the other effects.

## 4.3. Response to Nuclear Radiation

1. Commanders should appreciate the significance of human exposure to radiation and weigh it carefully against any immediate or short-range advantage that may be gained. Initial nuclear radiation can affect personnel protected from blast and thermal radiation. The effects from comparatively small doses of nuclear radiation may be delayed, permitting some personnel to remain effective long enough to complete specific tasks. However, the delayed effects may significantly reduce the unit's overall combat effectiveness for a long period of time. Units may have to reorganize or reconstitute to maintain combat effectiveness after nuclear attacks or radiation exposures. The amount and frequency of prior doses and the requirements of the tactical situation will determine the degree to which friendly personnel can be exposed during a nuclear attack and still remain operationally effective.

2. For the assessment of medical effects due to radiation, STANAG 2553 – N A T O Planning Guide for the Estimation of CBRN Casualties – AMedP-8(C) shall be used.

## 4.4. Additional Responses

1. **Area Target Damage**. Understanding weapons effects and target response is necessary in assessing the full impact on the target when a particular fractional coverage is used as the defeat criterion. The three basic weapons effects, nuclear radiation, blast and thermal radiation extend to varying distances for certain levels of personnel response. The relationship between distances to a specific level of response from one effect to another depends on yield, height of burst and weapon type.

2. **EMP, SGEMP, and TREE**. EMP, SGEMP and TREE may cause permanent damage or temporarily degrade electrical and electronic equipment by burning out or degrading components, introducing undesirable signals, or altering the state of circuits without damaging components. The levels of equipment damage depend on the type of equipment, its external circuitry, its components such as antennas and connecting cables, and the deliberate measures taken to make the equipment more survivable. Damage radii for specific equipment can be estimated on the basis of its sensitivity levels to electromagnetic fields. EMP, SGEMP, and TREE do not cause casualties directly. However, they can be significant for friendly unit vulnerability and damage preclusion considerations. Damage to command and control equipment may impair the effective military operations of survivors.

3. **Blackout of Communications**. Radio waves transmitted near or through a region of the atmosphere disturbed by a nuclear fireball may be disrupted or blacked out totally.

The actual blackout interference on the battlefield will depend on the number of nuclear detonations, the time period of the detonations, the bursts' altitudes, and the atmospheric and environmental conditions. Blackouts from low-altitude bursts will probably not be very significant. Serious blackout problems from high-altitude bursts can be expected for synchronous satellite relays and sky wave propagation. Blackout may be reduced by using:

a. Fiber-optic cable.

b. Alternate routing to bypass the blackout region.

c. An assigned alternate frequency (ionized region suspected as cause: Try higher frequencies; dust suspected as cause: Try lower frequencies).

4. **Combined Nuclear and Chemical Exposure**. Chemical weapons may be employed simultaneously or sequentially with nuclear weapons to take advantage of whatever operational or physiological interaction might occur. Further, damage to either a chemical protective over-garment or to skin by nuclear weapons effects will provide entries for chemical warfare agents to get at sensitive tissues.

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# CHAPTER 5 APPLICATION

## 5.1 Damage Assessment Tables

1. This document provides summary descriptions of initial and residual effects from nuclear weapons and responses of personnel and equipment. Unclassified values of range-to-effect for a variety of notional weapon types are included in this document. Those unclassified data are appropriate **ONLY** for use in the conduct and planning of exercises. **The data provided in the following tables is not appropriate for operational use.**

2. The term "Radius of Damage (RD)" has no meaning unless the target and degree of damage are specified:

a. Each nuclear weapon burst will produce a great number of RDs. For example, a single surface burst of 100 KT may be considered to simultaneously produce the following RDs:

(1) <u>410 meters</u>. Severe damage to supply depots.

(2) <u>1400 meters</u>. Moderate damage to tanks.

(3) <u>2550 meters</u>. Severe damage to wood buildings.

