Final Coordinating Draft

ARMY, MARINE CORPS, NAVY, AIR FORCE

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR (CBRN) AVOIDANCE MULTISERVICE TACTICS, TECHNIQUES, AND PROCEDURES (MTTP)

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MULTISERVICE TACTICS, TECHNIQUES, AND PROCEDURES

Final Coordinating Draft

FOREWORD

This publication has been prepared under our direction for use by our respective commands and other commands as appropriate.

STANLEY H. LILLIE
Brigadier General, USA
Commandant
US Army Chemical School

EDWARD HANLON, JR.
Lieutenant General, USMC
Commanding General
Marine Corps Combat
Development Command

JOHN M. KELLY
Rear Admiral, USN
Commander
Navy Warfare Development Command

BENTLEY RAYBURN
Major General, USAF
Commander
Headquarters Air Force Doctrine Center

This publication is available at Army Knowledge Online www.us.army.mil.

PREFACE

1. Scope

This multiservice operations publication provides tactics, techniques, and procedures (TTP) for conducting Chemical, Biological, Radiological, and Nuclear (CBRN) Avoidance. This document presents comprehensive tactics, techniques, and procedures for passive and active avoidance measures. Users of this manual will be CBRN staff officers, CBRN Noncommissioned Officers (NCOs), non CBRN personnel performing collateral duties as an additional duty CBRN Officer / NCO, commanders and staff at the tactical through strategic levels, and civilian agencies.

NOTE: The United States Marine Corps (USMC) uses the acronym METT-T (mission, enemy, terrain and weather, troops available and time available). Civilian considerations are inherently measured within the context of this acronym.

2. Purpose

The purpose of this publication is to provide commanders, staffs, key agencies, and service members a key reference for planning and conducting Chemical, Biological, Radiological, and Nuclear (CBRN) Avoidance. It provides the tools for CBRN Defense personnel to implement active, as well as passive CBRN avoidance measures, and support the decision-making process. It also serves as a key source document for refining existing training support packages (TSPs), training center exercises, and service school curricula. This publication implements NATO ATP-45(B) procedures..

3. Application

This publication is designed for use at the operational and tactical levels but has implications at the strategic level in the implementation of NATO ATP-45(B). The document will support command staff planning in preparing for and conducting CBRN avoidance operations. The manual also provides guidance to unit leaders and personnel for implementing CBRN avoidance tactics, techniques, and procedures.

4. Implementation Plan

Participating service command offices of primary responsibility (OPRs) will review this publication, validate the information; and reference and incorporate it in service and command manuals, regulations, and curricula as follows:

Army. The United States Army (USA) will incorporate the procedures in this publication in USA training and doctrinal publications as directed by the commander, United States Army Training and Doctrine Command (TRADOC). Distribution is according to Department of the Army (DA) Form 12-99-R (Initial Distribution Requirements for Publications).

Marine Corps. The USMC will incorporate the procedures in this publication in training and doctrinal publications as directed by the commanding general (CG), United States (US) Marine Corps Combat Development Command (MCCDC). Distribution is according to the USMC publication distribution system.

Navy. The United States Navy (USN) will incorporate the procedures in this publication in training and doctrinal publications as directed by the Commander, Navy Warfare Development Command (NWDC). Distribution is according to the military standard requisitioning and issue procedures (MILSTRIP) desk guide.

Air Force. The United States Air Force (USAF) will validate and incorporate appropriate procedures according to applicable governing directives. It will develop and implement this and other NBC multiservice tactics, techniques, and procedures (MTTP) publications through a series of USAF manuals providing service-specific TTP. Distribution is according to the USAF publication distribution system.

5. User Information

a. The United States Army Chemical School (USACMLS) developed this publication with the joint participation of the approving service commands.

b. We encourage recommended changes for improving this publication. Please reference the specific page and paragraph, and provide a rationale for each recommendation. Send comments and recommendations directly to—

Army

Commandant
US Army Chemical School
ATTN: ATSN-CM-DD
401 MANSCEN Loop, Suite 1029
Fort Leonard Wood, MO 65473-8926
COMM (573) 596-0131, extension 3-7364

Marine Corps

Commanding General
US Marine Corps Combat Development Command
ATTN: C42 (Director)
3300 Russell Road
Quantico, VA 22134-5001
DSN 278-6234; COMM (703) 784-6234

Navy

Commander
Navy Warfare Development Command
ATTN: N5
686 Cushing Road
Newport, RI 02841-1207
DSN 948-4201; COMM (401) 841-4201

Air Force

HQ Air Force Doctrine Center
ATTN: DJ
155 North Twining Street
Maxwell AFB, AL 36112-6112
DSN 493-7224; COMM (334) 953-7224

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

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FM 3-11.3 — **US Training and Doctrine Command**
Fort Monroe, Virginia

MCWP 3-37.2A — **Marine Corps Combat Development Command**
Quantico, Virginia

NTTP 3-11.25 — **Navy Warfare Development Command**
Newport, Rhode Island

AFTTP(I) 3-2.56 — **Headquarters Air Force Doctrine Center**
Maxwell Air Force Base, Alabama

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR (CBRN) AVOIDANCE MULTISERVICE TACTICS, TECHNIQUES, AND PROCEDURES

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Chapter II

DEVELOPING CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR COMMON OPERATIONAL PICTURE

Chapter II provides the functions of CBRN COP. It also describes CBRN IM processes, activities and capabilities. The chapter provides CBRN information flow strategy and COP management.

Chapter III

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR WARNING AND REPORTING SYSTEM

Chapter III provides an overview of CBRNWRS organizations and responsibilities. It also describes how the CBRNWRS provides and integrates IM, DST, and reachback capabilities.

PROGRAM PARTICIPANTS

The following commands and agencies participated in the development of this publication:

Joint

Joint Requirements Office, 401 MANSCEN Loop, Suite 1309, Fort Leonard Wood, MO 65473

Army

United States Army Chemical School, 401 MANSCEN Loop, Suite 1029, Fort Leonard Wood, MO 65473

United States Army Medical Department Center and School, 1400 E. Grayson Street, Fort Sam Houston, TX 78234

United States Army Edgewood Chemical and Biological Center, Aberdeen Proving Ground, MD 21040

Marine Corps

United States Marine Corps Combat Development Command, 3300 Russell Road, Suite 318A, Quantico, VA 22134-5021

Navy

United States Navy Warfare Development Command, 686 Cushing Road, Sims Hall, Newport, RI 02841

Air Force

HQ Air Force Doctrine Center, ATTN: DJ, 155 North Twining Street, Maxwell AFB, AL 36112-6112

United States Air Force Civil Engineer Support Agency, 139 Barnes Drive, Suite 1, Tyndall AFB, FL 32403.

Chapter I
CONTAMINATION AVOIDANCE

1. Background

The best defense against chemical, biological, radiological, and nuclear (CBRN) weapons is using the fundamental principle of contamination avoidance. Avoid the hazard by either deterring or preventing the hazard from being released in the first place or know exactly where, what, and how much CBRN hazard is present in the area of operation (AO) and do not enter that area unless vital to mission success.

a. Successful contamination avoidance prevents disruption to operations and organizations by minimizing unnecessary time in cumbersome protective postures and minimizing decontamination requirements. This may be achieved by bypassing contamination or calculating the best time to cross contaminated areas using the procedures described in this manual. Avoiding contamination requires the ability to recognize the presence or absence of CBRN hazards in the air, on water, land, personnel, equipment, and facilities, at both short and long range.

b. Surveillance and detection capabilities enable forces to recognize CBRN hazards. The fusion of these capabilities with information from other sources yields an overall common operational picture (COP) supporting decisions for specific avoidance, protection, and decontamination actions.

c. These surveillance and detection results also establish requirements for other avoidance measures such as sounding alarms, marking hazards, and warning forces. To support commander's decisions on contamination avoidance implementation measures are executed to avoid or limit exposure, such as increased use of shelters during CBRN employment windows, and providing key information for movement before, during, and after CBRN attacks.

2. Sense, Shape, Shield, Sustain

a. Chemical, biological, radiological and nuclear defense has four operational elements, which serve as key capability categories. Figure I-1 displays the interrelationship between these four S-elements. The elements include sense, shape, shield, and sustain.

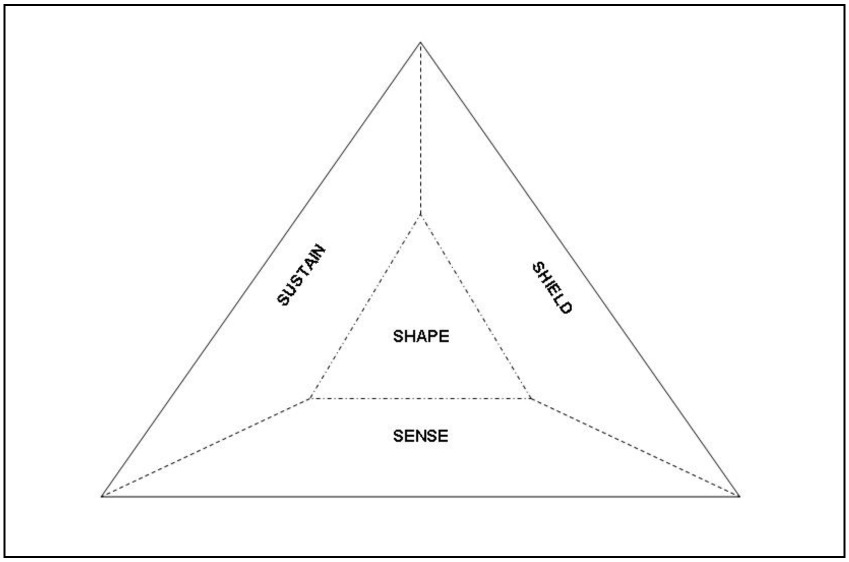


Figure I-1. CBRN Operational Elements

b. The elements interrelate to varying extents, with shape having the most influence on the other S-elements. The four operational elements are as follows:

(1) Sense. Sense is the capability to continually provide updated and accurate information about the CBRN situation at a specific time and place. Contamination avoidance implements this element by detecting, identifying, and quantifying those CBRN hazards in all physical states (solid, liquid, gas) with sensors, arrays and detectors.

(2) Shape. Provides the ability to characterize the CBRN hazard to the force commander, develop a clear understanding of the current and predicted CBRN situation, collect and assimilate information from sensors, intelligence, medical, etc., in near real time to inform personnel, provide actual and potential impacts of CBRN hazards, envision critical sense, shield and sustain end states (preparation for operations); visualize the sequence of events that moves the force from its current state to those end states. The CBRN TTP and appendices in this manual assists commanders in shaping the CBRN hazard.

(3) Shield. The capability to shield the force from harm caused by CBRN hazards by preventing or reducing individual and collective exposures, applying prophylaxis to prevent or mitigate negative physiological effects, and protecting critical equipment. Avoidance, mitigation, active and passive defense measures assist the commander with shield of personnel and equipment.

(4) Sustain. The ability to conduct decontamination and medical actions that enable the quick restoration of combat power, maintain/recover essential functions that are free from the effects of CBRN hazards, and facilitate the return to preincident operational capability as soon as possible.

3. Fundamentals and Principles of Contamination Avoidance

The possibility that an adversary will use CBRN weapons against the US and its allies continues to increase daily. If these weapons are used, our forces must be ready to implement the principles of CBRN defense. The first of these is contamination avoidance, which, if successful, may limit the need for individual and collective protective equipment or the need to conduct time and labor intensive decontamination activities. In addition to the current arsenals of CBRN weapons systems, almost all areas of the world have various types of factories, research facilities, pharmaceutical production lines, and power plants that contain large quantities of materials which may be hazardous when released into the atmosphere. Experiences with the chemical release at Bhopal, India, and the nuclear contamination release at Chernobyl, Ukraine, demonstrate that toxic industrial materials (TIM) can be just as hazardous as military weapons. Release other than attack (ROTA) of TIMs, either intentionally or due to collateral damage, is a potential challenge for our forces.

a. Fundamentals of CBRN Defense. The three fundamentals of CBRN defense are contamination avoidance, protection, and decontamination (see Figure I-2). Executed at all levels and coupled with an effective retaliatory response, these fundamentals will increase the likelihood of U.S. victory. While avoiding contamination is always desirable, the mission may force individuals and units to either occupy or cross a contaminated area. Units can minimize their performance degradation and limit exposure to contamination by following the principles and procedures outlined in this manual.

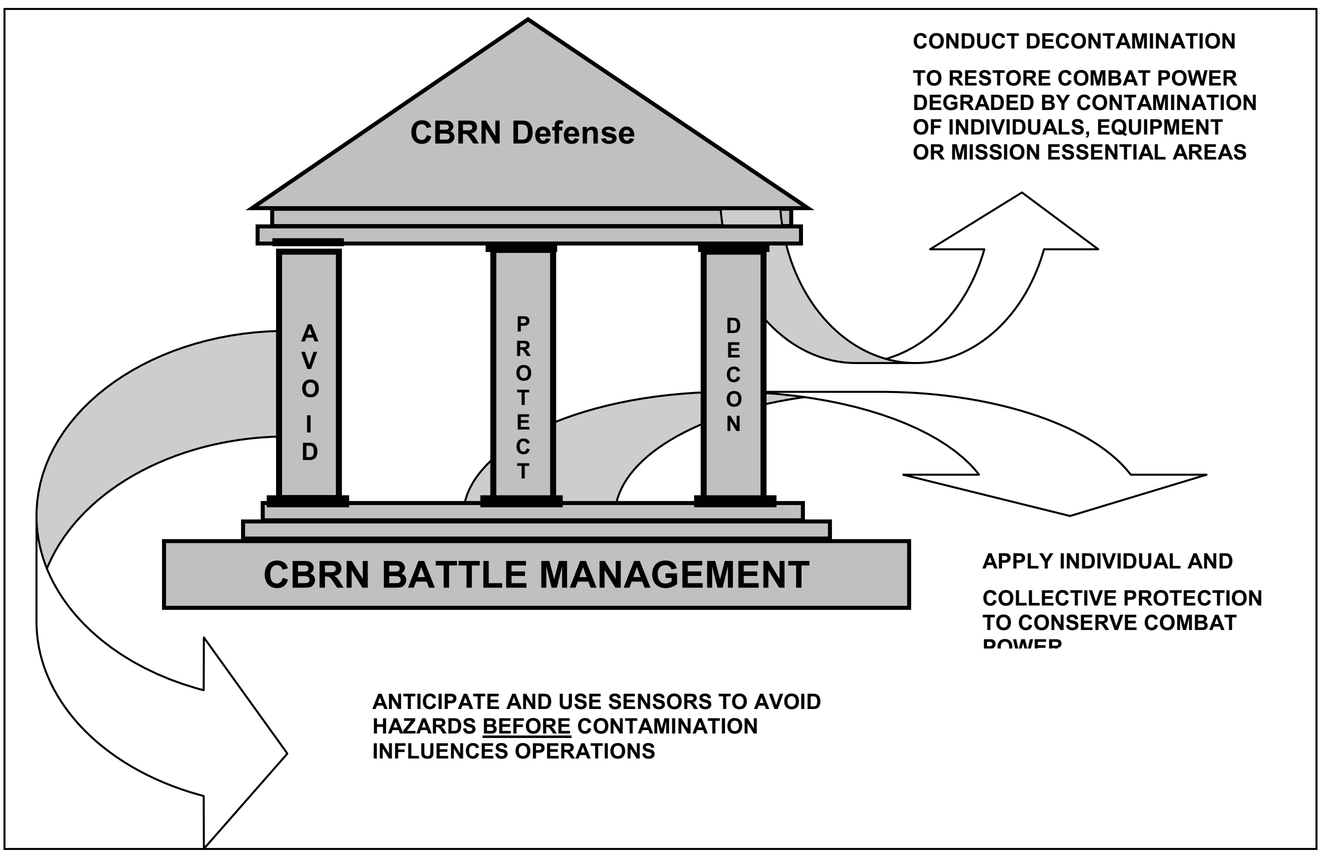


Figure I-2. Fundamentals of CBRN Defense

b. Contamination Avoidance. Contamination avoidance is defined as taking actions to avoid or reduce the effects of a CBRN attack and to minimize the effects of CBRN/TIM contamination hazards. There are both active and passive measures that can be taken to avoid contamination. Passive defense measures include those measures taken to avoid being targeted and hit by a weapons system. These include operational security, camouflage and concealment, hardening positions, and dispersion of service members and equipment. Contamination avoidance includes the following four CBRN specific steps:

(1) Implement passive defensive measures.

(2) Warn and report CBRN/TIM events.

(3) Locate, identify, track, and predict CBRN/TIM hazards.

(4) Limit exposure to CBRN/TIM hazards.

c. Tenets of Contamination Avoidance**.** The doctrinal tenets of contamination avoidance are sound and can be applied to all situations at all levels. The tactics, techniques, and procedures (TTP) of applying contamination avoidance will vary according to mission, the type agent encountered, and the environmental conditions. For example, the TTP applied to a large fixed facility such as an airfield will differ from those selected for a mobile unit. Some TIM are not detected by standard military detectors. The following list outlines some of the skills and procedures necessary to implement contamination avoidance.

(1) Knowledge of potential hazards.

(2) Intelligence preparation of the battlefield.

(3) Vulnerability analysis.

(4) Situational awareness (SA) based on the three items listed above as well as actual data on the location of contamination.

d. Fixed and Mobile. Units and activities can generally be characterized as fixed or mobile. In a similar manner, contamination within the battlespace is either confined to a specific location or is being carried across the terrain by wind. Since the Services currently have a very limited capability to perform standoff detection, most detection will occur in close proximity to, or in the midst of, a unit. In many cases, the warning to a unit of a potential hazard will come from another unit that has become contaminated. At higher echelons, specialized units (e.g., CBRN reconnaissance, biological detection) provide attack indications through the Chemical, Biological, Radiological, and Nuclear Warning and Reporting System (CBRNWRS). Each unit provides CBRN information into the CBRNWRS commensurate with their detection capability. Fusion of data from many sources provides the commander with SA of CBRN contamination and its potential effect on his scheme of maneuver.

e. Knowledge of Hazards**.** Contamination avoidance begins with knowledge of the hazards that may be encountered. This includes the physical characteristics, field behavior, and employment techniques that may be used. A thorough IPB is also essential to avoidance. Understanding the threat's CBRN capabilities and delivery systems allows the Joint Force Commander (JFC) to employ the assets necessary to protect the force and emplace the sensor array necessary to implement the CBRNWRS to support the operational intent. Because all detectors have both technical and practical limitations, they should be integrated and networked throughout the battlespace in order to provide maximum coverage against threats.

f. Principles of Avoidance**.** The principles of avoidance include elements of detection, identification, prediction, warning, reporting, contamination marking, and relocation or rerouting.

(1) Detection. Detection is the learning of the presence of CBRN threats through intelligence or identification methods.

(a) Detection for Warning. Standoff detection provides warning of an approaching cloud (not a specific CB agent) in sufficient time to implement protective measures before exposure to agent contamination occurs.

(b) Detection for Treatment. Detection for treatment focuses on identifying the type of agent dispersed in an attack so that the best possible treatment can be rendered as early as possible.

(c) Detection for Verification. Detection for verification provides critical information to support decisions regarding national strategic direction and integration.

(d) Detection for Surface Contamination. Detection for surface contamination means detecting deposited contamination on surfaces of personnel, terrain, and equipment to make determinations such as whether decontamination is necessary or whether bypass routes are needed to help facilitate unit operations

(e) Detection for Unmasking. Detection for unmasking (dewarning) means detecting the reduction of contamination to acceptable levels. Comparison with methods and results from earlier detection of agent(s) will be an important aspect of determining when to unmask.

(2) Identification. Identification allows commanders to take measures required for protection and treatment. Follow on surveys and sampling can then be used for verification and/or confirmation.

(3) Prediction. CBRN personnel prepare hazard predictions for CBRN attacks, as the attack is not confined to the area directly attacked. The resulting aerosol or fallout travels with the wind and can cover a large area downwind of the attack area. To prevent casualties, units quickly estimate the possible hazard area and warn units within that area. The estimates of the hazard areas are only an approximation. Terrain and weather, as well as delivery system variations, modify the hazard area. In addition, the methods used to predict the downwind hazard are “safe sided” for personnel safety. This ensures that the hazard should be within the predicted area, giving units in the area time to take appropriate precautions.

(4) Warning and Reporting. Warning and reporting informs US forces, allies and friendly forces of impending or actual use of CBRN weapons.

(5) Contamination Marking. Contamination is marked to warn friendly personnel. Units or CBRN reconnaissance teams mark all likely entry points into the area and report contamination to higher HQ,

(6) Relocating and Rerouting. Relocation may be an option depending upon the tactical situation and the mission. This is a viable option for units that are mobile, but it not valid for fixed site, ports and airfields.

4. Vulnerability Reduction

Active measures prevent the enemy from using CBRN weapons; passive measures increase survivability. Individual and unit collective measures are only discussed briefly here. See *Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical (NBC) Protection* for detailed information.

a. Active Measures**.** Active measures are those measures taken to find and destroy either the munitions or the delivery systems. Destruction of delivery systems and munitions is the best method of reducing the chances of being attacked. The destruction of stockpiles of CBRN munitions and production facilities is usually beyond the capabilities of lower level commanders. Strategic levels of command will have the responsibility and sufficient assets for finding and destroying these targets. Operational and tactical levels do not have the capability to locate and destroy stockpiles or production facilities; but they do have the capability to find and destroy delivery systems.

b. Passive Measures. It is not possible to destroy all threat CBRN munitions and/or delivery systems; units must always take precautions to avoid being targeted or to reduce the effects of an attack if one does occur. These are passive measures. All units must use passive measures as part of normal operations to reduce the effects of operating under CBRN conditions. These measures include—

(1) Plan Ahead. Commanders must take time to carefully think out courses of action (COA's) and allow for the additional time requirement. This is commonly referred to as wargaming. A bad decision could cause the unit to become needlessly contaminated or suffer casualties.

(2) Avoid Detection. Avoiding detection is the best way to prevent CB attacks. Do this by employing good operational security (OPSEC) measures. These include camouflage, light discipline, and especially, signal security. Both active and passive measures must be used to prevent the enemy from gaining target information.

(3) Provide Warning. If the unit is unable to avoid CBRN attacks, early warning of battlefield hazards is very important. The CBRNWRS notifies units that adjacent units have been attacked or that a downwind hazard is present.

(4) Seek Protection. Natural terrain may provide shelter from some effects of CBRN weapons. However, ditches, ravines, and natural depressions allow accumulation of chemical agents. Heavy forests and jungles protect against liquid chemical agents, but vapor hazards will increase.

(5) Disperse. Dispersion must reduce vulnerability but not hinder operations or prevent the unit from concentrating when necessary. Supplies especially food, POL, and ammunition must be dispersed so they will not all be destroyed at once. The degree of acceptable for dispersion will depend upon METT-TC.

(6) Remain Mobile. Mobility gives the commander the best chance for avoidance. Constant movement prevents the enemy from pinpointing locations and accurately employing CBRN weapons.

(7) Cover Supplies and Equipment. Store the supplies and equipment under cover to prevent contamination.

5. Chemical, Biological, Radiological, and Nuclear Battle Management

Future requirements for CBRN defense must contribute to the achievement of full force protection as envisioned by *Joint Vision 2020* (see Figure I-2). Currently, our ability allows us to incorporate existing sensors into a manual system with "man in the loop". Future artificial intelligence applications will reduce, but not eliminate, human judgment requirements. Combining service capabilities, coalition partners, and available civil defense assets into a standardized warning and reporting system provides the best opportunity to produce CBRN awareness. The sensors collect data, the data is turned into information by using the CBRN report formats, the information is processed into knowledge by experts who provide hazard predictions and contamination overlays, and the knowledge is used by commanders as the basis of understanding for subsequent planning and order development (see Figure I-3).

> "The potential of such asymmetric approaches is perhaps the most serious danger the United States faces in the immediate future – and this danger includes long-range ballistic missiles and other direct threats to US citizens and territory. The asymmetric methods and objectives of an adversary are often far more important than the relative technological imbalance, and the psychological impact of an attack might far outweigh the actual physical damage inflicted. An adversary may pursue an asymmetric advantage on the tactical, operational, or strategic level by identifying key vulnerabilities and devising asymmetric concepts and capabilities to strike or exploit them. To complicate matters, our adversaries may pursue a combination of asymmetries, or the United States may face a number of adversaries who, in combination, create an asymmetric threat. These asymmetric threats are dynamic and subject to change, and the US Armed Forces must maintain the capabilities necessary to deter, defend against, and defeat any adversary who chooses such an approach. To meet the challenges of the strategic environment in 2020, the joint force must be able to achieve full spectrum dominance."
>
> ----- *Joint Vision 2020*

Figure 1-2. Excerpt from Joint Vision 2020

CBRN battle management requires consideration of the risks associated with adversary CBRN employment and friendly CBRN defense actions. It includes the proper employment of the CBRNWRS and applies principles of information management to the CBRN defense challenges facing the command.

a. CBRNWRS. The CBRNWRS provides the data and information to support the CBRN battle management process. Input and output from the CBRNWRS provides a means to inform friendly units of possible contamination. For the CBRNWRS to be effective, units send information on first use by the fastest communications means available. For example, first-use reports require FLASH precedence. Units send subsequent information by any reliable communications means. Follow-up information is also critical when units must also follow up with closeout reports of an initial observer or contamination report that turns out to be a false positive.

b. CBRN Information Management (see Figure I-3, page I-8). CBRN information management refers to the processes a commander uses to obtain, manipulate, direct, and control information. Information management includes all processes involved in the creation collection and control, dissemination, and storage and retrieval of information. CBRN SA of the operations environment allows the commander to anticipate future conditions and accurately assesses risks. Graphic depictions of CBRN hazard estimates/plots with text files (messages, reports, etc.) are very useful versus sole reliance on map boards and overlays. The vertical and horizontal exchange of CBRN-related information keeps different commands and functional/staff personnel informed. The CBRN staff determines the need for specific types of CBRN information (i.e., the when and where of the CBRN attack). Positioning the required information at its anticipated points of need speeds the flow and reduces demands on communications systems. The information received from sensor networks also helps to provide an assessment of the current situation by detecting/identifying CBRN hazards in air, on water, or on land. It detects/identifies CBRN hazards affecting personnel, equipment, or facilities and the physical state of such hazards (gas, liquid, or solid). The detection of hazards is a key enabler and provides a visualization of the CBRN environment. This visualization helps to develop clear understanding of the current and predicted CBRN situation, envision the end state (mission accomplishment without CBRN casualties and operational tempo [OPTEMPO] degradation), and anticipate the sequence that moves the force from its current state to the desired end state. The commander's SA and risk assessment leads to decisions to implement measures to protect the force and maintain an advantage in OPTEMPO while preventing casualties under CBRN conditions by reducing the threat, reducing operational vulnerability, and avoiding contamination.

(1) General. The CBRN staff translates all source information into an understanding of the CBRN threat and the operational environment for CBRN defense actions. This process requires (see Figure I-3):

- Timely conduct to assess vulnerability.
- Specific COAs for reducing vulnerability and countering specific threats.
- CBRN warning and reporting on potential and actual CBRN attacks to facilitate risk assessments and actions to minimize the short- and long-term health effects of toxic exposures.

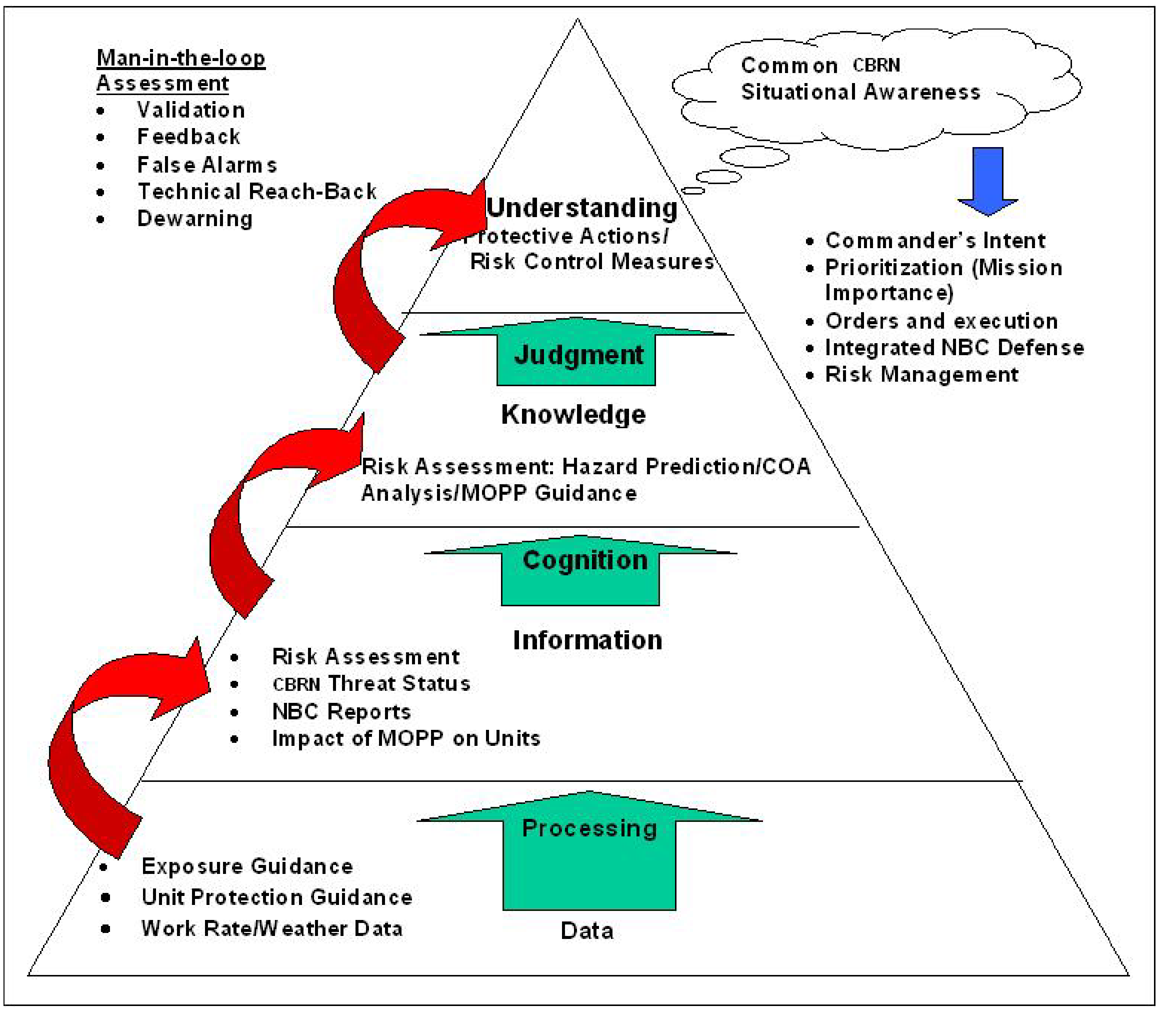


Figure I-3. CBRN Information Management

(2) Enablers. To maintain SA, units conduct CBRN information management through—

- Obtaining the relevant battlespace data.
- Processing data into relevant information.
- Gaining knowledge by determining the impact of the information on operations.
- Applying judgment to develop understand. "I know what has occurred and its impact on operations, and this is what I am going to do about it."
- Supporting CBRN defense execution through orders and risk management.
- Maintaining SA with man-in-the-loop assessment.

(3) Data. The CBRN staff focuses on knowing what data is relevant, determining what data can be collected prior to events, and developing a data collection plan to obtain other data.

(4) Information. The CBRN staff processes data into operationally significant information and develops a collection plan to obtain additional data if information is incomplete.

(5) Knowledge. The CBRN staff uses the military decision-making process (MDMP) to translate information into knowledge. It estimates and assesses hazards to develop possible COAs.

(6) Understanding. Understanding requires SA; the commander uses this awareness to communicate intent and issue orders that mitigate risk through application of various CBRN defense measures.

6. Commander-Staff Interactions in Meeting Chemical, Biological, Radiological, and Nuclear Defense Challenges

a. CBRN defense challenges call for close commander and staff interactions. Operations in CBRN environments demand close attention to technical details by CBRN staff experts and integration of CBRN defense knowledge into the overall organization's plans and actions. Technical experts must be fully familiar with the organization's mission, capabilities, and current situation so that their assessments and recommendations provide meaningful options for action by the commander.

b. In addition to applying the principles of CBRN defense and exercising CBRN battle management capabilities in the most effective manner, CBRN staff experts must be aware of the military and civilian environments in which the organizations operations are unfolding. While the primary responsibility of the commander and the military organization as a whole to accomplish the mission and care for the lives and welfare of individuals in uniform, the military exists in an interdependent mode with its surrounding community. Therefore, due to consideration in risk assessments, other recommendations, and plans must be given to the broader environment, including the civilian populace, in order to make militarily effective plans that are not frustrated by adversary damage inflicted on the civilian community.

7. Chemical, Biological, Radiological and Nuclear Operations

a. CBRN Defense Planning and Considerations.

(1) Operational Implications. At the operational level, the analysis of the battlespace environment should concentrate on characteristics, such as the capability of road, rail, air, and sea transportation networks to support movement; logistic support to CBRN weapons; zones of entry into and through the operational area and area of interest; the impact of large geographic features such as mountains, large forests, deserts, and archipelagos on military operations; and seasonal climatic efforts on CBRN weapons effects. In addition to large unit order of battle, analysis of the adversary should include doctrine for command and control, logistic support, release procedures for the use of CBRN weapons, TBM forces, special operations and use of paramilitary forces. CBRN defense planning and analysis assists the Commander and staff in visualizing and assessing the full spectrum of adversary offensive CBRN weapons capabilities across all dimensions of the battlespace. The following is a list of items to be considered when planning CBRN defense:

(a) Intelligence Collection, Analysis, and Production. Assessments should include threat agents and weapons as well as identification of industrial sites containing toxic materials that would present a hazard to deployed forces if sabotaged or destroyed.

(b) Ensuring SA. Ensure that the CBRNWRS is operational as quickly as possible after entry into a theater. Assets such as the Biological Integrated Detection System (BIDS) should be deployed to monitor high value assets. Detection systems for CBRN agents should be deployed and networked to provide warning of attack.

(c) Common Planning, Training, and Equipment Standards. Gaps in the CBRN defense capabilities of multinational forces are identified to promote effectiveness in both planning and operations.

(d) Medical CBRN Defense. Medical CBRN defense integrates into the planning process to support unit readiness.

(e) Protection of the Joint Rear Area and Theater Sustainment Capabilities. A successful adversary CBRN attack on an essential port of debarkation or other critical logistic facility can degrade Joint Force operational tempo and force generation capabilities.

(f) Logistic Burden of CBRN Attacks. The resupply of protective clothing, equipment and repair parts, medical supplies (antidotes and antibiotics), and other resources must be factored into computation of resource requirements.

(g) In-Theater Active Defense Systems. Planning should consider deployment configurations and concepts of operations that maximize the defended areas of available systems.

(h) Preplanning for Attack Operations. Attack operations are prioritized and may be a high National Command Authority priority at any point in a crisis, during the transition to war, and during hostilities as a means to deny an adversary the capability to produce, store, transport, or employ CBRN weapons.

(i) Effects of CBRN Attacks on Command, Control, Communications, and Computers. Limitations will result from the requirement to operate in CBRN protective equipment, from contamination of equipment, and from the effects of electromagnetic pulse on electrical and electronic equipment.

(j) Capabilities and Limitations of Multinational Forces. The planning process should consider the implications and feasibility of diverting US assets and capabilities to support host nations (HNs) and other multinational members in meeting common operational objectives.

(k) In-Theater Consequence Management. Plans for in-theater consequence management; that is, mitigation and management of the effects of CBRN attacks

(2) Tactical Implications. At the tactical level, the size and location of the battlespace are influenced by the physical location of adversary land, air, naval, space, and other forces that could pose a direct threat to the security of the friendly force or the success of its mission. The extent to which the effects of the battlespace environment are analyzed at the tactical level is largely dependent on the mission and planning time available. At a minimum, tactical level forces should analyze the battlespace environment in terms of military objectives, avenues of approach, and the effects of an CBRN environment on personnel, military operations, weapons systems, and force mobility. CBRN defense at the tactical level will be based on, and result in, a higher degree of detail than would be necessary at higher levels of military operations.

(3) Homeland Defense Implications. A challenge for commanders conducting consequence management operations is the requirement to adequately protect personnel, materiel, and equipment from an CBRN incident. There is a need for a response capability to save lives, contain an incident, and recover to a point that permits operations to resume. Confronting this challenge requires a comprehensive and integrated approach from threat mitigation to incident response and recovery. Military units develop deliberate plans to respond to CBRN attacks within their assigned regions. Response plans should be updated regularly and coordinated with the appropriate response agencies in the region. Plans should focus on both the unanticipated event and potential terrorist targets such as special events, high profile buildings, medical and scientific research centers, and air and rail transportation platforms. Response elements also should prioritize planning efforts in coordination with the other response agencies within their region. Planning efforts should be prioritized based on the most likely threats.

b. Chemical Defense Planning and Considerations (refer to Appendix E for TTP).

(1) Operational Implications. Chemical warfare can be used to contaminate ground and resources with persistent chemical hazards. Non-persistent vapor hazards, and the vapor from persistent contamination, can spread downwind and can pose a hazard over a significant portion of the area of operations given the right meteorological conditions. Commanders will need to consider the avoidance and evacuation of hazard areas. Chemical warfare protection will be needed for forces that remain in the area. Operational capability and tempo is likely to be degraded because of the need for the force to adopt CBRN Defense detection, warning, protection and control measures. Chemical detection, identification, protection and decontamination will put a burden on the theater logistics system.

(2) Tactical Implications. Forces remaining in or near chemical warfare hazard areas will probably need to remain in CBRN protection for long periods of time. This can cause some loss of operational tempo due to the fact that it may:

(a) Cause personnel to work in individual protective equipment, degrading performance, increasing fatigue, and possibly lowering force cohesion and morale.

(b) Reduce the overall speed, cohesion, and freedom of movement of forces in the local area because of contaminated areas and assets.

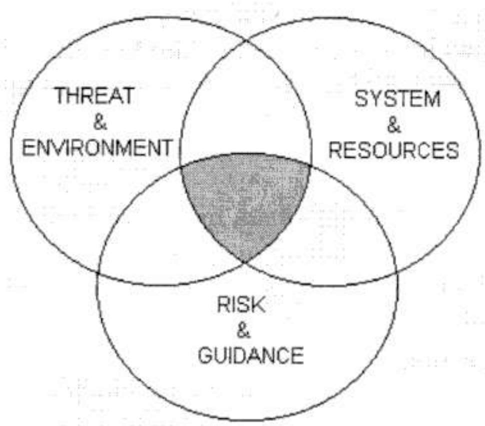
(c) Restrict the local use of ground and operational assets, cause resource-intensive decontamination of key assets, and distort the logistics chain.

(3) Homeland Defense Implications. The use of chemical agents can cause psychological as well as physiological effects and also cause contamination or damage that will restrict the use of facilities and/or equipment/supplies. Fear and panic are the normal reactions to discussions of chemical agents, and most civilian authorities will need considerable assistance in locating, containing, and recovering from a chemical incident.

c. Biological Defense Planning and Considerations. (Refer to Appendix F for TTP).

(1) Concept of Biological Surveillance, Detection, Identification, and Warning Planning. Biological surveillance, detection, identification, and warning planning balances multiple considerations that include the threat, battlespace environment, available systems and resources, risk assessments, and the commander's guidance. By maximizing the effect of the overlapping factors contributing to the biological surveillance, detection, identification and warning, synergy is established (see Figure 1-3). This synergy drives the effective probability of mission success, ensures the operational concept is executable, and ensures the biological surveillance, detection, identification and warning plan is logistically supportable.

Figure 1-3. Concept of Biological Surveillance and Detection



Elements of Risk & Guidance:
- Mission
- Capability holes
- Time available
- Uncertainty
- Commander's risk level
- Other specific guidance
  - False alarms
  - Decision Time

Elements of System and Resources:
- Number of Systems available.
- Types of system in area of operations.
- Down Wind detection capability.
- Amount of resources available.
- Logistical supportability.

Elements of Threat & Environment:
- Environmental Background
- Size and type of area of operations
- Threat to system
- Topography
- Agent, Delivery Systems
- Delivery Mechanism
- Weather

(2) Operational Implications. The potential impact of biological warfare attacks at the operational level can be both wide-ranging and significant, particularly if detection and identification of an attack proves difficult and countermeasures are difficult to implement. Large numbers of casualties can reduce the operational capability of the Joint Force, reduce morale, and divert medical and logistic resources from current operations. When combined, these factors may reduce operational tempo.

(3) Tactical Implications. There will be some loss of operational capability by those forces remaining in or near biological warfare hazard areas. This will be caused by the need to do the following:

(a) Remain in CBRN protection for long periods of time.

(b) Maintain frequent and regular health monitoring of personnel, increased standards of hygiene and the protection of rations and water.

(c) Avoid use of contaminated areas and assets.

(d) Decontaminate key assets.

(4) Homeland Defense Implications. One of the dangers of biological weapons is amplified by the fact that exposure to the agents would probably not be known until symptoms appear. Personal protection generally consists of individual protection and medical measures such as immunization or the application of some other post-incident medical treatment, such as the use of antibiotics. Biological agent dissemination could be accomplished by measures such as aerosol dissemination, by use of vectors or bursting devices. Biological agents can be produced in the laboratory or purchased from a number of medical research firms. For planning purposes, individual protection at any suspected biological incident is of the utmost importance. Mobile laboratories can process samples and identify pathogens. Early identification is essential in order to begin treatment protocols.

d. Nuclear and Radiological Defense Planning and Considerations. (Refer to Appendix G and H for TTP).

(1) Operational Implications. The devastation resulting from a nuclear burst is likely to require that a significant proportion of the Joint Force assets be deployed to assist in recovery in the area of the nuclear burst. The fallout from the nuclear detonation will cover a portion of the joint operations area (JOA) and measures to control the contamination and the exposure of all personnel in the area will be needed. The operational capability of the Joint Force is likely to be degraded for a considerable period. The potential for mass casualties in the local civilian population is also likely to place a burden on the operational command and staff.

(2) Tactical Implications. In the area of a nuclear detonation, the operational capability of the Joint Force will be seriously degraded. Degradation will not only be caused by the loss of personnel, equipment and resources; the need to rescue and treat injured personnel and to fight possible fires will require a significant expenditure of resources. The blocking of transportation routes and mobility corridors by debris and trees may also degrade recovery. There will also be a need to deploy assets to assist other agencies and the HN. The immediate area of the nuclear detonation is likely to be highly contaminated and movement, except to save life, severely limited. Fallout and induced radiation patterns will require that units follow the operational exposure guidelines in Appendix C.

(3) Homeland Defense Implications. While the detonation of a nuclear device is perhaps the least likely scenario for a terrorist incident, it has the potential to cause the greatest damage both in terms of destruction and in terms of psychological damage (fear and panic). Effects of a nuclear detonation include thermal, blast, and nuclear radiation. Even for a small nuclear device, the numbers of casualties from blast, thermal, and initial nuclear radiation could number in the hundreds. The presence of an induced radiation pattern and downwind fallout will require a large number of monitors using radiac equipment and might require the evacuation of large numbers of people until the radiation decayed to a safe level.

e. Radiological Weapon Defense Planning and Considerations (refer to Appendix G and Appendix H for TTP).

(1) Operational Implications. Radiological warfare can be used to contaminate ground and resources with radioactive hazards. Commanders will need to consider the avoidance and evacuation of the hazard areas, particularly during military operations other than war (MOOTW). Radiological protection will be needed for forces that remain in the area. Operational capability and tempo is likely to be degraded because of the need for the Joint Force to adopt CBRN Defense detection, warning, protection, and control measures.

(2) Tactical Implications. There will be some loss of operational capability by those forces remaining in or near radiological hazard areas. This will be caused by the need to:

(a) Remain in CBRN protection for long periods of time.

(b) Manage exposure to radioactive hazard and rotate personnel, particularly during MOOTW.

(c) Avoid the use of contaminated routes, areas, and assets.

(d) Decontaminate key assets.

(3) Homeland Defense Implications. A terrorist could wrap an improvised explosive device with radiological materials to create an incident in which the initial explosion may kill or injure persons in the immediate vicinity of the device. Following the incident, the possible ingestion and inhalation of radioactive particles would also pose a health risk. Simple radiological dispersal is an act intended to spread radioactive material not involving an explosive device. A terrorist need only secure a supply of radiological material (e.g., gamma, beta, or alpha emitters) from a medical laboratory, industrial, or other site, and disperse the material.

f. ROTA TIM Defense Planning and Considerations (refer to Appendix H for TTP).

(1) Operational Implications. The sites of significant TIM facilities in the JOA need to be plotted and, whenever and wherever possible, avoided during operations. Contingency plans need to be made with the HN to control and contain the hazards if TIM facilities are damaged. Whatever the circumstances of a TIM release, the impact on military capability will need to be assessed. A large-scale release from TIM facilities, particularly if there are also large fires, has the potential to spread toxic aerosols and smoke across a significant percentage of the operational area. Such hazards will need to be avoided by the Joint Force or protection will be needed, particularly during MOOTW. This is likely to restrict the freedom of action of the Joint Force and may degrade operational tempo. Damage to nuclear facilities, even without a breach to core containment, may also

spread radioactive aerosols and smoke. In addition, if threat CBRN weapon production or storage sites are targeted and hit, downwind hazard prediction should be accomplished to determine if there is any threat to the force or HN personnel.

(2) Tactical Implications. Forces that remain in the area will probably need to adopt protection. It is possible that because of the nature of the TIM, countermeasures may not be within the CBRN defense capability of the Joint Force. In this case a specialist in the field of hazardous material management will be needed either from the HN or from outside the theater. If conflict takes place in the area of TIM storage facilities, the risk of collateral damage and the release of TIM must be assessed. Disused industrial sites with hard stands and warehouses often provide ideal logistic facilities but need to be checked for all forms of TIM before use. Particular note of TIM needs to be taken when accommodations for personnel is selected.