(4) <u>2800 meters</u>. Moderate damage to exposed wheeled vehicles.

b. When concerned with personnel casualties rather than material damage, the term RD will still be used. The RD is the distance from GZ where 50 percent of the personnel will experience a particular level of ineffectiveness (IPI, ITI, LI) as defined in Annex B.

c. The tabular data in this Chapter, Tables 1 thru 14 are RDs for each of 10 yields considered. RDs are given for surface and optimum airburst HOB. The procedures used assume that enemy airburst weapons always burst at the optimum HOB for whatever target and degree of damage is under consideration. Such RDs may therefore be considered as "worst case" RDs or Max RD and the resulting estimates of damage (casualties) as worse case estimates.

# TABLES

## Table 1 - Moderate Damage to Materiel

| System | | | Radius of damage (meters) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | | Surface burst | | | |
| | | | Wheeled Vehicles | | | | Wheeled Vehicles | | | |
| Warhead | Yield Designator[3] | Yield | Exposed | Shielded | Tanks | Towed Artillery | Exposed | Shielded | Tanks | Towed Artillery |
| Little Bomb | Y1 | 0.1 | 600 | 500 | 200 | 300 | 500 | 400 | 100 | 200 |
| | Y2 | 5 | 880 | 600 | 400 | 600 | 750 | 500 | 400 | 500 |
| | Y3 | 50 | 1900 | 1730 | 1000 | 1000 | 1800 | 1600 | 1000 | 900 |
| Big Bomb | Y1 | 1 | 600 | 500 | 200 | 200 | 700 | 600 | 200 | 100 |
| | Y2 | 10 | 1020 | 870 | 550 | 550 | 900 | 800 | 550 | 400 |
| | Y3 | 200 | 5000 | 3000 | 1800 | 1800 | 3800 | 2900 | 1800 | 1700 |
| Cruise Missile | Y1 | 3 | 700 | 550 | 300 | 300 | 600 | 500 | 300 | 200 |
| | Y2 | 100 | 4000 | 2500 | 1400 | 1400 | 2800 | 1900 | 1400 | 1100 |
| ICBM | Y1 | 200 | 5000 | 3000 | 1800 | 1800 | 3800 | 2900 | 1800 | 1700 |
| SLBM | Y1 | 150 | 4500 | 2700 | 1600 | 1600 | 3300 | 2400 | 1600 | 1500 |

## Table 2 - Severe Damage to Materiel, Buildings

| System | | | Radius of damage (meters) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | | Surface burst | | | |
| Warhead | Yield Designator | Yield | Wood Frame Buildings | Multi Story Brick Apart ments | Factories | Supply Depots | Wood Frame Buildings | Multi Story Brick Apartm ents | Factories | Supply Depots |
| Little Bomb | Y1 | 0.1 | 260 | 210 | 70 | 320 | 210 | 180 | 70 | 300 |
| | Y2 | 5 | 1100 | 840 | 450 | 370 | 910 | 740 | 380 | 350 |
| | Y3 | 50 | 2410 | 1840 | 1180 | 410 | 2020 | 1620 | 1010 | 390 |
| Big Bomb | Y1 | 1 | 630 | 480 | 220 | 350 | 510 | 420 | 180 | 330 |
| | Y2 | 10 | 1420 | 1080 | 600 | 400 | 1160 | 940 | 510 | 380 |
| | Y3 | 200 | 3900 | 2940 | 2030 | 1220 | 3210 | 2580 | 1730 | 1200 |
| Cruise Missile | Y1 | 3 | 920 | 700 | 360 | 360 | 760 | 620 | 300 | 340 |
| | Y2 | 100 | 3070 | 2340 | 1550 | 430 | 2550 | 2050 | 1330 | 410 |
| ICBM | Y1 | 200 | 3990 | 3040 | 2040 | 1220 | 3210 | 2580 | 1730 | 1200 |
| SLBM | Y1 | 150 | 3280 | 2510 | 1570 | 1000 | 2550 | 2050 | 1330 | 980 |