(3) Homeland Defense Implications. TIMs are substances that may create signs and symptoms similar to CBRN exposure. These materials are found throughout the normal transaction of daily business in the United States, and are transported on our rail lines, roadways, and waterways. They may or may not be precursors to CBRN agents. Most of the materials contain volatile organic compounds, which are materials that contain hydrocarbons and possibly other hazardous elements. They may be naturally occurring or manmade, and may evaporate easily based on agent characteristics. Testing has proven that extended exposure may lead to debilitating injury. Some are carcinogenic such as benzene, or mutagenic such as hexane (nervous system disorder). Technological innovations and the widening proliferation of CBRN hardware and scientific expertise increase the likelihood that states, non-state actors, or transnational groups could threaten the US homeland and population directly and, in times of conflict, deny US access to critical overseas and domestic infrastructure. Terrorism remains one of the deadliest and most persistent threats to US security. The motives, perpetrators, and methods of terrorist groups are evolving in ways that complicate analysis, collection and counteraction, and require the ability to respond flexibly and quickly. Sophisticated detection, analytical, and protective equipment is required to detect and identify TIMs and special protective equipment may be needed.

Chapter II

DEVELOPING THE CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR COMMON OPERATIONAL PICTURE

1. Background

CBRN avoidance measures can consist of passive measures as described in Chapter I. However, the reporting of critical information will support time-sensitive decision to warn and/or protect our forces. Effective and efficient processing of CBRN information will support the unit mission and the commander's force protection (FP) decision making. Timely CBRN information management is built on integrating NBC report input into the command and staff common operational picture (COP).

A CBRN COP provides the commander and his forces with information that is accurate, timely, usable, precise, and reliable. As defined in JP 1-02, COP is a single identical display of relevant information shared by more than one command. A COP facilitates collaborative CBRN planning and assists all echelons situational awareness (SA). While the COP is intended to support the unit mission, the CBRN staff will display information displays specifically designed to support their operations (e.g., NBC reports, hazard predictions). The key consideration is that the information must be organized and easily understood. The CBRN staff supports preparation of the COP through the following:

- Identifying information requirements (e.g., adversary CBRN capabilities, potential time and place of attacks).
- Collecting and processing information (e.g., collection, analysis, and dissemination of NBC reports).
- Providing information to build COP/display (e.g., hazard overlays, areas of contamination).
- Developing understanding (e.g., supporting the commanders decision-making process to take avoidance or protective measures)

2. Chemical, Biological, Radiological, and Nuclear Common Operational Picture Functions

a. There are four representative functions that support CBRN COP operations. They are:

(1) Detection. In CBRN environments, detection is the act of locating CBRN hazards by use of CBRN detectors or monitoring and/or survey teams.

(2) Identification. Identification is the process of determining the benign or hazardous character of an unknown detected substance.

(3) Contamination Marking. Contamination marking is used to provide warning to friendly forces of the presence of contamination

(4) Warning and Reporting. The warning and reporting of a CBRN attack is done using the CBRNWRS.

3. Chemical, Biological, Radiological, and Nuclear Information Management

CBRN information management (IM) is the provision of quality information to the right person at the right time in a usable form to facilitate understanding and decision making. CBRN IM uses the CBRNWRS as a tool to provide relevant, precise, accurate, timely, usable, and complete information.

NOTE: An automated version of the CBRNWRS (Joint Warning and Reporting Network [JWARN]) is currently being integrated into existing command, control, communications, computers, and intelligence (C4I) systems in order to collect, process, store, protect, display, and disseminate CBRN information.

a. CBRN Processes. CBRN IM supports the commander in three main areas: achieving SA/understanding, making decisions, and communicating execution information to implement those decisions. CBRN IM is cyclical in nature and has four basic steps, which are depicted in Figure II-1.

(1) Identify information requirements. Information requirements are the criteria that must be known about the battlespace to enable mission accomplishment. Information requirements such as MET data, friendly unit locations, enemy CBRN capabilities, the likelihood of CBRN weapons use and where, how and what CBRN materials may have already been employed against friendly forces will all have a direct impact on a information requirements.

(2) Collect and process information. The process continues with the collecting and processing of information to fulfill IRs. The receipt of NBC 1 and/or NBC 4 reports will require processing in accordance with the appendices E-H and will directly contribute to the fulfilling/Identifying of IRs.

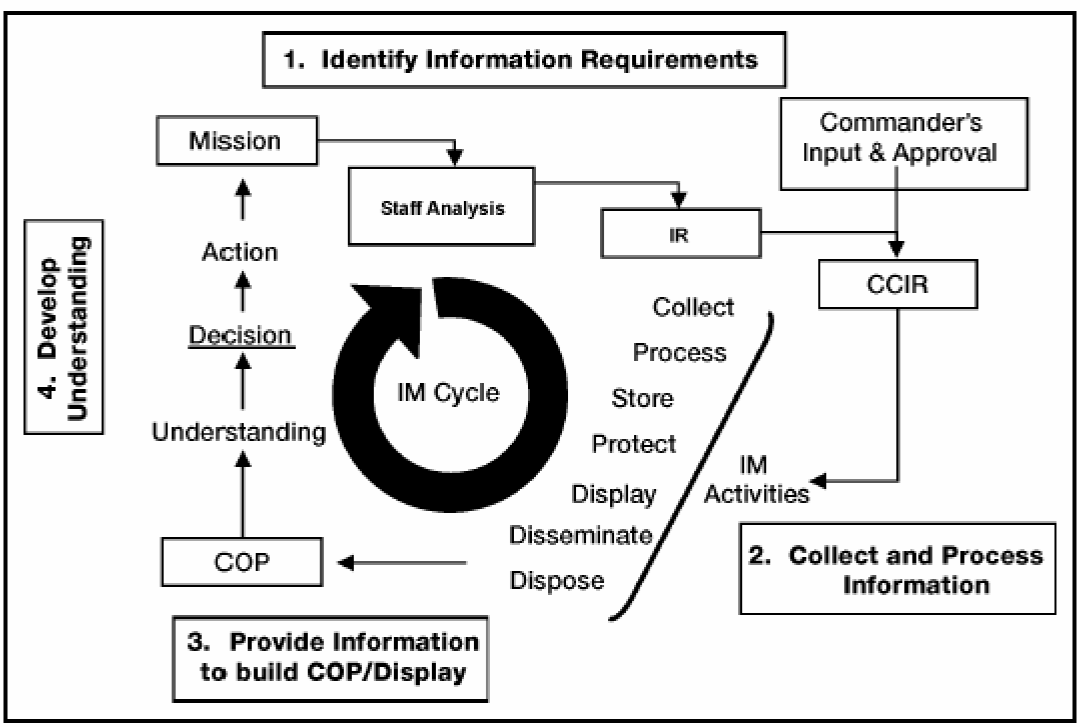


Figure II-1. Information Management Cycle

(3) Build a COP/display. CBRN information that is accurate, timely, usable, complete, precise, and reliable, is used to build a COP. COP is a single identical display of information shared by more than one command. CBRN information contributes to the COP. The impact of a CBRN attack can affect more than one command. Each command affected requires relevant information on the CBRN attack (e.g., when, where, impact).

(4) Develop understanding. Awareness is provided by information but understanding results in decisions based on that information. It allows anticipation of consequences and decisions are made. Subordinates may be directed to take actions such as changing a route of advance to avoid contamination or adjust their MOPP level.

b. CBRN IM Activities. CBRN IM includes seven basic activities—collecting, processing, storing, protecting, displaying, disseminating, and disposing of information.

(1) Collecting—obtaining information on CBRN attacks from NBC 1 and 4 reports in any manner, including direct observation or other R&S means.

(2) Processing—raising the meaning of information from data to knowledge, and filters, formats, compiles, organizes, correlates, plots, and evaluates CBRN information.

(3) Storing—the retention of CBRN information in any form for orderly, timely retrieval, and documentation until needed.

(4) Protecting—measures taken to ensure the availability of information and information systems.

(5) Displaying—representing CBRN information in a usable, easily understood audio or visual form tailored to the needs of the user. The display conveys the COP for decision making and exercising C2 functions. Historically, the display of CBRN information has taken the form of formatted charts, written reports, verbal narrative reports, and graphic map displays.

(6) Disseminating—communication of evaluated information such as NBC2/3/5 reports require detailed planning and coordinated and the procedures to disseminate applicable information should be incorporated into standard operating procedures (SOP).

(7) Disposing—actions taken on inactive records. These include destruction and archiving of information.

c. CBRN IM Capabilities. The capability to receive and report CBRN attack information varies from command to command. The CBRN staff makes an assessment of the capability that exists within their command. Capabilities may range from detectors and alarms that are not integrated to fully integrated sensors at selected locations.

(1) Currently, many CBRN agent detectors and alarms arrays operate as independent units. When a CBRN attack is detected, only those personnel in the immediate vicinity hear the alarm. Adjacent units need to be notified by radio, wire communications, or audible/verbal means. CBRN calculations/computations in support of CBRN hazard prediction are often done manually.

(2) As part of a process to improve and automate the process Government Off-the-Shelf (GOTS) Commercial Off-the-Shelf (COTS) programs were fielded as part of the Joint Warning and Reporting Network (JWARN) Block I. JWARN Block I included the following improvements:

(a) NBC Analysis (NBCA). NBCA is a COTS software program that provides hazard prediction warning and reporting procedures for CBRN attacks based on standard North Atlantic Treaty Organization (NATO) Allied Tactical Publication-45B (ATP-45B). NBCA was designed for war fighters to determine and display CBRN hazard areas resulting from the use of CBRN weapon systems and dissemination devices. It has the ability to provide hazard estimates for onset times and duration of hazard. NBCA also provides database management to store information used to warn units and can generate the standard ATP-45B message set and overlays. Reports can be stored as scenarios, and NBCA requires that map sets be imported manually into the program for the desired location.

(b) Hazard Prediction and Assessment Capability (HPAC). HPAC is a GOTS software program developed for predicting the hazard effects of CBRN facility accidents/incidents and to provide overlays of nuclear, biological and chemical hazard calculation on a map or as a cross-section of the atmosphere. HPAC includes the ability to support a general assessment capability for CBRN material released from incidents or accidents at production and storage facilities, or nuclear weapons events. HPAC provides a workstation-based capability for modeling winds over complex terrain and for forecasting weather. HPAC includes maps of the world provided by the National Geospatial-Intelligence Agency (NGA). The program includes the ability to provide a footprint of the hazard area to be viewed for any location. HPAC does not include the standard ATP-45B message set.

(c) Vapor Liquid Solid Tracking (VLSTRACK). VLSTRACK is a GOTS software program developed to provide downwind hazard prediction for a wide range of chemical and biological agents and munitions. It determines the size, shape, onset time, duration and level of hazard from an CBRN event. VLSTRACK has no meteorology forecast or diagnostic wind field capability, but can simulate flow over complex terrain at the resolution of the available resolution. Output can be obtained as either a cumulative hazard from the time of attack or as a periodic hazard for each time period. VLSTRACK does not utilize digitized maps; however, hazard predictions output to graphs that display the hazard footprint or contour for agent deposition, dosage, or concentration. These graphs are scaleable and can be applied as overlays on maps. VLSTRACK can read NBC 1, 2 or 3 messages and outputs a NBC 2 message in the correct format. VLSTRACK does not provide hazard prediction for nuclear materials.

(3) Selected fixed sites have been provided with CBRN detector arrays. An operator will monitor the performance of the fixed sensors on that shore facility via telemetry or local area network links. The operator executes command and control functions when prompted by the network's CBRN sensors. The sensors will issue detection indications to the personnel in the local area and will send both visual and audible indications to the operator if a CBRN threat is detected. The operator will be able to enable or disable the local sensor indications. The sensors will send indications, either automatically or via operator, to the next higher operational headquarters where the fixed-site commander combines this information with other resources (intelligence, current operations, medical information, etc.) to make decisions and take appropriate actions. Indication of a CBRN attack may not be automatically sent to an external network. The operator, as required, generates standard NBC reports for dissemination. The selected fixed sites use NBCA, HPAC, and VLSTRACK (as required) to respond to the use of reports of CBRN agents.

4. Chemical, Biological, Radiological, and Nuclear Information Flow Strategy

a. CBRN IM procedures must provide for the rapid vertical and horizontal flow of information. Traditional staff arrangements help determine that the flow of CBRN should logically flow to the CBRN Cell(s); however, that should not form a firewall to the exchange of CBRN information with other staff elements (e.g., operations, intelligence, logistics) or commands. Optimum information flow within a headquarters requires both speed and clarity of transfer without creating fragmented or useless information. Effective flow of CBRN information requires the information to be—

(1) Positioned properly. Positioning the required information at its anticipated points of need speeds the flow (e.g., using public folders or web pages to post required CBRN information such as MET reports).

(2) Mobile. Information flow must immediately adjust to support the vertical and lateral flow of information between adjacent forces (e.g., collaborative planning system on the integration of CBRN R&S assets).

(3) Accessible. All levels of command must be able to pull the information they need to support concurrent or parallel planning and mission execution (e.g., graphic depiction of CBRN forces in a COP).

(4) Fused. Information is received from many sources, in many mediums, and in different formats, and to blend that information from multiple sources into an accurate summary (e.g., a CBRN threat assessment disseminated in graphic form on an automated COP system).

b. The information flow provides input for the command's decision support matrix (DSM). The DSM identifies key decisions, expected events and planned friendly actions that the commander expects to make during the next stage or phase of the operation. The DSM links information to key CBRN decisions. The CBRN staff provides input to help develop a DSM during the planning process. The DSM identifies the CCIR needed by the commander in order to make decisions to achieve the desired results. (For more information on DSM's please refer to *Information management,* MCWP 6-23).

c. Implementing the CBRN information flow strategy provides for the required input for the decision making process. The CBRN staff performs the representative functions that furnishes information to support the COP and the decision making process.

(1) Collect and analyze sensor inputs (e.g., detector data, detector alarms, medical alerts).

(2) Maintain information on the status of CBRN networked sensor grids.

(3) Format and forward NBC reports to facilitate warning of personnel.

(4) Disseminate NBC reports and detector data over service tactical communication networks.

(5) Conduct planning, training and certifying of warfighters to help ensure that deployed and/or fielded CBRN (developmental CBRN, environmental, and TIM) detectors are interoperable with the warning and reporting system. If not integrated detectors are to be used ensure personnel are trained in manual report procedures.

(6) Generate and display scalable hazard overlays (e.g., plots) resulting from CBRN and TIM hazards.

(7) Provide hazard prediction analysis capabilities and perform CBRN and TIM risk assessments and provide situational reports in support of CBRN reconnaissance/survey plans, and decontamination plans.

(8) Create CBRN annexes to operation plans (OPLANs), operation orders (OPORDs), and fragmentary orders (FRAGORDs).

(9) Store, modify, retrieve, display, archive, and transfer data on weather, terrain, unit locations, intelligence, location of attacks, and sources (suspected and actual) of attack and CBRN or TIM hazards. This archived data is needed for event reconstruction in the postattack phase. Weather, terrain, unit location, etc. information is required for input to the basic hazard prediction analysis capability.

(10) Provide hazard estimated times of arrival (ETAs) and estimated times of departure (ETDs) to units near a hazard area.

(11) Maintain information on the locations of the assigned (remote, direct, and networked) detectors.

(12) Maintain unit CBRN information status, radiation exposure status (RES) for reporting units, and operational status and expected changes for supporting CBRN units. Monitoring CBRN unit status facilitates the decision process, driving risk assessment, and provides current and expected unit status for support of CBRN defense missions.

(13) Provide recommendations on dewarning via manual voice, or automatic means to affected units within and without the area of concern.

(14) Provide input, as required, on detailed characteristics of CBRN agents, their delivery means, their symptoms (e.g., human effects) and other data required for adequate risk assessment.

(15) Provide basic hazard predictions of CBRN agents and TIM to assist in preparation of vulnerability assessments.

(16) Provide a man-in-the-loop filtering capability at the operator level to validate CBRN detections to reduce the likelihood of being falsely warned and to reduce information overload for single and multiple attacks.

(17) Log and archive CBRN reports detector/sensor inputs.

(18) Receive and accept input of intelligence data from tactical, operational, and strategic sources, predicted intercepts of theater air and missile (TAM) data from air defense radar systems from defense C2 systems, and other C4ISR inputs.

(19) Receive and accept meteorology and oceanography (METOC) data from tactical, operational, and strategic sources.

5. Common Operating Picture Management

a. Information Inputs. CBRN data feeds into the COP can be automated or manual. CBRN IM input may include the following inputs:

(1) Friendly CBRN air, maritime, and ground force tracks/locations within the operational area.

(2) Enemy air, maritime and ground force CBRN capabilities within the operational area.

(3) CBRN operational overlays.

(4) MET and terrain overlays.

(5) CBRN-related NGA products.

(6) Any other information or graphic displays required.

b. Standardization. CBRN information requirements are often predictable. The staff can position information at its anticipated points of need to speed information flow and reduce demands on communications systems. One method is establishing a standard reports matrix to meet recurring information requirements. Table II-1 contains some sample reports, requests, and orders. The table provides a brief description of the report, the sender, receiver, and when and how to transmit. The matrix reflects the following information:

(1) Report title: Report title or type of information provided.

(2) Submitted by: The component or agency normally responsible for submitting the report.

(3) Submitted as of: Close out time for recurring reports. This should be within no more than one hour of the arrival NLT time.

(4) Arrival NLT: Time to post the report for JTF review.

(5) Transmission type: System used (such as email, AUTODIN, and so forth).

(6) Precedence: The precedence to use when notifying the JTF the report is available (not applicable to some notification methods).

(7) Addressee: Who the report goes to.

(8) Info to: Additional addresses.

Table II-1. Reports Matrix (Sample)

Report Title	Submitted by	Submit as of	Arrive NLT	Transmission Type	Precedence	Addressee	Info to
Personnel Status Report	Components	2000Z	2100Z	Email home page	Routine	J1/G1/PERS	
Intel RFI	Components	As required	As required	COLLISEUM	Priority	J2/G2/INTEL	
Spot Reports	Components	As required	As required	Email	Routine	J2/G2/INTEL	
SITREP (CDRs SITREP)	Components	2400Z	0100Z	AUTODIN/ home page	Priority	J3/G3/ Operations	Components
Orders (FRAGORD, WARNORD, OPORD)	J3/G3/ Operations	As required	As required	AUTODIN/ home page	Priority	All	Components
NBC1	Components	As required	As required	Voice, email	Flash	CBRN Cell	Components
NBC2	Components	NLT 2 hours after "as of time"	As required	GCCS email	Immediate	CBRN Cell	Components
NBC3	Components	As required	As required	GCCS email	Immediate	CBRN Cell	Components
NBC4	Components	As required	As required	GCCS email	Immediate	CBRN Cell	Components
NBC5	Components	After survey completed	As required	GCCS email	Immediate	CBRN Cell	Components
NBC6	Components	When requested	When requested	GCCS email	Immediate	CBRN Cell	Components

Table II-1. Reports Matrix (Sample) (Continued)

Basic Wind Report (BWR)							
Basic Wind Message	J2/G2 Intelligence Weather	Contains weather information for the following 6 hours	As required	All	Immediate	All	Components
Basic Wind Forecast	J2/G2 Intelligence Weather	Contains weather information for the subsequent 6 hours	As required	All	Immediate	All	Components
Effective Downwind Report							
Effective Downwind Message	J2/G2 Intelligence Weather	Contains weather information for the following 6 hours	As required	All	Immediate	All	Components
Effective Downwind Forecast	J2/G2 Intelligence Weather	Contains weather information for subsequent 6 hours	As required	All	Immediate	All	Components
Chemical Downwind Reports							
Chemical Downwind Message	J2/G2 Intelligence Weather	Contains weather information for the following 6 hours	As required	All	Immediate	All	Components
Chemical Downwind Forecast	J2/G2 Intelligence Weather	Contains weather information for subsequent 6 hours	As required	All	Immediate	All	Components

c. CBRN Information Network Applications.

(1) Networking technologies are expanding the options available for managing the flow of CBRN-related information.

(2) A collaborative environment for sharing CBRN-related information can be achieved using tools such as web pages, public folders, and email. An intranet network infrastructure for HQ may differ from one HQ to another, but the concepts are generally the same. A HQ intranet is a communications network in which access to published information is restricted.

(a) Web sites and portals. A well-organized web site assembles, organizes, and presents vital CBRN information in a timely manner. The CBRN staff may develop and maintain their own web pages for the site. CBRN information on these web pages could include important updates, status reports, common staff products, and current activities.

(b) Electronic mail (email). Email is a highly effective means to communicate CBRN information, providing rapid dissemination of time critical information within the HQ. The CBRN staff considers establishing functional versus individual accounts to avoid unnecessary email overload. This helps prevent a message backlog for personnel not on shift. Additionally, use of a precedence system within email identifies messages requiring timely handling and review.

(c) Shared disk drives and folders are another means to allow common access to information. Shared drive folder names may be topical or use the same titles as those shown in the file plan drive. See Table II-2 for a sample HQ topically named shared message folders.

Table II-2. HQ Shared Message Folders (Sample)

Personnel	INTEL	Operations	Logistics	CBRN
Admin	Action Items	Air Ops	Briefings	Admin
Completed Taskers	Admin	Airlift	General Info	Directories/Rosters
Daily News Briefs	JULLS	Fighters	RFI	Organization Structure
Incoming Messages	MSG-Air	Army Aviation	Play-Info	Briefing Slides
Need Information Requests	MSG-BDA	Army Ground	Reports	Incoming Messages NBC1/4/6 SITREP
Outgoing Messages	MSG-FP	CMOC	Admin	Outgoing NBC3/4
Personnel	MSG-Ground	Everybody Read	Civil Engineers	CBRN R&S
SITREPS	MSG-IIR/Collection Report	EWO	Comptroller	JULLS
J1 Reports	MSG-INSUM	General Info	Contracting	Admin
Personnel Status Request	MSG-Naval	Info Ops	Director	Computer System Support
Receipts (Verification)	MSG-Political	JOC	Fuels	Current Ops
Policy Guidance	MSG-Refugees/Med	JULLS	LNO	OPLAN/OPORD/ FRAGORD Input
Postal	MSG-SITREPs	LNOs (J1, J2, J3, J4, J5, J6)	Medical	Future Ops
Incoming	MSG-Targets	MSEL Events	Plans	Future Plans

Table II-2. HQ Shared Message Folders (Sample) (Continued)

Outgoing	MSG-Terrorist Activity	Navy Ops	Services	Decon Plans
Suspense’s	MSG-Warning/Execute Order	Ops/Plans	Supply	SITREP Inputs
	WMD/CBRN/SCUDS	Ops-Analysis	Suspense’s	CBRN IPB
	Weather	Orders	Taskers	Joint SYSCON
		FRAGORDs	Transportation	JULLS
		Warning Orders	Weapons	LNO

Chapter III

CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR WARNING AND REPORTING SYSTEM

1. Background

Collection, evaluation, and exchange of information on CBRN incidents are extremely important part of avoidance. Chapter I provided an overview of CBRN avoidance and how avoidance fits into the overall CBRN defense CONOPS. Chapter II provided an overview of the CBRN COP and CBRN IM. The CBRNWRS is a cornerstone of CBRN avoidance. It provides for the information transfer necessary to develop the CBRN COP and IM. Commanders at all levels must be provided with timely, accurate, and evaluated information on contamination from CBRN attacks and ROTA. These incidents can have a significant effect on any military operations, plans and decisions. The primary means of warning units of an actual or predicted CBRN hazard is the CBRNWRS. The CBRNWRS allows commanders and CBRN staffs to determine required protective measures and plan operations accordingly. It is the responsibility of commanders at all levels to ensure that plans, directives, and standard operating procedures (SOPs) consider CBRN defense as a priority.

2. Organizations

a. CBRN Warning and Reporting Areas. In order to organize the reporting, evaluating and sharing of CBRN incidents information the following information areas and zones will be established:

(1) Chemical, Biological, Radiological and Nuclear Area of Observation, is a geographical area consisting of several CBRN zones of observation, and is normally equal to an entire country. Large countries may be divided into more nuclear, biological, chemical areas of observation. When operating in areas where the CBRN area of observation is not defined beforehand, the area must be defined and agreed to by the involved commands. An example of a Area of Observation would be a US Army Corps.

(2) Chemical, Biological, Radiological and Nuclear Zone of Observation, is a geographical area which defines the responsibility for collecting and reporting information on enemy or unidentified nuclear detonations, biological or chemical attacks, nuclear, biological and chemical releases other than attacks, and resulting contamination. CBRN zones of observations must cover the entire geographical area defined by a CBRN area of observation. An example of CBRN Zone of Observations would be a US Army Division Area of Operations.

b. CBRN Warning and Reporting Centers/Cells. These sections will be responsible for the processing and evaluation of CBRN related data, updating the IRs and assisting with the development of the CBRN COP and to update battlefield intelligence. Refer to Appendix B for more information on the responsibilities and TTP on CBRN Center/Cell operations.

3. Information Management

Managing the CBRNWRS is crucial for the success of a command. To be useful, nuclear information must be collected, reported, and evaluated. Once evaluated, it can be used to update battlefield intelligence. Obtaining and converting CBRN information into usable CBRN intelligence does not just happen. The volume of information that needs to be collected and reported could easily disrupt both communications and tactical operations if not properly managed. This section describes what information is available and how that information gets to the person or unit needing it.

a. Gathering Information. The first step in managing the CBRNWRS is to determine what information is available and who is available to collect it. Two types of data must be collected. Observer data provides information that a CBRN attack has occurred. Monitoring, survey, and recon data provide information on where the hazard is located. Every unit is responsible for observing and recording enemy attacks. But every unit does not automatically forward NBC 1 reports. Many units may observe a nuclear burst, for example. But if every unit forwarded a report, nothing would get through. For this reason, selected units with equipment to make accurate measurements submit NBC 1 reports. These units are called designated observers. The units required to forward NBC reports will be designated in the FSOP/OPORD/OPLAN. Additional units are selected during tactical operations based on their physical locations. These units may or may not be listed in the operations order.

(1) Designated Observers. Although all units have some information-gathering responsibilities, certain units, because of their capabilities and/or location, are chosen as designated observers for attacks. Designated observers must be as accurate as possible when providing data on enemy releases. Observers are selected to provide total coverage over the entire area of interest. This requires both ground and aerial observers. The designated observer system provides the essential data to prepare hazard location predictions and CBRN damage assessments. It provides raw observer data, using a standard report format. The communications section of the OPORD will specify the primary and alternate means of communication.

(a) Ground. Ground units are selected for the designated observer system based on the following factors:

- Battlefield Location.
- Available Communication Nets.
- Mission (Current and Future).
- Training and Experience.
- Availability of accurate measuring devices.

(b) Aerial. Aircraft provide excellent observer coverage for CBRN attacks. The aviation unit commander selects the crews. Designated aircrews are instructed to report data about the type of attack and when and where it occurred. If aviators measure cloud parameters, they must also provide the location from which it was measured. Aviators have the advantage of height. They are able to see and report actual GZ locations. They also can see and estimate crater width. Such data is usually not obtainable from ground observer units.

(2) Monitoring, Survey, and Reconnaissance Data. NBC 1 reports are the first step to predict where CBRN hazards will be. These predictions (NBC 3 reports) are only an estimation of the hazard area. Feedback is needed from the reporting units to determine exactly where contamination is located.

(a) This feedback comes from monitoring, survey, and recon (NBC 4 reports). Monitoring and recon operations give the initial location of CBRN hazards. Initial monitoring and recon reports are generally forward through intelligence channels to the processing CBRN Center/Cell. This information may also be sent via integrated C2 systems (i.e, the Joint Warning and Reporting Network [JWARN]).

(b) NBC 4 reports are then plotted on the situation map. If more information is needed, the CBRN staff will direct a unit (picked because of its location and/or capability) to collect and forward the necessary data. Depending on the type of information required this unit may be an organic CBRN defense team or a CBRN reconnaissance unit.

(c) The collection of CBRN information is a joint effort between tactical units and the processing CBRN Staff. The unit does the actual collecting of information. The CBRN staffs plans for and directs the collection effort. The FSOP/OPORD/OPLAN will describe who collects and forwards information for evaluation.

b. Evaluating Information. After an attack has occurred and data has been collected, it will be forwarded to it and evaluated by the CBRN Center/Cell. It will then used to update battlefield intelligence. Units and intermediate headquarters may use the raw data that is being reported to develop their own intelligence until detailed results are made available from the CBRN Cell.

c. Transmitting Information. Procedures used to transmit information to and from the CBRN Cell are an important part of the CBRNWRS. The signal/communications section of the FSOP/OPORD/OPLAN will outline what information is to be sent to what sections. Figure III-1 shows the direction that various NBC reports will travel. Usually the flow of CBRN data is through the normal chain of command. However, there are some exceptions to this:

(1) The CBRN Center/Cell may request information such as reconnaissance or survey information. The unit doing the survey shall be responsible and will report directly back to the CBRN Cell. This is especially true for aerial surveys. The surveying unit should also send a copy back to its parent unit for archiving and for recording of CBRN exposure, if necessary.

(2) Designated observers send reports directly to the CBRN Cell.

(3) Attached or OPCON units may have no direct contact with a parent unit. In these cases the headquarters to which they are OPCON will receive the information.

(4) Units that operate independently in an area will report through the headquarters controlling that AO.

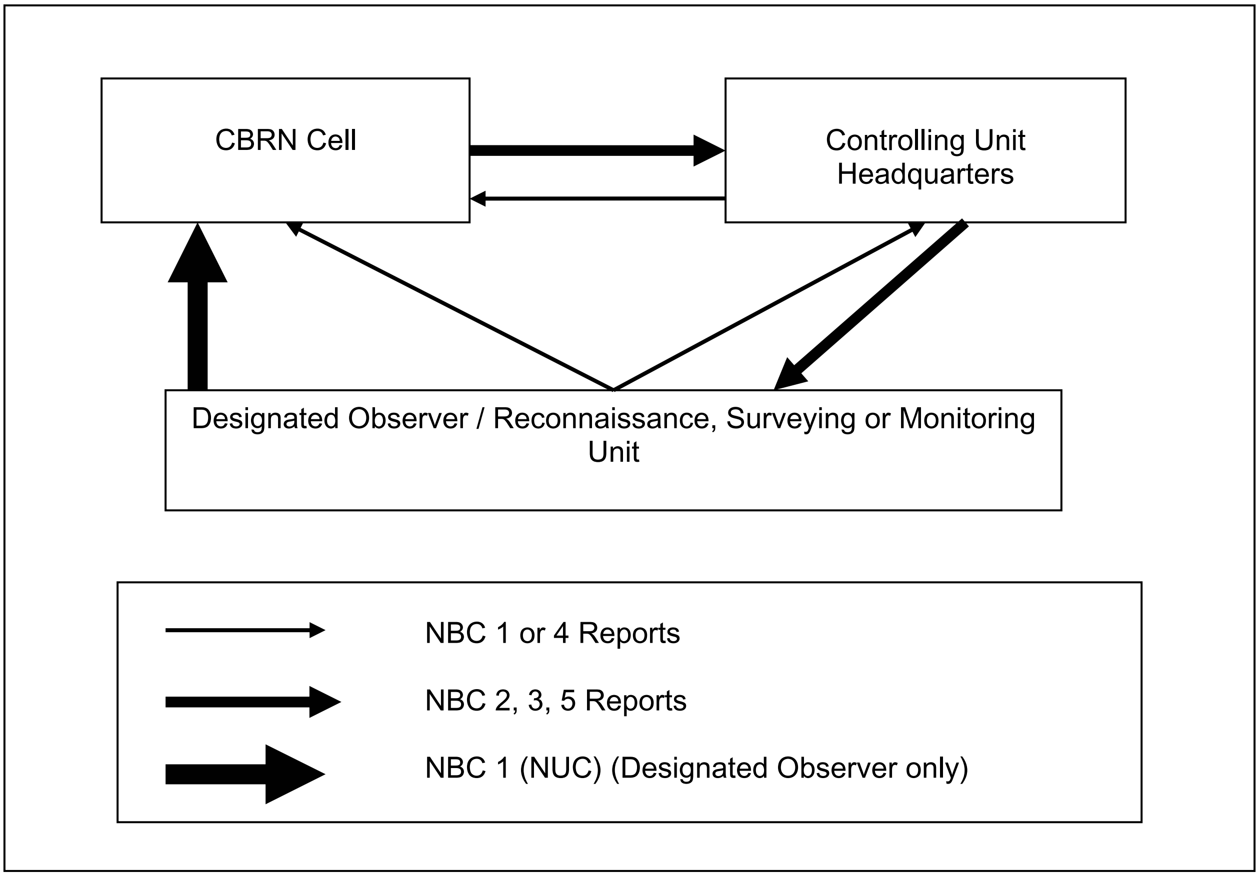


Figure III-1. Flow of NBC Reports

(5) The method of transmitting information depends on the tactical situation and mission of the unit. Methods will be specified in orders, plans, and/or unit SOPs.

(6) NBC reports should be formatted ahead of time and be as short and concise as possible. In this case, wire communications are best.

4. Types of Reports

a. Standard CBRN Reports. The CBRNWRS consists of six standard reports for CBRN incidents. STANAG 2103 (Edition 8), dated 31 August 2000, and the United States Message Text Format (USMTF) standardize each of the CBRN Reports. The U.S. and its NATO allies use the same message formats. This improves accuracy, comprehension and interoperability of the system. It also increases the speed of dissemination and submission. The standard NBC Reports are as follows:

(1) The NBC1 Report is an Observer's Report. This report gives basic data on the CBRN attack.

(2) The NBC2 Report is used for passing evaluated data from collected NBC 1 Reports.

(3) The NBC3 Report is used for immediate warning of predicted contamination and hazard areas.

(4) The NBC4 Report is used for reporting detection data and passing monitoring and survey results. This report is used for two cases: 1) If an attack is not observed and the first indication of contamination is by detection, and 2) to report measured contamination as a part of a survey or monitoring team.

(5) The NBC5 Report is used for passing information on areas of actual contamination. This report can also include areas of possible contamination, but only when actual contamination coordinates are also included in the report.

(6) The NBC6 Report is used for passing detailed information on CBRN events.

(7) The standard CBRN reports use a standard format and line items to shorten the message (see Table III-1, page III-6). The CBRNWRS is based on a code letter system. The meaning of each letter used to transmit an NBC report is described in this MTTP. Each type of NBC report is comprised of a sequence of lines and has a unique identifier. Letter formats for the CBRNWRS and the meaning of the lines is described below and in the applicable appendix for the specific type of report. Each set contains a sequence of fields. NBC reports start with a common message heading consisting of NBC, Report number (1-6), and event. The format for the fields, allowable entries, and conditions are explained later in this chapter and the applicable appendices**.**

Table III-1. Standard Format and Line Items

Line:	MEANING:
A	Strike Serial Number
B	Location of observer and direction of attack or event
C	Date-time group of report or observation and end of event
D	Date-time group of attack or detonation and attack end
F	Location of attack or event
G	Delivery and quantity information
H	Type of nuclear burst
I	Release information on biological/chemical agent attacks or ROTA events
J	Flash-To-Bang Time in Seconds
K	Crater description
L	Nuclear burst angular cloud width at H+5 minutes
M	Stabilised cloud measurement at H+10 minutes
M	Description and status of ROTA event
N	Estimated nuclear yield in kilotons
O	Reference date-time group for estimated contour lines
PA	Predicted attack/release and hazard area
PB	Detailed fallout hazard prediction parameters
PC	Radar determined external contour of radioactive cloud
PD	Radar determined downwind direction of radioactive cloud
PX	Hazard area location for weather period
Q	Location of reading/sample/detection and type of sample/detection
R	Level of contamination, dose rate trend & decay rate trend
S	Date-time group of reading or initial detection of contamination
T	Terrain/topography and vegetation description
W	Sensor information
X	Actual contour information
X	Predicted contour information
Y	Downwind direction and downwind speed
Z	Actual weather conditions
GENTEXT	General text

b. The Merchant Warning System (MERWARN). A simplified contamination warning system has been established throughout NATO for broadcasting, via MERCOMMS and coastal radio stations, warnings of contamination dangerous to merchant shipping. This system calls for the origination, by NATO naval authorities, of five types of messages:

(1) MERWARN NBC Effective Downwind Message (MERWARN NBC EDM). The MERWARN NBC EDM is a prediction, for a specified sea area and time interval, of the fallout, which will result from a one megaton (1 MT) nuclear surface explosion. It will give the master of a ship, observing a nuclear explosion, an immediate indication of the area likely to be affected by fallout.

(2) MERWARN NBC 3 (NUC). The MERWARN NBC 3 NUC will be issued after a nuclear attack and gives fallout data for a specific nuclear explosion or series of explosions, which will be identified in the message.

(3) MERWARN NBC Chemical Downwind Message, (MERWARN NBC CDM). This contains a forecast of the meteorological data needed for the chemical hazard area prediction procedure.

(4) MERWARN NBC 3 (CHEM). This message is issued to pass immediate warning of a predicted chemical contamination and hazard area.

(5) MERWARN DIVERSION ORDER. This is a general diversion order, based upon the fallout threat, whereby merchant ships proceeding independently are passed evasive routing instructions of a general nature.

NOTE: In some cases it may be better to provide warning of contamination by means of general plain language messages rather than by the formats above. See Appendix G for more information on the nuclear MERWARN messages and Appendix C for CB.

c. Strike Warning (STRIKWARN). Friendly forces need to receive advanced warning of nuclear strikes to ensure that they are not placed at unnecessary risk. Such attacks are announced through a STRIKWARN message This system applies to nuclear strikes that may affect forces operating on land, over land, or at sea. STRIKWARN messages typically use Automatic Data Processing (ADP) messages but can use alternate means of communication to transmit warnings using the STRIKWARN format. Appendix I of this manual covers STRIKWARN in more detail.

d. Meteorological and Weather Reports. Current meteorological data is a vital prerequisite for radiological fallout and biological, chemical and ROTA downwind hazard prediction. Meteorological data is transmitted as a Basic Wind Report (BWR). The Effective Downwind Report (EDR) and the Chemical (Biological) Downwind Report (CDR) are prepared at the CBRN CC and disseminated to all units served by the preparing CBRN CC.

(1) Basic Wind Report. A BWR is either a Basic Wind Message (BWM) or a Basic Wind Forecast (BWF). These messages contain basic meteorological data to be used for fallout prediction (see Appendix D of this manual for more information). The BWR is an ADP formatted message used to accommodate either the NBC BWM or the NBC BWF.

(2) Effective Downwind Report. An EDR is either an Effective Downwind Message (EDM) or an Effective Downwind Forecast (EDF). These messages contain information on downwind speed and downwind direction (towards which the wind is blowing) for each of seven pre-selected weapon yields (see Appendix I). The NBC EDR is an ADP formatted message used to accommodate either the NBC EDM or the NBC EDF message when transmitted.

(3) Chemical Downwind Report. An NBC CDR is either an NBC Chemical Downwind Message (CDM) or an NBC Chemical Downwind Forecast (CDF). These

messages contain basic meteorological information for predicting biological aerosol (see Appendix E) and chemical vapour hazard areas (see Appendix F). The NBC CDR is an ADP formatted message used to accommodate either the NBC CDM or the NBC CDF message when transmitted.

5. Mandatory Entries in Nuclear, Biological, and Chemical Reports

In order to process and evaluate the CBRN attack data quicker and with more efficiency, ensure validity of information and assist with manually inputting data into automated systems, each line has mandatory information that must be contained for the NBC message to be considered properly formatted. Certain rules apply to all lines or messages and are as follows:

a. In the instructions the field contents are described by one of the following: A = alphabetic, N = numeric, S = special characters (e.g. &, *), B = blank, or X = any code. Combinations of the codes exist in some fields.

b. Fields must be filled with the number and type of characters identified or a dash (-) may be inserted into a field when the information is not available. However, some fields have variable length, which is indicated by giving a range for the number of characters (e.g. 1-20X).

c. Whenever a line is repeatable, this is indicated by a preceding asterisk, e.g. (*=3) indicates that data can be entered up to 3 times.

d. If a repeatable line is used, then all fields within that line must be used each time that line is repeated.

e. In manual procedures all information under one set is put into one sentence.

f. In STRIKWARN, the units of measurement are default values and are therefore excluded from the fields.

g. All directional/angular measurements must be stated in either degrees (3N) or mils (4N) (i.e. 40 degrees = 040, 18 mils = 0018).

h. Sets or fields are either mandatory (M), operationally determined (O) or conditional (C).

Table III-2. Information Required by Line

ALPHA **Strike Serial Number**

```
/- /-     /-     /-     /-     //
|  |      |      |      (O) Grading of Message/Report, 1-3 N.
|  |      |      (M) Type of Incident*, 1-2 A.
|  |      (M) Sequence Number, 1-10 X.
|  (M) Code for Originator, 1-6 X.
(M) Nationality, 2A or:
(M) Area Control Center Code, 2-3 AN.
```

***N=**Nuclear Attack, **B=**Biological Attack, **C=**Chemical Attack, **RN=**Nuclear ROTA, **RB=**Biological ROTA, **RC=**Chemical ROTA, **RU=**Unidentified ROTA.

BRAVO **Location of Observer and Direction of Attack or Event**

```
/- /-     //
| (M) Direction of Attack or Event from Observer and Unit of Measurement
| (see paragraph 5.g), 6-7AN
Location of Observer, one of the following:
(M) Geographic Place Name, 1-30 X, or
(M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
(M) Geographic Position, UTM 10-Meter, 13 AN, or
(M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
(M) Geographic Position, UTM 100-Meter, 11 AN.
```

CHARLIE **Date Time Group of Report or Observation and End of Event**

```
/- /-     //
| (O) Date Time-Group Event ended in Zulu-Time, Month and Year, 14 AN
(M) Date-Time-Group of Report or Observation in Zulu-Time, Month and Year, 14 AN
```

DELTA **Date Time Group of Attack or Detonation and Attack End**

```
/- /-     //
|(O) Date Time-Group Attack ended in Zulu-Time, Month and Year, 14 AN
(M) Date-Time-Group of Attack or Detonation in Zulu-Time, Month and Year, 14 AN
```

FOXTROT **Location of Attack or Event**

```
/-*       /-     // (* = 6)
|          (M) Location Qualifier (AA=Actual Area, EA=Estimated Area), 2A
Attack or Event Location, one of the following:
(M) Geographic Place Name, 1-30 X, or
(M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
(M) Geographic Position, UTM 10-Meter, 13 AN, or
(M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
(M) Geographic Position, UTM 100-Meter, 11 AN
```

Explanation of Repeatable Field

Line FOXTROT: Fields 1-2 are repeatable to accommodate up to 6 data entries in order to define a line or area attack.

Table III-2. Information Required by Line (Continued)

GOLF **Delivery and Quantity Information**

/- /- /- /- /- //
| | | | (M) Number of Agent Containers, 1 - 3 N, or
| | | | (M) Size of Release*, 3 A
| | | (M) Type of Agent C Containers**, 3 A
| | (M) Number of Delivery Systems, 1-3 N
| (M) Type of Delivery***, 3 A
(M) Suspected/Observed Event (SUS=Suspected, OBS=Observed), 3 A

*****SML** (Less than 200 Liters or 200 Kilograms), **LRG**, **XLG** (More than 1,500 Liters or Kilograms), **UNK**
******BML**=Bomblets, **BOM**=Bomb, **BTL**=Pressurized Gas Bottle, **BUK**=Bunker, **CON=**Generic Storage Container, **DRM=**Nominal 55 gallon Storage Drum, GEN=Generator (Aerosol), **MSL=**Missile, **RCT=**Reactor, **RKT=**Rocket, **SHL=**Shell, **SPR=**Spray (tank), **STK=**Stockpile, **TNK=**Storage Tank, **TOR=**Torpedo, **MNE=**Mine (NBC filled only), **UNK=**Unknown**, WST=**Waste
*** **AIR=**Aircraft, **BOM=** Bomb (delivering Bomblets only), **CAN=**Cannon, **MLR=**Multiple Launched Rocket System, **MSL=**Missile, **MOR=**Mortar, **PLT=**Plant, **RLD=**Railroad Car, **SHP=**Ship, **TPT=**Transport, **UNK=**Unknown

---

HOTEL **Type of Nuclear Burst**

/- //
(M) Type of Nuclear Burst (AIR, SUBS, SURF, UNK), 3-4 A

INDIA **Release Information on Biological/ Chemical Agent Attacks or ROTA Events.**

/- /- /- /-* // (* = 2)
| | | (O) Type of Detection*, 3-5 A
| | (O) Type of Persistency**, 1-3 A
| (O) Type of Agent (see Table III-3), 1-4 A , or
| (O) Agent Name (see Table III-4), 1-4 A or
| (O) UN/NA Identification Number (see ERG), 4 N
(M) Type of Agent-Release-Height (AIR, SUBS, SURF, UNK), 3-4 A

Explanation of Repeatable fields.
Line INDIA: Field 4 is repeatable to accommodate up to 2 entries in order to provide information on multiple types of detection.
* **OTH=**Other (use GENTEXT to specify), **MPDS=**Manned Point Detection System, **UMPDS=**Un-Manned Point Detection System, **MSDS=**Manned Stand-off Detection System, **UMSDS=**Un-Manned Stand-off Detection System, **MSVY=**Manned Survey, **UMSVY=**Un- Manned Survey
** **P=**Persistent, **NP=**Non-persistent, **T=**Thickened, **UNK=**Unknown

---

JULIET **Flash-to-Bang Time in Seconds**

/- //
(M) Flash-to-Bang Time in Seconds, 1-3 N

KILO **Crater Description**

/- /- //
| (O) Crater Width and Unit of Measurement*, 2-7 AN
(M) Crater Indicator (CRATER=Crater present, NONE=No crater present, UNK=Unknown), 3-6 A
***KM=**Kilometers, **NM=**Nautical Miles, **FT=**Feet, **KF=**Kilofeet (1000 feet), **HM=**Hectometres (100 meters),**YD=**Yards, **M=**Meters, **SM=**Statute Miles

---

LIMA **Nuclear Burst Angular Cloud Width at H+5 Minutes**

/- //
(M) Angular Cloud Width (at H + 5 Min) and Unit of Measurement (DEG or MIL), 6-7 AN

MIKE **Stabilized Cloud Measurement at H+10 Minutes**

/-* /- /- // (* = 2)
| | (M) Cloud Height and Unit of Measurement, 2-7 AN
| (M) Cloud Angle and Unit of Measurement (MIL or DEG), 6-7 AN
(M) Cloud Section (TOP or BOT), 3 A

Explanation of Repeatable Field
Line MIKE: Fields 1-3 are repeatable to accommodate up to 2 data entries in order to describe the cloud height and/or the cloud angle for cloud top and/or for cloud bottom.