[3] Yield designator can be used for computer based designation

## Table 3 - Severe Damage to Materiel, Transportation

| System | | | Radius of damage (meters) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | | Surface burst | | | |
| | | | Bridges | | Railroad | | Bridges | | Railroad | |
| Warhead | Yield Designator | Yield | Fixed | Floating | Loco-motive | Box & Flat Cars | Fixed | Floating | Loco-motive | Box & Flat Cars |
| Little Bomb | Y1 | 0.1 | 100 | 340 | 420 | 420 | 60 | 270 | 400 | 400 |
| | Y2 | 5 | 500 | 600 | 1140 | 1140 | 400 | 500 | 1000 | 1120 |
| | Y3 | 50 | 730 | 850 | 2250 | 2250 | 770 | 870 | 2000 | 2200 |
| Big Bomb | Y1 | 1 | 170 | 400 | 600 | 600 | 130 | 370 | 600 | 600 |
| | Y2 | 10 | 930 | 1000 | 1430 | 1430 | 860 | 1000 | 1400 | 1400 |
| | Y3 | 200 | 1690 | 2400 | 3500 | 3500 | 1800 | 2600 | 3400 | 3400 |
| Cruise Missile | Y1 | 3 | 470 | 540 | 640 | 640 | 400 | 500 | 600 | 600 |
| | Y2 | 100 | 1280 | 1900 | 2500 | 2500 | 1500 | 1400 | 2400 | 2400 |
| ICBM | Y1 | 200 | 1680 | 2400 | 3500 | 3500 | 1800 | 2600 | 3400 | 3400 |
| SLBM | Y1 | 150 | 1430 | 2100 | 3000 | 3000 | 1600 | 1800 | 2900 | 2900 |

## Table 4 - Severe Damage to Materiel, Missile and Rocket Systems

| System | | | Radius of damage (meters) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | | Surface burst | | | |
| | | | Surface to Air Missiles | | Missiles & Rockets | | Surface to Air Missiles | | Missiles & Rockets | |
| Warhead | Yield Designator | Yield | Exposed | Riveted | Travelling | Erected | Expose d | Riveted | Travel-ling | Erected |
| Little Bomb | Y1 | 0.1 | 100 | 50 | 480 | 200 | 100 | 50 | 370 | 170 |
| | Y2 | 5 | 400 | 300 | 1200 | 950 | 400 | 300 | 1000 | 810 |
| | Y3 | 50 | 950 | 600 | 2500 | 2360 | 900 | 600 | 2300 | 2040 |
| Big Bomb | Y1 | 1 | 200 | 100 | 700 | 510 | 200 | 100 | 600 | 430 |
| | Y2 | 10 | 600 | 500 | 1500 | 1260 | 600 | 500 | 1300 | 1070 |
| | Y3 | 200 | 2200 | 2000 | 3450 | 3000 | 2200 | 2000 | 3500 | 3000 |
| Cruise Missile | Y1 | 3 | 250 | 200 | 1000 | 770 | 250 | 200 | 800 | 660 |
| | Y2 | 100 | 1600 | 1500 | 2500 | 2130 | 1600 | 1450 | 1800 | 1690 |
| ICBM | Y1 | 200 | 2200 | 2000 | 3500 | 3000 | 2200 | 1750 | 3300 | 3000 |
| SLBM | Y1 | 150 | 1800 | 1700 | 3000 | 2450 | 1800 | 1600 | 2500 | 2300 |