Table III-2. Information Required by Line (Continued)

MIKER **Description and Status of ROTA Event**
/- /- //
| (M) Status of ROTA-Event (PUFF=Single Release of a Cloud, CONT=Continuous
| SPRAY=Spraying) 4-5 A
(M) Description of ROTA-Event*, 4-6 A
*** CLOUD=**Visible Cloud, **FIRE=**Burning Fire, **POOL=**Large Quantity of Still Liquid, **LEAK=**Continuous Flow from Damaged Pipe or Container, **SPILL=**Small Quantity of Still Liquid, **LIQUID=**Liquid

---

NOVEMBER **Estimated Nuclear Yield in Kilotons**
/- //
(M) Estimated Nuclear Yield in Kilotons, 1-6 NS

OSCAR **Reference Date Time Group for Estimated Contour Lines**
/- //
(M) Reference Date-Time-Group for estimated contour lines in Zulu-Time, Month and Year, 14 AN

PAPAA **Predicted Attack/Release and Hazard Area**
/- /- /- /- //
| | | (M) Duration of Hazard in Hazard Area and Unit of Measurement*,
| | | 5-8 ANS
| | (M) Hazard Area Distance (see Table E-4 for CHEM or Appendix F, paragraph.4.c.(3) for BIO)
| | and Unit of Measurement (M, KM, YD), 2-7 AN
| (M) Duration of Hazard in Attack or Release Area and Unit of Measurement*,
| 5-8 ANS
(M) Attack or Release Area Radius and Unit of Measurement (M, KM, FT), 2-7 AN

*** DAY=**Days, **HR=**Hours, **MIN=**Minutes, **SEC=**Seconds, **WK=**Weeks, **MON=**Month

---

PAPAB **Detailed Fallout Hazard Prediction Parameters**
/- /- /- /- /- //
| | | | (M) Right Radial Line and Unit of Measurement*,
| | | | 6-7 AN
| | | (M) Left Radial Line and Unit of Measurement*, 6-7 AN
| | (M) Cloud Radius and Unit of Measurement, 3-4 AN
| (M) Downwind Distance of Zone I and Unit of Measurement, 4-5 AN
(M) Effective Wind Speed and Unit of Measurement (MPS=Meters per Second, KPH=Kilometers per Hour, KTS=Knots, MPH=Miles per Hour), 6 AN.

* **DGM=**Degrees/Magnetic North, **DGT=**Degrees/True North, **DGG=**Degrees/Grid North, **MLM=**Mils/Magnetic North, **MLT=**Mils/True North, **MLG=**Mils/Grid North

---

PAPAC **Radar Determined External Contour of Radioactive Cloud**
/-* // (* = 6)
External Contour of Radioactive Cloud, one of the following:
(M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
(M) Geographic Position, UTM 10-Meter, 13 AN, or
(M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
(M) Geographic Position, UTM 100-Meter, 11 AN.

Explanation of Repeatable Fields
Set PAPAC: Field 1 is repeatable to accommodate up to 6 entries in order to describe the radioactive cloud outline.

PAPAD **Radar Determined Downwind Direction of Radioactive Cloud**
/- //
(M) Downwind Direction of Radioactive Cloud and Unit of Measurement*, 6-7 AN
***DGM=**Degrees/Magnetic North, **DGT=**Degrees/True North, **DGG=**Degrees/Grid North, **MLM=**Mils/Magnetic North, **MLT=**Mils/True North, **MLG=**Mils/Grid North

Table III-2. Information Required by Line (Continued)

PAPAX** **Hazard Area Location for Weather Period (**=3)**

/- /-* // (* = 20)
| Hazard Area Location, one of the following:
| (M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
| (M) Geographic Position, UTM 10-Meter, 13 AN, or
| (M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
| (M) Geographic Position, UTM 100-Meter, 11 AN.
(M) Date-Time-Group of Start of Meteorological Period in Zulu-Time, Month and Year, 14 AN

PAPAX is repeatable up to 3 times in order to describe three possible hazard areas corresponding to the time periods from the CDM. A hazard area for a following time period will always include the previous hazard area.

Field 2 is repeatable up to 20 times in order to describe the hazard area outline.

Note: If hazard area location has only one position, draw a circle with a radius of the (remaining) hazard area distance from line PAPAA. If hazard area location has only two positions, these are the extreme ends of a linear attack. For each point, draw a circle with radius of the (remaining) hazard area distance from line PAPAA and connect the circles by two tangents.

QUEBEC* Location of Reading/Sample/Detection and Type of Sample/Detection (* = 20)

/- /- /- /- //
| | | ((O) Height of Measurement above Ground Level and Unit of Measurement, 2-7 AN
| | (M) Type of Detection*, 3-5 A
| (M) Type of Sample**, 1-5 A
Location of Reading/Sample/Detection, one of the following:
(M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
(M) Geographic Position, UTM 10-Meter, 13 AN, or
(M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
(M) Geographic Position, UTM 100-Meter, 11 AN.

QUEBEC is repeatable up to 20 times in order to describe multiple detectors, monitoring or survey points.

* **OTH=**Other (use GENTEXT to specify), **MPDS=**Manned Point Detection System, **UMPDS=**Un-Manned Point Detection System, **MSDS=**Manned Stand-off Detection System, **UMSDS=**Un-Manned Stand-off Detection System, **MSVY=**Manned Survey, **UMSVY=**Un- Manned Survey
**** LIQ=**Liquid sample, **VAP=**Vapor, **SOIL=**Soil Sample, **SOLID=** Solid Sample, **VEG=**Vegetation Sample, **WATER=**Water Sample

---

ROMEO* Level of Contamination, Dose Rate Trend, and Decay Rate Trend. (* = 20)

/- /- /- //
| | (O) Relative Decay Rate (DN=Normal, DF=Fast, DS=Slow), 2 A, or
| | (O) Actual Decay Rate, 3-4 NS.
| (O) Dose Rate*, 4 A.
(M) Level of Dose Rate/Dosage and Unit of Measurement**4-12 ANS, or
(M) Level of Dose and Unit of Measurement***, 4-12 ANS, or
(M) Level of Contamination and Unit of Measurement***4-12 ANS, or
(M) Miosis*****, 4-5A

Line is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.
***BACK=**Background,**DECR=**Decreasing, **INCR=**Increasing, **INIT=**Initial, **SAME=S**ame, **PEAK=**Peak
****CFU=**Colony forming units, **CGH=**Centigray per hour, **CSH=**Centisievert per hour, **MSH=**Millisievert per hour, **USH=**Microsievert per hour, **BQS=**Becquerel, **MM3=**Milligram-minutes per cubic meter
*****CGY=**Centigray, **CSV=**Centisievert, **MGY=**Milligray , **MSV=**Millisievert, **USV=**Microsievert
**** **ACPL=**Agent containing particles per litre, **BQM2=**Becquerel per square meter, **BQM3=**Becquerel per cubic meter, **MGM2=**Milligrams per square meter, **MGM3=**Milligrams per cubic meter, **PPM=**Parts per Million (10^6), **PPB=**Parts per Billion (10^9)
*******LDXX=**Lethal Dose xx = LD_1 to LD_{99}, **IDXX=**Incapacitating Dose xx = ID_1 to ID_{99}, **ICTXX=**ncapacitating Dosage xx = ICt_1 to ICt_{99}, **LCTXX=**Lethal Dosage xx = LCt_1 to LCt_{99}, **MCTXX=**Eye effecting Dosage xx (Miosis) = MCt_1 to MCt_{99}

Table III-2. Information Required by Line (Continued)

SIERRA* **Date Time Group of Reading or Initial Detection of Contamination (* = 20)**

/- //
(M) Date-Time Group, Contamination Detected in Z-Time, Month and Year, 14 AN, or
(M) Date-Time Group of Reading in Z-Time, Month and Year, 14 AN.

SIERRA is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

TANGO* **Terrain/Topography and Vegetation Description (* = 20)**

/- /- //
| (M) Vegetation Description*, 3-5 A.
(M) Terrain/Topography Description**3-6 A.

TANGO is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

***BARE=**Bare, **SCRUB=**Scrubby Vegetation, **WOODS=**Wooded Terrain, **URBAN**=Urban, **UNK=**Unknown
****FLAT=**Flat, **URBAN=**Urban, **HIL=**Hill, **SEA=**Sea, **VALLEY=**Valley, **UNK=**Unknown

---

WHISKEY **Sensor information**

/- /- /- /- //
| | | (O) Assurance Level of Results, (LOW, MED, HIGH), 3-4 A
| | (O) Confirmatory Test (Y or N) 1 A
| (M) Non Specific Potential Harmful Result (POS or NEG) 3 A
(M) Generic Alarm Result (POS or NEG) 3 A
(N) WHISKEY format is prepared for future use. Procedures on how to use it will follow later,

---

XRAYA** **Actual Contour Information (** = 50)**

/- /-* // (*=50)
| Limit Contour Line or Area of Contamination, one of the following:
| (M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
| (M) Geographic Position, UTM 10-Meter, 13 AN, or
| (M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
| (M) Geographic Position, UTM 100-Meter, 11 AN
(M) Level of Dose Rate/Dosage and Unit of Measurement*, 4-12 ANS, or
(M) Level of Dose and Unit of Measurement**, 4-12 ANS, or
(M) Level of Contamination and Unit of Measurement***, 4-12ANS, or
(M) Level of Hazard****, 4-5 AN, or
(M) Miosis****, 4-5AN

Field 2 is repeatable to accommodate up to 50 data entries in order to describe respective contour lines.

XRAYA is repeatable up to 50 times to represent multiple contours.

***CFU=**Colony forming units, **CGH=**Centigray per hour, **CSH=**Centisievert per hour, **MSH=**Millisievert per hour, **USH=**Microsievert per hour, **BQS=**Becquerel, **MM3=**Milligram-minutes per cubic meter

****CGY=**Centigray, **CSV=**Centisievert, **MGY=**Milligray , **MSV=**Millisievert, **USV=**Microsievert

**** **ACPL=**Agent containing particles per litre, **BQM2=**Becquerel per square meter, **BQM3=**Becquerel per cubic meter, **MGM2=**Milligrams per square meter, **MGM3=**Milligrams per cubic meter, **PPM=**Parts per Million (10^6), **PPB=**Parts per Billion (10^9)
******LDXX=**Lethal Dose xx = LD_1 to LD_{99}, **IDXX=**Incapacitating Dose xx = ID_1 to ID_{99}, **ICTXX=**ncapacitating Dosage xx = ICt_1 to Ict_{99}, **LCTXX=**Lethal Dosage xx = LCt_1 to LCt_{99}, **MCTXX=**Eye effecting Dosage xx (Miosis) = MCt_1 to MCt_{99}

1 **Table III-2. Information Required by Line (Continued)**

XRAYB** **Predicted Contour Information (** = 50)**

/- /- /-* // (*=50)
| | Limit Contour Line or Area of Contamination, one of the following:
| | (M) Geographic Position, LAT/LONG, Seconds, 15 AN, or
| | (M) Geographic Position, UTM 10-Meter, 13 AN, or
| | (M) Geographic Position, LAT/LONG, Minutes, 11 AN, or
| | (M) Geographic Position, UTM 100-Meter, 11 AN
| (M) Level of Dose Rate/Dosage & Unit of Measurement*, 4-12 ANS or
| (M) Level of Dose and Unit of Measurement**, 4-12 ANS or
| (M) Level of Contamination and Unit of Measurement***, 4-12ANS
| (M) Level of Hazard****, 3-5 AN, or
| (M) Miosis****, 5A
(M) Type of Contour*****, 2 N

Field 3 is repeatable to accommodate up to 50 data entries in order to describe respective contour lines. XRAYB is repeatable up to 50 times to describe multiple contours or segments.

***CFU=**Colony forming units, **CGH=**Centigray per hour, **CSH=**Centisievert per hour, **MSH=**Millisievert per hour, **USH=**Microsievert per hour, **BQS=**Becquerel, **MM3=**Milligram-minutes per cubic meter

****CGY=**Centigray, **CSV=**Centisievert, **MGY=**Milligray , **MSV=**Millisievert, **USV=**Microsievert

**** **ACPL=**Agent containing particles per litre, **BQM2=**Becquerel per square meter, **BQM3=**Becquerel per cubic meter, **MGM2=**Milligrams per square meter, **MGM3=**Milligrams per cubic meter, **PPM=**Parts per Million (10^6), **PPB=**Parts per Billion (10^9)

******LDXX=**Lethal Dose xx = LD_1 to LD_{99}, **IDXX=**Incapacitating Dose xx = ID_1 to ID_{99}, **ICTXX=**ncapacitating Dosage xx = Ict_1 to Ict_{99}, **LCTXX=**Lethal Dosage xx = LCt_1 to LCt_{99}, **MCTXX=**Eye effecting Dosage xx (Miosis) = MCt_1 to MCt_{99}
*******01 through 99=**Probability in percent terms of exceeding value in field 2 of Set XRAYB

YANKEE* **Downwind Direction and Downwind Speed (* = 20)**

/- /- //
| (M) Downwind Speed and Unit of Measurement, 4-6 AN
(M) Downwind Direction and Unit of Measurement, 6-7 AN

YANKEE is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

ZULU* **Actual Weather Conditions (* = 20)**

/- /- /- /- /- //
| | | | (M) Cloud Coverage*, 1 N
| | | (M) Significant Weather Phenomena**, 1 AN
| | (M) Relative Humidity Range***, 1 N
| (M) Surface Air Temperature and Unit of Measurement (-48F, 27C), 2-4 ANS
(M) Detailed Air Stability Category****, 1 N or
(M) Simplified Air Stability Category, (U=unstable, N=neutral or S=Stable), 1 A.

ZULU is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

***0=**Less than half covered (scattered), **1**=More than half covered (broken), **2=**completely covered (overcast), **3=**No Clouds (clear conditions)

****0=**No Significant Weather Phenomena, **1=**Sea Breeze, **2=**Land Breeze, **3=**Blowing Snow, Sand Storm, Dust Storm, **4=**Fog, Ice Fog, Thick Haze (visibility less than 4 km), **5=**Drizzle, **6=**Rain, **7=**Snow, Rain, Snow mixed (no shower), **8=**Showers of Rain, Snow, Rain and Snow mixed, Hail, **9=**Thunderstorm with or without Precipitation, **A=**Top of inversion layer lower than 800 M, **B=**Top of inversion layer lower than 400 M, **C=**Top of inversion layer lower than 200 M

*****0=**0-9 Percent, **1=**10-19 Percent, **2=**20-29 Percent, **3=**30-39 Percent,**4=**40-49 Percent, **5=**50-59 Percent, **6=**60-69 Percent, **7=**70-79 Percent, **8=**80-89 Percent, **9**=90-100 Percent

******1=**Very Unstable, **2=**Unstable, **3=**Slightly Unstable, **4=**Neutral, **5=**Slightly Stable, **6=**Stable, **7=**Very Stable

Table III-2. Information Required by Line (Continued)

GENTEXT **General Text (unlimited free text).**
/- /- //
| (M) Free Text, Unlimited X.
(M) Text Indicator, (NBCINFO or NBC SITREP), 1-61 X

Table III-3. Types of Agents

Nuclear		**Biological**		**Chemical**	
NIL	No agent detected (only used in NBC4)	**BIO**	Biological	**BL**	Blister agent
OTR	Other agent	**NIL**	No agent detected (only used in NBC4)	**BLOD**	Blood agent
RNP	ROTA nuclear power plant	**OTR**	Other agent	**CHOK**	Choking agent
TIM	Toxic Industrial Material	**TIM**	Toxic Industrial Material	**G**	G agent
UNK	Unknown	**TOX**	Toxin	**H**	Mustard agent
		UNK	Unknown	**INCP**	Incapaciting agent
		BAC	Bacterial	**IRT**	Irritant
		CLA	Chlamydia	**NERV**	Nerve agent
		RIC	Rickettsiae	**NIL**	No agent detected (only used in NBC4)
		VIR	Viral	**OTR**	Other agent
				PENT	Penetrating agent
				TIM	Toxic Industrial Material
				UNK	Unknown
				V	V-agent
				VMT	Vomiting agent

Table III-4. Agent Name

Nuclear		**Biological**		**Chemical**	
ALP	Alpha			**AC**	Hydrogen cyanide
BETA	Beta			**BZ**	Quinuclidinyl benzilate
GAM	Gamma			**CG**	Phosgene
NEU	Neutron			**CK**	Cyanogen chloride
COB	Cobalt-60			**CX**	Phosgene oxime
CES	Cesium-137			**DP**	Di-Phosgene
FF	Fresh Reactor Fuel			**GA**	Tabun
FL	Nuclear Weapon Fallout			**GB**	Sarin
				GD	Soman
IO	Iodine			**GF**	Cyclo-Sarin
OF	Spent Reactor Fuel			**HD**	Mustard distilled
PU	Plutonium			**HL**	Mustard-Lewisite
				HN	Nitrogen mustard
				HT	Trimeric mustard
				L	Lewisite
				PS	Chloropicrin
				SA	Arsin
				TG	Tear gas
				VX	VX

If Biological Agent Identity is known, enter in set GENTEXT.

6. Classification and Precedence

a. Classification. Unless the NBC message contains specific operational information, e.g. effects on troops, all such messages should be unclassified.

b. Precedence. NBC 1 messages reporting the first enemy use of CBRN weapons (first use of nuclear weapons, first use of biological weapons and first use of chemical weapons) or ROTA incidents must be given precedence FLASH. All other messages should be given a precedence that reflects the operational value of the contents. Normally, immediate would be appropriate. Once a CBRN event occurs, the number of NBC messages will be substantial. CBRN staffs must prepare their SOPs carefully in order to avoid an unnecessary load on the communication systems.

7. Decision Support Tools

Collection, evaluation, processing and relaying all of the reports from the field can be extremely difficult and time consuming task when done manually. In order to help reduce the number of errors and expedite the process the United States Government (USG) has developed various modelling programs and systems to help commanders make more informed decisions, quicker and more accurately. There are a large number of models available through various Department of Defense (DoD) and other Federal agencies. Models are volatile and dynamic; therefore, considerable expertise is required to avoid misuse or misreading of the results. For additional information on models, refer to the Modeling & Simulation Information Analysis Center website, www.msiac.dmso.mil.

a. Passive Defense (JWARN). The JWARN when completed will provide the military services near real-time operational capabilities to collect analyze and report CBRN agent detections, identification, location and warning information. JWARN will be interoperable and integrated with Joint/Service command, control, communication, computers, information and intelligence (C4I2) systems and networks, supporting automated data exchange between the actual detector/sensor and the C4I2 system providing CBRN analyzed data. By using the data provided, decisions for disseminating warnings down to the lowest level of the battlefield can be made. JWARN will provide additional data processing, reports and access to specific CBRN information, which will improve the efficiency of limited CBRN personnel assets. JWARN enables commanders to understand both the tactical and strategic implications of a CBRN attack or hazard. JWARN provides a comprehensive analysis and near real-time response capability to minimize the effect of hostile CBRN attacks or accidents/incidents by collecting, analyzing, reporting, and disseminating CBRN agent detection, identification, location and warning information. The JWARN software is comprised of various modules which can stand alone and provide limited functionality or be tied together to get a more robust complete program. The main modules included within JWARN are:

(1) NBC-Analysis. NBC-Analysis was designed to determine and display CBRN hazard areas resulting from the use of CBRN weapons systems and dissemination devices. It has the ability to provide hazard estimates for onset times and duration of hazard. NBC-Analysis also provides database management to store information used to warn units and can generate the standard ATP-45 (B) message set and overlays. The program operates in exercise (EXER) and operational (OPER) modes. Reports from several exercises and operations can be store as scenarios.

(2) Hazard Prediction and Assessment Capability (HPAC). The HPAC program is used to predict hazard effects of CBRN weapons, facility accidents and incidents. Additionally, HPAC provides an overlay for nuclear, biological, and chemical hazard calculations. Once the effects of hazardous materials at geographical locations are calculated, the results are displayed in either surface deposition, air concentration or as a cross-section of the atmosphere. HPAC includes the ability to support an assessment capability for CBRN material released from incidents or accidents at production and storage facilities, or nuclear weapons events.

(3) Vapor Liquid Solid Tracking (VLSTRACK). The VLSTRACK program provides downwind hazard prediction for a wide range of chemical and biological agents and munitions. It also determines the approximate size, shape, onset time, duration, and level of hazard from a chemical or biological attack. This program includes a vertical wind profile meteorology forecast for high altitude releases, as well as variable meteorology, which allows the attack to be interfaced with a meteorological forecast, extending the practical range of applicability beyond constant meteorological conditions that would only be valid for a couple of hours. Output can be obtained as either a cumulative hazard from the time of attack or as a periodic hazard for each time period.

b. Consequence Management.

(1) CATS. The Consequence Assessment Tool Set (CATS) is an integrated disaster analysis system. The CATS estimates damage and assesses consequences to population, infrastructure, and critical resources. The CATS can assess consequences from both technological and natural hazards. Technological hazards include NBC weapons and chemical/nuclear facility accidents. Natural hazards include hurricanes and earthquakes. The CATS is currently available to and being used by the Army National Guard Civil Support Teams. The CATS combines state-of-the-art physical effects models, digital databases, a geographic information system, and an easy to use graphical interface.

(2) NBC Hazard Prediction Model for Industrial Chemical Hazards from Accidents or Incidents (D2PC). Hazards from industrial chemical accidents and releases are modeled using D2PC. This model is used by Army depots that store chemical munitions. Hazard assessment is made in terms of the accumulated dosage or peak concentration which may result from instantaneous, continuous, or varying releases of the agent.

(3) Other Government Modeling Programs.

(a) Computer-Aided Management of Emergency Operations (CAMEO). CAMEO is a suite of software programs that allow the user to plan for and respond to chemical emergencies. It was developed for chemical emergency planners and responders by the CAMEO team. That team includes the U.S. Environmental Protection Agency's Chemical Emergency Preparedness and Prevention Office and the National Oceanic and Atmospheric Administration's Office of Response and Restoration. CAMEO includes a set of databases, or modules, a toxic gas dispersion model ("plume model") called ALOHA, and an electronic mapping program called MARPLOT. CAMEO is used for two primary purposes:

- To access, store, and evaluate information needed for emergency response to hazardous materials incidents.

- To develop hazardous materials emergency plans for civilian communities. CAMEO was also designed to help local governments meet the requirements of the Emergency Planning and Community Right-to-Know Act, or EPCRA

(b) Area Locations of Hazardous Atmospheres (ALOHA). ALOHA is a computer program designed for use by people responding to chemical accidents, as well as for emergency planning and training. ALOHA can predict the rates at which chemical vapors may escape into the atmosphere from broken gas pipes, leaking tanks, and evaporating puddles. It can then predict how a hazardous gas cloud might disperse in the atmosphere after an accidental chemical release.

(c) Mapping Application for Response, Planning, and Operational Tasks (MARPLOT). MARPLOT is a general-purpose mapping application, jointly developed by Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration and Chemical Emergency Preparedness and Prevention Office, U.S. Environmental Protection Agency. It is designed to allow the user the ability to create, view, and modify maps quickly and easily for ALOHA, CAMEO or other programs.

8. Technical Reach-Back Capabilities

The commander will require not only accurate and timely information but also tremendous reach-back capabilities. Reachback occurs when commanders access the capabilities of remotely-located informational resources through their C2 systems.

Reach-back is a process that employs communications assets to identify and bring to bear resources not present at a CBRN site.

a. General.

(1) Technical reach-back is the ability to contact technical SMEs when a technical issue exceeds the on-scene SME's capability. Reach back should be conducted using established unit protocols. Many of the listed reach-back resources have other primary missions and are not specifically resourced for reach-back. Issues may include the following:

(a) Nonstandard agent identification of CBRN and TIM. If a TIM is used or is suspect, then CBRN personnel must obtain technical information. This information could include persistency, medical effects, and decontamination or protection requirements.

(b) Modeling/Hazard Prediction. The spread of contamination must be known to operational units. Technical experts can use modeling to provide a better indication of where vapor, liquid, or aerosolized hazards may occur. Technical reach-back should provide the ability for detailed analysis of the area to assist in determining downwind hazard areas and locating staging areas, OPCENs, decontamination sites, etc. Tools that can be used include decision support tools (such as hazard prediction and assessment capability), consequence assessment tool set, joint assessment of catastrophic events, etc.

(2) Reach back can be accomplished through various means, from the telephone to broadband satellites.

b. Technical Reach-Back Capabilities. The following technical reach-back capability is available if technical issues exceed on-site, local SME capabilities (see Table III-2). Reach back should be conducted using established local protocols and SOPs.

Table III-2. Technical Reach-Back Points of Contact

Defense Threat Reduction Agency	1-877-244-1187
Armed Forces Radiobiology Research Institute	1-301-295-0316/0530
Technical Chemical and Biological Assistance Hot Line	1-877-269-4496
US Army Medical Research Institute of Infectious Diseases	1-888-872-7443
US Army Medical Research Institute for Chemical Defense	1-800-424-8802
Navy Environmental and Preventive Medical Units	See Paragraph 8.b.(6)
Navy Medical Research Center	1-301- 319-7510
Navy Environmental Health Center	See paragraph 8.b.(7)
National Response Center, Chemical Terrorism/Chemical Biological Hot Line	1-800-424-8802

(1) DTRA. DTRA can provide technical reach-back information and services for on-scene personnel. The focal/coordination point for support is through the DTRA EOC. The DTRA OPCEN enables first responders and warfighters to deal with CBRN threats through on-line assistance and provides a wide-band infrastructure for user support. As part of the Combat Support Directorate in DTRA, the OPCEN is manned 7-days a week, 24-hours a day, and has the requisite communications links to act as the single POC for on-line assistance and the dispatch of other agency resources, as required. For more information on DTRA visit http://www.dtra.mil.

(2) Armed Forces Radiobiology Research Institute (AFRRI). The AFRRI can provide DOD technical support capability for nuclear/radiological incidents or accidents.

(3) Technical Chemical and Biological Assistance Hot Line. The US Army Soldier Biological and Chemical Command (SBCCOM) hotline provides technical assistance to emergency responders. The hotline is manned and operated 7-days a week, 24-hours a day. Technical CB assistance from SBCCOM can be obtained by calling 1-877-269-4496.

(4) USAMRIID. The USAMRIID provides medical and scientific SMEs and technical guidance to commanders and senior leaders on the prevention and treatment of hazardous diseases and prevention and the medical management of biological casualties. The USAMRIID serves as the DOD reference center for the identification of biological agents from clinical specimens and other sources. The USAMRIID can provide technical guidance for assessing and evaluating a biological terrorist incident from initial communication of the threat through incident resolution.

(5) USAMRICD. The USAMRICD provides medical and scientific SMEs and technical guidance to commanders and senior leaders on the prevention and treatment of chemical casualties. The USAMRICD can provide technical guidance for assessing and

evaluating a chemical terrorist incident from initial communications of the threat through incident resolution.

(6) NEPMU. Regional NEPMUs have the mission to provide specialized consultation, advice, recommendations, and technical support in matters of environmental health, preventative medicine, and occupational safety to Navy and Marine Corps shore activities and units of the operational forces within their designated areas of responsibility. An ashore or afloat command requesting guidance relating to suspect bioagent material can consult one of the following NEPMUs within their AOR. The units are available on-call 24/7. The NEPMU staff can provide technical assistance and confirmatory laboratory analysis for biological and chemical agents. They can also provide assistance on requests for additional support teams (CBIRF, TEU, CB-RRT, etc). Response teams are deployable within 48 hours upon notification from OPNAV N931/BUMED M3F. Regional NEPMU locations and contact information are listed below:

NEPMU-2, Norfolk, VA
(DSN) 564-7671, (COM) 757-444-7671
Email: nepmu2@nepmu2.med.navy.mil
Classified Message Traffic:
NAVENPVNTMEDU TWO NORFOLK VA

NEPMU-5, San Diego, CA
(DSN) 526-7070, (COM) 619-556-7070
Email: nepmu5@nepmu5.med.navy.mil
Classified Message Traffic:
NAVENPVNTMEDU FIVE SAN DIEGO CA

NEPMU-6, Pearl Harbor, HI
(DSN) 473-0555, (COM) 808-473-0555
Email: nepmu6@nepmu6.med.navy.mil
Classified Message Traffic:
NAVENPVNTMEDU SIX PEARL HARBOR HI

NEPMU-7, Sigonella, ITALY
(DSN) 314-624-9251, (COM) +39-095-86-9251
Email: nepmu7@nepmu7.med.navy.mil
Classified Message Traffic:
NAVENPVNTMEDU SEVEN SIGONELLA IT

(7) Navy Medical Research Center — Biological Defense Research Directorate. The NMRC conducts research and development, test and evaluation, and disease surveillance to enhance the health, safety, performance and deployment medical readiness of the Navy and Marine Corps. Its BDRD has a staff that is recognized as a leader in the rapid and confirmatory diagnosis of infectious diseases. The directorate explores basic and applied microbiological, immunological and related scientific research methodologies for the development of medical diagnostics. The BDRD staff have designed, developed and tested a broad variety of methodologies that have allowed for swift and accurate diagnosis essential for substantive medical protection and readiness of Navy and Marine Corps personnel. They have been instrumental in the advancement and refinement of confirmatory diagnostic methods utilizing polymerase chain reaction (PCR) methodologies in tandem with state of the art biosensor technologies. Additional information is available at the

NMRC website http://www.nmrc.navy.mil.The BDRD staff can be contacted via NIPRNET at: bdrd1@nmrc.navy.mil or bdrd2@nmrc.navy.mil, or via telephone at (COM) 301-319-7510. Subsequent SIPRNET communications links will be established as necessary.

(8) Navy Environmental Health Center The mission of the NEHC is to ensure Navy and Marine Corps readiness through leadership in the prevention of disease and promotion of health. The command has specialists in environmental health, radiation health, industrial hygiene, medical entomology, biochemistry, toxicology, and preventative medicine. Chemical, biological, radiological, and environmental medical defense technical support and consultative assistance is available within the Plans and Operations Directorate. The SIPRNET email address is plansops@nehc.navy.smil.mil and secure telephone (STU-III) number is 757-953-0699. This command can be reached during duty hours via unsecured telephone at (DSN) 377-0700 or (COM) 757-953-0700; after-hours at (DSN) 377-1967 or (COM) 757-621-1967. The command website http://www-nehc.med.navy.mil, contains numerous links to additional useful references and instructions.

(9) The National Response Center mans the hot line service and serves as an emergency resource for first responders to request technical assistance during an incident. The intended users include trained emergency personnel. such as emergency operators and first responders (such as firefighters, police, and EMTs who arrive at the scene of a CB terrorist incident). Other potential users may include the state EOCs and hospitals that may treat victims of agent exposure.

(a) The USCG operates the NRC, and trained operators staff the hot line 7-days a week, 24-hours a day. Operators use extensive databases and reference material in addition to having immediate access to the nation's top SMEs in the field of NBC agents. NRC duty officers take reports of actual or potential domestic terrorism and link emergency calls with applicable SMEs (such as US Army SBCCOM, USAMRICD) for technical assistance and with the FBI for federal response actions. The NRC also provides reports and notifications to other federal agencies, as necessary. Specialty areas include the following:

- Detection equipment.
- PPE.
- Decontamination systems and methods.
- Physical properties of CB agents.
- Toxicology information.
- Medical symptoms from exposure to CB agents.
- Treatment of exposure to CB agents.
- Hazard prediction models.
- Federal response assets.
- Applicable laws and regulations.

(b) The CB hot line is a joint effort of the USCG, FBI, FEMA, EPA, DHHS, and DOD. The NRC is the entry point for the CB hot line. The NRC receives basic incident information and links the caller to the DOD and FBI CB and terrorism experts. These and other federal agencies can be accessed within a few minutes to provide technical assistance during a potential CB incident. If the situation warrants, a federal response action may be initiated.

(c) Use the local established policies and procedures for requesting federal assistance before contacting the CB hot line. State and local officials can access the hot line in emergency circumstances by calling 1-800-424-8802.

(d) For more information on the NRC visit http://www.nrc.uscg.mil/.

8. Avoidance Tools

Conducting CBRN Avoidance operations is a complex process. Various tools and TTP have been developed to systematically and accurately prepare for and conduct CBRN avoidance operations.

a. Many of the tools required to conduct CBRN avoidance operations are included in this manual. They are:

- CBRN Checklists (Appendix A)
- CBRN Center/Cell Operations (Appendix B).
- Guidance on the management of readiological hazards (Appendix C).
- Meteorological reports (Appendix D).
- TTP for chemical contamination avoidance (Appendix E).
- TTP for biological contamination avoidance (Appendix F).
- TTP for nuclear contamination avoidance (Appendix G).
- TTP for ROTA contamination avoidance (Appendix H).
- Guidance on the use of the Strikewarn message (Appendix I).
- Required Nomograms, Tables, and Graphs (Appendix J).
- Calculations used in conducting CBRN avoidance operations (Appendix K).
- Forms used when conducting CBRN avoidance operations. (appendix L).

b. Other TTP specifically designed to support CBRN avoidance operations are found in *MTTP for NBC Reconnaissance*, *MTTP for NBC Vulnerability Assessment* and *Biological Surveillance MTTP*.

Appendix A

CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR AVOIDANCE CHECKLIST

This appendix provides a series of checklists that outline CBRN contamination avoidance procedures. The various checklists are designed to assist commanders and CBRN staff personnel. These checklists are not all-inclusive and may be adapted or modified for local use. Checklist items are not necessarily in chronological order; actions may occur simultaneously and some may deviate based on the situation. All actions should be considered.

NOTE: These statements are common tasks/actions for chemical, biological, and nuclear attacks. Complete this checklist along with specific the chemical, biological, and nuclear tasks/actions in Appendixes E, F, and G, respectively.

Table A-1. Preattack Checklist for CBRN Attacks (Sample)

	PRE-ATTACK **(CBRN)**	
ITEM #	**TASK/ACTION**	**OPR**
1.	Establish/activate primary and alternate CBRN cells.	CBRN
2.	Recommend alarm signal / CBRN threat/protection levels, and FPCON. (e.g., Alarm [Color], MOPP [level], FPCON)	CBRN
3.	Verify with higher HQ: • Procedures and timelines how to receive attack warnings. • Reporting procedures. • (e.g., CBRN Warning and Reporting System (CBRNWRS) procedures and responsibilities (Include geographically separated units, joint service, allied, coalition, and host-nation CBRN defense units). • Establish preformatted or preaddressed NBC Warning and Reporting System (NBCWRS) messages. Verify the base warning system is able to provide attack warning and notification to the base population within 10 minutes. **NOTE**: Ensure the OPS has direct access to activate the installation-wide warning network.	CBRN/OPS
4.	Conduct CBRN VA	INTEL/CBRN
5.	Position CBRN detectors and ISR assets according to VA	CBRN

	PRE-ATTACK (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
6.	Review specific CA actions based on alarm signal and type of attack **NOTE**: Adjust transattack actions to local policies/procedures.	CBRN/OPS
7.	Reconfirm communications with CBRND teams are available for 24 hour operations.	SRC
8.	Verify availability of MET forecast data.	
9.	Ensure maps / overlays include: • Theater missile defense zones. • Friendly forces. • Key facilities/shelters. • CBRN detectors. • CBRN templates. • CBRN reconnaissance routes	INTEL/OPS/ CBRN
10.	Determine environmental and medical baselines.	MED
11.	Provide current information to ensure all personnel are trained for CBRN avoidance measures (e.g., alarms, CBRN markers, reporting).	CBRN
12.	Identify and direct CBRN CA training of noncombatants at overseas locations in accordance with theater or DOS directives.	OPS / CBRN
13.	Review MOA/MOU arrangements with local, state, federal, or HN authorities to ensure proper NBCWRS communications and that roles and responsibilities are mutually understood.	LEGAL/OPS/ CBRN
14.	Coordinate with operations on dispersal of critical assets.	OPS
15.	Direct priority items to be placed inside facilities, under cover or double-wrapped with plastic sheeting.	OPS/CBRN
16.	Keep windows and doors closed whenever possible.	All
17.	Review preattack, during-attack, postattack and recovery actions checklists, plans, and concepts.	All

Table A-2. During-attack Checklist for CBRN Attacks (Sample)

	DURING-ATTACK **(CBRN)**	
ITEM #	**TASK/ACTION**	**OPR**
18.	Declare alarm signal, MOPP level, FPCON, situation (e.g., *Alarm Red*, MOPP4, FPCON Delta, missiles inbound, ETA 3 minutes).	OPS/CBRN
19.	Actions for personnel in open areas: • Seek the best available protection (building, bunker). • If a building or bunker is not available, move to a ditch, depression, or structure that provides protection from blast, fragments, and small arms fire • If no warning is received and an attack begins, drop to the ground, don the protective mask, crawl to closest available protection, and don the remaining IPE. • Use any available material to provide overhead cover (rain gear, poncho, tarps, or plastic). **NOTE**: **Adjust to local policies/procedures.**	All
20.	Vehicle/Equipment operators and passengers: • Drive to the best available protection within a minute’s drive, while passengers don IPE. • Move the vehicle or equipment into or under shelter if possible. • If unavailable, drive near a ditch, depression, or structure that provides protection from blast, fragments, and small arms fire. • All personnel exit, take cover, and don IPE. • Missile attacks only: All personnel remain inside the vehicle or equipment (window up and doors closed), and don IPE. **NOTE**: **Adjust to local policies/procedures.**	All
21.	Aircrews operating aircraft: • Taxi tactical aircraft into any available shelter. • For large frame aircraft or if shelter is not available for smaller aircraft, notify passengers to don IPE, and request instructions from ground control. **NOTE**: **Adjust to local policies/procedures.**	All
22.	Perform buddy checks ensuring IPE is correctly worn.	All
23.	Perform self-aid/buddy care while maintaining a low profile.	All

	DURING-ATTACK (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
24.	If time allows, close doors and windows and cover items with plastic.	All
25.	Monitor and report attack indicators to CBRN Cell: • CBRN detector response. • Casualty data. • Environmental data.	All
26.	Turn off air handlers on facilities not provided collective protection.	LOGISTICS
27.	Monitor overpressure and filtration systems for proper operations.	LOGISTICS
28.	Monitor CBRNWRS for reports of CBRN attacks.	CBRN/OPS
29.	Monitor Intel/airborne radar data.	INTEL

Table A-3. Postattack Checklist for CBRN Attacks (Sample)

	POST-ATTACK (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
30.	Declare Alarm Signal, MOPP level, FPCON, situation (e.g. *Alarm Black*, MOPP4, FPCON Charlie, begin postattack reconnaissance).	OPS/CBRN
31.	Remain in during-attack posture until directed to do otherwise.	All
32.	Initiate contamination control and decontamination measures.	All
33.	Seek overhead cover and perform immediate personal decontamination if required.	All
34.	Evaluate the risk of a reattack.	OPS/INTEL/ CBRN
35.	Initiate request for additional DOD resources.	CP
36.	Project follow-on attacks, assess other facilities as sources of assistance, burden, or hazard; provide threat and target support to unit operations.	INTEL/OPS

	POST-ATTACK (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
37.	Determine attack location.	CBRN
38.	Report information on status of automated CBRN detection devices: • Operational status. • Alarming or silent. • Displays.	CBRN
39.	Limit outside movement to teams involved in the identification of hazards and recovery.	OPS/CBRN
40.	Inspect shelters for damage and report findings to OPS/CBRN.	LOGISTICS
41.	Verify the integrity of the filtration and over pressurization systems.	LOGISTICS
42.	Direct personnel to unmask if system operation remains normal (shelters with filtration systems only). **NOTE**: **Direct personnel to don the protective mask if agent effects are observed.**	CBRN/OPS
43.	Periodically check the CCA or entrance to the facility for contamination and decontaminate as necessary.	CBRN/OPS
44.	Begin PAR operations at direction of CBRN cell and report findings: • Contamination. • UXO. • Damage. • Fires. • Enemy activity/suspicious personnel using SALUTE format. • Enemy casualties and abandoned weapons. • Casualties.	PAR Teams/ CBRN
45.	Track and plot reports of casualties, contamination, damage, etc.	CBRN/OPS
46.	Submit appropriate NBC reports.	CBRN
47.	Warn friendly forces of dangers.	CBRN/OPS/ INTEL

Table A-4. Recovery Checklist for CBRN Attacks (Sample)

	RECOVERY (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
48.	Track levels of contamination and forward to the SRC.	CBRN Recon
49.	Determine the extent of contamination; develop a sampling plan and conduct the required sampling.	CBRN
50.	Relocate personnel/operations as required.	CBRN/OPS
51.	Identify type and specifics of contamination.	CBRN Recon
52.	Determine hazard persistency and protective measures needed.	CBRN
53.	Reassess and change MOPP level/alarm signal to the lowest possible level consistent with identified hazards.	CBRN/OPS
54.	Make recommendation on the need for CCA/ACCA operations.	CBRN / MED
55.	Assess ability of installation/units to continue to support primary unit mission.	OPS
56.	Establish, prioritize and direct recovery actions to restore mission capability and protect personnel.	OPS/CBRN/ LOGISTICS
57.	Verify operation of automated CBRN detectors.	CBRN Recon
58.	Take contaminated waste to unit waste disposal points.	All
59.	Ensure control of contaminated areas, facilities and equipment to prevent spread of contamination.	CBRN/OPS
60.	Track the status of all contaminated items/areas.	CBRN/OPS
61.	Perform operational decontamination on contaminated items as needed.	All
62.	Perform patient decontamination as needed.	CBRN/MED
63.	Perform vehicle decontamination as needed.	CBRN
64.	Perform aircraft/AGE decontamination as needed.	CBRN
65.	Perform limited area decontamination as needed.	CBRN

	RECOVERY (CBRN)	
ITEM #	**TASK/ACTION**	**OPR**
66.	Control contaminated run off from decontamination operations and transfer to installation waste collection sites.	CBRN
67.	Obey all restrictions placed on previously contaminated items. **NOTE: Low levels of contamination may continue after decontamination and present a hazard to personnel nearby.**	All
68.	Ensure control of contaminated areas, facilities and equipment to prevent spread of contamination.	CBRN
69.	Document the agent exposure in medical records.	CBRN/MED
70.	Brief personnel on health hazards and protective measures, and monitor exposures.	CBRN/MED
71.	Monitor the effectiveness of decontamination.	CBRN/MED
72.	Provide environmental protection and remediation advice.	CBRN/ LOGISTICS
73.	Advise mortuary affairs on occupational and environmental concerns regarding contaminated remains.	CBRN/OPS
74.	Process human remains using mortuary processing stations/systems.	LOGISTICS
75.	Review and track the status of reported damage.	LOGISTICS
76.	Support the local community in accordance with higher HQ direction, SOFA, or MOU. Inform the US Embassy.	OPS/LEGAL
77.	Consider reconstitution issues for contaminated items.	CBRN/MED/ LOGISTICS
78.	Prepare a written record that identifies the location of previously contaminated areas, unrecovered human remains, contaminated waste burial sites, missile and bomb craters, and unrecovered UXOs.	CBRN/OPS

Appendix B
CHEMICAL, BIOLOGICAL, RADIOLOGICAL, AND NUCLEAR CENTER AND CELL OPERATIONS

1. Introduction

The CBRN cell is the focal point for all data relating to CBRN attacks and ROTA events within its established AO. The organization of CBRN cells will be theater, mission and Service dependent, which is meant to be flexible in both size and composition.

2. Responsibilities

The responsibilities of the CBRN staff will vary upon the echelon at which the cell is established. All CBRN Cells will have several of the same functions regardless of the echelon at it is established. These common functions are:

- Advising the commander and staff on CBRN defense matters.
- Monitoring subordinate unit's CBRN status.
- Operating the CBRNWRS for the AO in which established.
- Assisting with vulnerability analysis.
- Assisting the intelligence section with identification CBRN-related intelligence requirements.
- Assisting the intelligence section with interpretation of CBRN-related intelligence.

a. At Theater, Corps, Air Force and Fleet levels of command CBRN cells must have an appropriate number of personnel equipped, trained, and qualified to perform efficiently and rapidly the tasks listed below: See Table B-1 (page B-2) for sample structure.

(1) Assess the status and capability of friendly units to operate in a CBRN environment.

(a.) The CBRN Cell evaluates the impact of CBRN contamination on tactical operations. The evaluation may include information on the degree of contamination at selected points or areas, effects of contamination on tactical units, and protection required by troops operating in designated contaminated areas. The CBRN Cell must be prepared to recommend the length of time troops can safely operate in radiologically contaminated areas. In coordination with the surgeon's staff, it also must be prepared to make recommendations about the psychological aspects of prolonged operations in a CBRN environment in MOPP gear.

(b) Once the effects of contamination on tactical operations has been assessed, the CBRN Cell may be needed to recommend the type and quantity of supplies and equipment required to support decontamination operations. It balances these recommendations with information received from the contaminated unit and the G4 on available CBRN supplies & equipment.

(2) Maintain status and coordination of CBRN support (i.e., decontamination or reconnaissance units).

(a) When CBRN information in the area of interest is inadequate, the CBRN Cell, in cooperation with appropriate support elements, recommends locations for conducting surveys. The CBRN Cell may coordinate and control a survey if transportation, communications, and personnel assets are available. The CBRN Cell briefs the survey parties and designates the areas to be surveyed. Briefing includes the type, the amount, the frequency, and the means of reporting. For detailed procedures pertaining to monitoring and surveys, see *Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical Reconnaissance*

(b) CBRN Cells at this level may also be responsible for the organization and the implementation of sampling, identification and evacuation of biological and chemical agents. This information can provide critical information for patient treatment, confirmation of exposure and/or be used as evidence for prosecution.

(3) Transmit CBRN warnings to adjacent HQs, military, and civilian agencies when predicted hazard areas extend beyond their own area of responsibility (NBC3).

(4) Organize and coordinate the CBRNWRS within their areas of operation.

(5) The CBRN cell tracks information on enemy CBRN activities. CBRN personnel prepare an overlay showing the locations, times, number, and extent of enemy CBRN attacks. This overlay provides higher commands data on number of attacks/strikes reported and nuclear yields employed. It also gives a brief assessment of the significance of these strikes.

(6) Make final filtering and correlation of all CBRN incidents in the area of operation.

Table B-1. Sample CBRN Cell at Theater, Corps, Air Force or Fleet Level

Duty Position	Shift
Senior CBRN Staff Officer	A/B
CBRN Staff Officer (1 per shift)	A
Senior NCO/Petty Officer	A
Computer Plotters (2 per shift)	A and B
Clerk Typist (1 per shift)	A and B
Operations NCO/Petty Officer	B
See paragraph 2.e for duty descriptions	

(7) Area HQ and Maritime HQ. Area HQ and Maritime HQ must maintain direct communication with regional HQ and/or appropriate units of the national civil defense organizations concerned. Information on nuclear bursts on shore targets and predictions of the land areas which will probably be affected by fallout, should be passed to

area HQ's and/or relevant CBRN Centers. In the same manner, information on CBRN and ROTA hazards should be exchanged between area HQs and maritime HQs.

b. The responsibilities at Shipboard, Division, Fixed site, Regiment, Brigade and Wing level of command have some common duties and responsibilities for both a higher and lower echelon CBRN reporting agency. At this level some of the main duties include but are not limited to:

(1) Receiving, consolidating and evaluating reports of CBRN attacks, ROTA, and the resultant contamination within the area of operation for the unit at which the center is established.