## Table 5 - Severe Damage to Materiel, Helicopters and Tracked Vehicles

| System | | | Radius of damage (meters) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | | Surface burst | | | |
| | | | Helicopters Randomly Parked | | Tracked Vehicles (No Tanks) | | Helicopters Randomly Parked | | Tracked Vehicles (No Tanks) | |
| Warhead | Yield Designator | Yield | Cargo Trans-port | Light Obser-vation | Exposed | Shield | Cargo Trans-port | Light Obser-vation | Exposed | Shield |
| Little Bomb | Y1 | 0.1 | 410 | 310 | 250 | 420 | 400 | 300 | 100 | 300 |
| | Y2 | 5 | 1100 | 900 | 450 | 640 | 1000 | 800 | 400 | 600 |
| | Y3 | 50 | 2350 | 2000 | 1130 | 1350 | 2000 | 1800 | 1100 | 1300 |
| Big Bomb | Y1 | 1 | 600 | 440 | 380 | 440 | 500 | 400 | 200 | 400 |
| | Y2 | 10 | 1430 | 1000 | 600 | 830 | 1150 | 950 | 600 | 800 |
| | Y3 | 200 | 3500 | 3000 | 2130 | 2500 | 3000 | 2800 | 2100 | 2300 |
| Cruise Missile | Y1 | 3 | 700 | 500 | 480 | 640 | 550 | 450 | 400 | 600 |
| | Y2 | 100 | 2500 | 2000 | 1500 | 1700 | 2000 | 1800 | 1400 | 1600 |
| ICBM | Y1 | 200 | 3500 | 3000 | 2130 | 2500 | 3000 | 2800 | 2100 | 2300 |
| SLBM | Y1 | 150 | 3000 | 2500 | 1800 | 2000 | 2500 | 2300 | 1600 | 1800 |

## Table 6 - Severe damage to materiel, Electronic Equipment

| System | | | Radius of damage (meters) | | | |
|---|---|---|---|---|---|---|
| | | | Air burst | | Surface burst | |
| Warhead | Yield Designator | Yield | Radios & Fire Control Equipment | Open Grid Radar Antenna | Radios & Fire Control Equipment | Open Grid Radar Antenna |
| Little Bomb | Y1 | 0.1 | 100 | 400 | 200 | 500 |
| | Y2 | 5 | 500 | 1500 | 600 | 1000 |
| | Y3 | 50 | 1400 | 3800 | 1500 | 3900 |
| Big Bomb | Y1 | 1 | 300 | 800 | 400 | 900 |
| | Y2 | 10 | 800 | 2000 | 900 | 2100 |
| | Y3 | 200 | 2400 | 6600 | 2500 | 6700 |
| Cruise Missile | Y1 | 3 | 400 | 1000 | 500 | 1100 |
| | Y2 | 100 | 1800 | 5000 | 1900 | 5100 |
| ICBM | Y1 | 200 | 2400 | 6600 | 2500 | 6700 |
| SLBM | Y1 | 150 | 2100 | 5800 | 2200 | 5900 |

## Table 7 - Casualties for Exposed Personnel

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | Surface burst | | |
| Warhead | Yield Designator | Yield | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 250 | 340 | 550 | 230 | 320 | 520 |
| | Y2 | 5 | 710 | 850 | 1150 | 660 | 790 | 1070 |
| | Y3 | 50 | 1130 | 1260 | 2380 | 1060 | 1190 | 1530 |
| Big Bomb | Y1 | 1 | 490 | 620 | 880 | 460 | 570 | 820 |
| | Y2 | 10 | 810 | 950 | 1350 | 750 | 890 | 1190 |
| | Y3 | 200 | 1770 | 1810 | 4170 | 1710 | 1760 | 3290 |
| Cruise Missile | Y1 | 3 | 640 | 770 | 1050 | 590 | 720 | 990 |
| | Y2 | 100 | 1310 | 1430 | 3030 | 1280 | 1380 | 2820 |
| ICBM | Y1 | 200 | 1630 | 1690 | 4180 | 1610 | 1660 | 3290 |
| SLBM | Y1 | 150 | 1180 | 1330 | 3040 | 1080 | 1280 | 2820 |

## Table 8 - Casualties for Personnel in Tanks and Armoured Ship Turrets

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | Surface burst | | |
| Warhead | Yield Designator | Yield | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 150 | 210 | 380 | 140 | 200 | 360 |
| | Y2 | 5 | 650 | 820 | 1100 | 640 | 800 | 1080 |
| | Y3 | 50 | 900 | 1090 | 1410 | 890 | 1070 | 1390 |
| Big Bomb | Y1 | 1 | 370 | 480 | 660 | 360 | 460 | 610 |
| | Y2 | 10 | 740 | 920 | 1220 | 720 | 900 | 1200 |
| | Y3 | 200 | 1310 | 1310 | 1675 | 1300 | 1290 | 1650 |
| Cruise Missile | Y1 | 3 | 550 | 650 | 890 | 540 | 630 | 870 |
| | Y2 | 100 | 1010 | 1170 | 1550 | 1000 | 1150 | 1530 |
| ICBM | Y1 | 200 | 1310 | 1310 | 1675 | 1300 | 1290 | 1650 |
| SLBM | Y1 | 150 | 1150 | 1210 | 1600 | 1140 | 1190 | 1555 |

## Table 9 - Casualties for Personnel in APC's and Equivalently Protected Ship Superstructures

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | Surface burst | | |
| Warhead | Yield Designator | Yield | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 420 | 430 | 510 | 400 | 410 | 480 |
| | Y2 | 5 | 630 | 760 | 1030 | 580 | 700 | 960 |
| | Y3 | 50 | 950 | 1100 | 1420 | 880 | 1020 | 1330 |
| Big Bomb | Y1 | 1 | 480 | 560 | 790 | 440 | 510 | 730 |
| | Y2 | 10 | 720 | 850 | 1140 | 670 | 790 | 1070 |
| | Y3 | 200 | 1500 | 1650 | 1790 | 1400 | 1590 | 1630 |
| Cruise Missile | Y1 | 3 | 570 | 690 | 950 | 530 | 640 | 890 |
| | Y2 | 100 | 1040 | 1210 | 1550 | 1000 | 1150 | 1470 |
| ICBM | Y1 | 200 | 1500 | 1650 | 1790 | 1400 | 1590 | 1630 |
| SLBM | Y1 | 150 | 1300 | 1450 | 1600 | 1200 | 1450 | 1470 |

## Table 10 - Casualties for Personnel in Open Foxholes

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | Surface burst | | |
| Warhead | Yield Designator | Yield | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 150 | 220 | 390 | 140 | 200 | 370 |
| | Y2 | 5 | 520 | 640 | 900 | 480 | 590 | 840 |
| | Y3 | 50 | 810 | 960 | 1390 | 760 | 900 | 1300 |
| Big Bomb | Y1 | 1 | 340 | 440 | 670 | 310 | 410 | 620 |
| | Y2 | 10 | 600 | 730 | 1010 | 560 | 680 | 940 |
| | Y3 | 200 | 1550 | 1570 | 2030 | 1520 | 1540 | 1920 |
| Cruise Missile | Y1 | 3 | 460 | 570 | 820 | 420 | 530 | 770 |
| | Y2 | 100 | 940 | 1070 | 1650 | 960 | 1050 | 1560 |
| ICBM | Y1 | 200 | 1350 | 1380 | 1960 | 1520 | 1540 | 1920 |
| SLBM | Y1 | 150 | 1140 | 1270 | 1850 | 1200 | 1250 | 1760 |

## Table 11 - Casualties for Personnel in Earth Shelters

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Warhead | Yield Designator | Yield | Air burst | | | Surface burst | | |
| | | | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 420 | 420 | 420 | 400 | 400 | 400 |
| | Y2 | 5 | 440 | 460 | 610 | 400 | 420 | 560 |
| | Y3 | 50 | 500 | 630 | 910 | 490 | 600 | 840 |
| Big Bomb | Y1 | 1 | 440 | 440 | 470 | 400 | 400 | 430 |
| | Y2 | 10 | 440 | 480 | 690 | 410 | 450 | 640 |
| | Y3 | 200 | 600 | 770 | 1090 | 660 | 790 | 1080 |
| Cruise Missile | Y1 | 3 | 440 | 450 | 550 | 400 | 410 | 510 |
| | Y2 | 100 | 540 | 550 | 900 | 570 | 690 | 950 |
| ICBM | Y1 | 200 | 600 | 700 | 1050 | 660 | 790 | 1080 |
| SLBM | Y1 | 150 | 560 | 600 | 1000 | 570 | 690 | 950 |