(2) Performing computer modeling and simulations. This level has the resources and techniques available to conduct more involved and complicated procedures than individual units. These techniques and procedures are based upon the comparison of data from many sources. Much of this data is not available to a single unit.

(3) Executing the tasks in their area of operation for CBRN incidents, which have or may have influence on their unit or sub units' operations. NBC reports generated or processed at this level will normally have a line ALPHA (Strike Serial Number).

(4) Calculating detailed fallout prediction, biological hazard areas, chemical hazard areas and ROTA hazard areas including recalculations as a result of significant weather changes. Pass the appropriate warnings to units likely to be affected (NBC 3).

(5) Directing CBRN reconnaissance and survey efforts within their area of operations.

(6) Analyzing survey and monitoring results and pass information on the actual contaminated areas to units likely to be affected (NBC 4 and NBC 5).

(7) Requesting and providing detailed information on CBRN or ROTA events as directed (NBC6).

(8) Exchanging CBRN information with appropriate national, military, and civilian authorities as outlined by directives and SOPs.

(9) Providing information to merchant shipping on predicted or actual contamination (via Naval MERWARN).

(10) Maintaining a CBRN Situation Map. At this level, the CBRN cell plots the data from NBC reports on the tactical situation maps or overlays. These maps and/or overlays show the actual areas affected by the contamination at a selected time for a given area of interest. The maps or overlays also show predicted downwind hazard areas. CBRN personnel re-compute and adjust the prediction several times daily based on changes, the decay rate, additional contamination, and/or the tactical situation.

(11) Preparing and disseminating wind messages. See Appendix D for more detailed information.

(12) Providing technical assistance in the interrogation of POWs on CBRN matters. This technical assistance is generally in the form of providing the interrogator a list of questions to ask the prisoner. The questions may include employment tactics, CBRN munitions, types of weapon systems available, and/or defense training status.

(13) Assisting the commander with the selection of Designated Observers.

c. Unit level procedures and Designated Observers. This level of command's primary concern is the collection of useful data for the CBRN cell and not the detailed analysis or evaluation of the data. The processing and analysis techniques at this level are designed for the rapid evaluation of data. These results are not as accurate as those obtained by the CBRN Cell, but are sufficient for planning until they can be replaced by those from the CBRN Cell. Designated observers are any unit tasked to report and forward information to a CBRN Cell such as CBRN observation posts, survey/reconnaissance teams and PAR teams fall into this category. Designated observers and unit level CBRN sections are responsible for:

(1) Reporting the initial enemy use of CBRN weapons by the most expeditious means available in accordance with directives and SOPs (NBC 1).

(2) Reporting immediately any CBRN incident and subsequent data to the respective CBRN Center (NBC 1 or 4).

(3) Reporting detection data, monitoring, reconnaissance and survey results to the respective CBRN Cell (NBC 4).

(4) Plotting simplified hazard predictions (See appendices for detailed instructions on how to complete them.)

(5) Submitting detailed information on CBRN and ROTA events as request (NBC6).

(6) Monitoring for symptoms/radiation and/or causalities.

(7) Collecting and forwarding samples.

d. Coordination. Coordination is essential for proper contingency planning at all levels of the CBRN warning and reporting organization. This planning aims to provide CBRN information rapidly where it is required and to reducing duplication of reports to an acceptable level. Cooperation and coordination between the NATO NBC warning and reporting system and the national military and civil systems is an important strengthening factor to the common defense effort. The details of information exchange depend upon national policy and the structure of the national forces and the civil defense organization. Commanders must delegate authority to the appropriate levels of command for negotiating agreements and arrangements with corresponding national armed forces and/or civil defense authorities. Warning information should be exchanged at the lowest level possible.

e. Duty Responsibilities. To achieve success on the modern battlefield, commanders and CBRN staff must create an effective and efficient command and control system for CBRN support efforts. CBRN staff must clearly understand their responsibilities and relationships with supported commanders and their staff elements.

(1) The CBRN Staff Officer is the principal advisor to the force commander for all CBRN matters. He/She is responsible for proper CBRN support to all elements of the force according to the decisions and priorities of the force commander. He/She performs staff planning and coordination for all CBRN subordinate units. He/She is responsible for staff supervision during the execution of CBRN support operations.

(2) Senior NCO/Petty Officer. The senior CBRN NCO/Petty Officer primary responsibilities are: Training of enlisted personnel within the CBRN Cell. He/She Functions as a 12-hour shift NCOIC, assisting the shift OIC. He/She supervises the processing of CBRN attack information, coordinating with other staff sections, preparing and

disseminating of CDM/EDM messages, and the managing of the CBRNWRS. He/She ensures that all staff journals, files, and records are maintained. He/She supervises maintenance of the section's vehicles, advises the senior CBRN officer on the distribution of chemical personnel within the AO and readiness issues.

(3) Computer Plotters. Receives, processes, and plots CBRN attack information and determines downwind hazard predictions of enemy chemical and biological agent clouds and radioactive fallout. Prepares the appropriate NBC reports and distributes them. The Computer plotter maintains the visual displays and the staff journals as required. He/She maintains the CBRN situation map in the CBRN Cell. Computer plotters gather CBRN information from the subordinate command's situation reports. Use various DSTs to assist with hazard prediction and to send and receive messages as needed. They transmits detailed instructions to radiological survey parties and/or survey operations. The Computer plotter calculates transmission and correlation factors as required from data provided by radiological monitoring or survey parties. Prepares and disseminates EDMs and CDMs. Select correlation factors for radiological decay from tables, graphs, or nomograms. They convert radiological contamination data to ground dose rates at a reference time. They also maintain radiation status reports of subordinate units.

(4) Operations NCO/Petty Officer. The Operations NCO/Petty Officers duties are to assist with the processing of CBRN attack information, coordinating with other staff sections, preparing and disseminating of CDM/EDM messages, and managing the CBRNWRS. He/She ensures that all staff journals, files, and records are maintained. He/She assists the Senior NCO/Petty Officer.

(5) Clerk. The Clerk performs general administrative support functions for the CBRN Cell. He/She acts as the radio-telephone operator. They prepare and dispatch messages and maintains the daily staff journal/message file. They record and forward NBC messages to the plotters and prepares chemical and radiological contamination overlays for transmission.

3. Overlap and Duplication

For functional and operational reasons, areas of responsibility (AORs) overlap between Services and within NATO. In addition, the AORs may overlap responsibilities or even be identical. NBC reports will inevitably be duplicated, particularly in the case of a nuclear detonation. Therefore, commanders at all levels must ensure that their plans are fully coordinated with all neighboring CBRN centers in order to avoid duplication of reports and to ensure rapid and efficient exchange of useful CBRN information. CBRN Warning and Reporting plans must be available and state the requirement for NBC reports to be submitted between units.

Appendix C
MANAGEMENT OF EXPOSURE TO RADIOLOGICAL HAZARDS

1. Background

Exposure of forces to radiological and nuclear hazards can have an immediate effect on personnel or affect their health or ability to survive subsequent exposures in the longer term.

a. Exposure Control. International recommendations, and the national regulations of the various force components, cover the management of exposure to ionizing radiation. There are also various regulations covering the exposure of personnel to other TIH. However, these are yet to become as pervasive as the ionizing radiation regulations. The JFC OEG needs to be prepared in the pre-event phase.

(1) US forces and all subordinate commanders are to avoid unnecessary exposure of personnel to radiological hazards.

(2) Where the avoidance of exposure is impractical because of other operational priorities, exposure is to be as low as reasonably achievable (ALARA). The local commander needs to balance the successful outcome of the mission with the maintenance of the ALARA principle.

(3) Exposures or suspected exposures to radiological hazards need to be recorded to assist the short and possible long-term employment of personnel.

(4) By waiting to enter a contaminated area, the contamination level will usually be reduced and with it the chance of exposure. Exposure can also be accidental. Personnel may not know that equipment is contaminated. Usually, this can be prevented by always marking contaminated equipment. But there are places where contamination hazards can accumulate such as in air filters. All engines have air filters which trap contaminants. These contaminants accumulate. So even if the hazard area is small, it can be deadly. Persons working around equipment should be aware of hidden hazards. Always dispose of contaminated collectors, such as air filters, as contaminated waste.

(5) All plans should include post-attack procedures for limiting exposure to radiological hazards. The longer a person is exposed to contamination, the greater the chance of becoming a casualty. Only personnel required to accomplish a mission are sent into a contaminated area.

b. Data Recording. The exposure of personnel to hazards will be recorded. This is so that, where practical, exposure levels can be made similar across the force and the long-term health of individuals can be managed.

c. Rotation of Assets. If it necessary for operational reasons to maintain forces in hazard areas, then commanders and staff need to plan to rotate other forces through the area. This is so that exposure to hazards is kept as even as possible throughout the force in accordance with the ALARA principle. Such rotation will require considerable planning effort by the Joint Staff if forces in the hazard area have been or become contaminated by hazards. Movement control to limit spread and decontamination may also be needed.

2. Information Management—Operational Exposure Guidance

The OEG concept requires that all units maintain radiation exposure records. For example, USA records are based on platoon-level data received daily, or after a mission in a radiological contaminated area. The unit dose is an average of the doses to individuals in the unit who have dosimeters, usually two per squad in the USA. Therefore, the US Army assumes that each soldier receives an individual dose equal to that of the average for the platoon. The records are usually kept by the unit chemical officer at battalion level. When a soldier transfers out of an exposed unit, the RES for that platoon is noted in the soldier's personnel file. When possible, soldiers are reassigned to platoons with the same RES category. Although this might create personnel strength management problems, it is intended to prevent personnel from incapacitation due to overexposure to radiation in future operations. The other services have service specific requirements to maintain radiation dose records. Individual dosimetry should be requested if the situation warrants, since individual dosimetry can greatly assist with patient assessment and management.

The credibility of leaders, and the trust on which that credibility is based, must be maintained. Leaders must keep troops informed on possible mission exposures, realistic risk estimates, unit dose information from RADIAC equipment, and other information that removes ambiguities and uncertainties in any given situation. Leaders must address, and not dismiss, real concerns. Leaders should know the OEG for their mission, the RES of their unit, and the risks associated with their mission. They should have an understanding of acute radiation exposure hazards in comparison with the immediate dangers of conventional combat. They should also understand the potential for long-term health risks when troops receive radiation exposures. Leaders should also be knowledgeable on how to request assistance in interpreting risks associated with radiation exposures or with readings from radiac equipment.

3. Nuclear/Radiological Exposure Control

a. Radiation Exposure Control. Radiation exposure plans and the OEG need to be prepared in the pre-event phase. This will be based on the CBRN IPB and the results of in-theatre reconnaissance and survey of local nuclear and radiological TIM facilities. Commanders and staffs need to ensure that:

(1) Exposure to radiation hazards is recorded by the issue and use of individual and group reading dosimeters, as appropriate to national force components.

(2) Exposure of groups to radiation is controlled by the calculation of nuclear RES and control doses so that the radiation doses received by groups are evenly distributed in accordance with STANAG 2083.

(3) Long-term medical records need to be maintained for all personnel after any exposure to any ionizing radiation above normal local background radiation.

(4) All plans should include post-attack procedures for limiting exposure to radiological hazards. Amount of exposure is important. Every minute spent in a radiologically contaminated environment increases a person's total radiation dose. Only personnel required to accomplish a mission are sent into a contaminated area.

b. LLR. Unlike residual radiation deposited by a nuclear detonation, LLR hazards may result from highly diverse materials and represent a similarly wide range of hazards.

Figure C-1 (page C-4) provides flow charts to conduct decision making for LLR. Possible sources of LLR are:

(1) Civil Nuclear Facilities. These facilities may include those for power generation, research and for the processing, storage and disposal of nuclear waste.

(2) Industrial and Medical. Wide scale use of radioactive sources include the testing of industrial products, medical or diagnostic treatment and equipment sterilization and food processing.

(3) Radiological Dispersal Weapons. Devices designed to release radioactive materials into the environment. This could be achieved by combining nuclear materials with conventional explosives or combustion to produce radioactive particles or smoke.

(4) Nuclear Weapon Release. The spread of fallout or rainout resulting from the distant (outside AO) or earlier use (within AO) of nuclear weapons.

(5) Military Commodities. Some military munitions (e.g., DU) and equipment contain radiation which if disrupted may present a radiation hazard.

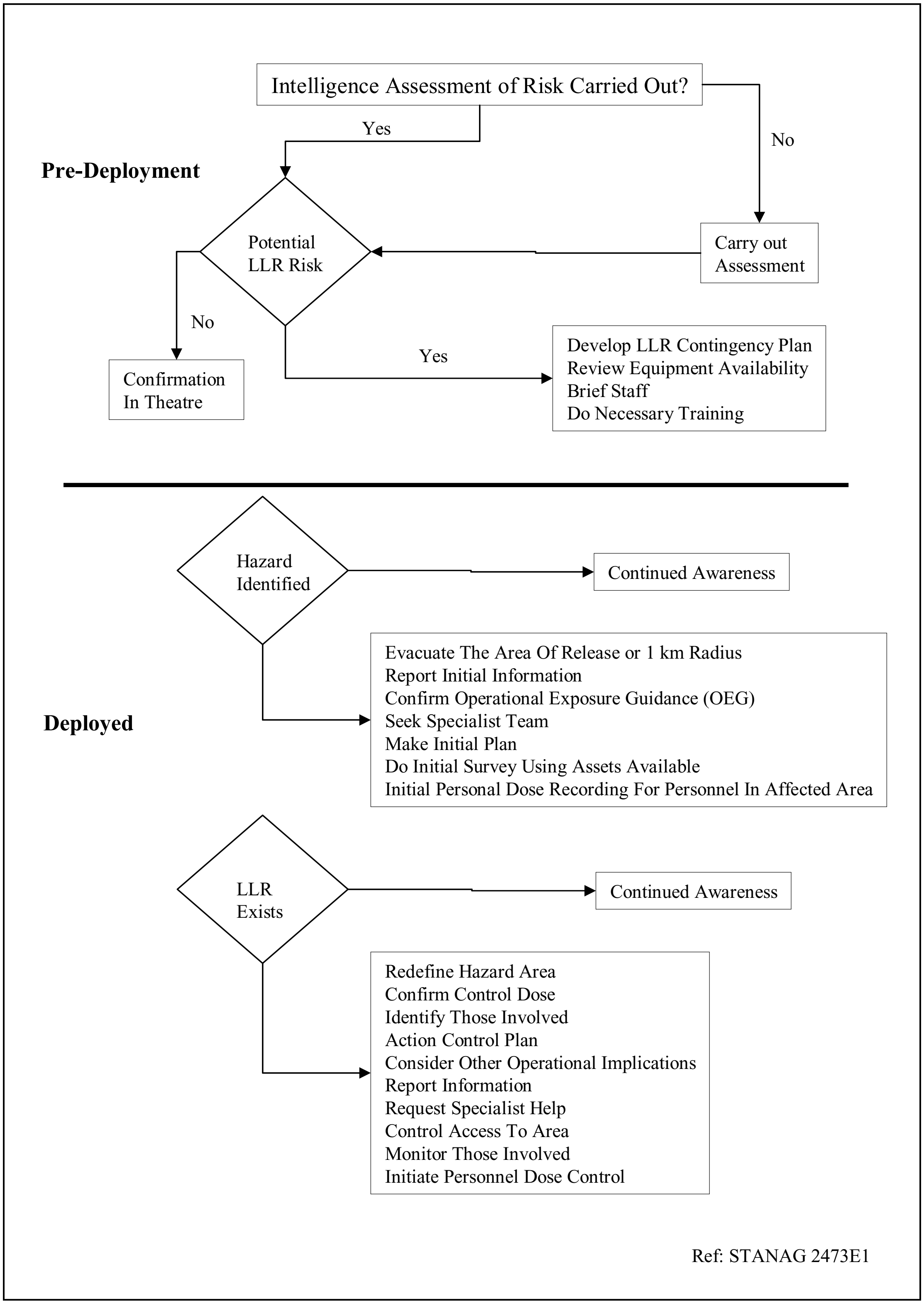


Figure C-1. LLR Decision Making

c. Medical Effects of LLR.

(1) Late or delayed effects of radiation occur following a wide range of doses and dose rates. Delayed effects may appear months to years after irradiation and include a wide variety of effects involving almost all tissues or organs. Some of the possible delayed consequences of radiation injury are life shortening, carcinogenesis, cataract formation, chronic radiodermatitis, decreased fertility, and genetic mutations. The effect upon future generations is unclear. Data from Japan and Russia have not demonstrated significant genetic effects in humans.

(2) Delivering the same gamma radiation dose at a much lower dose rate, or in fractions over a long period of time, allows tissue repair to occur. There is a consequent decrease in the total level of injury that would be expected from a single dose of the same magnitude delivered over a short period of time. Neutron-radiation damage does not appear to be dose-rate dependent.

(3) Chronic Radiation Syndrome (CRS) is defined as a complex clinical syndrome occurring as a result of the long-term exposure to single or total radiation doses that regularly exceed the permissible occupational dose. CRS is highly unlikely to affect military personnel in operational settings. Prolonged deployments to heavily contaminated areas or long-term ingestion of highly contaminated food or water would be required. A near-ground weapon detonation, radiation dispersion device, major reactor accident, or similar event that creates contamination with high dose rates, given prolonged exposure, would permit development of this syndrome.

d. Command Radiation Exposure Guidance. Commanders will require advice from their medical officers concerning radiation effects on their personnel. Medical advice must be practical, based upon both the requirements of the mission and the diversity of human response to radiation. Overreaction to contamination could make enemy use of an RDD more tenable. The effects of radiation that exceeds normal occupational exposure levels must not be either minimized or exaggerated. CBRN risks must be in their proper places relative to the other hazards of combat. Widespread environmental radiological contamination can never be so great as to preclude mandatory mission accomplishment. Maintain dose records of those exposed to LLR.

(1) Commanders need to be aware of individual dose histories when planning future operations at risk of LLR exposure.

(2) On completion of the military operation, long term health monitoring may be required for those personnel who have been exposed to radiation. This should be done in accordance with national regulations. Post operations assessment of internal doses may also be required.

e. Evacuating Personnel from a Radiological Area. When evacuation personnel are sent into a radiologically contaminated area, an OEG must be established. Prolonged wearing of individual, protective equipment under MOPP conditions, climate, workload, and fatigue combine to limit personnel effectiveness and consequently hamper casualty evacuation. Based on factors such as missions, priorities, and OEG, commanders decide which evacuation assets will be sent into the contaminated area. As a general principle, to limit contamination of evacuation assets, patients should be decontaminated before evacuation.

f. Radiation Dispersal Device (RDD). The severity of the psychological effects of an RDD will depend on the nature of the RDD material itself and the method of deployment. A point source of radiation produces physical injury only to soldiers within its immediate vicinity. An RDD that uses a conventional explosion as a dispersal method will cause psychological injury from the physical effects of the blast in addition to the radiation and heavy-metal hazard inherent in many radioactive materials. Misinterpretation of the explosion as a nuclear detonation may induce psychological effects similar to those produced by a true nuclear detonation. The number of casualties from the blast and a generally more frantic situation will intensify the level of stress on soldiers.

(1) The presence of an RDD within a civilian population center will produce more detrimental psychological damage to soldiers than would a military target. Military units in a theater of operation during war often have limited contact with civilian populations. However, during peacetime missions such as operations other than war, a closer relationship may exist between civilians and soldiers. Treatment of civilian casualties, particularly children, from exposure to an RDD could markedly increase the psychological impact on soldiers.

(2) Mass psychosomatic symptoms from the unrealistic fear of the effects of radioactive material pervasive in many civilian populations could severely overload both medical support and operations.

4. Radiological Exposure

a. Radiation Exposure During War. Consult with medical specialists for medical assessments and recommendations. With exposures below 125 cGy, the overall effectiveness of combat units will not be degraded. However, above this threshold, commanders must be aware that their forces' capability to fight will be diminished. The term "combat effective" is used for personnel who will be suffering radiation sickness signs and symptoms to a limited degree and who will be able to maintain their performance at least 75 percent of their preexposure performance level. Those individuals who are predicted to be "performance degraded" would be operating at a performance level between 25 and 75 percent of their pre-exposure performance. Those predicted as "combat ineffective" should be considered as capable of performing their tasks at 25 percent (at best) of their pre-exposure performance level. Tables C-1, C-2, C-3 and C-5 (pages C-6 through C-10) provide an example of expected radiation intensities and effects after a nuclear attack.

Table C-1. Projected Radiation Intensities after Nuclear Attack (cGy per hour)

1 Hour	5 Hours	25 Hours	50 Hours	100 Hours	300 Hours
1000	100	21	9	4	1
500	75	11	5	2	<1
250	37	5	6	1	<1
100	15	2	1	<1	<1
50	8	1	<1	<1	<1
10	2	<1	<1	<1	<1
Source: Derived from Allied Tactical Publication 45B (ATP-45B), *Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas*					
NOTE: This chart shows a normal decay rate (1.2). The actual decay rate may be slower or faster. Refer to ATP-45B for detailed information on decay rates and radiation prediction methods.					

Table C-2. Effects by Nuclear Weapon Yield in Kilometers from GZ

	Weapon Yield			
	1 KT	10 KT	100 KT	1 MT
Blast: Lethality				
Threshold 30-50 psi	0.18	0.38	0.81	1.8
50 percent 50-75 psi	0.14	0.30	0.65	1.4
100 percent 75-115 psi	0.12	0.25	0.55	1.2
Blast: Lung Damage				
Threshold 8-15 psi	0.34	0.74	1.6	3.4
Severe 20-30 psi	0.21	0.46	0.98	2.1
Blast: Eardrum Rupture				
Threshold 5 psi	0.44	0.96	2.1	4.4
50 percent 14 psi	0.25	0.54	1.1	2.5
Thermal				
50 percent First Degree Burns	1.2	3.4	8.3	17
50 percent Second Degree Burns	0.86	2.5	6.5	14
50 percent Third Degree Burns	0.71	2.1	5.6	12
Flash Blindness	3.7	9	18	31
Retinal Burns	33	49	66	84
Ionizing Radiation Effects				
50 cGy Threshold acute effects	1.1	1.6	2.2	3.1
100 cGy <5 percent deaths years	1.0	1.5	2.0	3.0
450 cGy 50 percent death weeks	0.77	1.2	1.7	2.6
1,000 cGy 100 percent death few days	0.65	1.0	1.6	2.4
10,000 cGy 100 percent death <1 day	0.36	0.66	1.1	1.9
Source: FM 4-02.283, *Treatment of Nuclear and Radiological Casualties*, 20 Dec 01				

b. RES.

(1) The RES of a given unit is based on the operational exposure above normal background radiation. It is designed to be an average, based upon unit-level dosimeters, and is not useful for the individual casualty. The degree-of-risk concept helps the commander to establish an OEG for a single operation and minimize the number of radiation casualties. By using the RES categories of subordinate units the commander establishes an OEG based on the acceptable degree of risk.

(2) Medical officers may adjust a unit's RES after careful evaluation of the exact exposure status of individual members of the unit. When possible, both physical and biological dosimetry should be used in this regard. The unit status should reflect the arithmetic mode of the available radiation exposure history of all individual members. Any unit member whose exposure status is more than one full category (or subcategory in operations other than war) greater than the mode should be replaced. A command health physicist should be consulted whenever possible. When the exposure dose rate is known to be less than 5 cGy per day, repair of injury is enhanced and the time for cellular repair reduced. Dosimetry should be available in these circumstances that would allow the RES category to be reduced after 3months at normal background levels. When individual dosimetry is unavailable, a period of 6 months since the last radiation exposure above

background is sufficient to upgrade a unit's RES status one category (or subcategory) one time only. Tables C-3 and C-4 (page C-9) provide RES categories and their respective effects.

Table C-3. Radiation Injuries and Effects of Radiation Exposure of Personnel

RES	Total dose[4]	Long-term health effects	Medical note	Medical actions
0	<0.05 cGy	Normal risk	U.S. baseline 20 percent lifetime risk of fatal cancer	Record in exposure record of normally monitored personnel
1	≤75 cGy	Up to 1 percent incidence of LI[3]		
1A	0.05 to 0.5 cGy	Up to 0.04 percent increased risk of lifetime fatal cancer	None (0.1 cGy annual general pop. exposure limit)	Record individual dose readings. Initiate periodic monitoring (including air and water)
1B	0.5 to 5 cGy	Occupational risk 0.04–0.4 percent increased risk of lifetime cancer	Reassurance (5 cGy US annual occupational limit).	Record individual dose readings Continue monitoring Initiate rad survey Prioritize tasks Establish rad control measures
1C	5 to 10 cGy	0.4–0.8 percent increased risk of lifetime fatal cancer	Counsel regarding increased long-term risk. No live virus vaccines x 3 months.	Record individual dose readings Continue monitoring Update rad survey Continue rad control measures Execute priority tasks[1] only
1D	10 to 25 cGy	0.8–2 percent increased risk of lifetime fatal cancer	Potential for increased morbidity of other injuries or incidental disease. <2 percent increased lifetime risk of fatal cancer.	Record individual dose readings Continue monitoring Update rad survey Continue rad control measures Execute critical tasks[2] only
1E	25 to 70 cGy	2-5.6 percent increased risk of lifetime fatal cancer	Increased morbidity of other injuries or incidental disease. <6 percent increased lifetime risk of fatal cancer.	Record individual dose readings Continue monitoring Update rad survey Continue rad control measures Execute critical tasks[2] only
2	>75 to 125 cGy	Up to 5 percent LI[3]	See Table C-9, page C-10	See Table C-9, page C-10
3	> 125 cGy	>5 percent LI	See Table C-9, page C-10	See Table C-9, page C-10

NOTES:
1. Examples of priority tasks are those missions to avert danger to persons or to prevent damage from spreading.
2. Examples of critical tasks are those missions to save lives.
3. Latent Ineffectiveness (LI) is the casualty criterion defined as the lowest dose at which performance is degraded. (i.e., 25-75 percent capable) within 3 hours and will remain so until death or recovery, or become combat ineffective at any time within 6 weeks.
4. Injury or exposure to CB agents may affect response to radiation.

c. Nuclear Risk Criteria. There are three degrees of risk: Negligible, Moderate, and Emergency. Table C-4 provides risks associated with each respective RES category. Latent Ineffectiveness (LI) is the casualty criterion defined as the lowest dose at which performance is degraded. (i.e., 25-75 percent capable) within 3 hours and will remain so until death or recovery, or become combat ineffective at any time within 6 weeks.

- Negligible 1 percent LI. Negligible risk is acceptable when the mission requires units to operate in a contaminated environment. However, is should not be exceeded unless a significant advantage will be gained.
- Moderate 2.5 percent LI. Moderate risk is usually acceptable in close support operations. Moderate risk must not be exceeded if troops are expected to operate at full efficiency.
- Emergency 5 percent LI. The emergency risk dose is only acceptable in rare situations termed, disaster situations. Only the commander can decide when the risk of the disaster situation outweighs the radiation emergency risk.

Table C-4. Nuclear Radiation cGy Exposure Status and Degree of Risk Exposure

Radiation Status Category (A)	**Possible Exposure Criteria for a single operation not resulting in exceeding the dose criteria for degree of risk (B)**
RES-0 Units (Previously unexposed)	Negligible: ≤ 75 Moderate: ≤ 100 Emergency: ≤ 125
RES-1 Units (Previously exposed >0 to ≤ 75 cGy)	Negligible: A+B ≤ 75 Moderate: A+B ≤ 100 Emergency: A+B ≤ 125
RES-2 Units (Previously exposed ≥75 to ≤ 125 cGy)	Any further exposure will exceed negligible and could exceed moderate risk. Negligible: > 0 Moderate: A+B ≤ 100 Emergency: A+B ≤ 125
RES-3 Units (Previously exposed >125 cGy)	Any further exposure will exceed emergency risk.

NOTES:

1. RES categories based on previous exposure. Risk levels are graduated within each RES category in order to provide more stringent criteria as the total radiation dose accumulated becomes more serious.

2. Reclassification from one RES category to less serious one is made by the commander, upon advice from medical personnel, after ample observation of actual state of health of exposed personnel.

3. All exposures to radiation are considered total body and simply additive. No allowance is made for body recovery from radiation injury.

4. Exposure criteria given for RES-1 and RES-2 units should be used only when the numerical value of a unit's total past cumulative dose is unknown.

5. Each of the degrees of risk can be applied to radiation hazards resulting from enemy or friendly weapons, or both, and from initial nuclear radiation resulting from planned friendly supporting fire.

Table C-5. Physiological Effects of Radiation (Continued)

Total Dose Estimate (cGy)[4]	Performance Capability	Symptoms	Initial Symptoms Interval [1]		Disposition Without Medical Care [2]	Medical Care Requirement [2]
			Onset	End		
<0.05	**CE**	**NOTE: U.S. baseline 20 percent lifetime risk of fatal cancer**				
0.05 to 0.5	**CE**	**NOTE: Up to 0.04 percent increased risk of lifetime fatal cancer**				
0.1	**CE**	**NOTE: Annual general population exposure limit**				
5	**CE**	**NOTE: U.S. occupational annual limit**				
5 to 10	**CE**	**NOTE: 0.4–0.8 percent increased risk of lifetime fatal cancer**				
10 to 25	**CE**	**NOTE: 0.8–2 percent increased risk of lifetime fatal cancer**				
25 to 75	**CE**	**NOTE: 2–6 percent increased risk of lifetime fatal cancer**				
35-75	**CE**	Nausea, mild headache, vomiting in up to 5 percent in upper range	6	12	Duty	None
75-125	**CE**	Transient mild nausea, vomiting in 5-30 percent	3-5	1 day	Restricted duty [3]	Restricted duty [3]
125-300 LD_5 to LD_{10}	**DT:** • PD 4 hours until recovery **UT:** • PD 6-24 hours • 6 weeks recovery	Transient mild to moderate nausea and vomiting in 20-70 percent of personnel Mild to moderate fatigability and weakness in 25-60 percent of personnel	2-3	2 days	Restricted duty [3],	Restricted duty [3]. Medical care may be needed at 3-5 weeks for 10-50 percent to attend to infection, bleeding and fever
300-530 LD_{10} to LD_{50}	**DT:** • PD 3 hours until death or	Transient nausea/vomiting in 50-100 percent	2	3-4 days	Survivors may be able to return to light duty >5 weeks. [3]	Restricted duty [3]

Table C-5. Physiological Effects of Radiation (Continued)

Total Dose Estimate (cGy)[4]	Performance Capability	Symptoms	Initial Symptoms Interval [1]		Disposition Without Medical Care [2]	Medical Care Requirement [2]
			Onset	End		
	recovery **UT:** • PD 4 hours - 2 days • PD 2 weeks – death or recovery	Mild to moderate fatigue in 60-90 percent 2-5 weeks: 20-60 percent infection, bleeding, fever, ulceration, loss of appetite and diarrhea			May Require Evacuation	May Require Evacuation
530-830 LD_{50} to LD_{90}	**DT:** • PD 1 hour - 3 weeks • CI until death **UT:** • PD 2 hours - 2 days • CE 4-7 days • PD 7 days - 4 weeks • CI 4 weeks until death or recovery	Moderate to severe nausea and vomiting in 50-100 percent of personnel. Moderate to severe fatigue and weakness in 90-100 percent of personnel 10 days-5 weeks: 50-100 percent infection, bleeding, fever, loss of appetite, ulceration, diarrhea, nausea, vomiting, fluid and electrolyte imbalance and hypotension	<1	days to weeks	Low end [3] Death may occur in 6 weeks High end [3] Death may occur in 3-5 weeks	Early evacuation to tertiary medical center before onset of illness.
830-3,000+ LD_{90} to LD_{100}	**DT:** • PD 45 minutes-3 hours • CI 3 hours until death **UT:**	Severe nausea, vomiting, fatigability, weakness, dizziness, and disorientation, possible high fever and sudden vascular collapse.	<3 min	Death	Death expected	1,000 cGy: Death at 2-3 weeks 3,000 cGy: Death at 5-10 days

Table C-5. Physiological Effects of Radiation (Continued)

Total Dose Estimate (cGy)[4]	Performance Capability	Symptoms	Initial Symptoms Interval [1]		Disposition Without Medical Care [2]	Medical Care Requirement [2]
			Onset	End		
	• PD 1-7 hours • CI 7-24 hours • PD 1-4 days • CI 4 days until death					If assets available, early evacuation to tertiary medical center, most will not survive.

Abbreviation Key

CE – Combat Effective = > 75 percent of full capacity

PD – Performance Decrement or Partially Degraded = 25 percent–75 percent of full capacity

CI – Combat Ineffective = < 25 percent of full capacity

DT – Demanding Task = Heavy physical work

UT – Undemanding Task = Sedentary or cognitive

Sources:

1. NATO STANAG 2473E1, *Commanders Guide on Low Level Radiation (LLR) Exposure in Military Operations*, 3 May 00.
2. NATO STANAG 2083, *Commander's Guide on Nuclear Radiation Exposure of Groups During War*, Dec 00.
3. FM 4-02.7, *Health Service Support in a Nuclear, Biological, and Chemical Environment*, Oct 02
4. *Medical Management of Radiological Casualties Handbook,* Second Edition, April 2003, Armed Forces Radiobiology Research Institute

NOTES:

1. **Time is in hours unless otherwise indicated.**
2. **Consult source publications for detailed information.**
3. **No further radiation exposure allowable; personnel very susceptible to disease and non-battle injuries (DNBI) due to infections.**
4. **Peacetime U.S. occupational annual radiation dose limit: 5 cGy = 0.8 percent increase in lifetime risk of death from cancer.**

d. Radiation Exposure during Military Support to Civil Authorities. The Health Physics Society believes that the receipt of doses of ionizing radiation by responders to a nuclear terrorism event is unavoidable and justifiable. For certain individuals, doses could exceed levels normally encountered in the typical utilization of radiation (e.g., occupational exposures, exposures to medical practitioners and patients, etc.). While regulatory limits of exposure have been well described for radiation doses from such routine utilization of radioactivity and radiation, exposure limits for emergency workers are not so well described.

(1) Occupational versus Emergency Dose Limits. In the regulatory scheme for occupational radiation exposure, a number of dose limits have been defined and described for members of the public and occupationally exposed persons. The basic assumptions used to derive these limits involve a balance of risk to the individual against the benefits to be obtained by permitting such exposure (both to the individual and to the society). In a terrorist event, however, the assumptions used in the justification of the limits would not likely apply, thus the limits may not be appropriate to members of the public nor to personnel responding to the event.

(2) Dose Guidelines to Responders to a Terrorist Event. It can be anticipated that the use of radioactivity or radiation as a means of terrorist attack will result in dose rates significantly higher than natural background. In a terrorist event, immediate response is critical for the mitigation of effects, the saving of lives, the protection of property, and the timely restoration of the affected area, particularly where the affected area has significant economic or iconic value to the area or country. Such compelling needs justify higher levels of dose in the performance of these duties; much higher than would normally be justified from routine life activities. Accordingly, higher dose limits can be justified (see Table C-6, page C-14).

- Dose Guideline is that it will not to exceed 50 REM for responders.

- Provisions are in place for long-term medical surveillance of responders exceeding 25 REM.

- The individuals most likely to be permitted these levels of exposures would be professional responders (e.g., firefighters, police, emergency medical technicians, etc.) who, by sake of employment, have implicitly agreed to assume significant risks in rescue operations.

- At 50 REM, the most like effect would be some minor fluctuations in blood count which are entirely reversible. In addition, the exposed persons might face a slightly higher chance of incurring a fatal cancer.

- These risk levels are comparable to other risk factors which are commonly found in these types of activities (e.g., smoke inhalation, physical trauma, heavy physical exertion, etc.).

- The benefit of such individual exposure would be the mitigation of a condition or situation that could result in dangerous levels of exposure to members of the public, or in some other way threaten the general public health and safety (for example, the mitigation of widespread fires, or the protection of critical infrastructure that is needed for organized evacuation or relocation of populations).

- During routine duties other than lifesaving, fire fighting, etc. the dose guideline is not to exceed 5 REM.
- Members of the Public dose guideline is not to exceed 0.1 REM

Table C-6. First Responder Exposure Limits

Locations	Exposure Limits	Restrictions
Outer Exclusion Zone	0. 02 cGy/hr	Designated response personnel only. Members of the general public are excluded.
Incident Command Centers, Staging Areas, etc.	0.10 cGy/hr	Command centers, staging areas, etc. may need to be set up close to the event. Such areas should be established in locations that are below the listed dose rate.
Hot Zone	1.00 cGy/hr	Responders should enter the area only on an "as needed" basis in order to accomplish specific tasks.
"Turn Around" Limit	100.00 cGy/hr	Dose rates in these areas represent levels of radiation that require detailed planning to enter. Entry permitted only with special authorization and to accomplish well defined tasks.
Justifiable Rescue Limit	1000.00 cGhr	At this dose rate, the likelihood of successful rescue of victims is outweighed by dose effects to the responders. This guideline represents the level that rescue operations *may* not be justified. Enter such areas only after it has been determined that the likelihood of success outweighs potential harm to the rescuers.

5. Radioactive Materials of Military Significance

a. Americium.

(1) Americium-241 (^{241}Am) is a decay daughter of plutonium and is primarily an alpha emitter and a very low energy gamma emitter. It is detectable with a standard radiac such as the FIDLER instrument due to emission of a 60-kEv gamma ray.

(2) It is used in smoke detectors and other instruments, and it will be found in fallout from a nuclear weapon detonation. Americium-241 is used as a sealed source in the M43A1 Chemical Agent Detector that is a component of the M8A1 alarm.

(3) It is a heavy metal poison but, in large quantities, can cause whole-body irradiation. Seventy-five percent of an initial lung burden is absorbed, with 10 percent of the particles retained in the lung. Gastrointestinal absorption of americium is minimal, but it may be absorbed rapidly from skin wounds. External exposure is not a concern unless large amounts of the substance are located in one area and personnel are in close contact for an extended period of time.

b. Cesium.

(1) Cesium-137 emits a beta particle as it decays to Barium-137, which in turn decays by emitting gamma rays. It emits both gamma rays and beta radiation and can be readily detected by gamma instruments.

(2) Cesium-137 (^{137}Ce) is found in medical radiotherapy devices and in the soil density and moisture testers. The mishandling of a medical radiotherapy device was responsible for the worst radiation accident in the Western Hemisphere. It was used in the Chechen RDD threat against Moscow.

(3) It is completely absorbed by the lungs and GI tract and from wounds. It is soluble in most forms and is treated by metabolism as a potassium analog. Excretion is in urine. Primary toxicity is whole-body irradiation. Deaths due to acute radiation syndrome have occurred.

c. Cobalt.

(1) Cobalt-60 (^{60}Co) is used in medical radiotherapy devices and commercial food irradiators. It will most likely be found after improper disposal, or after destruction of a hospital or commercial facility. It generates high-energy gamma rays and 0.31-MeV beta rays. It is easily detectable with a gamma detector.

(2) Cobalt could be used as a contaminant in an improvised nuclear device to make the fallout more radioactive.

(3) Cobalt will be rapidly absorbed from the lung, but less than 5 percent will be absorbed from the GI tract. Nothing is known about absorption from wounds. Primary toxicity will be from whole-body irradiation and acute radiation syndrome.

d. DU.

(1) DU emits alpha, beta, and weak gamma radiation. Due to the metal's high density, much of the radiation never reaches the surface of the metal. It is thus self-shielding. Also, intact DU rounds and armor are packaged to provide sufficient shielding to stop the beta and alpha radiations. Gamma radiation exposure is minimal. After several months of continuous operations in an armored vehicle completely loaded with DU munitions, crew exposures might exceed peacetime general population exposure limits but would not exceed peacetime occupational exposure limits. Hence, DU is not a serious irradiation threat. It is readily detectable with a typical end-window G-M (Geiger-Mueller) counter.

(2) Although DU is not a chemical or radiological hazard, it can present a chemical toxicity hazard and perhaps a long-term radiological health risk under some conditions when it is introduced internally to the body. Some risks associated with DU munitions have been evaluated experimentally, some risks are still under study, and some risks were identified from practical experience during Operation Desert Storm. DU internalization via inhalation is the primary concern.

(3) Inhaled uranium compounds may be metabolized and result in urinary excretion. Inhalation of DU oxides may occur during tank fires or by entering destroyed armored vehicles without a protective mask. Absorption will be determined by the chemical state of the uranium. Soluble salts are readily absorbed; the metal is not. DU fragments in wounds become encapsulated and are gradually metabolized, resulting in whole-body distribution, particularly to bone and kidney. In laboratory tests, DU does cross the placenta. No renal toxicity has been documented to date.

e. Iodine.

(1) Iodine–131, 132, 134, 135 ($^{131, 132, 134, 135}I$) will be found after reactor accidents and following the destruction of a nuclear reactor by hostile forces. Radioactive

iodine (RAI) is a normal fission product found in reactor fuel rods. It is released by rupturing the reactor core and its containment vessel. Post destruction winds will determine the fallout pattern. Most of the radiation is beta rays, with some gamma.

(2) Primary toxicity is to the thyroid gland. Thyroid uptake concentrates the RAI and allows local irradiation similar to therapeutic thyroid ablation. A high incidence of childhood thyroid carcinoma was documented following the Chernobyl disaster.

f. Nickel-63. Nickel-63 is a pure beta emitter with a radiological half-life of 92 years, and is used in the chemical agent monitor (CAM). The beta energy of Nickel-63 is too low to penetrate the dead layer of skin; however, efforts should be taken to prevent internalization.

g. Phosphorus.

(1) Phosphorus-32 (^{32}P) will generally be found in research laboratories and in medical facilities where it is used as a tracer. It has a strong beta ray and can be detected with the beta shield open on a beta-gamma detector.

(2) Phosphorus is completely absorbed from all sites. It is deposited in the bone marrow and other rapidly replicating cells. Local irradiation causes cell damage.

h. Plutonium.

(1) Plutonium-239, 238 ($^{239, 238}Pu$) is produced from uranium in reactors. It is the primary fissionable material in nuclear weapons and is the predominant radioactive contaminant in nuclear weapons accidents. The primary radiation is in the form of alpha particles, so plutonium does not present an external irradiation hazard. It is always contaminated with americium, which does have a fairly easily detectable x ray by use of a thin-walled gamma probe.

(2) Primary toxicity is from inhalation. Five-micron or smaller particles will remain in the lung and are metabolized based on the salt solubility. Particles that remain will cause local irradiation damage. GI absorption will depend upon the chemical state of the plutonium; the metal is not absorbed. Stool specimens will be positive after 24 hours and urine specimens after 2 weeks. Wound absorption is variable. Plutonium may be washed from intact skin.

i. Radium.

(1) Radium-226 (^{226}Ra) is not a federally regulated commodity and has no US. military use. It may be encountered in Former Soviet Union (FSU) equipment as instrument illumination, in industrial applications, and in older medical equipment. Primary radiation is alpha particles, but daughter products emit beta and gamma rays and, in quantity, may present a serious external irradiation hazard.

(2) Most exposure is by ingestion, with 30 percent absorption. Little is known about wound absorption, but radium will follow calcium to bone deposition. Long-term exposure is associated with leukemia, aplastic anemia, and sarcomas.

NOTE: FSU equipment is manufactured and used by militaries throughout the world as a result of arms purchases and technology transfers.

j. Strontium.

(1) Strontium-90 (^{90}Sr) is a direct fission product (daughter) of uranium. It and its daughters emit both beta and gamma rays and can be an external irradiation hazard if present in quantity.

(2) Strontium will follow calcium and is readily absorbed by both respiratory and GI routes. Up to 50 percent of a dose will be deposited in bone.

k. Thorium-232.

(1) Thorium-232 is a naturally occurring radioisotope of thorium and is an alpha emitter.

(2) When thorium is heated in air, it glows with a white light. For this reason, one of the major uses of thorium has been the Welsback lantern mantle used in portable gas lanterns. Thorium-232 is also used in radiac sets AN/VDR-2, AN/PDR-54, and the AN/PDR-77 for use as calibration check sources. Thorium-coated optics are found on many night vision devices and thermal optic fire control systems. Also, heat resistant thorium alloys are used in the combustor liner for the Abrams tank turbine engine and on various military aircraft engines.

l. Tritium.

(1) Tritium is the heaviest isotope of hydrogen and is a low energy beta emitter with a physical half-life of 12 years. Tritium gas rapidly diffuses into the atmosphere.

(2) It is used in nuclear weapons and muzzle-velocity detectors. Tritium is generally used in devices requiring a light source, such as luminescent gun sights, watches, compasses, and fire control devices for tanks, mortars, and howitzers.

(3) Tritium is a beta emitter and is not a significant irradiation hazard. Only a release of a large amount in a closed space can cause an exposure of clinical importance. No adverse health effects have been reported from a single exposure.

m. Uranium.

(1) Uranium-238, 235, 239 ($^{238,\ 235,\ 239}U$) is found, in order of increasing radioactivity, in depleted uranium (DU), natural uranium, fuel rods, and weapons-grade material. Uranium and its daughters emit alpha, beta, and gamma radiation. DU and natural uranium are not serious irradiation threats. Used fuel rods and weapons-grade (enriched) uranium containing fission products can emit significant levels of gamma. If enough enriched uranium is placed together, a critical mass may form and emit lethal levels of radiation. This could be encountered in a fuel-reprocessing plant or melted reactor core.

(2) Inhaled uranium compounds may be metabolized and excreted in the urine. Urinary levels of 100 µg per deciliter following acute exposure may cause renal failure.

(3) Absorption will be determined by the chemical state of the uranium. Soluble salts are readily absorbed; the metal is not.

(4) In general, Thorium-232 presents a minimal hazard, but care should be taken to avoid internalization of any particles from damaged components or during metal working activities.

n. Table C-7 provides the International System of Units and their conversions. This information along with the Radiation Type and Quality Factors provided in Table C-8 are used when measuring and qualifying different radioactive materials.