## Table 12 - Casualties for Personnel in Multi-story Brick Apartments

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| Warhead | Yield Designator | Yield | Air burst | | | Surface burst | | |
| | | | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 230 | 290 | 480 | 210 | 270 | 450 |
| | Y2 | 5 | 860 | 890 | 1080 | 760 | 800 | 1000 |
| | Y3 | 50 | 1840 | 1850 | 1890 | 1620 | 1630 | 1700 |
| Big Bomb | Y1 | 1 | 510 | 570 | 800 | 450 | 520 | 740 |
| | Y2 | 10 | 1090 | 1110 | 1250 | 950 | 980 | 1150 |
| | Y3 | 200 | 2940 | 2940 | 2950 | 2580 | 2590 | 2600 |
| Cruise Missile | Y1 | 3 | 720 | 770 | 980 | 640 | 700 | 910 |
| | Y2 | 100 | 2340 | 2340 | 2360 | 2050 | 2050 | 2090 |
| ICBM | Y1 | 200 | 3040 | 3040 | 3050 | 2580 | 2590 | 2600 |
| SLBM | Y1 | 150 | 2510 | 2510 | 2530 | 2050 | 2050 | 2090 |

## Table 13 - Casualties for Personnel in Wood Frame Buildings

| System | | | Radius of damage (meters) | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Air burst | | | Surface burst | | |
| Warhead | Yield Designator | Yield | Immediate Permanent | Immediate Transient | Latent Ineffective | Immediate Permanent | Immediate Transient | Latent Ineffective |
| Little Bomb | Y1 | 0.1 | 270 | 310 | 500 | 230 | 290 | 480 |
| | Y2 | 5 | 1100 | 1110 | 1210 | 910 | 930 | 1080 |
| | Y3 | 50 | 2410 | 2410 | 2420 | 2020 | 2030 | 2050 |
| Big Bomb | Y1 | 1 | 640 | 670 | 840 | 520 | 570 | 780 |
| | Y2 | 10 | 1420 | 1420 | 1480 | 1160 | 1170 | 1270 |
| | Y3 | 200 | 3900 | 3900 | 3900 | 3210 | 3210 | 3220 |
| Cruise Missile | Y1 | 3 | 920 | 940 | 1060 | 770 | 790 | 960 |
| | Y2 | 100 | 3070 | 3070 | 3080 | 2550 | 2550 | 2560 |
| ICBM | Y1 | 200 | 3990 | 3990 | 3990 | 3210 | 3210 | 3220 |
| SLBM | Y1 | 150 | 3280 | 3280 | 3280 | 2750 | 2750 | 2760 |

## Table 14 - 50 % Casualties for Personnel in the Open, Second Degree Burns

| System | | | Radius of damage (meters) | | | |
|---|---|---|---|---|---|---|
| | | | Air burst | | Surface burst | |
| Warhead | Yield Designator | Yield | Combat Uniforms | CBRN Overgarment Uniforms | Combat Uniforms | CBRN Overgarment Uniforms |
| Little Bomb | Y1 | 0.1 | 100 | 40 | 40 | 20 |
| | Y2 | 5 | 750 | 400 | 280 | 160 |
| | Y3 | 50 | 2360 | 1440 | 1120 | 590 |
| Big Bomb | Y1 | 1 | 320 | 170 | 120 | 70 |
| | Y2 | 10 | 1150 | 600 | 430 | 230 |
| | Y3 | 200 | 4170 | 2470 | 2170 | 1300 |
| Cruise Missile | Y1 | 3 | 570 | 300 | 210 | 120 |
| | Y2 | 100 | 3030 | 1890 | 1600 | 880 |
| ICBM | Y1 | 200 | 4180 | 2470 | 2170 | 1300 |
| SLBM | Y1 | 150 | 3030 | 1870 | 1600 | 880 |

# ANNEX A NUCLEAR INCIDENT PLANNING EXERCISES

## A.1. GENERAL

This annex may be used by exercise planning staff in preparing CBRN exercise scenarios and nuclear incidents, and by players in reacting to nuclear exercise incidents.