Table C-7. International System of Units (SI)—Conversions

Old unit	SI unit	Old unit	SI unit
Curie (Ci)	**Becquerel (Bq)**	**Rem**	**Sievert (Sv)**
1 pCi	37 mBq	0.1 mrem	1 µSv
27 pCi.	1 Bq	1 mrem	0.01 mSv
1 µCi	37 kBq	1 mrem	10 µSv
27 µCi	1 MBq	100 mrem	1 mSv
1 Ci	37 GBq	500 mrem	5 mSv
27 Ci	1 TBq	1 rem	10 mSv
		1 rem	1 cSv
		100 rem	1 Sv
rad	**gray (Gy)**		
1 rad	10 mGy		
1 rad	1 cGy		
100 rad	1Gy		
Symbol	**Name**	**Multiplier**	**Value**
p	pico	10^{-12}	million millionth
n	nano	10^{-9}	thousand millionth
µ	micro	10^{-6}	millionth
m	milli	10^{-3}	thousandth
c	centi	10^{-2}	hundredth
k	kilo	10^{3}	thousand
M	mega	10^{6}	million
G	giga	10^{9}	billion (thousand million)
T	tera	10^{12}	thousand billion
P	peta	10^{15}	million billion
E	exa	10^{18}	billion billion

1 rad = 100 ergs/gram

1 Gy = 1 joule/kilogram = 100 rads

Rem = QF x Rad

Sievert = QF x Gy

1 Sv = 1 joule/kilogram = 100 rem

Table C-8. Radiation Type/Quality Factor

Radiation Type	Quality Factor
X-Ray, Gamma Ray, Beta	1
Alpha particles, fission fragments, and heavy nuclei	20
Neutrons	3-20*

* Values of quality factors for neutrons are dependent upon the energy of the neutron.

Appendix D

WEATHER EFFECTS ON NUCLEAR, BIOLOGICAL, AND CHEMICAL AGENTS AND METEOROLOGICAL REPORTS

1. Background

Meteorological Reports are used—

- As the basis to assess weather data determining if environmental factors are conducive to enemy employment of CBRN weapons.
- In conjunction with plotting tools to predict downwind vapor hazard and fallout patterns.
- To assess the impact of seasonal climate on CBRN weapons effects.

a. Meteorological Operations.

(1) Identify critical weather information needed to determine the effects of weather on the use of CBRN weapons. Analyze the seasonal or monthly normal variations in weather patterns that might affect the use of CBRN weapons.

(2) Intelligence ensures that effective downwind messages (EDMs) and chemical downwind messages (CDMs) are passed to subordinate commands, in coordination with the Air Force staff weather officer.

(3) The CBRN staff must have close coordination with the Intelligence and Meteorology personnel.

(4) The CBRN staff is responsible at every echelon of command for CBRN defense. They assess whether environmental factors are conducive to enemy use of CBRN weapons.

(5) The CBRN staff provides input on hazard predictions increasing the commander's SA.

b. US Navy. Modeling and Simulation assistance is available from the Naval Atlantic Meteorology and Oceanography Command (NLMOC). NLMOC provides meteorology, climatology, forecasting, modeling, and analyses support to Navy agencies. Atlantic Meteorology and Oceanography (METOC) detachments are strategically located to provide specific geographic coverage.

2. Weather Effects on Nuclear, Biological, and Chemical Agents

a. Nuclear. Any condition that significantly affects the visibility or the transparency of the air affects the transmission of thermal radiation. Clouds, smoke (including artificial), fog, snow, or rain absorb and scatter thermal energy. Depending on the concentration, they can stop as much as 90 percent of the thermal energy. On the other hand, clouds above the burst may reflect additional thermal radiation onto the target that would have otherwise traveled harmlessly into the sky.

(1) Rain.

(a) Rain on an area contaminated by a surface burst changes the pattern of radioactive intensities by washing off higher elevations, buildings, equipment, and vegetation. This reduces intensities in some areas and possibly increases intensities in drainage systems; on low ground; and in flat, poorly drained areas.

(b) Rain and fog may lessen the blast wave because energy dissipates in heating and evaporating the moisture in the atmosphere.

(c) Clouds and air density have no significant effects on fallout patterns.

(d) Precipitation scavenging can cause the removal of radioactive particles from the atmosphere. This is known as rainout. Because of the uncertainties associated with weather predictions, the locations that could receive rainout cannot be accurately predicted. Rainout may occur in the vicinity of ground zero or the contamination could be carried aloft for tens of kilometers before deposition. The threat of rainout especially exists from a surface or subsurface burst. Vast quantities of radioactive debris will be carried aloft and be deposited downwind. However, rainout may cause the fallout area to increase or decrease and also cause hot spots within the fallout area.

(e) For airbursts, rainout can increase the residual contamination hazard. Normally, the only residual hazard from an airburst is a small neutron induced contamination area around GZ. However, rainout will cause additional contaminated areas in unexpected locations.

(f) Yields of 10 kilotons or less present the greatest potential for rainout, and yields of 60 kilotons or more offer the least. Additionally, yields between 10 kilotons and 60 kilotons may produce rainout if the nuclear clouds remain at or below rain cloud height.

(2) Wind Speed and Direction.

(a) Wind speed and direction at various altitudes are two factors that determine the shape, size, location, and intensities of the fallout pattern on the ground because contaminated dirt and debris deposit downwind.

(b) Surface winds also play an important role in the final location of fallout particles. Just as snow falls on pavements or frozen surfaces and surface winds pile it in drifts, so, too, can local winds cause localization of fallout material in crevices and ditches and against curbs and ledges. This effect is not locally predictable, but personnel must be aware of the probability of these highly intense accumulations of radioactive material occurring and their natural locations.

(3) Cold Weather Operations.

(a) Weather conditions limit the number of passable roadways. Radiological contamination on roadways may further restrict re-supply and troop movement. Seasonal high winds in the arctic may present a problem in radiological contamination predictions. These winds may reduce dose rates at ground zero. At the same time, they extend the area coverage and create a problem for survey/monitoring teams. Hot spots or areas of concentrated accumulation of radiological contamination may also occur in areas of heavy snow and snow drifts.

(b) At subzero temperatures, the radius of damage to material targets can increase as much as 20 percent. Blast effects can drastically interfere with troop movement by breaking up ice covers and causing quick thaws. These effects can cause avalanches in mountainous areas. In flat lands, the blast may disturb the permafrost to such an extent as to restrict or disrupt movement.

(c) The reflecting nature of the surface over which a weapon is detonated can significantly influence the distance to which blast effects extend. Generally, reflecting surfaces, such as thin layers of ice, snow, and water, increase the distance to which overpressures extend.

(d) The high reflectivity of ice and snow may increase the minimum safe distance as much as 50 percent for unwarned troops and even warned, exposed troops. Reflectivity may also increase the number of personnel whose vision is affected by the brilliant flash, or light dazzle, especially at night.

(e) Cold temperatures also reduce thermal effects on materials. Snow, ice, and even frost coverings on combustible materials greatly reduce the tendency of the materials to catch fire. However, thermal effects will dry out exposed tundra areas, and grass fires may result.

(4) Mountain Operations.

(a) The clear mountain air extends the range of casualty-producing thermal effects. Within this range, however, the added clothing required by the cool temperatures at high altitudes reduces casualties from these effects.

(b) In the mountains, the deposit of radiological contamination will be very erratic because of rapidly changing wind patterns. Hot spots may occur far from the point of detonation, and low intensity areas may occur very near it. Limited mobility makes radiological surveys on the ground difficult, and the difficulty of maintaining a constant flight altitude makes air surveys highly inaccurate.

(5) Desert Operations.

(a) Desert operations present many varying problems. Desert daytime temperatures can vary between 90°F to 125°F (32°C to 52°C). These temperatures create an unstable temperature gradient. However, with nightfall, the desert cools rapidly and a stable temperature gradient results. A possibility of night attacks must be considered in all planning.

(b) Blowing winds and sand make widespread radiological survey patterns likely.

(5) Jungle Operations. Radiation hazards also may be reduced because some of the falling particles are retained by the jungle canopy. Subsequent rains, however, will wash these particles to the ground and concentrate them in water collection areas. Radiation hot spots will result.

b. Biological.

(1) Air Stability. A stable atmosphere results in the greatest cloud concentration and area coverage of biological agents. Under unstable and neutral stability conditions, more atmospheric mixing occurs. This leads to a cloud of lower concentration, but the concentration is sufficient to inflict significant casualties. The coverage area under unstable stability conditions is also reduced. Table D-1, page D-4 provides a snapshot of how weather effects biological dissemination.

Table D-1. Weather Effects on Biological Dissemination

Weather Conditions	Cloud Performance	Operational Considerations
Favorable Stable or Inversion Conditions	Agent clouds travel downwind for long distances before they spread laterally. High humidity and light rains generally favor wet agent dissemination.	Agent clouds tend to dissipate uniformly and remain cohesive as they travel downwind. Clouds lie low to the ground and may not rise high enough to cover the tops of tall buildings and/or other tall objects.
Marginal Neutral Conditions	Agent clouds tend to dissipate quickly.	More agent required for same results as under stable conditions. Desired results may not be achieved.
Unfavorable Unstable or Lapse Conditions	Agent clouds rise rapidly and do not travel downwind any appreciable distance. Cold temperatures affect wet dissemination.	Agent clouds tend to break up and become diffused. Little operational benefit from off-target dissemination.
Source: JP 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*		

(2) Temperature. Air temperature in the surface boundary layer is related to the amount of sunlight the ground has received. Normal atmospheric temperatures have little direct effect on the microorganisms of a biological aerosol. Indirectly, however, an increase in the evaporation rate of the aerosol droplets normally follows a temperature increase. There is evidence that survival of most pathogens decreases most sharply in the range of -20°C to -40°C and above 49°C. High temperatures kill most bacteria and most viral and rickettsial agents. However, these temperatures will seldom if ever be encountered under natural conditions. Subfreezing temperatures tend to quick-freeze the aerosol after its release, thus decreasing the rate of decay. Exposure to ultraviolet light—one form of the sun's radiation—increases the decay rate of microorganisms. Ultraviolet light, therefore, has a destructive effect upon the biological aerosol. Most toxins are more stable than pathogens and are less susceptible to the influence of temperature.

(3) Relative Humidity. The relative humidity level favoring employment of a biological agent aerosol depends upon whether the aerosol is distributed wet or dry. For a wet aerosol, a high relative humidity retards evaporation of the tiny droplets containing the microorganisms. This decreases the decay rate of wet agents, as drying results in the death of these microorganisms. On the other hand, a low relative humidity is favorable for the employment of dry agents. When the humidity is high, the additional moisture in the air may increase the decay rate of the microorganisms of the dry aerosol. This is because moisture speeds up the life cycle of the microorganisms. Most toxins are more stable than pathogens and are less susceptible to the influence of relative humidity.

(4) Pollutants. Atmospheric pollutant gases can also affect the survival of pathogens. Pollutant gases have been found to decrease the survival of many pathogens. These gases include nitrogen dioxide, sulfur dioxide, ozone, and carbon monoxide. This could be a significant factor in the battlefield over which the air is often polluted.

(5) Cloud Coverage. Cloud coverage in an area influences the amount of solar radiation received by the aerosol. Thus, clouds decrease the amount of destructive ultraviolet light the microorganisms receive. Cloud coverage also influences factors such as ground temperature and relative humidity.

(6) Precipitation. Precipitation may wash suspended particles from the air. This washout may be significant in a heavy rainstorm but minimal at other times. High relative humidity associated with mists, drizzles, and very light rains are also an important

factor, these may be either favorable or unfavorable, depending upon the type of agent. The low temperatures associated with ice, snow, and other winter precipitation prolongs the life of most biological agents.

c. Chemical. Adversaries will seek to employ chemical agents under favorable weather conditions, if possible, to increase their effectiveness. Table D-2 provides an overview of how weather effects aerosolized chemical agents.

(1) Atmospheric Stability. One of the key factors in using chemical weapons is the determination of the atmospheric stability condition that will exist at the time of attack. This determination can be made from a meteorological report or by observing field conditions.

(a) Unstable conditions (such as many rising and falling air currents and great turbulence) quickly disperse chemical agents. Unstable is the least favorable condition for chemical agent use because it results in a lower concentration, thereby reducing the area affected by the agent. Many more munitions are required to attain the commander's objectives under unstable conditions than under stable or neutral conditions.

(b) Stable conditions (such as low wind speeds and slight turbulence) produce the highest concentrations. Chemical agents remain near the ground and may travel for long distances before being dissipated. Stable conditions encourage the agent cloud to remain intact, thus allowing it to cover extremely large areas without diffusion. However, the direction and extent of cloud travel under stable conditions are not predictable if there are no dependable local wind data. A very stable condition is the most favorable condition for achieving a high concentration from a chemical cloud being dispersed.

(c) Neutral conditions are moderately favorable. With low wind speed and smooth terrain, large areas may be effectively covered. The neutral condition occurs at dawn and sunset and generally is the most predictable. For this reason, a neutral dispersion category is often best from a military standpoint.

Table D-2. Weather Effects on Aerosol Chemical Agents

Factors	Wind (KPH)	Air Stability	Temperature (C)	Humidity	Precipitation
Favorable	Steady <5	Stable	>21	>60	None
Moderate	Steady 5-13	Neutral	4-21	40-60	Light
Unfavorable	>13	Unstable	<4	<40	Any

Source: JP 3-11, *Joint Doctrine for Operations in Nuclear, Biological, and Chemical (NBC) Environments*

(2) Vapor Concentration and Diffusion.

(a) Agent concentration is governed by the volume of the agent cloud. Since clouds continually expand, agent concentration levels decrease over time. Wind speed determines the downwind growth of the cloud. Vertical and horizontal turbulence determines the height and width of the cloud. The rate at which the downwind, vertical, and horizontal components expand governs the cloud volume and the agent concentration.

(b) To be effective the agent cloud, at a specific concentration level, must remain in the target area for a definite period. Wind in the target area mixes the agent and distributes it over the target after release. For ground targets, high concentrations and good coverage can best be achieved with low turbulence and calm winds when the agent is delivered directly on target. A steady, predictable wind drift over the target is best when the agent is delivered on the upwind side of the target. Conditions other than these tend to produce lower concentrations and/or poorer target coverage. However, unless weather conditions are known within the target area, the effects of the agent on target will be approximations.

(c) The concentration and diffusion of a chemical agent cloud are also influenced by:

- Hydrolysis is the process of the agent reacting with water vapor in the air. It does not influence most agent clouds in tactical use because the rate of hydrolysis is too slow. However, hydrolysis can be important for smoke screens.

- Absorption is the process of the agent being taken into the vegetation, skin, soil, or material. Adsorption is the adding of a thin layer of agent to vegetation or other surfaces. This is important in dense vegetation. Both absorption and adsorption of chemical agents may kill vegetation, thus defoliating the area of employment.

- When a chemical cloud is released into the air, shifting air currents and horizontal turbulence blow it from side to side. The side-to-side motion of the air is called meandering. While the agent cloud meanders, it also spreads laterally. Lateral spreading is called lateral diffusion. In more unstable conditions, the lateral spread tends to be greater than in stable conditions.

- Wind currents carry chemical clouds along the ground with a rolling motion. This is caused by the differences in wind velocity. Wind speeds increase rapidly from near zero at the ground to higher speeds at higher elevations above the ground. The drag effect by the ground, together with the interference of vegetation and other ground objects, causes the base of an agent cloud to be retarded as the cloud stretches out in length. When clouds are released on the ground, the drag amounts to about 10 percent of the vertical growth over distance traveled over grass, plowed land, or water. It amounts to about 20 percent over gently rolling terrain covered with bushes, growing crops, or small patches of scattered timber. In heavy woods, the drag effect is greatly increased.

- Wind speeds can vary at different heights. The wind direction can also change with an increase in height. This is known as wind shear. Because of wind shear, a puff (or chemical cloud) may become stretched in the downwind direction and may travel in a direction different from that of the surface wind. Additionally, a chemical cloud released in the air may be carried along faster than it can diffuse downward. As a result, air near the ground on the forward edge of the cloud may be uncontaminated, while the air a few feet up may be heavily contaminated. This layering effect becomes more pronounced and increases proportionately with the distance of the forward edge of the cloud from the source.

- The vertical rise of a chemical cloud depends upon weather variables, such as temperature gradient, wind speed, and turbulence, and the difference between the densities of the clouds and the surrounding air. As mentioned earlier, the temperature of both the cloud and the air influences their relative densities. Hotter gases are less dense and, therefore, lighter than cooler gases and air. Therefore, they rise until they are mixed and somewhat diluted and attain the same temperature and approximately the same density as surrounding air.

- The vapor cloud formed by an agent normally employed for persistent effect rises in a similar manner, but vapor concentrations build up more gradually.

(3) Wind.

(a) High wind speeds cause rapid dispersion of vapors or aerosols, thereby decreasing effective coverage of the target area and time of exposure to the agent. In high winds, larger quantities of munitions are required to ensure effective concentrations. Agent clouds are most effective when wind speeds are less than 4 knots and steady in direction. The clouds move with the prevailing wind as altered by terrain and vegetation. Steady, low wind speeds of 3 to 7 knots enhance area coverage unless an unstable condition exists. With high winds, chemical agents cannot be economically employed to achieve casualties.

(b) Evaporation of liquid agents due to wind speed depends on the amount of the liquid exposed to the wind (the surface of the liquid) and the rate at which air passes over the agent. Therefore, the duration of effectiveness is longer at the places of greater liquid agent contamination and in places where the liquid agent is sheltered from the wind.

(c) The rate of evaporation of agents employed for persistent effect in a liquid state is proportional to the wind speed. If the speed increases, evaporation increases, thus shortening the duration of effectiveness of the contamination. Increased evaporation, in turn, creates a larger vapor cloud. The vapor cloud, in turn, is dispersed by higher winds. The creation and dispersion of vapor are a continuous process, increasing or decreasing in proportion to wind speed.

(4) Temperature. There will be increased vaporization with higher temperatures. Also, the rate of evaporation of any remaining liquid agent from an exploding munition can vary with temperature.

(5) Humidity. Humidity is the measure of the water vapor content of the air. Hydrolysis is a process in which compounds react chemical change. with water resulting in a Chemical agents with high hydrolysis rates are less effective under conditions of high humidity. Humidity has little effect on most chemical agent clouds. Some agents (phosgene and lewisite) hydrolyze quite readily. Hydrolysis causes these chemical agents to break down and change their chemical characteristics. If the relative humidity exceeds 70 percent, phosgene and lewisite can not be employed effectively except for a surprise time on-target (TOT) attack because of rapid hydrolysis. Lewisite hydrolysis by-products are not dangerous to the skin; however, they are toxic if taken internally because of the arsenic content. Riot control agent (RCAs) CS also hydrolyzes, although slowly, in high humidity. High humidity combined with high temperatures may increase the effectiveness of some agents because of body perspiration that will absorb the agents and allow for better transfer.

(6) Precipitation.

(a) The overall effect of precipitation is unfavorable because it is extremely effective in washing chemical vapors and aerosols from the air, vegetation, and material. Weather forecasts or observations indicating the presence of or potential for precipitation present an unfavorable environment for employment of chemical agents.

However, light rains distribute persistent agents more evenly over a large surface. Since more liquid is then exposed to the air, the rate of evaporation may increase and cause higher vapor concentrations. Precipitation also accelerates the hydrolysis effect. Rain that is heavy or for a long duration tends to wash away liquid chemical agents. These agents may then collect in areas previously uncontaminated (such as stream beds and depressions) and present an unplanned contamination hazard.

(b) The evaporation rate of a liquid agent reduces when the agent is covered with water but returns to normal when the water is gone. Precipitation may force back to the surface some persistent agents that have lost their contact effectiveness by soaking into the soil or other porous surfaces. These agents may again become contact hazards.

(c) Snow acts as a blanket, covering the liquid contaminant. It lowers the surface temperature and slows evaporation so that only very low vapor concentrations form. When the snow melts, the danger of contamination reappears.

3. Overview of Meteorological Reports

a. Basic Wind Report (BWR).

(1) The BWR contains information on the wind conditions, i.e. wind directions (from which the wind is blowing) and wind speeds in a number of layers from the surface of the earth to 30,000 M altitude.

(2) It gives information on the basic wind message (BWM) based on actual weather data, or the basic wind forecast (BWF) based on predicted data.

(a) The BWM contains weather information for the following 6 hour period.

(b) The BWF contains information for subsequent 6 hour periods.

(3) Each layer has a thickness of 2000 M. The message begins with information on the wind conditions within the layer from the surface to 2000 M, then for the 2000 to 4000 M layer etc. A numerical identifier is used for each of the layers, beginning with 2 for the 0 M – 2000 M layer, 4 for the 2000 M – 4000 M layer etc.

(4) The BWR is used for nuclear incidents and also for elevated releases from ROTA incidents.

b. Effective Downwind Report (EDR).

(1) The EDR is used to provide the effective downwind data needed for prediction of fallout areas following nuclear burst for either the nearest 6 hours or for a period more than 6 hours ahead. Seven downwind speeds and downwind directions are transmitted in the effective downwind message, corresponding to seven pre-selected yield groups.

(2) An Effective Downwind Report is either an effective downwind message (EDM) or an effective downwind forecast (EDF). The EDM contains weather information for the following 6 hour period. The EDF contains information for subsequent 6 hour periods.

(3) Special Case. When the effective downwind speed is less than 8 KPH, the predicted fallout area will be circular, the radii of two concentric circles around GZ being

equal to the Zone I downwind distance and the Zone II downwind distance respectively. The downwind distance of Zone I can be determined using Figure D-6 (page D-34). Enter the yield and an effective downwind speed of 8 km/h to read the value of the Zone I downwind distance. Multiply the distance by 2 to obtain the downwind distance of Zone II.

c. Chemical Downwind Report (CDR)

(1) The CDR contains all the weather information needed to calculate a chemical and biological downwind hazard.

(2) The CDR is also used for ROTA incidents.

(3) It is prepared by corps and division NBCCS from information obtained through the USAF Air Weather Service (AWS), Staff Weather Officer (SWO), or the Fleet Weather Service.

(4) The CDR is transmitted at least 4 times a day, and each message is valid for a 6 hour period. Each 6 hour period is subdivided into three 2 hours periods.

d. MET Report Fields. Figures D-3 and D-4 provide fields and lines used in the different MET reports.

Table D-3. Common Message Headings for MET Reports

Field	BWR	EDR	CDR
EXER	O	O	O
OPER	C	C	C
MSGID	M	M	M
REF	O	O	O
DTG	M	M	M
ORGIDDFT	M	M	M
NBCEVENT	M	M	M

M = Mandatory
O = Optional
C = Conditional

Table D-4. NBC MET Reports

Field*	BWR	EDR	CDR
AREAM	M	M	M
ZULUM	M	M	M
UNITM	M	M	M
LAYERM	M	-	-
ALFAM	-	M	-
BRAVOM	-	O	-
CHARLIEM	-	O	-
DELTAM	-	O	-
FOXTROTM	-	O	-
GOLFM	-	O	-
WHISKEYM	-	-	M
XRAYM	-	-	O
YANKEEM	-	-	O

* = Letter “M” added behind field signifies a MET message
\- = Not used
M = Mandatory
O = Optional

e. Common Report (ADP) Field Explanations

- EXER

    Exercise identification

    Example using example of EXER/VALIANTCOURAGE2004/-//

    EXER/VALIANTCOURAGE2004/-//

    Exercise nickname
    1-56 letters and numbers
    Mandatory if EXER is used

    EXER/VALIANTCOURAGE2004/-//

    Additional Identifier
    4-16 letters and blank spaces
    Optional if EXER is used

- OPER

    Operation Code Word

    Example using example of GRAND ACCOMPLISHMENT/-/-/-//

    OPER/GRAND ACCOMPLISHMENT/-/-/-//

    Operation code word
    1-32 letters and blank spaces
    Mandatory if OPER is used

    OPER/GRAND ACCOMPLISHMENT/-/-/-//

    Plan originator and number
    5-36 letters and numbers
    Optional if OPER is used

    OPER/GRAND ACCOMPLISHMENT/-/-/-//

    Nickname
    1-23 letters and numbers
    Optional if OPER is used

    OPER/GRAND ACCOMPLISHMENT/-/-/-//

    Secondary nickname
    1-23 letters and numbers
    Optional if OPER is used

- MSGID
  Message text identifier
  Example using MSGID/CDR/AWS/382856/-/-/-//
  - MSGID/CDR/AWS/382856/-/-/-//
    - Message text format identifier
    - 3-20 letters and numbers
    - Mandatory
  - MSGID/CDR/AWS/382856/-/-/-//
    - Originator
    - 1-30 letters and numbers
    - Mandatory
  - MSGID/CDR/AWS/**382856**/-/-/-//
    - Message serial number
    - 1-7 numbers
    - Mandatory
  - MSGID/CDR/AWS/382856/-/-/-//
    - Month name
    - 3 letters
    - Optional
  - MSGID/CDR/AWS/382856/-/-/-//
    - Qualifier
    - 3 letters
    - Optional
  - MSGID/CDR/AWS/382856/-/-/-//
    - Serial number of qualifier
    - 1-3 numbers
    - Optional
- REF
  Reference
  Example using REF/A/CMP/NBCACCUK/20040427/-/-/-//
  - REF/A/CMP/NBCACCUK/20040427/-/-/-//
    - Serial letter
    - 1 letter

Mandatory

REF/A/CMP/NBCACCUK/20040427/-/-/-//

Communication type

3-20 letters and numbers

REF/A/CMP/NBCACCUK/20040427/-/-/-//

Originator

1-30 letters and numbers

REF/A/CMP/NBCACCUK/20040427/-/-/-//

DTG of Reference

6 numbers

Day-Time of Reference

7 letters or numbers

Verified Day-Time of Reference

8 letters or numbers

Day-Time and Month of Reference

10 letters or numbers

Verified Date-Time and Month of Reference

11 letters or numbers

DTG of Reference

14 letters or numbers

Verified DTG of Reference

15 letters or numbers

Date of Reference, Day-Alphamonth-Year

9 letters or numbers

Date of Reference, Day-Month-Year

8 numbers

Date of Reference, Year-Month-Day

8 numbers

REF/A/CMP/NBCACCUK/20040427/-/-/-//

Reference serial number or

Document serial number

10 letters or numbers

Optional

REF/A/CMP/NBCACCUK/20040427/-/-/-//

Special notification
5 letters
Optional

REF/A/CMP/NBCACCUK/20040427/-/-/-//

Signal Indicator Code (SIC) or
File number
1-10 letters or numbers
Can be repeated 3 times
Optional

- DTG

Date-Time Group
14 letters and numbers
Example using DTG/231100ZNOV2004//

DTG/231100ZNOV2004//

Day of the month

DTG/231100ZNOV2004//

Time in Zulu

DTG/231100ZNOV2004//

Month and Year

- ORGIDDFT

Organization designator of drafter/releaser
Example using ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

Unit designation name
1-15 letters, numbers, and special characters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

Unit size indicator
1-7 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

Geographical entity
2 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Unit role indicator code "A"
2-6 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Unit role indicator code "B"
2-6 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Unit role indicator code "C"
2-6 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Unit role indicator code "D"
2-6 letters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Higher formation name
1-15 letters, numbers, or special characters
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/**A**/-//
Armed Service (1 letter or number) or
Civilian agency code (2-8 letter and numbers)
Mandatory

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
Unit Identification Code (UIC)
7-9 letters and numbers
Conditional

- NBCEVENT

Type of NBC meteorological report
Example using NBCEVENT/CDM/-//

NBCEVENT/CDM/-//

Type of weather report

BWM

BWF

EDM

EDF

CDM

CDF

3 letters

NBCEVENT/CDM/-//

Validation code

1-10 letters and numbers

Used only with automated data processing systems

f. MET Report (ADP) Field Explanations

- AREAM

Area affected; may be a mapsheet number or an area such as I CORPS

2-20 letters and numbers

- ZULUM

DTG for:

Observation time

Valid from

Valid to

Three sets of 14 letters and numbers

Example ZULUM

ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//

Day of the month

ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//

Time in Zulu

ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//

Month and Year

- UNITM

Units of measurement used in the message

Example using UNITM/-/DGT/KPH/-//

Length or height

1-2 letters

NOTE: Not used for BWR or CDR

-	Not used or unknown
KM	Kilometers
NM	Nautical Miles
FT	Feet
KF	Kilofeet (1000 feet)
HM	Hectometers (100 metres)
YD	Yards
M	Meters
SM	Statute Miles

UNITM/-/DGT/KPH/-// (3 letters for degrees and 4 letters for mils - Direction from which the wind is blowing)

-	Not used or unknown
DGM	Degrees/Magnetic North
DGT	Degrees/True North
DGG	Degrees/Grid North
MLM	Mils/Magnetic North
MLT	Mils/True North
MLG	Mils/Grid North

UNITM/-/DGT/KPH/-// (3 letters - Speed)

-	Not used or unknown
KPH	Kilometers per Hour
MPS	Meters per Second
KTS	Knots
MPH	Miles per Hour

UNITM/-/DGT/KPH/-// (1 letter - Temperature)

NOTE: Not used for EDR or BWR

-	Not used or unknown
C	Celsius
F	Fahrenheit

- ALFAM

  Effective Downwind for 2 KT and less

  Yield group explanations using example of ALFAM/-/310/015/-//

ALFAM/-/310/015/-// (Yield Group)

ALFAM
BRAVOM
CHARLIEM
DELTAM
ECHOM
FOXTROTM
GOLFM

ALFAM/-/310/015/-// (Radius of Zone 1)

- Not used or unknown

3 numbers

NOTE: (If used then direction, wind speed and angle of expansion are not used)

ALFAM/-/310/015/-// (Direction the wind is heading towards)

3 numbers for degrees and 4 numbers for mils

ALFAM/-/310/015/-// (Wind speed)

- Not used or unknown

3 numbers

ALFAM/-/310/015/-// (Angle of expansion)

- Not used or unknown

1 number

4	40 degrees
5	50 degrees
6	60 degrees
7	70 degrees
8	80 degrees
9	90 degrees
0	100 degrees
1	110 degrees
2	120 degrees
3	more than 120 degrees

- BRAVOM

  Effective Downwind for more than 2 KT to 5 KT yield group

  Same as ALFAM

- CHARLIEM

  Effective Downwind for 5 KT to 30 KT yield group

  Same as ALFAM

- DELTAM

  Effective Downwind for more than 30 KT to 100 KT yield group

  Same as ALFAM

- ECHOM

  Effective Downwind for 100 KT to 300 KT yield group

  Same as ALFAM

- FOXTROTM

  Effective Downwind for 300 KT to 1 MT yield group

  Same as ALFAM

- GOLFM

  Effective Downwind for more than 1 MT to 3 MT yield group

  Same as ALFAM

- LAYERM

  Wind Conditions at 2,000 M increments up to 30,000 M

  Repeatable up to 15 times

  Example using LAYERM/02/265/020//

  LAYERM/02/265/020// (2 numbers - wind layer)

  02 0 - 2,000 M

  04 2,000 - 4,000 M

  ~

  28 26,000 - 28,000 M

  30 28,000 - 30,000 M

  LAYERM/04/290/030// (3 numbers for degrees and 4 numbers for mils - wind direction from which the wind is blowing)

  LAYERM/26/025/020// (3 numbers - wind speed)

- WHISKEYM

  Weather conditions for first of 3 consecutive two-hour periods

NOTE: The optimal measuring height should be 10 M above the ground in open terrain averaged over a period of 10 minutes.

Example using WHISKEYM/120/010/4/18/7/4/2//

WHISKEYM/120/010/4/18/7/4/2//

- Downwind direction
- 3 numbers for degrees and 4 numbers for mils

WHISKEYM/120/010/4/18/7/4/2//

- Windspeed
- 3 numbers

NOTE: The optimal measuring height should be 10 M above the ground in open terrain averaged over a period of 10 minutes.

WHISKEYM/120/010/4/18/7/4/2//

- Air stability
- 1 letter or number
- Simplified
  - U Unstable
  - N Neutral
  - S Stable
- Detailed
  - 1 Very Unstable
  - 2 Unstable
  - 3 Slightly Unstable
  - 4 Neutral
  - 5 Slightly Stable
  - 6 Stable
  - 7 Very Stable

WHISKEYM/120/010/4/18/7/4/2//

- Temperature
- 1 special character and 2 numbers or 2 to 3 numbers
  - -20 Minus 20 degrees
  - -03 Minus 3 degrees
  - 00 Zero degrees
  - 02 2 degrees
  - 15 15 degrees

999 999 degrees

WHISKEYM/120/010/4/18/7/4/2//

Humidity shown in percentage

1 number

0	0-9%
1	10-19%
2	20-29%
3	30-39%
4	40-49%
5	50-59%
6	60-69%
7	70-79%
8	80-89%
9	90-100%

WHISKEYM/120/010/4/18/7/4/2//

Significant weather phenomena

1 letter or number

0	No Significant Weather Phenomena
1	Sea Breeze
2	Land Breeze
3	Blowing snow or sand
4	Fog, ice fog, or thick haze
5	Drizzle
6	Rain
7	Light rain or snow
8	Showers of rain, snow, hail or mixture
9	Thunderstorm
A	Top of inversion layer lower than 800 M
B	Top of inversion layer lower than 400 M
C	Top of inversion layer lower than 200 M

WHISKEYM/120/010/4/18/7/4/**2**//

Cloud cover

1 number

0	Less than half covered (scattered)

1 More than half covered (broken)
2 Completely covered (overcast)
3 No Clouds (clear conditions)

- XRAYM

  Surface weather conditions for first of 3 consecutive two-hour periods

  See WHISKEYM for details of message

- YANKEEM

  Surface weather conditions for first of 3 consecutive two-hour periods

  See WHISKEYM for details of message

4. Nuclear Meteorological Reports

a. The BWR can accommodate the BWM based on actual weather data, or the BWF based on predicted data.

(1) The BWM and the BWF MET message contain information on the wind conditions, i.e. wind directions (from which the wind is blowing) and wind speeds in a number of layers from the surface of the earth to 30,000 M altitude. The BWM contains weather information for the following 6 hour period. The BWF contains information for subsequent 6 hour periods.

(2) Each layer has a thickness of 2000 M. The message begins with information on the wind conditions within the layer from the surface to 2000 M, then for the 2000 to 4000 M layer etc. A numerical identifier is used for each of the layers, beginning with 2 for the 0 M – 2000 M layer, 4 for the 2000 M – 4000 M layer etc. Sample BWM—

```
MSGID/CDR/AWS/382856/NOV/-/-//
DTG/231130NOV2004//
ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//
NBCEVENT/BWM/-//
AREAM/NFEB4//
ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//
UNITM/-/DGT/KPH/-/
LAYERM/02/265/020/
LAYERM/04/270/030/
LAYERM/06/270/035/
LAYERM/08/300/035/
LAYERM/10/280/035/
LAYERM/12/290/040/
LAYERM/14/250/040/
LAYERM/16/250/040/
```

LAYERM/18/220/050/
LAYERM/20/220/050/
LAYERM/22/240/055/
LAYERM/24/240/070/
LAYERM/26/245/070/
LAYERM/28/255/070/
LAYERM/30/265/075//

b. Wind Vector Plot.

(1) The information contained in the BWM is used for the construction of a wind vector plot in the following way: convert the BWM into downwind directions for each layer of height, by reversing the wind direction by 180 degrees.

(2) The wind speed of each layer as given in the BWM is to be represented by a vector, the length of which is extracted from the appropriate table. The following tables (D-5 through D-10, pages D-22 through D-25) give the vector length in centimeters for different scale maps listed in kilometers per hour (kph) and knots (kts). Ensure the correct map size and wind speed is selected.

NOTE: Above 18,000 meters, altitude layers for plotting vector diagrams continue to be at 2 000 meter intervals. However, the map distance factors vary so little that some of the columns in the above tables are combined for convenience.

Table D-5. Map Distance in cm for Windspeed in KPH, Map Scale 1:50,000

Wind Speed KPH	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	6.8	5.8	5.2	5.0	4.8	4.4	4.2	4.0	3.8	3.8	3.6	3.4
10	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.6	7.2	6.8
15	20.4	17.6	15.6	15.0	14.4	13.4	12.6	12.0	11.6	11.2	10.8	10.2
20	27.2	23.6	20.8	20.0	19.2	18.0	16.8	16.0	15.6	15.0	14.2	13.6
25	34.0	29.4	26.0	25.2	24.0	22.4	21.0	20.0	19.4	18.8	17.8	17.0

Table D-6. Map Distance in cm for Windspeed in KPH, Map Scale 1:100,000

Wind Speed KPH	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	3.4	2.9	2.6	2.5	2.4	2.2	2.1	2.0	1.9	1.9	1.8	1.7
10	6.8	5.9	5.2	5.0	4.8	4.5	4.2	4.0	3.9	3.8	3.6	3.4
15	10.2	8.8	7.8	7.5	7.2	6.7	6.3	6.0	5.8	5.6	5.4	5.1
20	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.5	7.1	6.8
25	17.0	14.7	13.0	12.6	12.0	11.2	10.5	10.0	9.7	9.4	8.9	8.5
30	20.4	17.7	15.6	15.1	14.4	13.4	12.6	12.0	11.7	11.3	10.7	10.2
35	23.8	20.6	18.1	17.6	16.8	15.7	14.7	14.0	13.6	13.1	12.5	11.9
40	27.2	23.6	20.7	20.1	19.2	17.9	16.8	16.0	15.6	15.0	14.3	13.6
45	30.6	26.5	23.3	22.6	21.6	20.2	19.0	18.0	17.5	16.9	16.1	15.3
50	34.0	29.5	25.9	25.1	24.0	22.4	21.1	20.0	19.4	18.8	17.9	17.0

Table D-7. Map Distance in cm for Windspeed in KPH, Map Scale 1:250,000

Wind Speed KPH	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	1.4	1.2	1.0	1.0	1.0	0.9	0.8	0.8	0.8	0.8	0.7	0.7
10	2.7	2.4	2.1	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.4
15	4.1	3.5	3.1	3.0	2.9	2.7	2.5	2.4	2.3	2.3	2.1	2.0
20	5.4	4.7	4.1	4.0	3.8	3.6	3.4	3.2	3.1	3.0	2.9	2.7
25	6.8	5.9	5.2	5.0	4.8	4.5	4.2	4.0	3.9	3.8	3.6	3.4
30	8.2	7.1	6.2	6.0	5.8	5.4	5.1	4.8	4.7	4.5	4.3	4.1
35	9.5	8.2	7.3	7.0	6.7	6.3	5.9	5.6	5.4	5.3	5.0	4.8
40	10.9	9.4	8.3	8.0	7.7	7.2	6.7	6.4	6.2	6.0	5.7	5.4
45	12.2	10.6	9.3	9.0	8.6	8.1	7.6	7.2	7.0	6.8	6.4	6.1
50	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.5	7.1	6.8
55	15.0	12.9	11.4	11.0	10.6	9.9	9.3	8.8	8.6	8.3	7.9	7.5
60	16.3	14.1	12.4	12.0	11.5	10.8	10.1	9.6	9.3	9.0	8.6	8.2
75	20.4	17.7	15.5	15.1	14.4	13.4	12.6	12.0	11.7	11.3	10.7	10.2
100	27.2	23.5	20.7	20.1	19.2	17.9	16.9	16.0	15.6	15.0	14.3	13.6

Table D-8. Map Distance in cm for Windspeed in KTS, Map Scale 1:50,000

Wind Speed KTS	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	12.6	11.0	9.6	9.4	9.0	8.4	7.8	7.4	7.2	7.0	6.6	6.4
10	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	14.0	13.2	12.6
15	37.8	32.8	28.8	28.0	26.8	25.0	23.4	22.2	21.6	20.8	19.6	19.0
20	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2
25	63.0	54.6	48.0	46.6	44.6	41.2	39.0	37.0	36.0	34.8	32.8	31.6
30	65.6	65.4	57.6	55.8	53.4	49.8	46.8	44.4	43.2	41.8	39.4	37.8

Table D-9. Map Distance in cm for Windspeed in KTS, Map Scale 1:100,000

Wind Speed KTS	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	6.3	5.5	4.8	4.7	4.5	4.2	3.9	3.7	3.6	3.5	3.3	3.2
10	12.6	10.9	9.6	9.3	8.9	8.3	7.8	7.4	7.2	7.0	6.6	6.3
15	18.9	16.4	14.4	14.0	13.4	12.5	11.7	11.1	10.8	10.4	9.8	9.5
20	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	13.9	13.1	12.6
25	31.5	27.3	24.0	23.3	22.3	20.6	19.5	18.5	18.0	17.4	16.4	15.8
30	37.8	32.7	28.8	27.9	26.7	24.9	23.4	22.2	21.6	20.9	19.7	18.9
35	44.1	38.2	33.6	32.6	31.2	29.1	27.3	25.9	25.2	24.3	22.9	22.1
40	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2
45	56.7	49.1	43.2	41.9	40.1	37.4	35.1	33.3	32.4	31.3	29.5	28.4
50	63.0	54.5	48.0	46.5	44.5	41.5	39.0	37.0	36.0	34.8	32.8	31.5

Table D-10. Map Distance in cm for Windspeed in KTS, Map Scale 1:250,000

Wind Speed KTS	Altitude Layers (Thousands of Meters)											
	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	2.5	2.2	1.9	1.9	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.3
10	5.0	4.4	3.8	3.7	3.6	3.3	3.1	3.0	2.9	2.8	2.6	2.5
15	7.6	6.5	5.8	5.6	5.3	5.0	4.7	4.4	4.3	4.2	3.9	3.8
20	10.1	8.7	7.7	7.4	7.1	6.6	6.2	5.9	5.8	5.6	5.2	5.0
25	12.6	10.9	9.6	9.3	8.9	8.3	7.8	7.4	7.2	7.0	6.6	6.3
30	15.1	13.1	11.5	11.2	10.7	10.0	9.4	8.9	8.6	8.3	7.9	7.6
35	17.6	15.3	13.4	13.0	12.5	11.6	10.9	10.4	10.1	9.7	9.2	8.8
40	20.2	17.4	15.4	14.9	14.2	13.3	12.5	11.8	11.5	11.1	10.5	10.1
45	22.7	19.6	17.3	16.7	16.0	14.9	14.0	13.3	13.0	12.5	11.8	11.3
50	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	13.9	13.1	12.6
55	27.7	24.0	21.1	20.5	19.6	18.3	17.2	16.3	15.8	15.3	14.4	13.9
60	30.2	26.2	23.0	22.3	21.4	19.9	18.7	17.8	17.3	16.7	15.7	15.1
75	37.8	32.7	28.8	27.9	26.7	24.9	23.4	22.2	21.6	20.9	19.7	18.9
100	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2

(3) Label GZ and Grid North (GN). From GZ draw a vector in the downwind direction of the layer 0 - 2000 M. Label the downwind end of the vector with the figure 2, and label the vector length alongside the vector. The vector now represents the downwind direction and the downwind speed within the height layer from the surface to 2000 M height.

- From the end of the first vector, draw the next vector. The downwind end of this vector is labeled 4, the vector thus representing downwind direction and downwind speed within the height layer 2000 M to 4000 M.

- Proceed in the same manner, using all information given in the BWM. The result will be a wind vector plot as shown in the example of Figure D-1, page D-26, Example Wind Vector Plot.

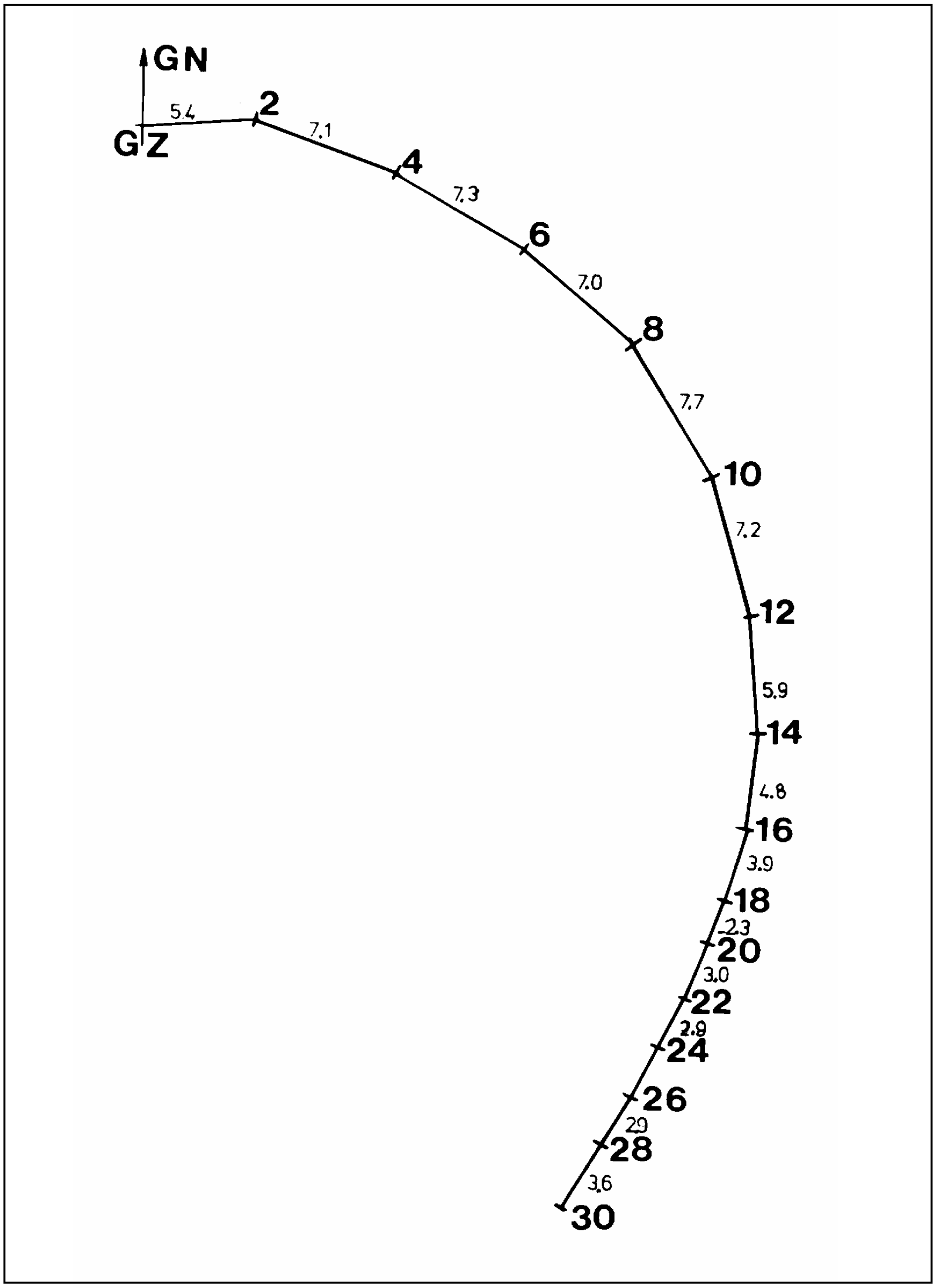


Figure D-1. Example Wind Vector Plot

c. The EDR is used to provide the effective downwind data needed for simplified prediction of fallout areas following nuclear burst for either the nearest 6 hours or for a period more than 6 hours ahead. Seven downwind speeds and downwind directions are transmitted in the effective downwind message, corresponding to seven pre-selected yield groups.

(1) An EDR is either an EDM or an EDF. The EDM contains weather information for the following 6 hour period. The EDF contains information for subsequent 6 hour periods.

(2) Since effective downwind speed and effective downwind direction vary with the yield, seven downwind speeds and downwind directions are transmitted, corresponding to seven pre-selected yield groups, ALFA through GOLF as follows:

ALFAM	is	≤	2 KT		
BRAVOM	is	>	2 KT	≤	5 KT
CHARLIEM	is	>	5 KT	≤	30 KT
DELTAM	is	>	30 KT	≤	100 KT
ECHOM	is	>	100 KT	≤	300 KT
FOXTROTM	is	>	300 KT	≤	1000 KT (1 MT)
GOLFM	is	>	1000 KT	≤	3000 KT (3 MT)

(3) To calculate the data, use the following procedure with 2 KT for ALFAM, 5 KT for BRAVOM, and 30 KT for CHARLIEM and so on:

- Step 1. Obtain a blank EDM Worksheet (DA Form 1971-3-R). This form can be found in Appendix L. (See Figure D-2, page D-29).

- Step 2. Place a sheet of overlay paper over the wind vector plot, and mark a GN reference line and GZ. Mark the cloud-top height, cloud-bottom height, and two-thirds stem height for the 2 KT yield. Draw radial lines from GZ through these three points. (See Figure D-3, page D-30).

- Step 3. To determine the effective wind speed (sss), measure the distance along the cloud-bottom radial line from GZ, to its intersection with the wind vector plot at the cloud-bottom height point. Multiply as indicated on the EDM worksheet. Round each result to the nearest KM (28.4 KM = 28, 28.5 KM = 29 KM).

NOTE: A situation may arise when the effective wind speed for one or more yield groups is less than 8 kmph. In this case the downwind distance for Zone I is determined, using the nomogram in Figure J-8, page J-15. Enter the nomogram with the effective wind speed of 8 km/h on the left-hand scale, and the highest yield for each yield group on the right-hand scale. Then, read the downwind distance for Zone I on the center scale.

- Step 4. To determine the Effective Downwind Direction, use a protractor and measure the azimuth from GZ to CT and the azimuth from GZ to 2/3 stem. Add these two measurements and divide by 2. This is known as bisecting the angles. The result of this bisection is the Effective Downwind Direction (ddd).

NOTE: When the ground zero/cloud top radial line or the GZ / 2/3 stem radial line fall in the first quadrant (0 to 90) and the other radial line falls in the fourth quadrant (270 to 360), the result of adding the GZ/CT azimuth and the GZ/2/3 stem azimuth divided by 2 will be the back azimuth of the effective downwind direction. In this case, determine ddd by the following method. If the total is greater than 180 degrees subtract 180 degrees, if the total is less than 180 degrees add 180 degrees and enter ddd in the effective downwind message.

- Step 5. Measure the angle between the cloud-top and two-thirds stem. If the angle exceeds 40 degrees, report the actual angle measured in the "Warning Area

Angle" column of the EDM. If the angle measured is an odd number, round the angle to the next highest even number.

- Step 6. Repeat steps 2 through 5 for the remaining yield groups. Use a separate sheet of overlay paper for each yield group.

- Step 7. Complete the EDM portion of the work sheet based on the data and calculations. Remember the 3-6-9-digit rule: 3 digits mean winds less than 8 kmph, and digits represent Zone I distance; 6 digits mean normal message; 9 digits mean expanded radial lines to a given number of degrees.

NOTE: For ADP EDM Reports the expanded angle special case will only contain 7 digits vice 9. For example if the EDM line reads CHARLIEM/-/310/015/6/, the ”6” represents an angle of 60 degrees. See “Special Cases” below.

(4) Special Cases.

- When the effective windspeed is less than 8 kmph for a given yield group, the applicable line will contain only three digits. These three digits will represent the radial line distance of Zone I. In this case no wind speed is given, and the fallout pattern will be two concentric circles.

- Another special case occurs when the fallout is not expected to fall within the normal 40-degrees angle of the prediction. In this case the appropriate line on the effective downwind message has nine digits. The first six digits represent wind direction and windspeed. The last three digits will be the angle in degrees between the left and right radial lines.

- The simplified procedure does not normally provide for a warning angle greater then 40 degrees. In the instances where the detailed procedure demands an angle greater then 40 degrees, this warning area is given in the EDM to subordinate units to expand their original warning area. The 40 degrees standard angle between the two radial lines must be expanded in equal degrees on each side of the reference line.

A sample of an EDM—

MSGID/CDR/AWS/382856/NOV/-/-//

DTG/231130NOV2004//

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

NBCEVENT/EDM/-//

AREAM/NFEB4//

ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//

UNITM/KM/DGT/KPH/-//

ALFAM/020/-/-/-/

BRAVOM/020/-/-/-/

CHARLIEM/-/310/015/6/
DELTAM/-/330/025/-/
ECHOM/-/350/045/-/
FOXTROTM/-/350/045/-/
GOLFM/-/340/050/-//

EFFECTIVE DOWNWIND MESSAGE WORKSHEET
For use of this form, see FM 3-3-1; the proponent agency is TRADOC

TIME OF WIND MEASUREMENT (DATE-TIME GROUP) D D t t t t ______
DATA AND CALCULATIONS

MESSAGE LINE	YIELD (KT)	CLOUD-TOP HEIGHT (METERS)	CLOUD-BOTTOM HEIGHT (METERS)	2/3 STEM HEIGHT (METERS)	① DISTANCE OF GZ/CB RADIAL LINE (KM)	EFFECTIVE WIND SPEED-sss (KMPH) ① x 1 / TIME OF FALL = sss ROUND OFF TO NEAREST KILOMETER PER HOUR	② AZIMUTH OF GZ/CT RADIAL LINE (DEGREES)	③ AZIMUTH OF GZ/2/3 STEM RADIAL LINE (DEGREES)	EFFECTIVE DOWNWIND DIRECTION-ddd (DEGREES) SUM OF ②+③ / 2 = ② AND ③ / 2 = ddd[1]	WARNING AREA ANGLE
A	2	4,900	2,600	1,700	____	____ X 1.136 = ____	____	____	____ = ____ / 2 = ____	____
B	5	7,100	4,400	2,800	____	____ X 0.758 = ____	____	____	____ = ____ / 2 = ____	____
C	30	11,600	7,700	5,100	____	____ X 0.455 = ____	____	____	____ = ____ / 2 = ____	____
D	100	14,400	9,300	6,200	____	____ X 0.385 = ____	____	____	____ = ____ / 2 = ____	____
E	300	16,700	11,000	7,400	____	____ X 0.333 = ____	____	____	____ = ____ / 2 = ____	____
F	1,000	21,600	13,500	9,000	____	____ X 0.286 = ____	____	____	____ = ____ / 2 = ____	____
G	3,000	26,250	15,800	10,500	____	____ X 0.250 = ____	____	____	____ = ____ / 2 = ____	____

EFFECTIVE DOWNWIND MESSAGE

ZULU	DDtttt	___ ___ ___ ___ ___ ___
ALFA	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
BRAVO	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
CHARLIE	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
DELTA	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
ECHO	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
FOXTROT	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___
GOLF	dddsss	___ ___ ___ ___ ___ ___ ___ ___ ___

[1] When the azimuth of the ground zero/cloud-top radial line ② or the azimuth of the ground zero/2/3 stem radial line ③ falls in the first quadrant (0° to 90°) and the other falls in the fourth quadrant (270° to 360°), result of (②+③)/② will be the back azimuth of the effective downwind direction. In this case, determine ddd by the following method: If result is greater than 180°, subtract 180°; If result is less than 180°, add 180°. Enter in the effective downwind message.

DA FORM 1971-3-R, SEP 94 EDITION OF SEP 86 IS OBSOLETE USAPPC V1.00

Figure D-2. EDM Worksheet

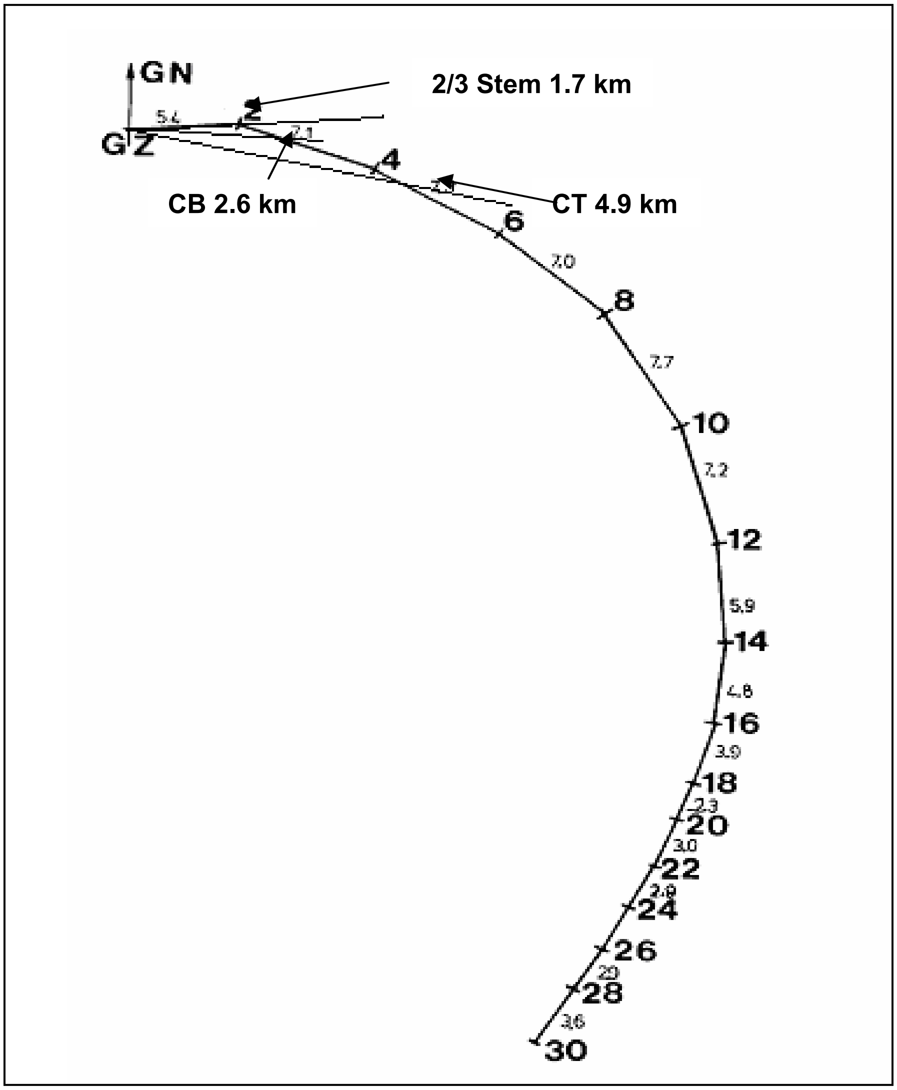


Figure D-3. Wind Vector Plot with Cloud and Stem Radial Lines (2 KT)

5. Chemical and Biological Meteorological Reports

a. A Chemical Downwind Report (CDR). The CDR contains all the weather information needed to calculate a CB downwind hazard. Biological agents will generally remain toxic through multiple changes in meteorological conditions and multiple CB meteorological reports.

(1) The CDR is prepared by corps and division CBRN staff (or service equivalent) from information obtained through the USAF AWS, SWO, or the Fleet Weather Service. The CDR is transmitted at least 4 times a day, and each message is valid for a 6 hour period. Each 6 hour period is subdivided into three 2 hours periods.

(2) A CDR is either a CDM or a CDF. The CDM contains weather information for the following 6 hour period. The CDF contains information for subsequent 6 hour periods. Example CDM—

MSGID/CDR/AWS/382856/NOV/-/-//

DTG/231130NOV2004//

ORGIDDFT/UKRA/BAT/UK/AA/BB/CC/DD/AG/A/-//

NBCEVENT/CDM/-//

AREAM/NFEB4//

ZULUM/231100ZNOV2004/231200ZNOV2004/231800ZNOV2004//

UNITM/-/DGT/KPH/C//

WHISKEYM/120/010/4/18/7/4/2//

XRAYM/100/015/4/15/7/5/2//

YANKEEM/110/010/4/13/7/6/2//

(3) The first step in preparing the CDM is to acquire the weather data. Weather information can also be obtained from the artillery meteorological section. Although they cannot provide forecasts, they can provide current weather information.

(4) The next step is to break it down into three consecutive two-hour increments. Line WhiskeyM is used for the first two-hour increment, line X-rayM for the second, and line YankeeM for the final two-hour increment. Then the CBRN Cell translates this data into codes and puts it in the proper format. Each forecast line contains 12 digits.

(5) The first six digits represent the downwind direction and wind speed. The last six digits represent the air stability, temperature, humidity, significant weather phenomena, and cloud cover. Weather data which is unavailable or for which no code exists is represented by a dash.

WHISKEYM/120/010/4/18/7/4/2//

b. CDM Preparations without Weather Service Support. A valid CDM may not always be available from the corps or division CBRN Cell or applicable to the unit area of operations. Units may estimate the air stability category by observing local meteorological conditions. A field expedient method of obtaining the necessary weather data may be used when all other sources are unavailable. In order to obtain local weather data, units may obtain a Belt Weather Kit (NSN—6660-01-024-2638) and barometer (NSN–660-00-551-3998) or use the equipment listed below. The weather information obtained in this manner is only for that particular area, for that period of time. It is by no means, a forecast from which a CDM maybe produced. However, it is a local method of verifying CDM weather data. If this method is used for local weather, include this data on the NBC 1 Chemical Report.

M1 Ananometer (66000663-8090)

Wet Bulb, Globe, Temp (C°) (6665-00-159-2218)

Lensatic Compass

(1) Step 1. Measure wind speed and direction with the lensatic compass and ananometer. Use the highest wind speed recorded. Take temperature and humidity

readings using the wet bulb at one meter above the ground. Obtain readings every two hours if practical, but not greater than four hours.

(2) Step 2. Determine the four transition periods of wind speed and direction during the day. Take average of the readings during each transition period. The most difficult aspect is determining the sun by observation. Since most units do not have equipment to do this, make the best estimation possible. Example—it is morning, the sun's angle is 45 degrees, and the sky is less than half covered. Find the time of day (morning) and angle of sun (45 degrees) on the chart at Table D-11. Find the sky condition (less than half covered). Read across and down to the point where the lines converge. The air stability category is U.

Table D-11. Air Stability Category Basic Chart

Time of Day	Angle of sun	Condition of Sky		
		Less than half covered	More than half covered	Overcast
Morning	<4	S	S	N
	5-32	N	N	N
	33-40	U	N	N
	>40	U	U	N
Evening	>46	U	U	N
	36-46	U	N	N
	13-35	N	N	N
	6-12	S	N	N
	0-5	S	S	N

(3) Atmospheric Stability Charts. The stability of a CB agent cloud is directly effected by the temperature of the air at the surface of the earth and the first few meters above the surface.

(4) Temperature Gradients. The air stability categories are dependent on the temperature gradient (difference of air temperature at two attitudes). The temperature gradient is determined by measuring the air temperature at two different altitudes. Compare the difference in air temperature to the normal or expected change in temperature. The normal change in temperature is 1 degree cooler for every 100 m increase in altitude. The four possible gradient conditions are inversion, neutral, lapse, and elevated inversion.

(a) Inversion Temperature Gradient (Stable-S). If the air at the higher altitude is warmer than the normal temperature at the lower altitude, the air will not move vertically. This represents an inversion temperature gradient. This condition usually exists on a clear or partially clear night when middle and low clouds cover less than 30 percent of the sky, and on early mornings until about 1 hour after sunrise when the wind speed is less than 5 knots. It is characterized by a minimum of convection currents and by maximum air stability-ideal for enemy employment of chemical agents. Weak inversion conditions tend to prevail during the day over large bodies of water.

(b) Neutral Temperature Gradient (Neutral-N). A neutral condition exists when air temperature shows very little or no change with air increase in altitude. This represents the neutral temperature gradient. This condition usually exist on heavily overcast days or nights at 1 or 2 hours before sunset or 1 to 2 hours after sunrise when the middle and low clouds cover more than 30 percent of the sky. Independent of cloud cover and time of day, a neutral condition may also exist when the wind speed is greater than 5 knots. Additionally, periods of precipitation are normally accompanied by a neutral condition. A neutral temperature gradient is most favorable for enemy use of biological agents because the associated wind speeds result in larger area coverage.

(c) Lapse Temperature Gradient (Unstable-U). If the air at the higher altitude is cooler than the expected difference, then there will be vertical movement of air creating turbulence. This condition normally exists on a clear day when the middle and low clouds cover less than 30 percent of the sky and when the wind speed is less than 5 knots. This is the least favorable condition for the enemy to employ chemical or biological agents. Over large bodies of water, weak lapse conditions tend to prevail at night. When a lapse condition exists, area coverage without diffusion will be enhanced with a steady low wind speed of 3 to 7 knots.

(d) Elevated Inversion (Stable).

- Elevated inversion may occur when cooler air settles under warmer air. This condition will generally occur when a warm and cold frontal system converge or over large bodies of water. Elevated inversions also occur when the stable boundary layer formed overnight weakens in the morning as the sun heats the surface. The significance of an elevated inversion layer is that the layer will act as a lid over the surface. This “lid” traps air particulants as well as chemical agents, in a concentrated form, at a given height above the ground, thus presenting an increased threat to aircrews. The SWO must report this condition, when it occurs to the CBRN and divisional aviation units.

- Once you have obtained the air stability category from the basic chart, enter the adjustment chart with that category. Select the appropriate weather and terrain condition from Table D-12. Read across to where they intersect and extract the final stability category. Use this stability category to determine the maximum downwind distance. For more information on field expedient behavior of chemical agents, see FM 3-11.6.

Table D-12. Air Stability Category Adjustment Chart

Weather and Terrain **All conditions must be checked. If more than one applies, choose the most stable category**	**Stability Category from** **Table D-12. Air Stability Category Basic Chart**		
Dry to slightly moist surface	U	N	S
Wet surface	N	N	S
Frozen surface	N	S	S
Completely covered with snow	S	S	S
Continuous rainfall	N	N	N
Haze or mist (1-4 KM visibility)	N	N	S
Fog (<1 KM visibility)	N	S	S
Windspeed >18 KPH	N	N	N

c. Naval Chemical Downwind Message.

(1) The Naval CDM is computed essential in the same manner as the land CDM. In most cases, the CDM information is obtained through land based NBC Centers.

(2) In the event, however, that land CDM information is not available or differs significantly from the weather conditions at sea, Figure D-4 is used to determine the stability category. The numbers one through seven depicted on “the graph refer to the seven stability categories used in the land CDM.

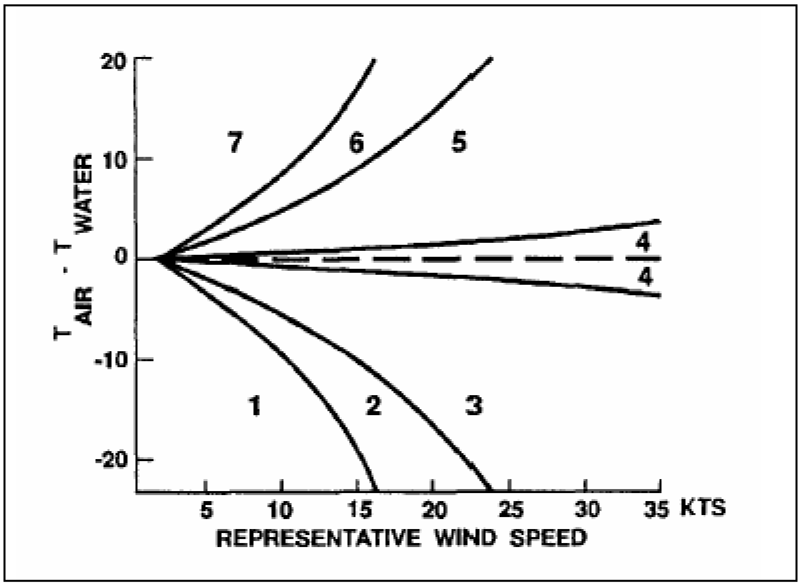


Figure D-4. Naval Air Stability

Appendix E

CHEMICAL CONTAMINATION AVOIDANCE TACTICS, TECHNIQUES AND PROCEDURES

1. Background

The CBRN Cell staff monitors and tracks all related CBRN information and within it's area of operations. Ongoing coordination between the commander, the CBRN cell, medical, and the intelligence sections support decisions that rely on the SA and an understanding of the significance of the gathered data. The commander and staff apply the information from intelligence, medical, and surveillance systems to support—

- Hazard predictions.
- Warning, reporting, and notification.
- Casualty prevention.
- Casualty management.

Units obtain relevant data from multiple sources (such as sensors, detectors, observers and medical staffs). The applicable NBC report data (for example, time of detection, locations and type of is processed, extracted, formatted, and forwarded. Commanders and their staff evaluate the information to assess any impact on operations. Risk assessment is part of the decision-making process and may result in directives and/or orders to help reduce the impact of the assessed hazards. Commanders may direct an integrated series of protective or avoidance measures (for example, moving of units or changing of objectives) to decrease the level of risk (decrease exposure opportunities) or reduce the effects of exposure. Because SA is an ongoing process, the plan is revised as updated information is received.

2. Chemical Contamination Avoidance Procedures

Avoidance procedures are broken down into actions before the attack, during the attack and after the attack. The lists given, while not all encompassing will assist in developing unit SOP and directives.

a. Before the Attack.

(1) Subordinate units are alerted.

(2) Commander specifies appropriate MOPP levels; establish automatic masking criteria; and, if MOPP Zero is assumed, determine the location for chemical protective clothing based on METT-TC.

(3) Unit continues the mission while implementing actions to minimize casualties and damage:

(a) Personnel, equipment, munitions, petroleum, oil and lubricants (POL), food, and water are protected from contamination.

(b) Detection paper is placed to provide visibility and maximum exposure to liquid agents.

(c) Operational security (OPSEC), dispersion, cover and concealment are practiced so the unit may avoid being targeted.

(d) Chemical detectors and alarms are checked and prepared for use.

(e) Updated CDMs are prepared for each unit

(f) Shipboard: Activate countermeasure washdown system (CMWDS), Shipboard Automatic Chemical Agent Detector and Alarm (ACADA), and AN/KAS-1A Chemical Warfare Directional Detector (CWDD) as appropriate.

b. During the Attack.

(1) All personnel automatically mask, sound alarm, decontaminate themselves as required, assume MOPP 4, and administer self-aid and buddy-aid.

(2) Chain of Command and communications are restored, and the unit continues with the mission.

(3) Adjacent units are immediately warned of the potential downwind vapor hazards.

(4) Unit identifies type of agent and submits an NBC1 Chemical Report as the mission permits.

(5) For attacks that leave liquid or solid contamination on equipment, personal, or terrain, unit performs the following actions:

(a) Conduct personal wipe down and operators spray/wipe down.

(b) Warn CASEVAC of contamination casualties. Killed in actions are wrapped and marked.

(c) Unit marks contaminated area and relocates to a clean area if the mission allows.

(d) Unit determines where and when further decontamination can be accomplished if necessary.

(e) Coordinate for decontamination and resupply protective clothing and decontaminates.

(f) Ensure contaminated battle dress overgarments are exchanged within 24 hours after being contaminated.

(g) Replace contaminated protective covers within 24 hours.

(h) For nonpersistent agents, conduct unmasking procedures, treat casualties and prepare for evacuation as the mission permits, and service detection systems to ensure operational status.

(i) Receive NBC2 Report, plot the potential hazard area, and inform the commander.

c. After the Attack.

(1) Unit has undergone decontamination operations and casualties have been evacuated.

(2) Unit reorders chemical defense equipment (e.g., MOPP suits, filters, M291 refill kits).

(3) If unit has not yet identified what agent was used, continue effort to identify the agent. This will be done by the following:

- M256A2 Kit.
- Improved Chemical Agent Monitor (ICAM).
- Automatic Chemical Agent Detector/Alarm (ACADA).
- Taking samples and forwarding to area lab for analysis.

(4) If unit must continue to operate in or occupy the contaminated area, the unit should:

- Continue efforts to refine the contamination hazard area and extent by continued sampling/detection.
- Adjust or improve MOPP as required.
- Mark contaminated areas and identify "hot spots".
- Monitor contamination decay or covering to determine when natural decay may render the area safe.
- Be alert for "transient contamination", the spreading or movement of contamination by natural sources (e.g., wind, rain, runoff, rivers) or by human sources, (e.g., vehicle traffic, rotorwash).

3. Chemical Contamination Reporting, Prediction, and Plotting

The chemical prediction procedure for land provides information on the location and the extent of the hazard area and the duration of the hazard resulting from attacks with chemical weapons. It provides the necessary information for commanders to warn units within the predicted hazard area. In general, the predicted hazard area will be dependent on the type of attack, the means of delivery, and MET factors in the attack area.

a. NBC1 Report. The NBC1 Report is the most widely used report. The observing unit uses this report to provide CBRN attack data. All units must be completely familiar with the NBC1 Report format and the information needed to complete the report. This report is prepared at unit level quickly and accurately, and then sent to the next higher HQ. NBC1 Reports are not routinely passed to corps or higher CBRN cells except for the initial use report. Line items BRAVO (location of observer), DELTA (DTG), GOLF (means of delivery), INDIA (release information for CB or ROTA), and TANGO (terrain, topography, and vegetation description) are mandatory entries in the NBC1 (CHEM) report.

(1) Precedence. Precedence of the NBC1 Report depends on whether or not it is an initial report. The initial use of a CBRN weapons report is *flash* precedence; all others are *immediate* precedence.

(2) Report Preparation. Individuals identified by unit SOP submit raw data to the unit CBRN defense team. NBC1 format should be used; however, a SALUTE or Spot Report may also be used and should be submitted to the unit's CBRN defense team. The

unit CBRN defense team normally consists of individuals that have been trained in CBRN defense. This ensures that the report is in the proper format and is as correct as possible.

(3) Sample NBC1 Report. Sample NBC1 Reports are provided below (see Table E-1). The column “Cond” will show “O” which means operationally determined (O) or mandatory (M) for each message type. Operationally determined lines listed may be added or deleted at the commands discretion.

Table E-1. Sample NBC1 (CHEM)

CHEM			
Line Item	**Description**	**Cond**	**Example**
A	Strike Serial Number	Will be assigned by appropriate NBC cell	
B	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERV/P/ACD//
T	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

b. NBC2 Report. The NBC2 Report is based on one or more NBC1 Reports. It is used to pass evaluated data to higher, subordinate, and adjacent units. A CBRN Cell is usually the lowest level that prepares NBC2 Reports. However, CBRN personnel at intermediate HQ may prepare the NBC2 Report if they have sufficient data. These intermediate HQ, however, will not assign a strike serial number. The CBRN cell prepares the NBC2 (CHEM) Report, assigns it a strike serial number, and disseminates it to the appropriate units. Each subordinate unit then decides whether to disseminate the report further. Line items ALPHA (strike serial number), DELTA (date/time group), FOXTROT (location of attack), GOLF (means of delivery), INDIA (release information), and TANGO (terrain, topography, and vegetation description) are mandatory entries in the NBC2 (CHEM). A sample NBC2 (CHEM) report is provided at Table E-2.

Table E-2. Sample NBC2 (CHEM)

CHEM			
Line Item	**Description**	**Cond.**	**Example**
A	Strike Serial Number	M	ALPHA/US/A234/001/B//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERV/P/ACD//
T	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

c. NBC3 Report. The NBC2 Report(s) and current wind information are used to predict the area of hazard. This prediction is disseminated as an NBC3 Report. It is sent to all units/activities that could be affected by the hazard. Each unit/activity prepares a plot of the NBC3 Report, determines which of its subordinate units/activities are affected, and warns them accordingly. Commanders should use this report as battlefield intelligence when planning missions. The NBC3 Report is a prediction of the hazard area. This prediction is safe-sided to ensure that a significant hazard will not exist outside of the predicted hazard area. As the JWARN is developed and fielded, the built in models will give a more realistic depiction of the hazard area. Units within the hazard area must adjust their MOPP level if necessary. They must ensure that chemical agent alarms are placed far enough upwind to provide adequate warning. A sample NBC3 (CHEM) Report is provided as Table E-3 (page E-6).

Table E-3. Sample NBC3 (CHEM)

CHEM			
Line	Description	Cond.	Example
A	Strike Serial Number	M	ALPHA/US/A234/001/C//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	O	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERV/P/ACD//
PA	Predicted Attack/Release and Hazard Area	M	PAPAA/1KM/3-10DAY/10KM/ 2-6DAY//
PX*	Hazard Area Location for Weather Period	M	PAPAX/201600ZSEP1997/ 32VNJ456280/32VNJ456119/ 32VNJ576200/32VNJ566217/ 32VNJ456280//
XB**	Predicted Contour Information	C	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	GENTEXT/CBRNINFO/RECALCULATION BASED ON WEATHER CHANGE//

d. Definitions used in Chemical Hazard Predictions.

(1) Attack Area. This is the predicted area immediately affected by the delivered chemical agent.

(2) Hazard Area. This is the predicted area in which unprotected personnel may be affected by vapor spreading downwind from the attack area. The downwind distance depends on the type of attack, the weather, and the terrain in both the attack area and the area downwind of the attack area.

(3) Contaminated Area. This is the area in which liquid hazard may remain for some time after the attack. The actual shape and duration can only be determined by surveys.

NOTE: If actual surveys alter the initial data used for determination of the attack, the NBC2 (CHEM) and/or the NBC3 (CHEM) must be changed or updated.

e. Types of Chemical Attacks. Chemical attacks can be divided into three types, as follows:

(1) Type A. Air Contaminating Attacks (non persistent agents). Type “A” attacks are to be assumed unless liquid is present which is subsequently confirmed to be a persistent agent.

(2) Type B. Ground Contaminating Attacks (persistent agents).

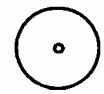
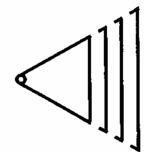
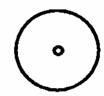
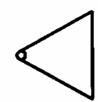
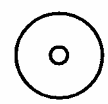
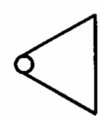
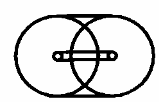
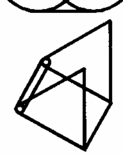
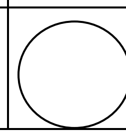
(3) Type C. Attack Origin Unknown.

f. Means of Delivery.

(1) The means of delivery and types of agent containers are listed in Table E-4.

(2) In cases where the type of agent container is unknown (UNK), then RKT should be used for computations.

Table E-4. Types and Cases of Chemical Attacks

Type Of Agent Container	Radius Of Attack Area	Wind Speed	Type	Case	Figure
BML, BOM, RKT, SHL, MNE, UNK, surface burst MSL	= 1 km	≤ 10 KPH	A	1	
BML, BOM, RKT, SHL, MNE, UNK, surface burst MSL	= 1 km	> 10 KPH		2	
BML, SHL, MNE, surface burst RKT and MSL	= 1 km	≤ 10 KPH	B	1	
BML, SHL, MNE, surface burst RKT and MSL	= 1 km	> 10 KPH		2	
BOM, UNK, air burst RKT and MSL	= 2 km	≤ 10 KPH		3	
BOM, UNK, air burst RKT and MSL	= 2 km	> 10 KPH		4	
SPR, GEN	= 1 km	≤ 10 KPH		5	
SPR, GEN	= 1 km	> 10 KPH		6	
Detection after unobserved attack (NBC4 (CHEM) message)	= 10 km		C		

BML – Bomblets	MNE – Mine	RKT – Rocket	SPR – Spray
BOM – Bomb	MSL – Missile	SHL – Shell	UNK - Unknown

g. Prediction of the Downwind Hazard. After an attack by chemical agents, personnel may encounter 3 types of hazard depending on their position relative to the attack area. These are a liquid hazard, a vapor hazard, or both a liquid and a vapor hazard.

(1) Liquid Hazard. Personnel in an area contaminated with liquid chemical agents will be exposed to a hazard that varies according to:

(a) The type and amount of agent disseminated.

(b) The method of dissemination.

(c) The local climatic conditions.

(d) The nature of the terrain.

(e) The time lapse after the contamination.

(f) Liquid agents may under very cold conditions completely stop evaporating and result in an all-clear survey. A hazard can be recreated when temperatures rise.

(2) Non-Persistent Agents. Most non-persistent agents are disseminated mainly as vapor, but some of the agent types may leave residual liquid in shell or bomb craters for either hours or days depending upon the climatic conditions and the munition type. Craters should be avoided until tests have proved the absence of a liquid hazard.

(3) Persistent Agents. Persistent agents are disseminated as liquid and present a vapor hazard as well as a contact hazard. This hazard will last for several hours to days depending on the terrain, climatic conditions, and munition type.

(4) Border areas. Some agents normally classified as non persistent may behave as persistent agents in very cold environments, and liquid from both non persistent and persistent agents may freeze at low temperatures e.g. HD freezes at temperatures below 14°C, and can present a delayed hazard to personnel when the temperature rises.

(5) Thickened, non-persistent agents may have to be treated as persistent, ground contaminating agents. Blister agents are normally classified as persistent agents and will be so indicated when detected by three way detection paper. Some agents however, are very volatile and should be treated as non-persistent, but still ground contaminating agents.

(6) Vapor Hazard. All chemical agents present a vapor or aerosol hazard to personnel downwind of the attack area. The area covered by this hazard may be estimated by using prediction techniques. The actual downwind distance covered by a toxic cloud will depend on the type and amount of agent disseminated the method of dissemination, the climatic conditions and the terrain.

h. Attack Chronology.

(1) The dimensions of the downwind hazard area will depend on the means of delivery, the category of agent, the type of attack, and on weather and terrain. The cloud arrival time at positions downwind of the attack point or area will depend on the representative downwind speed.

(2) The ability to provide timely warning to personnel downwind of the point or area of attack will depend on the time taken to learn of the attack, the time taken to predict

a downwind hazard area and the time required to transmit the warning to those in the hazard area.

i. Principles of Chemical Predictions and Limitations.

(1) Unprotected personnel in an attack area will be exposed to the chemical agent hazards unless they take immediate protective action at the first indication of an attack. It is assumed that once chemical warfare has been initiated, troops in areas attacked by aircraft or missiles, or coming under artillery or other bombardment, will immediately and automatically carry out appropriate chemical defense tactics whether or not a chemical alarm has been given.

(2) An attacked unit will attempt to warn all friendly forces in the immediate vicinity, using the procedures prescribed in STANAG 2047 [Emergency Alarms of Hazard or Attacks (NBC and air attacks only)]

(3) In fixed installations, and in other cases where established communications and/or alarms are available, these should also be used.

(4) Units and installations warned in this way should not promulgate the alarm beyond their own area.

NOTE: As soon as a CBRN Cell realizes that completion and submission of a NBC3 (CHEM) would not warn a unit in the hazard area in time, it will attempt to pass the alarm by the most expeditious means available.

(5) The CBRN Cells will use this information to provide timely warning to units and/or installations in the predicted downwind hazard area. Due to climatic and geographical variations, the lateral limits of the predicted hazard area are normally to be defined by an angle of lateral spread 30° on either side of the forecast representative downwind direction.

(6) The hazard area prediction will be less reliable as the distance from the point of emission increases.

(7) Units in the downwind hazard area, warned by a CBRN Cell, will not raise an alarm outside their own area, but will submit a NBC4 (CHEM) in accordance with SOPs when the chemical agent cloud actual arrives.

(8) The limiting dosages of agents assumed in establishing the procedures for hazard area prediction, while not sufficient to produce casualties immediately, may produce later effects, i.e. miosis from nerve agents.

j. Simplified Hazard Prediction (LAND). The simplified hazard prediction tells subordinate units whether they are in a chemical downwind hazard area. Since Type A attacks present the greatest hazard, the simplified procedures are based on that type of attack. It is valid until an NBC3 Report is received from HHQ. Units need to make a simplified prediction using a Chemical Downwind Message and a simplified template. The template can be made out of acetate, overlay paper, or plastic. Figure E-1 shows a sample simplified predictor. The following steps show you how to use a simplified prediction:

(1) Step 1. Get the wind speed from the CDM. If it is s 10 kilometers per hour, use the circular portion of the prediction. If it is > 10 kilometers per hour, follow the remaining steps.

(2) Step 2. Get the wind direction from the CDM. Mark that direction on the compass circle of the template.

(3) Step 3. Get the air stability code from the CDM; adjust the code using Table E-5, using the codes determine the downwind distance (see Table E-6).

(4) Step 4. Place the template on the map with the attack center of the prediction (the cross mark) over the actual attack center. Rotate the predictor until the downwind direction points toward GN.

(5) Step 5. Draw the downwind line perpendicular to the downwind direction using distance obtained in step 3.

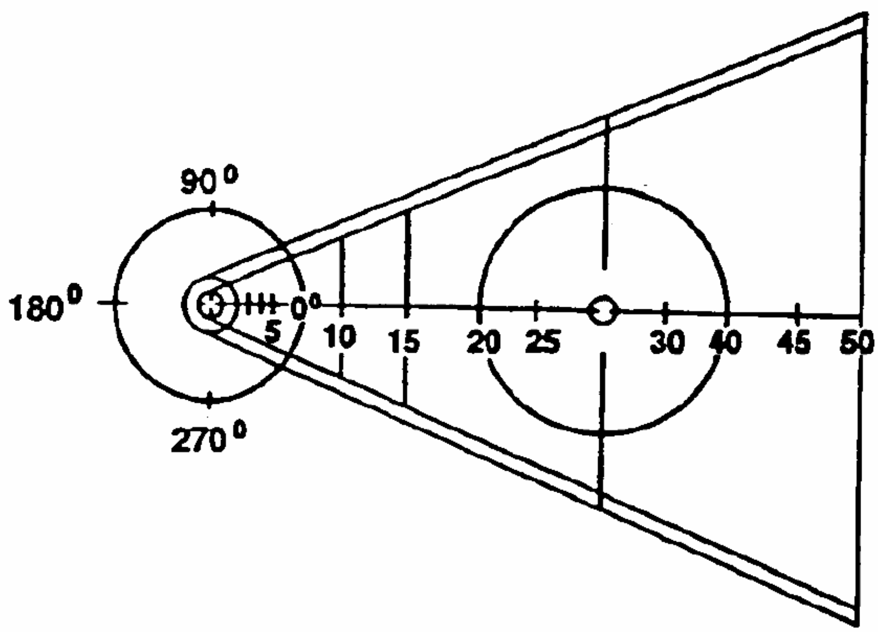


Figure E-1, Simplified Type "A" Chemical Predictor

Table E-5. Stability Category Adjustment

Specific ground (terrain) and	Stability Category from Table		
Weather influences	U	N	S
Dry to slightly moist surface.	U	N	S
Wet surface (i.e. after continuous rain) or dew.	N	N	S
Frozen surface or partly covered with snow, ice or hoarfrost.	N	S	S
Surface completely covered with snow.	S	S	S
Continuous rainfall (no shower activity).	N	N	N
Haze or mist (visibility 1 - 4 km).	N	N	S
Fog (visibility less than 1 km).	N	S	S
Downwind speed more than 18 KPH.	N	N	N

Table E-6. Type "A" Case “2” Attack Downwind Distance of Hazard Area

Type of agent container	Distance from center of attack area along downwind axis, when stability condition is:		
	U	**N**	**S**
Shell, Bomblets and Mines. (SHL, BML, MNE)	10 KM	30 KM	50 KM
Air burst Missiles, Bombs, Rockets and Unknown Munitions. (MSL, BOM, RKT, UNK)	15 KM	30 KM	50 KM

k. Detailed Type “A” Attack Downwind Hazard Prediction (LAND).

(1) Type “A” agents are normally dispersed as an aerosol or vapor cloud with little or no ground contamination. A nonpersistent nerve agent employed upwind of the target. Air-contaminating agents are normally dispersed in ground-bursting munitions such as artillery shells and multiple rocket launchers.

(2) For the following two cases of chemical attacks see examples in Figures E-2 and E-3) the following information is required:

(a) NBC1 (CHEM) or NBC2 (CHEM), and

(b) Detailed MET information,

NOTE: If detailed MET information is not available, the air stability category should be determined by using Table D-12, and this category should be adjusted using Table E-5. The downwind direction and downwind speed must be measured locally.

(3) Type "A", Case "1" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/001/C//

DELTA/271630ZAPR1999//

FOXTROT/33UUB206300/AA//

INDIA/SURF/NERV/NP//

PAPA ALPHA/01KM/-/10KM/-//

PAPA XRAY/271600ZAPR1999/-//

YANKEE/105DGT/009KPH//

ZULU/4/18C/9/-/2//

GENTEXT/CBRNINFO/TYPE A, CASE 1//

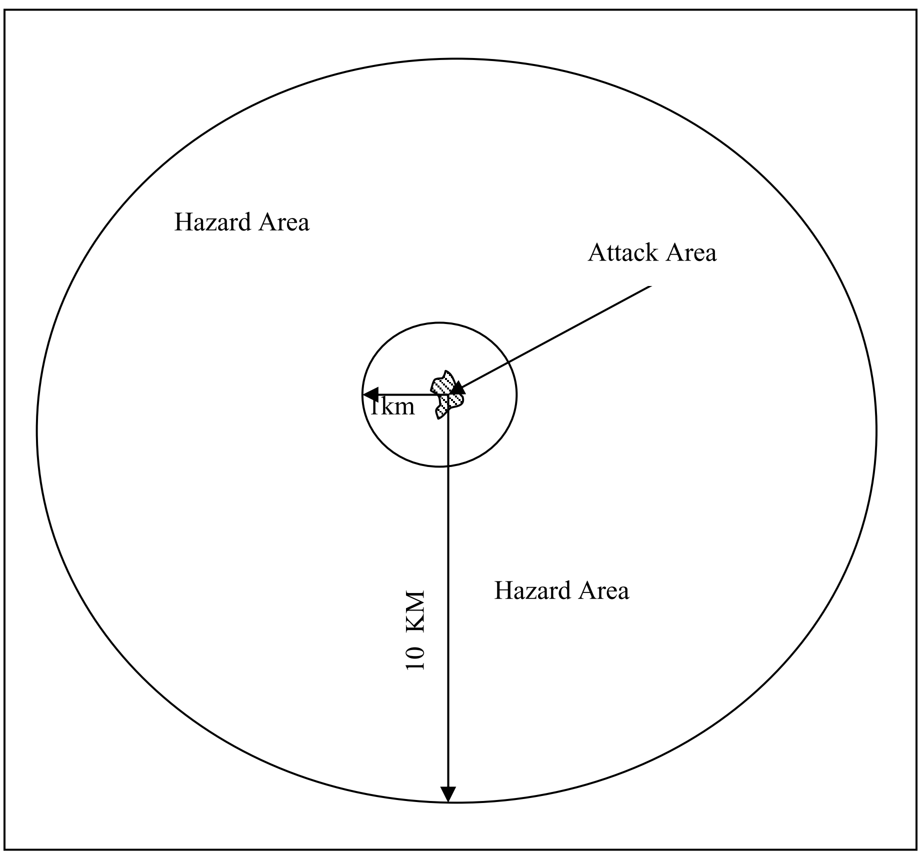


Figure E-2. Hazard Area from Type "A" Attack, Case "1" Wind Speed 10 KPH or Less

(a) Obtain the location of the attack from the relevant NBC report(s) and plot it on the map.

(b) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(c) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(d) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

(4) Type "A", Case "2" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/003/C//

DELTA/271647ZAPR1999//

FOXTROT/32UPG560750/AA//

INDIA/AIR/NERV/NP//

PAPA ALPHA/01KM/-/10KM/-//

PAPA XRAY/271600ZAPR1999/

32UPG674791/

32UPG557759/

32UPG550752/

32UPG552742/

32UPG638657//

YANKEE/105DGT/015KPH//

ZULU/2/15C/8/-/2//

GENTEXT/CBRNINFO/TYPE A, CASE 2, DHD 10KM//

NOTE: In order that a recipient of a NBC3 (CHEM) be able to plot the downwind hazard easily and quickly, the GENTEXT/CBRNINFO line may contain the type, case and the downwind hazard distance (DHD).

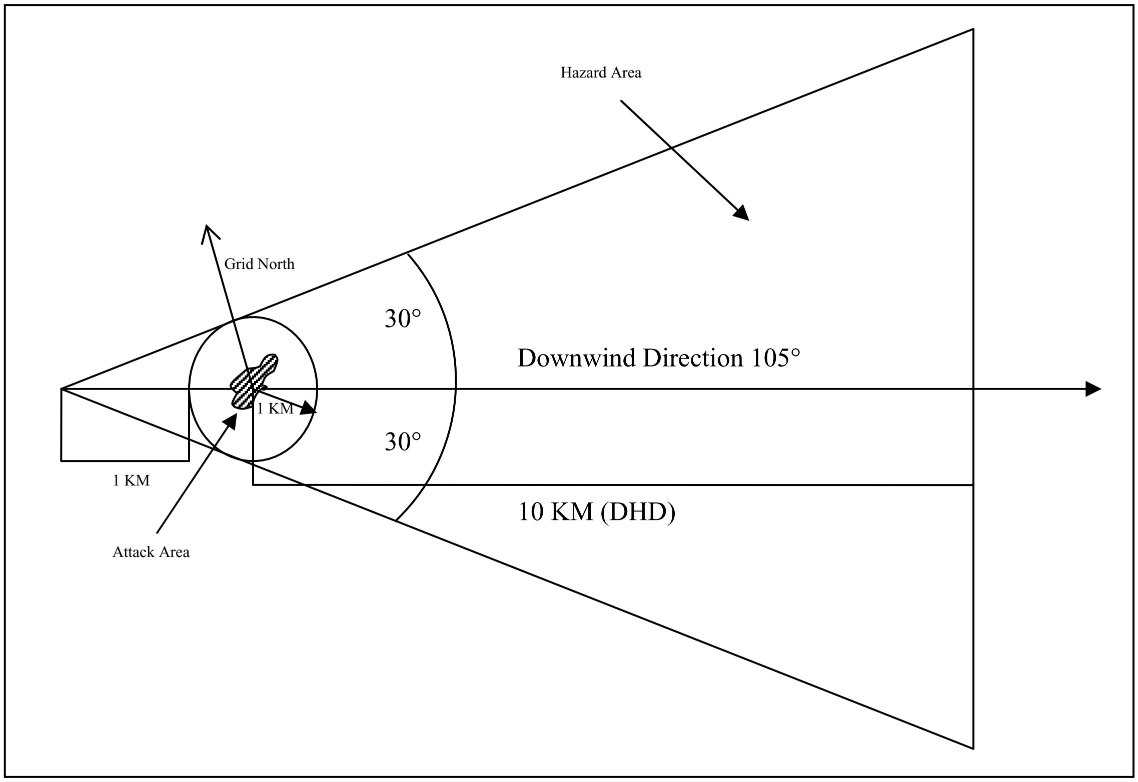


Figure E-3. Hazard Area from Type "A" Attack, Case "2" Wind Speed more than 10 KPH

(a) Obtain the location of the attack from the relevant NBC report(s) and plot it on the map.