## A.2. PROCEDURES

1. The following steps provide guidance in planning a nuclear incident during an exercise.

a. Plan the yield and the location of GZ that will achieve the damage desired by the directing staff (DISTAFF). The planners must themselves use the data provided in this publication as a reference.

b. Prepare the appropriate CBRN-1 NUC or CBRN-2 NUC reports to inject the strike into the exercise play.

c. Prepare a message for later injection into the exercise play that will require the players to estimate damage using this publication as a reference. Afterwards, as the exercise is running, the DISTAFF will compare the players' estimate with the assessment planned in advance by the DISTAFF.

## A.3. TARGETS

1. The damage estimation for a target consists of determining the target covered by the RD.

2. This method is basically a visual estimation since the target is not circular or a point target.

**Steps**. The following steps describe the procedures to follow for targets:

a. Obtain the target information.

b. Obtain the nuclear burst information.

c. Obtain the RD from the appropriate tables.

d. With the centre of GZ, draw a circle with a radius equal to the RD on the map and place centre of it over the actual GZ.

**Example**

a. **Target**. Infantry unit in open foxholes;

b. **Weapon Yield**. 100 KT airburst;

c. **Location of GZ**. 1500 meters from the target centre;

d. **Solution**. From Table 10, the RDs are:

(1) Immediate Permanent Ineffectiveness (IPI) = 940m.

(2) Immediate Transient Ineffectiveness (ITI) = 1070m.

(3) Latent Ineffectiveness (LI) = 1650m.

# GLOSSARY

**Note: Bracket indicates the short title of the source from which they are taken.**

**ground zero**
The point on the earth's surface directly above or below a nuclear detonation. (AAP-06)

**immediate permanent ineffectiveness (IPI)**
Physiological response to radiation whereby personnel become CI a few minutes after radiation exposure and never recover, usually dying in one day.

**immediate transient ineffectiveness (ITI)**
Physiological response to radiation whereby personnel become CI within a few minutes, but may partially recover shortly thereafter for several hours. They usually die within one week.
Although primarily defined as a radiation effect, ITI is also computed for injury from overpressure.

**latent ineffectiveness (LI)**
Physiological response whereby personnel become performance degraded within several hours, and then perform with reduced efficiency for several weeks until death or recovery. LI can be caused by radiation or blast and is the only casualty criterion also established for thermal radiation.

**nuclear damage**
a. Light damage. Damage which does not prevent the immediate use of equipment or installations for which it was intended. Some repair by the user may be required to make full use of the equipment or installations.
b. Moderate damage.
Damage which prevents the use of equipment or installations until extensive repairs are made.
c. Severe damage.
Damage which prevents use of equipment or installations permanently. (AAP-06)

**nuclear airburst**
The explosion of a nuclear weapon in the air, at a height greater than the maximum radius of the fireball. (AAP-06)

**nuclear surface burst**
An explosion of a nuclear weapon at the surface of land or water; or above the surface at a height less than the maximum radius of the fireball. (AAP-06)

**radius of damage**
The RD is the distance in meters from Ground Zero (GZ) of a nuclear weapon burst at which a specified target element has a 50 percent probability of receiving at least a specified degree of damage.

**target**
The object of a particular action, for example a geographic area, a complex, an installation, a force, equipment, an individual, a group or a system, planned for capture, exploitation, neutralization or destruction by military forces. (AAP-06)

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