(b) From the center of the attack location, draw a Grid North line (GN Line).

(c) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(d) Using the valid NBC CDM, or from locally measured data, identify the air stability category, the downwind direction and the downwind speed.

(e) From the center of the attack area, draw a line showing the downwind direction.

(f) Determine the Downwind Hazard Distance.

- Simplified procedure; if no more detailed information is available using the appropriate air stability category and means of delivery.

- Detailed procedure; if more detailed information is available regarding agent type, means of delivery and wind speed use the table E-5, or the equations in AEP-45, Appendix D-26.

NOTE: When information concerning means of delivery is not available, use the figures for multiple launched rocket systems, missiles, bombs and unknown munitions.

(g) Plot the maximum downwind distance from the center of the attack area on the downwind line.

(h) From the maximum downwind distance, draw a line at right angles to the downwind direction line. Extend the line either side of the downwind direction line.

(i) Extend the downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

(j) From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the maximum downwind distance line. These lines will form a 30° angle either side of the downwind line.

(k) The hazard area is taken to be the area bounded by:

- The upwind edge of the attack area circle.
- The two 30° tangents.
- The maximum downwind distance line.

(l) Prepare and transmit NBC3 (CHEM) and/or Map overlays, to those units and installations within the hazard area in accordance with SOPs.

(m) To estimate the earliest and latest arrival times of the chemical cloud at a certain point, calculate the speeds that the leading and trailing edges of the chemical cloud will travel by:

(5) To estimate the earliest and latest arrival times of the chemical cloud at a certain point, calculate the speeds that the leading and trailing edges of the chemical cloud will travel by:

(a) Leading Edge Speed = Downwind Speed x 1.5

$$\text{Earliest Arrival time} = \frac{\text{Distance to point}}{\text{Leading edge speed}}$$

(b) Trailing Edge Speed = Downwind Speed x 0.5

$$\text{Latest Arrival time} = \frac{\text{Distance to point}}{\text{Trailing edge speed}}$$

NOTE: The distance to the points considered must be measured from the upwind edge (circle center for Case “1”) of the attack area.

l. Detailed Type "B" Attack Downwind Hazard Prediction (Land).

(1) Type B agents are normally dispersed in liquid form to contaminate surfaces. Persistent nerve and mustard agents are examples of this type of attack. Ground-contaminating agents are normally dispersed by aircraft spray tanks, air-bursting artillery shells, rockets, missiles, and mines. Evidence of ground contamination on may include the observer's report of agent falling to the ground from air-bursting munitions, identification of agent with ABC-M8 paper, positive response of M9 Paper, or the identification of blister agent with the M256 series sampler, or reading on the ICAM.

(2) For the following 6 cases of chemical attack the following information is required:

(a) NBC1 (CHEM) or NBC2 (CHEM), and

(b) Detailed MET information, e.g. Chemical Downwind Message or similar information.

NOTE: The daily mean surface temperature is needed for the estimation of the probable time after which personnel may safely remove their protective masks. See Table E-7.

NOTE: The air stability category is not considered in Type "B" hazard prediction as the maximum downwind distance is always 10 km.

(3) Type "B", Case "1" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/001/C//

DELTA/271630ZAPR1999//

FOXTROT/33UUB206300/AA//

INDIA/SURF/NERV/P//

PAPA ALPHA/01KM/-/10KM/-//

PAPA XRAY/271600ZAPR1999/-//

YANKEE/105DGT/009KPH//

ZULU/4/18C/9/-/2//

GENTEXT/CBRNINFO/TYPE B, CASE 1//

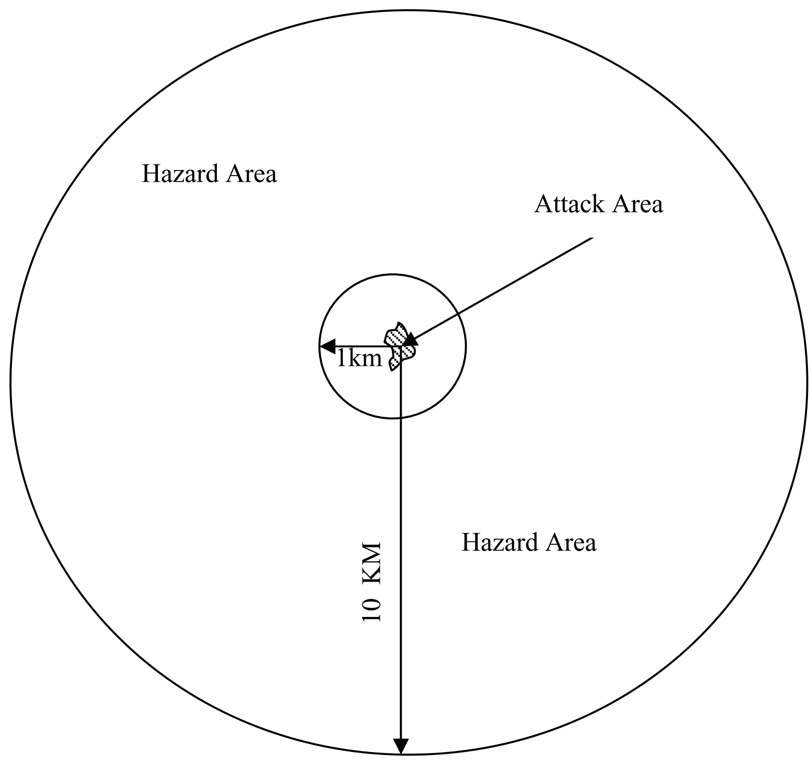


Figure E-4. Hazard Area from Type "B" Attack, Case "1". Wind Speed 10 KPH or Less

(a) Obtain the location of the attack from the relevant NBC chemical message(s) and plot it on the map.

(b) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(c) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(d) Prepare and transmit NBC3 (CHEM) and/or Map overlays, to those units and installations within the hazard area in accordance with SOPs.

(4) Type "B", Case "2" (not to scale)—

Example NBC3 CHEM

ALPHA/US/A234/011/C//

DELTA/271650ZAPR1999//

FOXTROT/32UNH250010/AA//

INDIA/AIR/NERV/P//

PAPA ALPHA/01KM/2-4DAY/10KM/1-2DAY//

PAPA XRAY/271600ZAPR1999/

32UNH371020/
32UNH250020/
32UNH241015/
32UNH241005/
32UNG301900//
YANKEE/120DGT/015KPH//
ZULU/2/15C/8/-/2//
GENTEXT/CBRNINFO/TYPE B, CASE 2//

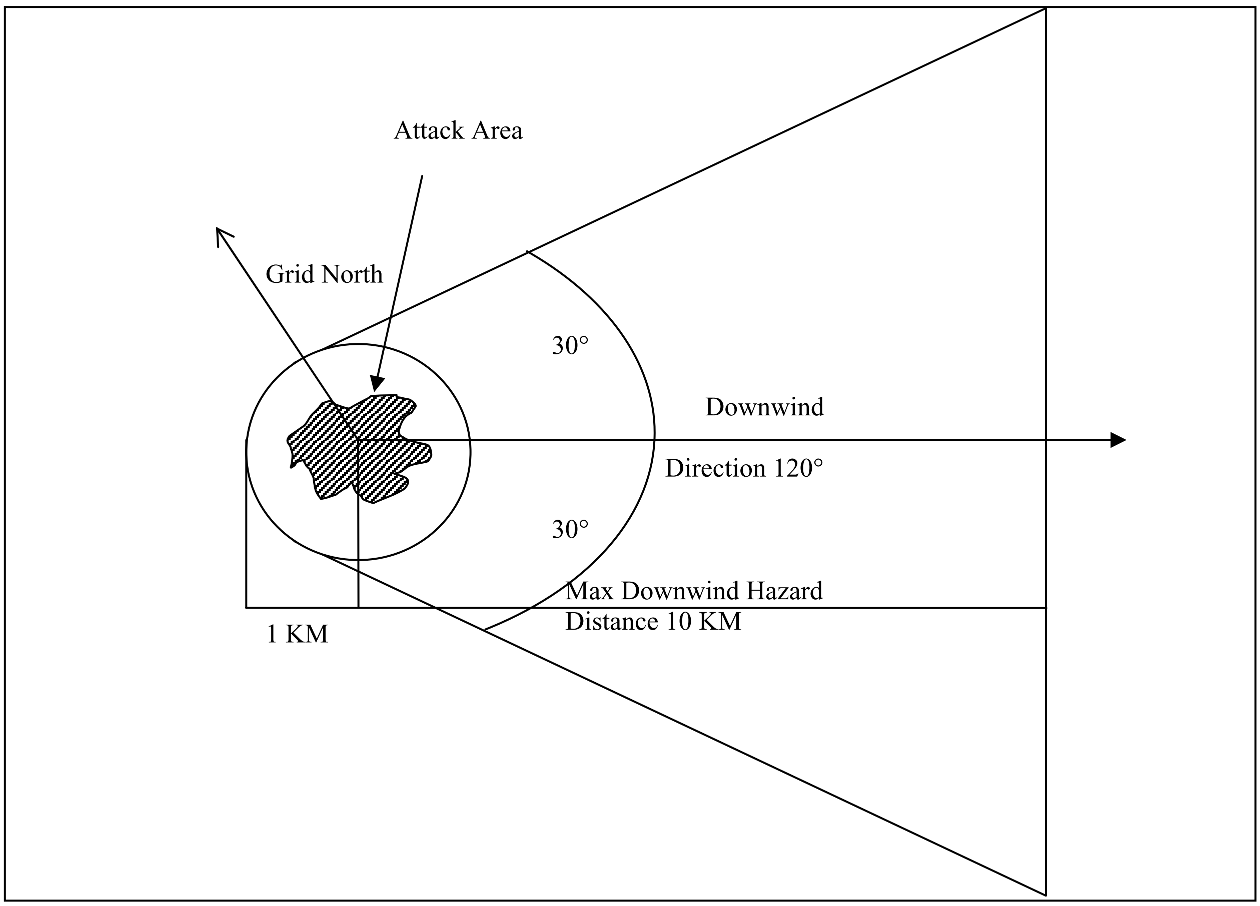


Figure E-5, Hazard Area from Type "B" Attack, Case "2" Radius of Attack Area Less Than or Equal to 1 km. Wind Speed more than 10 KPH

(a) Obtain the location of the attack from the relevant NBC report(s) and plot it on the map.

(b) From the center of the attack location, draw a Grid North line (GN Line).

(c) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(d) From the center of the attack area, draw a line showing the downwind direction.

(e) Plot the 10 km downwind distance from the center of the attack area on the downwind line.

(f) From the 10 km downwind distance, draw a line at right angles to the downwind direction line. Extend the line either side of the downwind direction line.

(g) Extend the downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

(h) From the upwind end of this line, draw 2 lines which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. These lines will form a 30 degree angle either side of the downwind line.

(i) Using Table E-7, find the probable time after ground contamination at which personnel may safely remove their protective masks.

(j) Prepare and transmit NBC3 (CHEM) and/or Map overlays, to those units and installations within the hazard area in accordance with SOPs.

(5) Type "B", Case "3" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/013/C//

DELTA/211605ZAPR1999//

FOXTROT/32UNH431562/EE//

GOLF/OBS/MSL/10/-/-//

INDIA/AIR/NERV/P//

PAPA ALPHA/02KM/2-4DAY/010KM/1-2DAY//

PAPA XRAY/211500ZAPR1999/-//

YANKEE/105DEG/8KPH//

ZULU/2/15C/6/-/2//

GENTEXT/CBRNINFO/TYPE B, CASE 3//

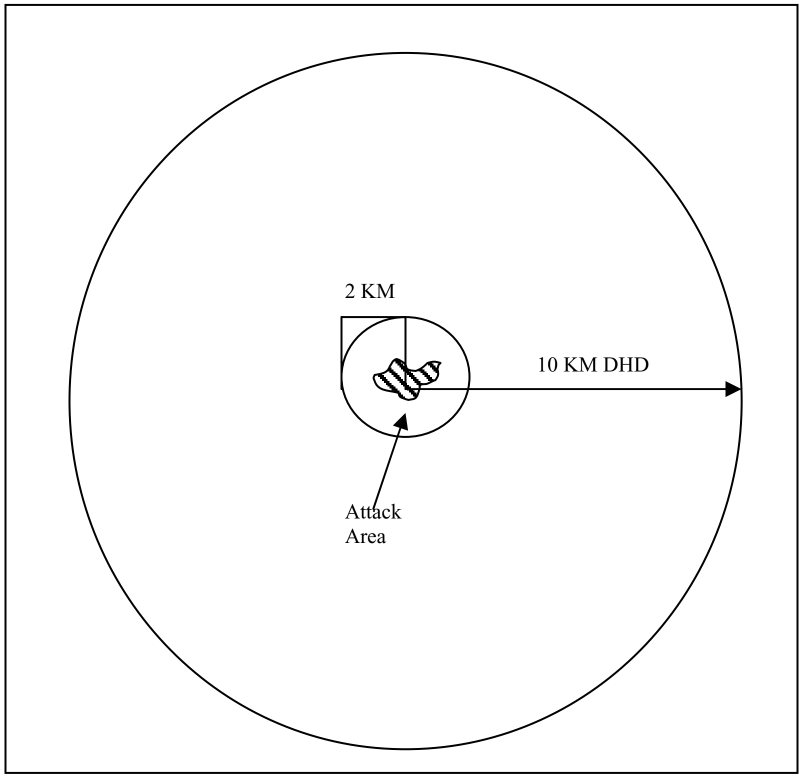


Figure E-6. Hazard Area from Type "B" Attack, Case "3" Attack Area Radius more than 1 km but ≤ 2 km. Wind Speed ≤ 10 KPH

(a) Obtain the location of the attack from the relevant report(s) and plot it on the map.

(b) Draw a circle, radius 2 km, around the center of the attack location. The area within this circle represents the attack area.

(c) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(d) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

(6) Type "B", Case "4" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/006/C//

DELTA/181730ZAPR1999//

FOXTROT/32UNH320010/EE//

INDIA/AIR/NERV/P//

PAPA ALPHA/02KM/2-4DAY/10KM/1-2DAY//

PAPA XRAY/181600ZAPR1999/

32UNH441051/

32UNH316029/

32UNH301016/
32UNG304997/
32UNG386899//
YANKEE/110DGT/020KPH//
ZULU/4/16C/-/-/2//
GENTEXT/CBRNINFO/TYPE B, CASE 4//

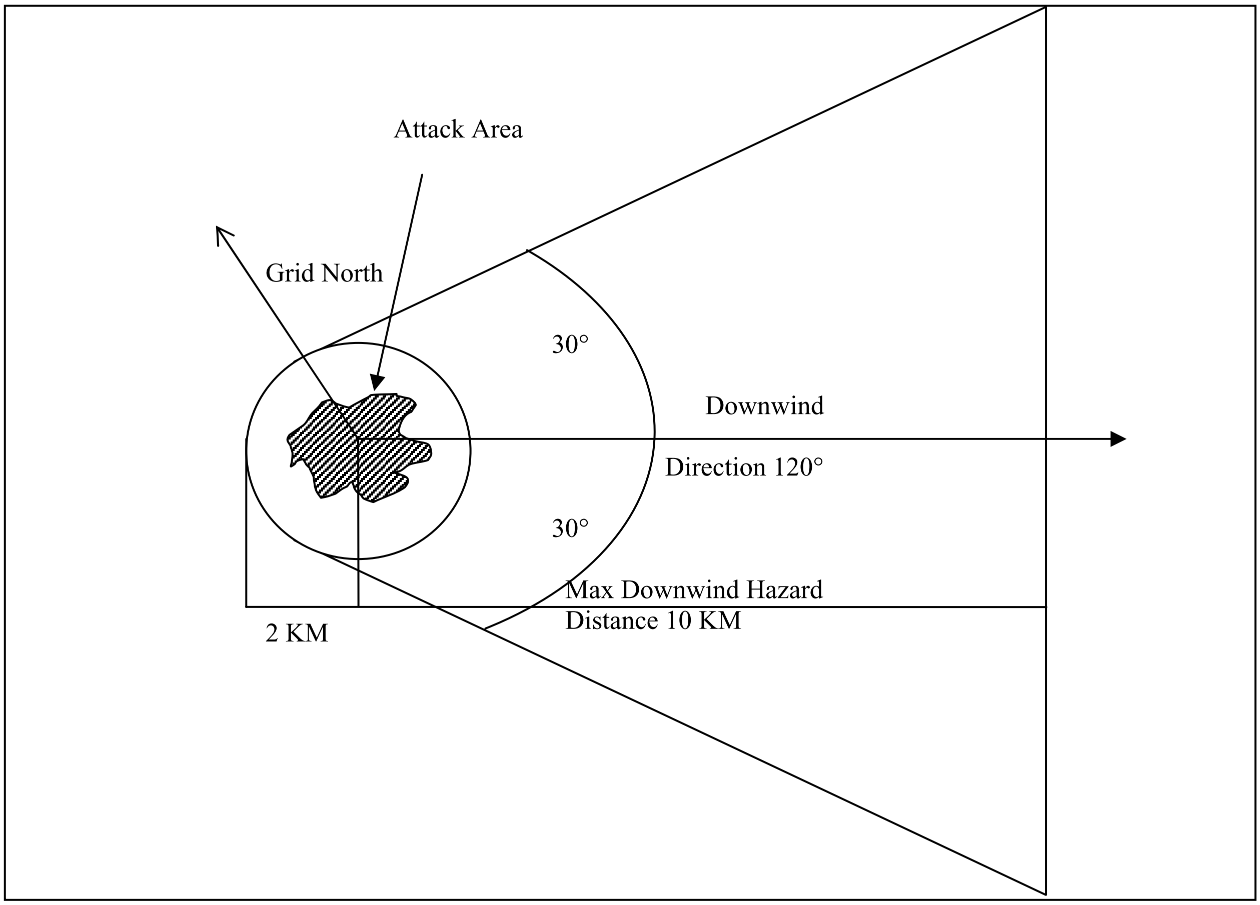


Figure E-7. Hazard Area from Type "B" Attack, Case "4" Attack Area Radius More Than 1 km But Less Than or Equal to 2 km. Wind Speed More Than 10 KPH

(a) Obtain the location of the attack from the relevant NBC report(s) and plot it on the map.

(b) From the center of the attack location, draw a Grid North line (GN Line).

(c) Draw a circle, radius 2 km, around the center of the attack location. The area within this circle represents the attack area.

(d) From the center of the attack area, draw a line showing the downwind direction.

(e) Plot the 10 km downwind distance from the center of the attack area on the downwind line.

(f) From the 10 km downwind distance, draw a line at right angles to the downwind direction line. Extend the line either side of the downwind direction line.

(g) Extend the downwind line, upwind from the center of the attack area, 4 km. This is equal to twice the radius of the attack area.

(h) From the upwind end of this line, draw 2 lines which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. These lines will form a 30° angle either side of the downwind line.

(i) Using Table E-7, find the probable time after ground contamination at which personnel may safely remove their protective masks.

(j) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

(7) Type "B", Case "5" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/014/C//

DELTA/201530ZAPR1999//

FOXTROT/32UNG420620/EE/

32UNG435620/EE//

INDIA/AIR/NERV/P//

PAPA ALPHA/01KM/2-4DAY/010KM/1-2DAY//

PAPA XRAY/211500ZAPR1999/-//

YANKEE/147DGT/009KPH//

ZULU/2/15C/6/-/2//

GENTEXT/CBRNINFO/TYPE B, CASE 5//

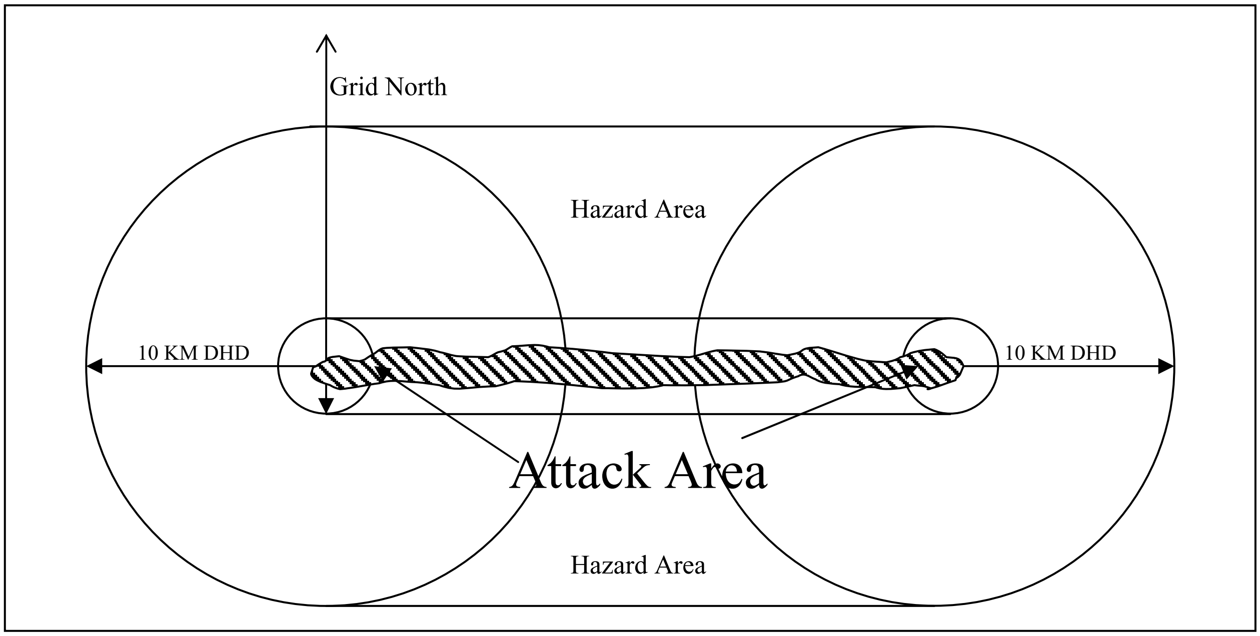


Figure E-8. Hazard Area from Type "B", Case "5" Any Dimension of Attack Area Greater Than 2 km. Wind Speed ≤ 10 KPH.

(a) Estimate the attack area from a NBC1 (CHEM) or NBC2 (CHEM) and plot a point at each extreme end.

(b) Connect the end points to form one or more attack lines.

(c) Draw a 1 km radius circle around each end point.

(d) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(e) Draw a 10 km radius around each 1 km circle at the end points.

(f) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the hazard area.

(g) Using Table E-7, find the probable time after ground contamination at which personnel may safely remove their protective masks.

(h) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

(8) Type "B", Case "6" (not to scale)—

Example NBC3 (CHEM)

ALPHA/US/A234/007/C//

DELTA/141550ZAPR1999//

FOXTROT/33UUC330060/EE/

33UUC370061/EE//

INDIA/AIR/NERV/P//

PAPA ALPHA/01KM/2-4DAY/10KM/1-2DAY//

PAPA XRAY/141400ZAPR1999/
33UUC482014/
33UUC374069/
33UUC368070/
33UUC328069/
33UUC320059/
33UUB326938/
33UUB366939//
YANKEE/147DGT/012KPH//
ZULU/4/18C/3/-/0//
GENTEXT/CBRNINFO/TYPE B, CASE 6//

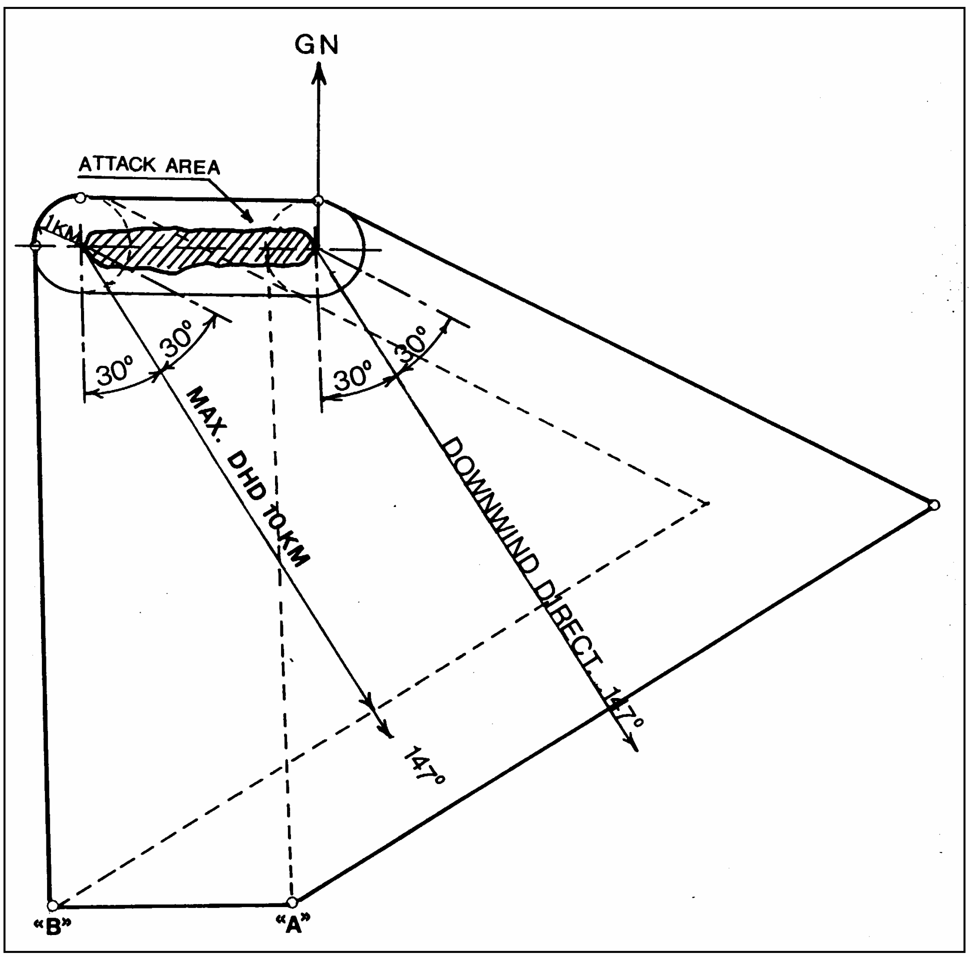


Figure E-9. Hazard Area from Type "B" Attack, Case "6" Any Dimension of Attack Area greater than 2 km Wind Speed more than 10 KPH

(a) Estimate the attack area from the NBC1 (CHEM) or NBC2 (CHEM) and plot it on a map.

(b) Identify and mark the extremities of the estimated attack area, and connect the end points to form one or more attack lines.

(c) Using the extremities as center points, draw circles, radius of 1 km, around each point. Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(d) Draw a Grid North line from the center of each circle.

(e) Consider each circle as a separate attack area and carry out the following procedure for each attack area:

- From the center of the attack area, draw a line showing the downwind direction.

- Plot the 10 km downwind distance from the center of the attack area on the downwind line.

- From the 10 km downwind distance, draw a line at right angles to the downwind direction line. Extend the line either side of the downwind direction line.

- Extend the downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

- From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. These lines will form a 30° angle either side of the downwind line.

- Draw a line connecting the downwind corners of the 2 vapour hazard areas (Points "A" and "B" in Figure E-7).

(f) Using Table E-7, find the probable time after ground contamination at which personnel may safely remove their protective masks.

(g) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

(9) To estimate the earliest and latest arrival times of the chemical cloud at a certain point, calculate the speeds that the leading and trailing edges of the chemical cloud will travel by:

(a) Leading Edge Speed = Downwind Speed x 1.5

$$\text{Earliest Arrival time} = \frac{\text{Distance to point}}{\text{Leading edge speed}}$$

(b) Trailing Edge Speed = Downwind Speed x 0.5

$$\text{Latest Arrival time} = \frac{\text{Distance to point}}{\text{Trailing edge speed}}$$

Table E-7. Type "B" Attack, Probable Time after Ground Contamination at which Personnel May Safely Remove Protective Masks

Daily mean surface air temperature	Within attack area (number of days)	Within hazard area (number of days)
< 0° - 10° C	3 to 10 days	2 to 6 days
11° - 20° C	2 to 4 days	1 to 2 days
> 20° C	up to 2 days	up to 1 day

NOTES: 1. The estimates assume ground contamination densities up to 10 g/m².

2. In making hazard estimates, vapour has been considered to be the determining factor within the attack area as well as in the downwind hazard area. The duration of hazard from contact with bare skin is, however, difficult to predict. The duration can only be determined by the use of chemical agent detection or confirmation devices.

3. When temperatures are considerably lower than 0 degrees C, the duration of contamination may be longer than indicated in the table. The absence of vapour does not preclude the presence of contamination.

4. Daily mean surface air temperature may be obtained from local MET sources.

m. Type "C" Attack Downwind Hazard Prediction (Land). A type "C" attack (Figure E-10) is an attack in which the attack origin is unknown. These types will most likely be found by a survey or reconnaissance.

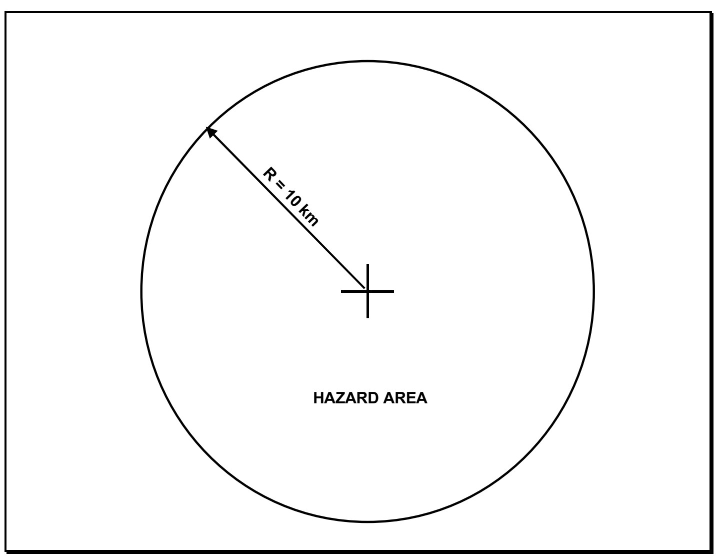


Figure E-10. Type "C"

(1) Obtain the location of detection from the relevant NBC4 (CHEM) (Line QUEBEC) and then plot it on the map.

(2) Draw a circle with a 10 km radius around the center of the detection location. The area within this circle represents both the attack area and the hazard area.

(3) Prepare and transmit a NBC3 (CHEM) to units and installations in the predicted hazard area in accordance with SOPs.

(4) If a new NBC4 (CHEM) message, that cannot be allocated to a strike, specifies a location outside of the hazard area, repeat procedures for the new location.

n. Adjusted Hazard Prediction (Land). The methods previously discussed are based on constant environmental conditions. After significant weather changes, the NBC3 report may no longer be accurate or apply. An adjusted NBC3 Report must be sent to unit/installations in the new hazard area, if possible. Also notify units who may no longer be in the hazard area. Significant weather changes are:

- Representative downwind speed of 10 KPH or more, or if the wind speed increases from less than 10 KPH to more than 10 KPH or the reverse.
- Air stability category (applies to type A attacks only).
- Downwind direction by 30 degrees or more.

Table E-8 shows which Cases and Types of attacks may be affected by different atmospheric changes.

Table E-8. Cases and Types of Attacks

CHANGES OF:	A 1	A 2	B 1	B 2	B 3	B 4	B 5	B 6
Wind Speed: By 10 KPH or more		X						
From > 10 KPH to ≤ 10 KPH		X		X		X		X
From ≤ 10 KPH to > 10 KPH	X		X		X		X	
Wind Direction: By 30 DEG or more		X		X		X		X
Stability Category:		X						

NOTE: For a charge in wind speed, determine the geographical center of the frontline of the traveling cloud at the time the new data becomes available. Calculate this distance by multiplying the original wind speed times to twice the time in hours since the attack. The center of the cloud front is then considered to be the new center of attack area. Once the new center of attack is determined, the downwind hazard area is determined using the procedures outline for that type of attack.

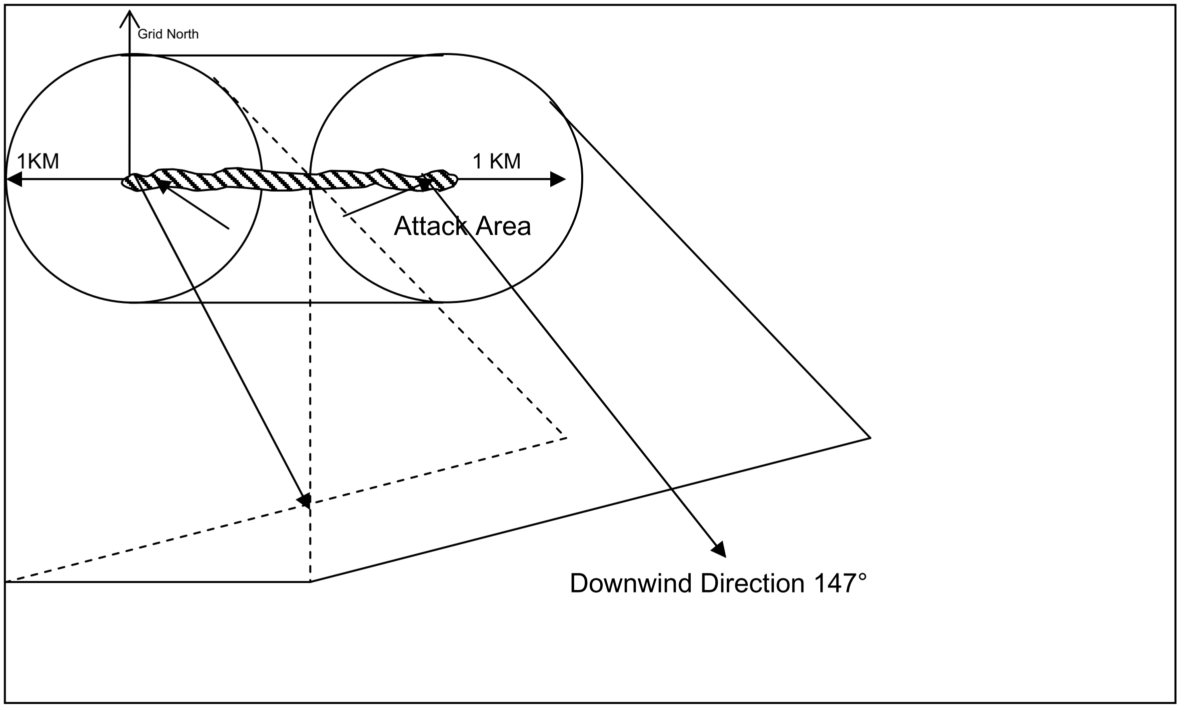


Figure E-11. Downwind Direction

(1) Recalculation of Hazard distances. When significant weather changes occur, or are predicted to occur, the following procedure for type "A" attacks should be used to determine:

(a) The distance the chemical agent cloud will have travelled prior to the change by using:

$\mathbf{d_1} = \mathbf{u_1 \times t_1}$

$\mathbf{d_1}$ = distance travelled prior to change in weather conditions.

$\mathbf{u_1}$ = downwind speed prior to change in weather conditions.

$\mathbf{t_1}$ = time elapsed between the time of attack and the end of the current CDR time period.

NOTE: If the distance travelled, as calculated above, is equal to or exceeds the original maximum downwind hazard distance, then recalculation is not required.

(b) For Type “A” case “2” attacks, measure the distance $\mathbf{d_1}$ along the downwind line and mark it. If that point is outside of the current CDR area, get the CDR for the area containing the new point and get the weather conditions for the next time period. Compare these weather conditions with those used for the current CDR time period and determine if significant weather changes are predicted.

(c) The distance the chemical cloud will travel after the change by using:

d_2 = **H_2 - d_1**

d_2 = remaining hazard distance.

H_2 = maximum hazard distance under the conditions prevailing after the change.

d_1 = distance travelled prior to change in weather conditions.

NOTE 1: If the second time period has a wind speed ≤ 10 kph (type A1), always draw a circle with a radius of 10 km (as if d_2 = 10 km)

NOTE 2: In constructing the hazard area, it must be kept in mind that the maximum hazard distance, valid during either set of weather conditions, must not be exceeded. If $d_2 \leq 0$, recalculation is not required.

(2) Type "A", Case "1" changing to a Type "A", Case "2" (Increase in wind from ≤ 10 KPH to > 10 KPH) (not to scale) (Figure E-12).

Example NBC CDM

AREAM/NFEA12//

ZULUM/230600ZAPR1999/230900ZAPR1999/

231500ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/140/008/4/06/8/-/2//

XRAYM/140/012/4/10/8/-/2//

YANKEEM/150/014/4/14/8/-/2//

Example NBC2 (CHEM)

ALPHA/US/A234/005/C//

DELTA/231030ZAPR1999//

FOXTROT/32VNH450956/AA//

GOLF/OBS/CAN/-/SHL/24//

INDIA/SURF/NERV/NP//

TANGO/FLAT/SCRUB//

YANKEE/140DGT/008KPH//

ZULUA/4/10C/8/-/2//

GENTEXT/CBRNINFO/

TYPE OF AGENT CONFIRMED BY CHEMICAL DETECTION KIT. RECALCULATION BASED ON CHANGE IN WIND SPEED 231100Z//

(a) Calculate **d_1**.

(b) Draw a circle around the center of the original attack area. Radius **d_1**. The area inside this circle represents the new attack area.

NOTE: If d_1 > 10 km then use: d_1 = 10 km.

(c) From the center of the attack area, draw a line showing the downwind direction.

(d) From the center of the attack draw a Grid North line.

(e) From where the downwind direction line cuts the new attack area circle, measure and mark the distance $\mathbf{d_2}$ on the downwind direction line.

(f) From the $\mathbf{d_2}$ distance, draw a line at right angles to the downwind direction line, and extend it either side of the downwind direction line.

(g) Extend the downwind line, upwind from the center of the attack area by 2 x d_1. This is equal to twice the radius of the new attack area.

(h) From the upwind end of this line, draw 2 lines which are tangents to the new attack area circle, and extend them until they intersect with the right angle line resulting from (f).

(i) Prepare and transmit NBC3 (CHEM) and/or map overlays, to those units and installations within the hazard area in accordance with SOPs.

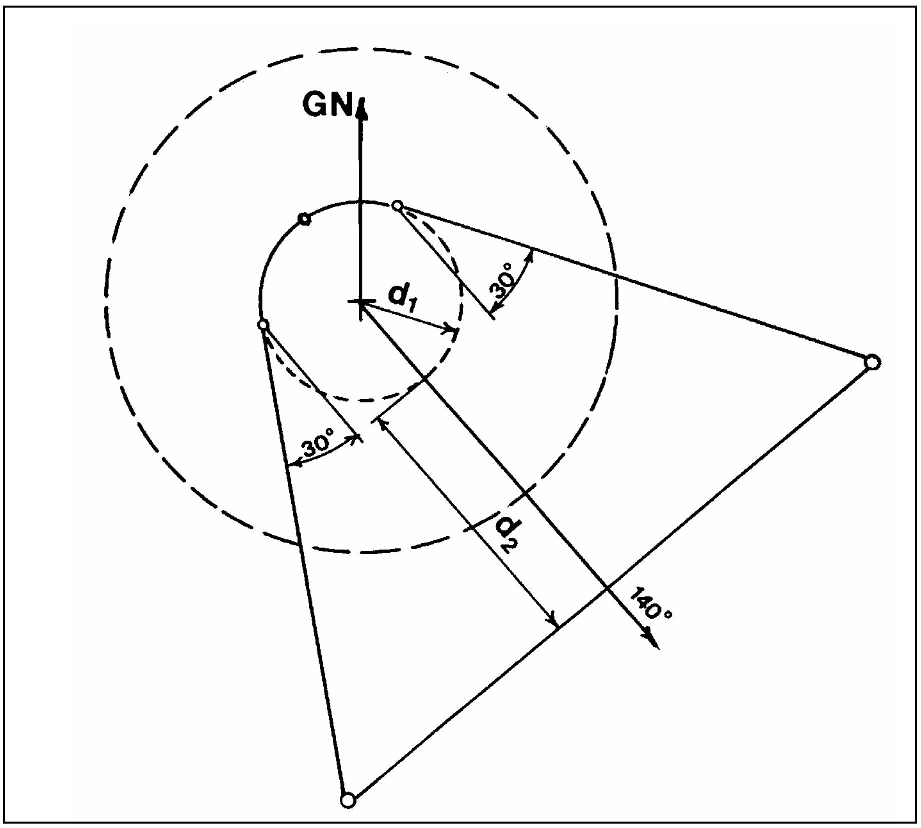


Figure E-12. Recalculation of Downwind Hazard Area Type "A" Attack, change in Wind Speed from ≤ 10 KPH to > 10 KPH

(3) Type "A", Case "2" changing to a Type "A", Case "1" (Decrease in Wind from > 10 KPH to ≤ 10 KPH) (not to scale) (Figure E-13, E-14, and E-15).

Example NBC CDM Example NBC2 (CHEM)

AREAM/NFEB43//

ZULUM/281200ZAPR1999/281500ZAPR1999/
282100ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/090/018/4/14/8/-/2//

XRAYM/090/008/4/10/8/4/2//

YANKEEM/090/006/2/06/8/4/2//

ALPHA/US/A234/005/C//

DELTA/281615ZAPR1999//

FOXTROT/32UPG387764/AA//

GOLF/OBS/MLR/-/RKT/12//

INDIA/SURF/NERV/NP//

TANGO/FLAT/SCRUB//

YANKEE/090DGT/018KPH//

ZULUA/4/14C/8/-/2//

GENTEXT/CBRNINFO/
SYMPTOMS OF NERVE
AGENT POISONING. RECALCULATION
BASED ON CHANGE IN WIND SPEED
AS OF 281700Z//

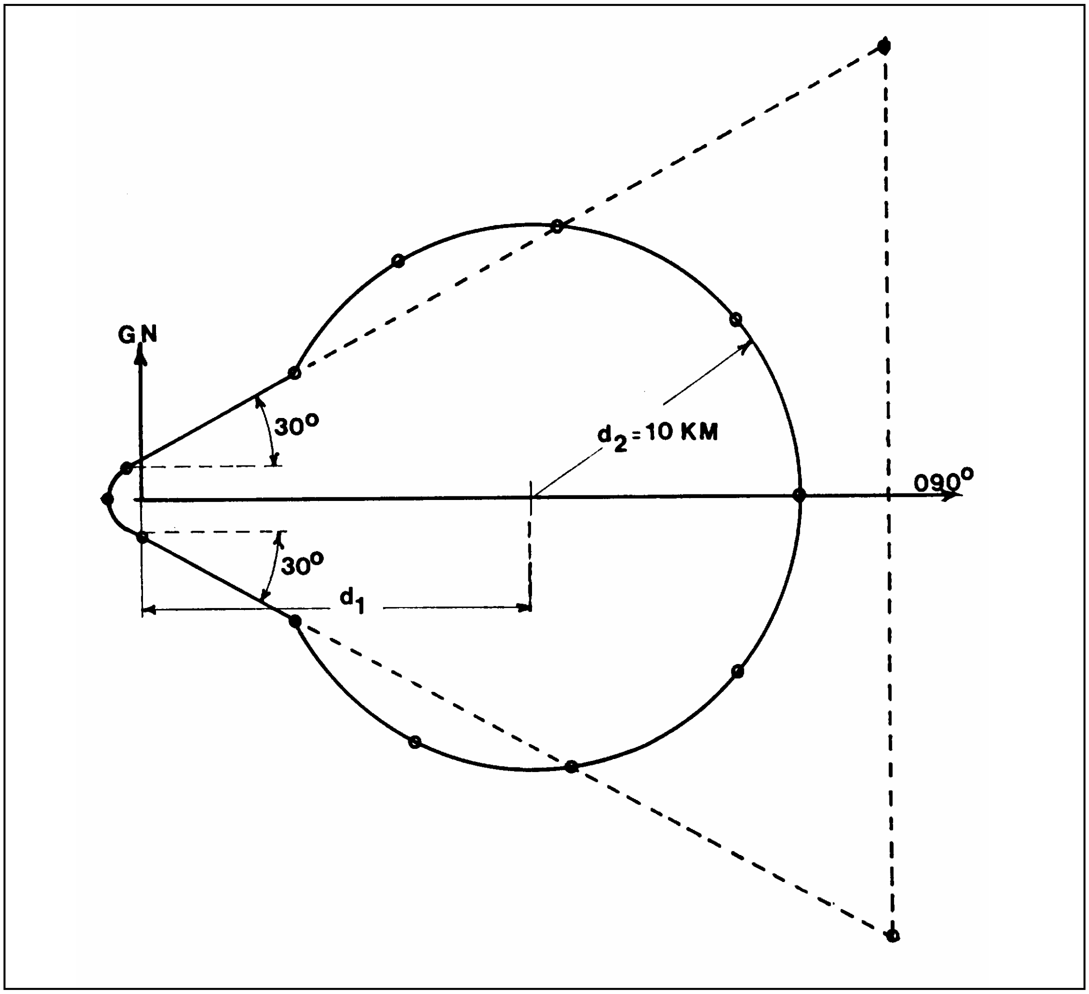


Figure E-13. Recalculation of Downwind Hazard Area Type "A" Attack, change in Wind Speed from > 10 KPH to ≤ 10 KPH.

Example NBC CDM

AREAM/NFEA12//

ZULUM/280600ZAPR1999/280900ZAPR 1999/

281500ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/120/014/4/06/8/-/2//

XRAYM/120/009/4/10/8/-/2//

YANKEEM/130/007/4/14/8/-/2//

Example NBC2 (CHEM)

ALPHA/US/A234/009/C//

DELTA/281030ZAPR1999//

FOXTROT/32UMG892764/AA//

GOLF/OBS/MLR/-/RKT/6//

INDIA/SURF/NERV/NP//

TANGO/FLAT/SCRUB//

YANKEE/120DGT/14KPH//

ZULU/4/06C/8/-/2//

GENTEXT/CBRNINFO/

RECALCULATION BASED

ON CHANGE IN WIND SPEED AS OF 281100Z//

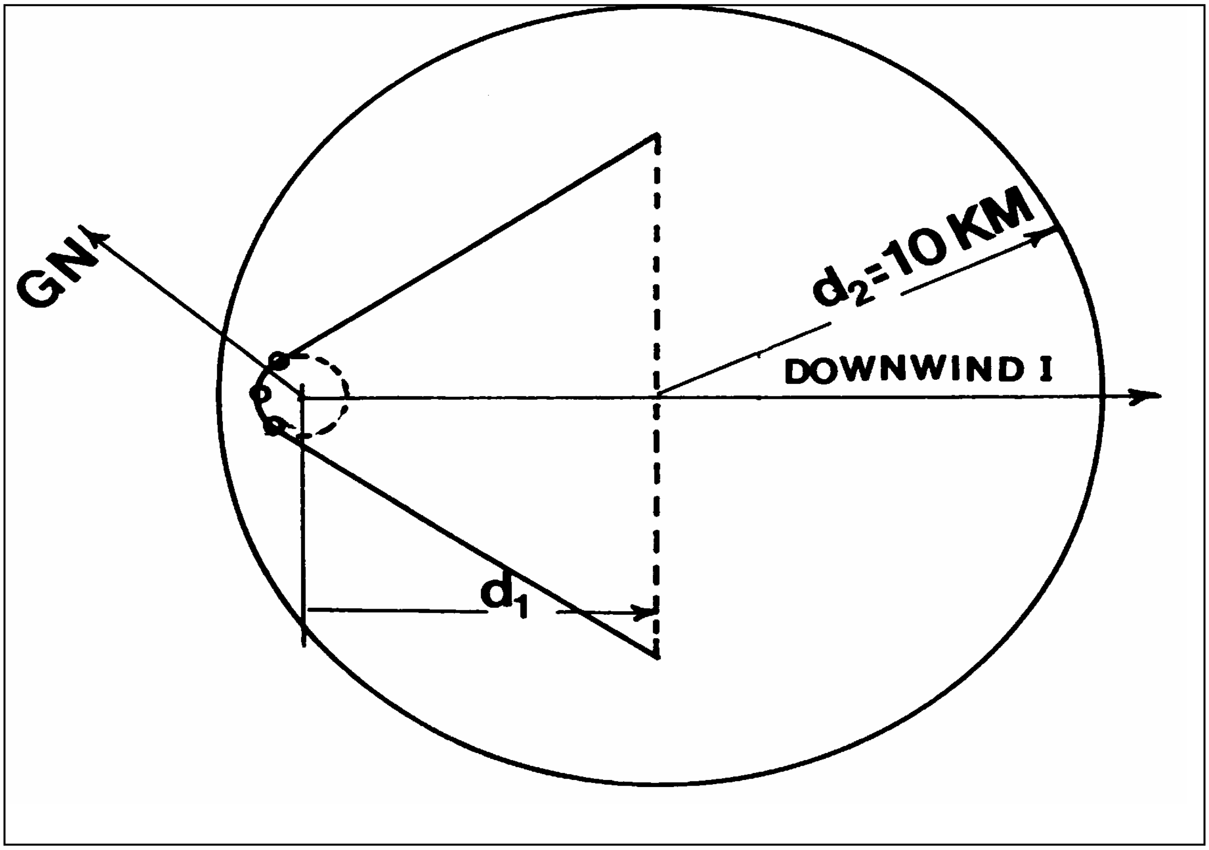


Figure E-14. Recalculation of Downwind Hazard Area Type "A" Attack, change in Wind Speed from > 10 KPH to ≤ 10 KPH.

Example NBC CDM

AREAM/NFEA12//

ZULUM/280600ZAPR1999/280900ZAPR1999/
281500ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/120/014/4/06/8/-/2//

XRAYM/120/009/4/10/8/-/2//

YANKEEM/130/007/4/14/8/-/2//

Example NBC2 (CHEM)

ALPHA/BE/1BDE/013/C//

DELTA/280930ZAPR1999//

FOXTROT/32UMG892764/AA//

GOLF/OBS/MLR/-/RKT/6//

INDIA/SURF/NERV/NP//

TANGO/FLAT/SCRUB//

YANKEE/120DGT/014KPH//

ZULU/4/06C/8/-/2//

GENTEXT/CBRNINFO/
RECALCULATION BASED
ON CHANGE IN WIND SPEED
AS OF 281100Z//

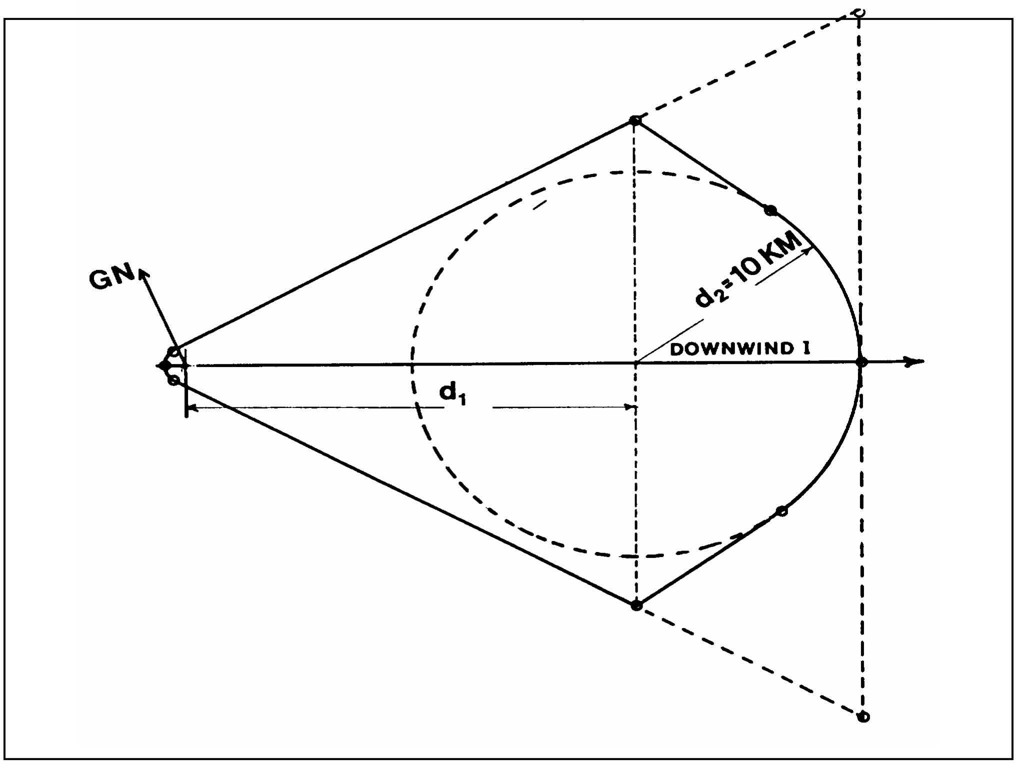


Figure E-15. Recalculation of Downwind Hazard Area Type "A" Attack, Change In Wind Speed from > 10 KPH to ≤ 10 KPH.

(a) Calculate $\mathbf{d_1}$.

(b) From the center of the original attack area measure the distance $\mathbf{d_1}$ along the downwind line and mark it.

(c) Using that point as the center, draw a circle with a 10 km radius, until it intersects the two 30° tangents from the original plot (see Figure E-13).

(d) If the circle does not intersect the tangent lines, draw a line at right angles to the downwind direction line at the $\mathbf{d_1}$ distance and mark the intersections with the tangent lines. From these points draw two new tangents to the 10 km radius circle (See Figure 3-8(c)).

(4) Type "A" Case "2" Attack with a change in the Downwind Direction (not to scale) (Figure E-14).

Example NBC CDM

AREAM/NFEB43//

ZULUM/280600ZAPR1999/280900ZAPR 1999/

281500Z APR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/090/012/2/06/-/-/2//

Example NBC2 (CHEM)

ALPHA/US/A234/010/C//

DELTA/281245ZAPR1999//

FOXTROT/32UNG885419/EE//

GOLF/OBS/MLR/-/RKT/6//

INDIA/SURF/NERV/NP//

XRAYM/090/014/2/08/-/-/2//

YANKEEM/140/015/2/08/-/-/2//

TANGO/FLAT/SCRUB//

YANKEE/090DGT/014KPH//

ZULU/2/08C/-/-/2//

GENTEXT/CBRNINFO/

CONFIRMED BY
DETECTOR KIT.
RECALCULATION
BASED ON CHANGE
IN WIND DIRECTION
AS OF 281300Z//

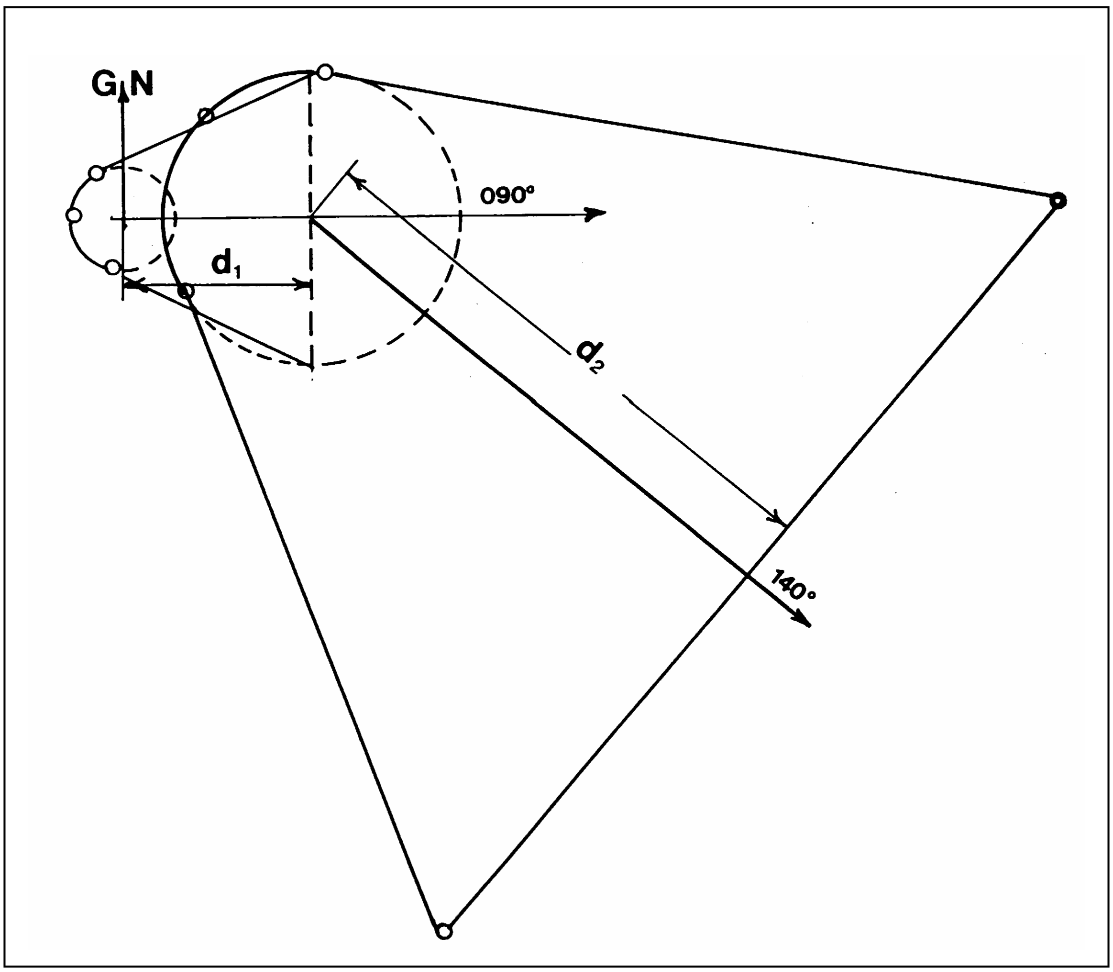


Figure E-16. Recalculation of Downwind Hazard Area Type "A", Case "2" Attack, change in Downwind Direction by 30 degrees or more.

(a) Calculate $\mathbf{d_1}$.

(b) From the center of the original attack measure the distance $\mathbf{d_1}$ on the downwind line before the change in direction, and mark it.

(c) Draw a line at right angles to the downwind line through the point $\mathbf{d_1}$ until it meets the 30 degrees lines from the original plot.

(d) Using the $\mathbf{d_1}$ point as the center, draw a new circle, the radius being the distance from the $\mathbf{d_1}$ point to one of the 30° tangents. The area within this circle is considered to be the new attack area.

(e) From the center of this circle draw a line representing the "new" downwind direction.

(f) From the center of this circle measure and mark the $\mathbf{d_2}$ distance on the new downwind direction line. If this distance falls within the circle then move it to the perimeter of the circle on the new downwind direction line. This will take into account the fact that some of the chemical cloud may travel at 1.5 times the mean wind speed, and will therefore have travelled further.

(g) Complete the plot by following the procedures outlined above.

(5) Type "A" Case "2" Attack with a change in Stability Category or Downwind Speed (not to scale).

Example NBC CDM

AREAM/NFEB34//

ZULUM/280600ZAPR1999/280900ZAPR 1999/28

1500ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/110/015/6/10/-/4/2//

XRAYM/110/015/6/10/-/4/2//

YANKEEM/110/025/4/10/-/4/2//

Example NBC2 (CHEM)

ALPHA/US/A234/012/C//

DELTA/281230ZAPR1999//

FOXTROT/32UPF730750/EE//

GOLF/OBS/AIR/6/BOM/18//

INDIA/SURF/NERV/NP//

TANGO/FLAT/SCRUB//

YANKEE/110DGT/015KPH//

ZULU/6/10C/-/4/2//

GENTEXT/CBRNINFO/

RECALCULATION BASED ON CHANGE IN STABILITY CATEGORY

AS OF 281300Z//

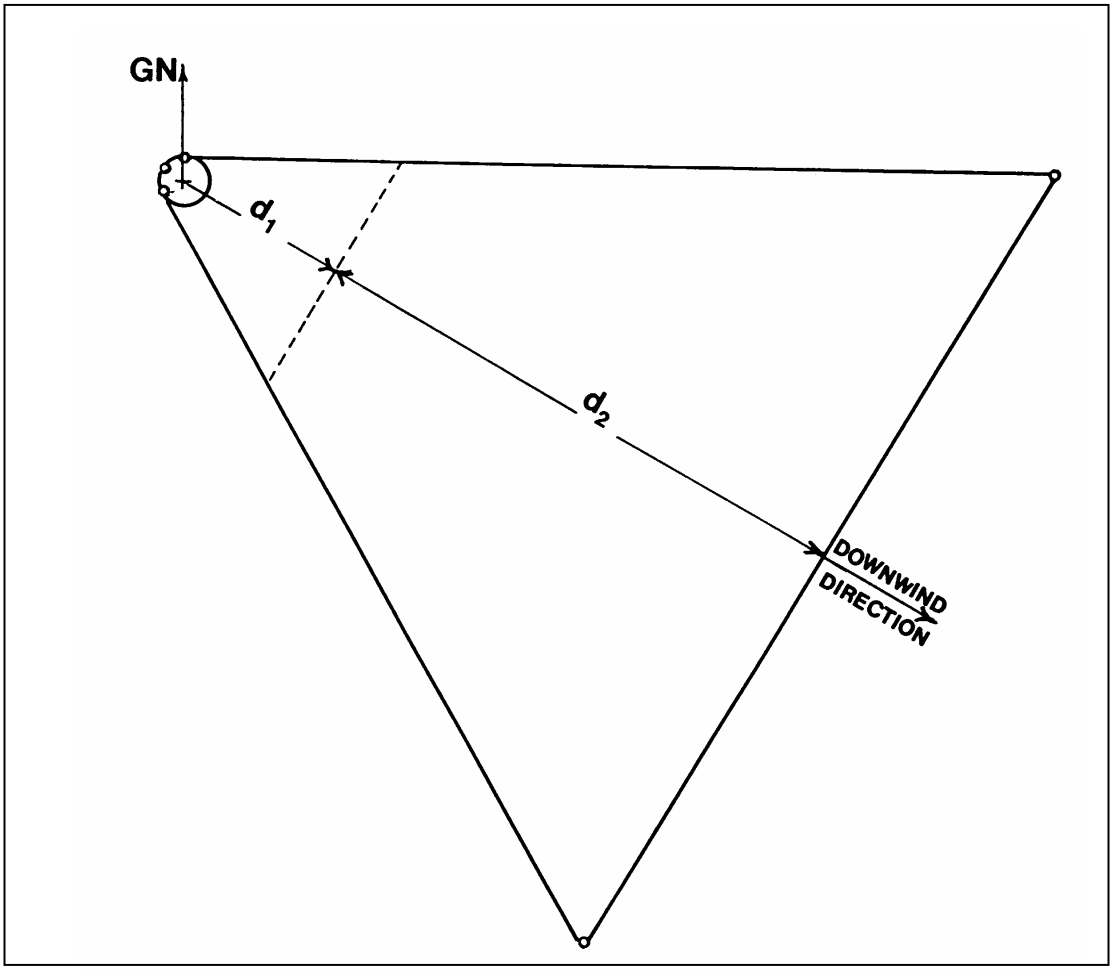


Figure E-17. Recalculation of Downwind Hazard Area Type "A", Case "2" Attack. Change in Stability Category and/or Downwind Speed.

From the center of the original attack location plot the hazard area as described above, using $\mathbf{H_2}$ as the maximum downwind distance.

(6) Type "B" Attack, Cases "2" and "4" with a change in Downwind Direction.

(a) From the center of the original attack location, draw the new downwind direction line.

(b) Plot the new hazard area as described in paragraphs (b) and (d) on page E-36, or reposition the template along the new downwind direction line and replot.

NOTE: The total area covered by the old and the new hazard areas must be considered dangerous until confirmation of the absence of a chemical hazard in the "old" area is received.

(7) Type "B" Attack, Case "6", with a change in Downwind Direction (not to scale) (Figure E-18).

Example NBC2 (CHEM)

ALPHA/US/A234/004/C//
DELTA/281000ZAPR1999//
FOXTROT/32VMH747388/EE//

GOLF/OBS/AIR/-/SPR/-//

INDIA/AIR/NERV/P//

TANGO/FLAT/SCRUB//

YANKEE/090DGT/020KPH//

ZULU/4/18C/8/-/0//

GENTEXT/CBRNINFO/SYMPTOMS OF

NERVE AGENT POISONING//

Example NBC CDM

AREAM/NFEA12//

ZULUM/280600ZAPR1999/280900ZAPR199
9/

281500ZAPR1999//

UNITM/KM/DGT/KPH/C//

WHISKEYM/090/020/4/18/8/-/0//
XRAYM/150/020/4/18/8/-/0//
YANKEEM/150/020/4/18/8/-/0//

Example NBC3 (CHEM)

ALPHA/US/A234/004/C//
DELTA/281000ZAPR1999//
FOXTROT/32VMH747388/EE/

32VMH897388/EE//
INDIA/AIR/NERV/P//
PAPAA/01KM/96HR/10KM/48HR//
PAPAX/281100ZAPR1999/

32VMH846318/32VMH846329/

32VMH856335/32VMH846341/

32VMH847456/32VMH742396/

32VMH740395/32VMH739394/

32VMH738393/32VMH738392/

32VMH737391/32VMH737389/

32VMH737388/32VMH736266/

32VMH836324/32VMH846318//

YANKEE/090DGT/020KPH//

ZULU/4/18C/8/-/0//

GENTEXT/CBRNINFO/

RECALCULATION BASED ON NBC
CDM WEATHER CHANGE AS OF
281100Z//

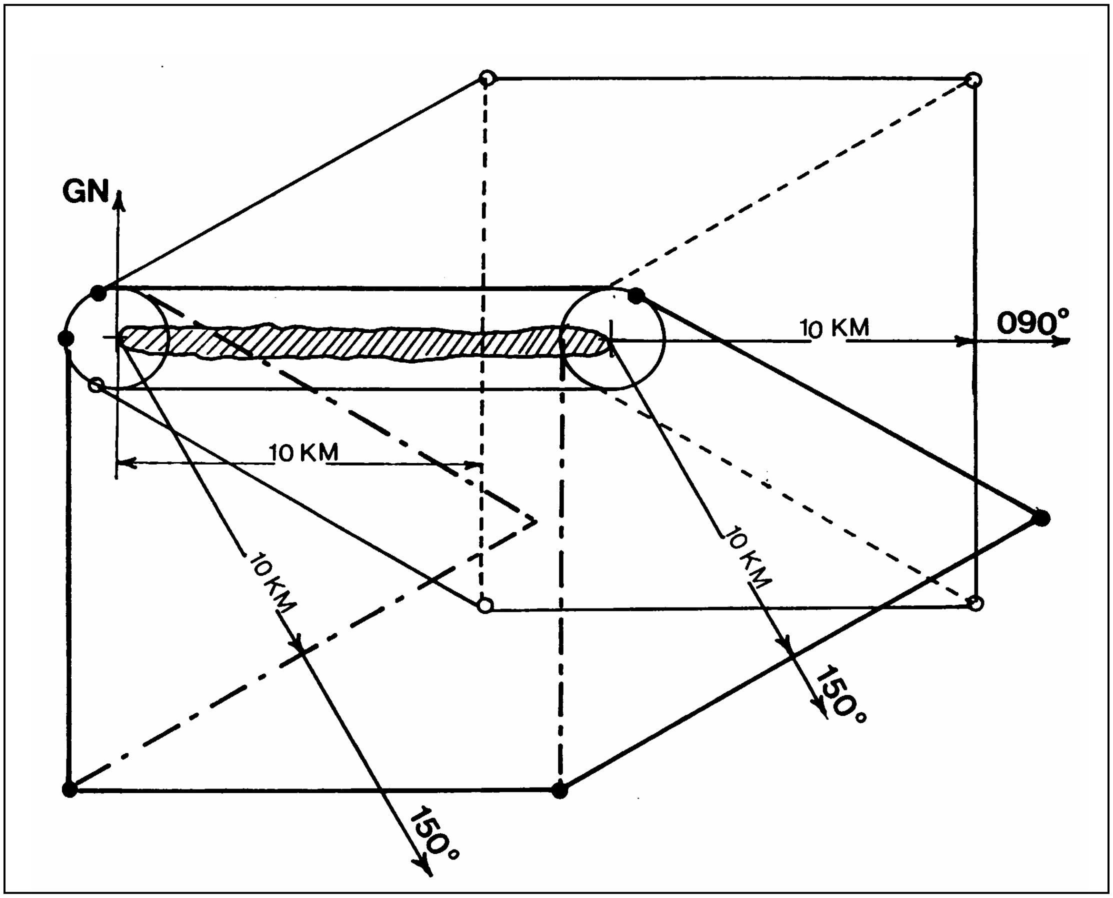


Figure E-18. Recalculation of Downwind Hazard Area Type "B", Case "6" Attack, change in Downwind Direction

(a) Plot the hazard area as calculated both for before and after the change in wind direction using the procedure described above.

(b) In the NBC3 (CHEM) indicate on the GENTEXT/CBRNINFO line the reason for recalculation and the effective time for the new hazard area.

(8) Type "B" Attack, Case 2, 4 and 6 with a change in Wind Speed from > 10 KPH to ≤ 10 KPH.

(a) Plot the hazard area as calculated for the wind speed > 10 KPH using the appropriate procedure described above for the correct case.

(b) Plot the hazard area as calculated for the wind speed ≤ 10 KPH using the appropriate procedure described above for the correct case.

(9) In the examples of the hazard area, which is valid after the change in wind direction, also includes the area before the change. This takes into account transient hazards caused by the shift in wind direction in the areas between the two hazards.

(10) When recalculation is completed, calculate the arrival time of the hazard, and issue a NBC3 (CHEM)/Map Overlays to the units or installations that will be affected. Issue the new NBC3 (CHEM) to those units initially warned, to inform them that there may be a residual vapour hazard in their area. The same Strike Serial Number should be used as in the previous message and the previous message should be referred to in the GENTEXT/CBRNINFO line of the new message.

n. The Merchant Warning System (MERWARN). A simplified contamination warning system has been established throughout NATO for broadcasting, via MERCOMMS and coastal radio stations, warnings of contamination dangerous to merchant shipping. This system calls for the origination, by NATO naval authorities, of three types of messages relating to chemical avoidance:

(1) MERWARN NBC3 (CHEM).

(a) This message is issued to pass immediate warning of a predicted chemical contamination and hazard area. MERWARN NBC3 (CHEM) reports are issued as soon as possible after each attack. They contain sufficient information to enable the master of a ship to plot the downwind hazard area. The following standard format will be used for MERWARN NBC3 (CHEM):

MERWARN NBC3 (CHEM) (Message identifier)

ALPHA:	Strike serial number (as defined by naval authority).
DELTA:	DTG (Z) of start and end of attack.
FOXTROT:	Location of event.
GOLF:	Delivery Means.
INDIA:	Release Information.
PAPA ALPHA:	Predicted attack and hazard area.

NOTE: **If downwind speed is 5 knots or less, or variable, this letter item will consist of three (3) digits instead of coordinates, representing the radius of a circle in nautical miles centered on the location of the attack contained in line(s) FOXTROT.**

YANKEE:	The downwind direction and speed.
ZULU:	Information on actual weather conditions.
GENTEXT:	Remarks

NOTE: **Some of the letter items above may not be completed in the report that is received, but there will be sufficient information for a Downwind Hazard plot to be carried out.**

(b) The MERWARN NBC3 (CHEM) standard format may not be suitable after a multiple chemical attack, which produces a hazard from several attacks or depositions in a large or complex target area. In such cases warnings will be plain language statements of a more general nature, indicating areas affected and expected movement of the hazard.

- Example 1*:*

  MERWARN NBC3 (CHEM)

  ALPHA/DA/CBRNCC-4/003/C//

  DELTA/020300ZSEP1999//

GENTEXT/ PERSISTENT NERVE AGENT VAPOUR HAZARD EXISTS FROM NORFOLK TO HATTERAS AT 020300Z SEP 1999 AND IS SPREADING SOUTH-EASTWARDS AT 017 KNOTS. SEA AREA OUT TO 100 NAUTICAL MILES FROM COAST LIKELY TO BE AFFECTED BY 020600ZSEP1999//

- Example 2:

MERWARN NBC3 (CHEM)

ALPHA/DA/CBRNC-3/003/C//

DELTA/020300ZSEP1999//

GENTEXT/ PERSISTENT NERVE AGENT VAPOUR HAZARD AT 020600 SEP 99 IS ESTIMATED TO BE OCCURRING OVER MOST OF THE SEA AREAS OUT TO 40 MILES EAST OF THE COAST LINE FROM NORFOLK TO HATTERAS. HAZARD IS EXPECTED TO HAVE DISPERSED BY 021000Z SEP1999//

(2) MERWARN Diversion Order. This is a general diversion order, based upon the threat, whereby merchant ships proceeding independently are passed evasive routing instructions of a general nature. In addition to the origination of a MERWARN NBC3 (CHEM) messages, naval authorities may, if circumstances dictate, broadcast general diversion orders, based upon the hazard areas, whereby merchant ships proceeding independently will be passed evasive routing instructions of a more general nature, using the standard Naval Control of Shipping (NCS) identifier MERWARN DIVERSION ORDER.

MERWARN DIVERSION ORDER

English Channel closed. All shipping in the North Sea is to remain north of 052 degrees N until 031500ZSEP1999.

n. MERWARN Plotting. When a chemical attack is reported in a MERWARN NBC3 (CHEM) message, the following procedure should be followed:

- Plot the location of the attack from the details in line FOXTROT.
- Plot the coordinates or radius of the circle contained in line PAPA ALPHA.

If a MERWARN NBC3 (CHEM) is not received but either observations of an attack, or a local report of an attack is received, then the following procedure should be carried out:

(1) Mark the actual or suspected location of the attack on the chart.

(2) Draw a circle, radius 0.5 NM, centered on the attack location. From the center of the attack area draw the downwind direction which is contained in line CHARLIE of the MERWARN NBC CDM.

(3) Place the center of the ship's chemical template (Figure E-14) on the center of the attack area. Position the center line of the template on the downwind direction line.

(4) Keeping the center line of the template on the downwind direction, move the template upwind until the 20° lines of the template make tangents with the circle around the attack area.

(5) Mark the tangent lines using the holes in the template. Join these marks with the attack area circle.

(6) If the chemical agent is identified as nerve agent, take the downwind hazard distance for the miosis level from Annex E for the agent. Measure this distance from the center of the attack area on the downwind direction line and mark it. Through this point draw a line perpendicular to the downwind direction line until it meets the 2 tangents.

(7) If the agent is unknown then use the downwind hazard distance of 44 NM as this will be the worst case.

(8) The hazard area is now defined as the area bounded by:

- The upwind radius of the attack area.
- The 20° tangents.
- The downwind hazard distance line.

(9) Adjustments to the downwind hazard distance can be made as and when the agent is identified.

o. Simplified Procedure Requirements (SEA). The simplified procedure requires the following:

- Sea chart of the area of operation.
- Ship's Chemical Template.
- NBC1 (CHEM) or NBC2 (CHEM), and
- NBC CDM.

If a valid NBC CDM is not available, Figure E-19 may be used to determine the air stability category which is the basis for the determination of the maximum downwind hazard distance. This distance is determined from Table E-9. When using the simplified procedure, use the downwind hazard distances related to miosis. The representative downwind direction and downwind speed must be determined on board.

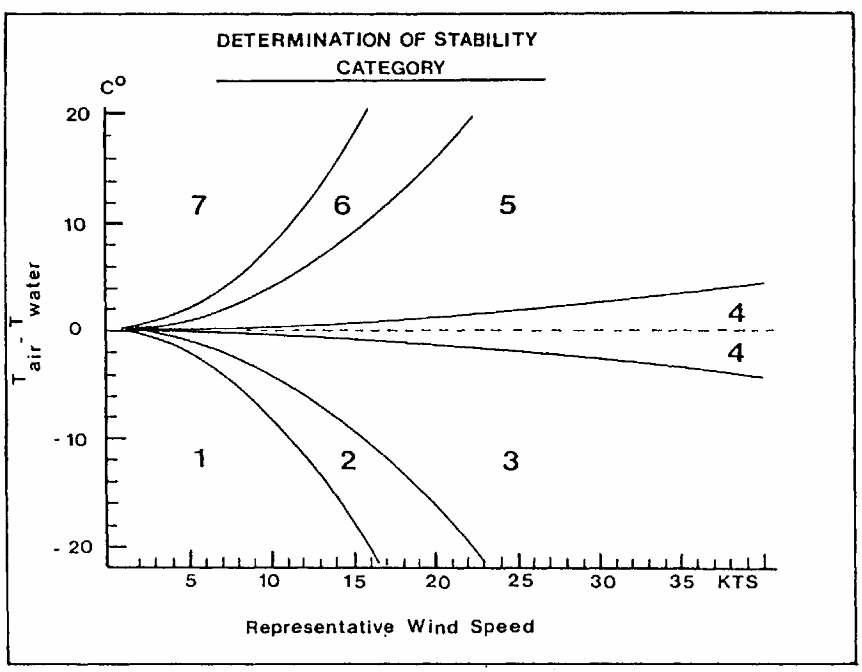


Figure E-19. Graph for Determination of Air Stability Category (SEA)

Table E-9. Downwind Hazard Distance Versus Wind Speed (KTS) and Air Stability, SEA

	Agent: SARIN Weapon: ARTILLERY (CANON/MORTAR) Effective Payload: 650 kg									Agent: SOMAN Weapon: ROCKET/MISSILE Effective Payload: 250 kg							
STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	2	2	LCt50	WIND	<1	<1	<1	<1	<1	<1	<1	LCt50
5 – 9	4	4	6	8	8	10	8	LCt5	5 –9	2	2	2	4	4	4	4	LCt5
KTS	4	6	8	10	12	12	12	MIOSIS	KTS	2	4	4	4	6	6	6	MIOSIS
WIND	<1	<1	<1	<1	<1	2		LCt50	WIND	<1	<1	<1	<1	<1	<1		LCt50
10 – 14	2	4	6	6	8	10		LCt5	10 – 14	2	2	2	2	4	4		LCt5
KTS	4	6	8	10	12	14		MIOSIS	KTS	2	2	4	4	6	8		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		<1	<1	<1	<1			LCt50
15 – 19		2	4	6	6			LCt5	15 – 19		2	2	2	2			LCt5
KTS		4	6	8	10			MIOSIS	KTS		2	2	4	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
20 – 24			4	4	6			LCt5	20 – 24			2	2	2			LCt5
KTS			4	6	8			MIOSIS	KTS			2	2	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
25 – 29			2	4	4			LCt5	25 – 29			2	2	2			LCt5
KTS			4	6	8			MIOSIS	KTS			2	2	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
30 – 34			2	4	4			LCt5	30 – 34			2	2	2			LCt5
KTS			4	4	6			MIOSIS	KTS			2	2	2			MIOSIS

Table E-9. Downwind Hazard Distance Versus Wind Speed (KTS) and Air Stability, SEA (Continued)

Agent: SARIN Weapon: BOMBS (6) Effective Payload: 600 kg									Agent: SARIN Weapon: Multiple Launched Rocket System Effective Payload: 3500 kg								
STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	2	2	LCt50	WIND	2	2	2	4	4	4	4	LCt50
5 – 9	4	4	6	6	8	8	8	LCt5	5 – 9	12	16	20	26	28	26	20	LCt5
KTS	4	6	8	10	12	12	10	MIOSIS	KTS	16	22	30	36	38	34	26	MIOSIS
WIND	<1	<1	<1	<1	<1	2		LCt50	WIND	2	2	2	2	4	4		LCt50
10 – 14	2	4	4	6	8	10		LCt5	10 – 14	10	14	20	26	30	32		LCt5
KTS	4	6	8	10	12	14		MIOSIS	KTS	16	20	28	38	44	42		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		2	2	2	2			LCt50
15 – 19		2	4	4	6			LCt5	15 – 19		10	16	20	26			LCt5
KTS		4	6	8	10			MIOSIS	KTS		16	22	30	38			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			2	2	2			LCt50
20 – 24			2	4	6			LCt5	20 – 24			12	18	22			LCt5
KTS			4	6	8			MIOSIS	KTS			18	26	34			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			2	2	2			LCt50
25 – 29			2	4	4			LCt5	25 – 29			10	14	20			LCt5
KTS			4	6	6			MIOSIS	KTS			16	22	30			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			2	2	2			LCt50
30 – 34			2	2	4			LCt5	30 – 34			10	12	18			LCt5
KTS			4	4	6			MIOSIS	KTS			14	20	28			MIOSIS

(1) Determination of the Hazard Area. The hazard area is determined as follows:

(a) The center of the attack area (line FOXTROT) is plotted on the chart. A circle representing the attack area, the radius of which is 0.5 NM, is drawn around the center (Figure E-14).

(b) The template for a simplified chemical hazard area prediction is placed on the chart in such a way that the center point of the template circle coincides with the center of the attack area. The value on the protractor corresponding to the downwind direction given in the NBC CDM must be oriented towards the north on the chart. This position of the template is marked on the chart by using the holes punched in the template along the downwind axis.

(c) The template is then moved back along the downwind axis until the radial lines become tangents to the circle (30 degrees standard). Use the holes punched out along the radial lines to mark the position and connect to the circle, forming tangents.

(d) The maximum downwind hazard distance is then marked on the downwind axis. Through this point, a line is drawn perpendicular to the downwind axis, to intersect the tangents (Figure E-20).

(e) When light winds are reported (wind speeds of 5 knots or less) in the NBC CDM, the hazard area is represented by a circle concentric to the attack area, with a radius equal to 15 NM.

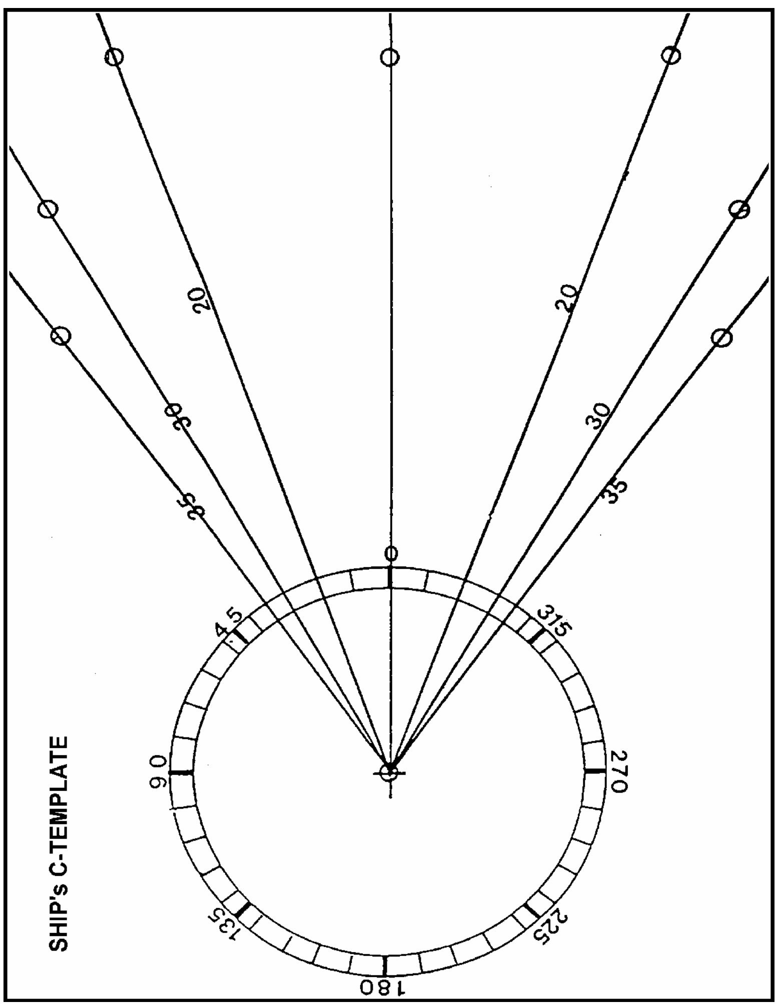


Figure E-20. Ship's Chemical Template (Example)

p. Detailed Procedure Requirements (SEA).

(1) Chemical Prediction Data Sheet (CPDS). The detailed procedure for prediction of chemical downwind hazard areas is designed for use at naval headquarters, and leads to a more accurate prediction than does the simplified procedure. The detailed procedure is based upon the information compiled in the CPDS and NBC1 (CHEM) or NBC2 (CHEM) reports. The CPDS (Table E-10) must be filled in immediately on receipt of a new and updated NBC CDM, and checked on the receipt of an NBC1 (CHEM) or NBC2 (CHEM) report, containing meteorological information in lines YANKEE and ZULU.

Table E-10. Example Chemical Downwind Message and CPDS

CHEMICAL PREDICTION DATA SHEET				
Agent: Sarin				
Delivery Means: Artillery				
Hazard Level: ICt5				
1	CBRN Cell: AMZ BSN			
2	AREA OF VALIDITY: NFEA			
3	ORIGINATOR OF CDM: F1Kdo/GEOPHYS B1St N			
4	DATE:11 JUN	**PERIOD**		
5	TIME OF VALIDITY: 0600Z-1200Z	**W**	**X**	**Y**
6	Downwind Direction (Degrees)	030	040	070
7	Representative Downwind Speed 10 m (KTS)	5	10	12
8	1.5 times the Wind Speed (KTS)	7.5	15	18
9	.5 times the Wind Speed (KTS)	2.5	5	6
10	Stability Category	1	3	4
11	Temperature (Centigrade)	14	15	16
12	Relative Humidity (Percent)	70	60	60
13	Significant Weather Phenomena	-	RAIN	RAIN
14	Cloud Coverage	-	-	-
15	Maximum Downwind Hazard Distance (NM)	4	6	6
16	Maximum Duration of Hazard (Hours)	2	1.2	1.2
17	Half Sector Angle (Degrees)	CIRCULAR	20	20
18	Remarks			

(2) Delineation of the Hazard Area. The delineation of the hazard area resulting from an attack with chemical agents requires information on the:

(a) Means of delivery.

(b) Location of the attack area as reported in NBC1 (CHEM) or NBC2 (CHEM).

(c) Representative downwind direction of the agent cloud (taken from CPDS).

(d) Maximum downwind hazard distance(s) related to the appropriate hazard level(s) (LCt_{50} and/or ICt_5 and/or miosis).

(e) Half-sector angle of the hazard area:

- 35 degrees for wind speeds higher than five knots, but less than ten knots.
- 20 degrees for wind speeds of ten knots and more.

(3) Low Wind Speeds. For wind speeds equal to five knots or less, the hazard area will be circular with radius equal to the downwind hazard distance for five knots wind speed. However, the radius should not exceed 15 NM.

q. Determination of the Downwind Hazard Area.

(1) Plotting the Downwind Hazard Area. To plot the chemical downwind hazard area on a sea chart or on General Operations Plot, the above information is used in the following way: (Figures E-20 and E-21).

(a) Plot the Location of the Attack Area. If the exact location (center of the attack) is known, draw a circle around this point with a radius of 0.5 NM. If only a dissemination area is reported, determine the center point of this area and draw a circle around this point, using a radius of 0.5 NM. If the size of the attack area is known to be larger, the radius must be adjusted accordingly.

(b) Plot the Downwind Direction. From the center of the attack area circle draw a line, representing the downwind direction.

(c) Draw the Tangents to the Attack Area. Draw two lines which, being tangents to the circle, form an angle equal to the half sector angle on either side of the representative downwind direction (downwind axis).

(d) Plot the Hazard Levels. Label the point on the downwind direction line (downwind axis), marking the extent of the downwind hazard distance(s) for the relevant level(s) of hazard (LCt50 and/or ICt5 and/or miosis). Draw a line through this (these) point(s), perpendicular to the downwind axis and intersecting the two tangents. The downwind hazard area(s) is (are) contained within this (these) line(s), the tangents and the upwind arc of the attack area circle.

(2) Low Wind Speeds. When low wind speeds are reported in the NBC CDM, (wind speed 5 knots or less), draw a circle concentric to the attack area circle, using the relevant downwind hazard distance as the radius. However, the radius should not exceed 15 NM (see Figure E-23).

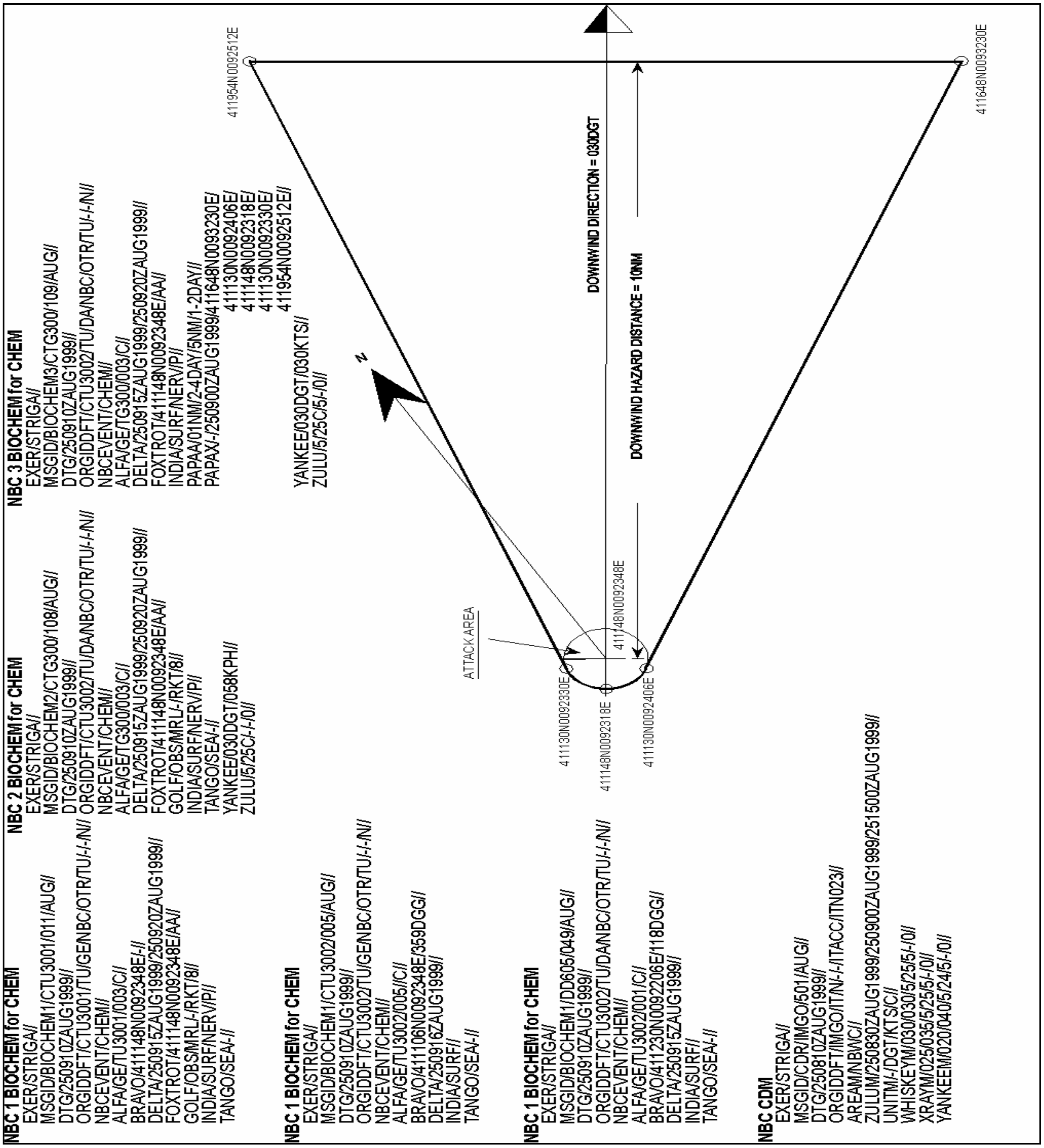


Figure E-21. Chemical Downwind Hazard Area Plot

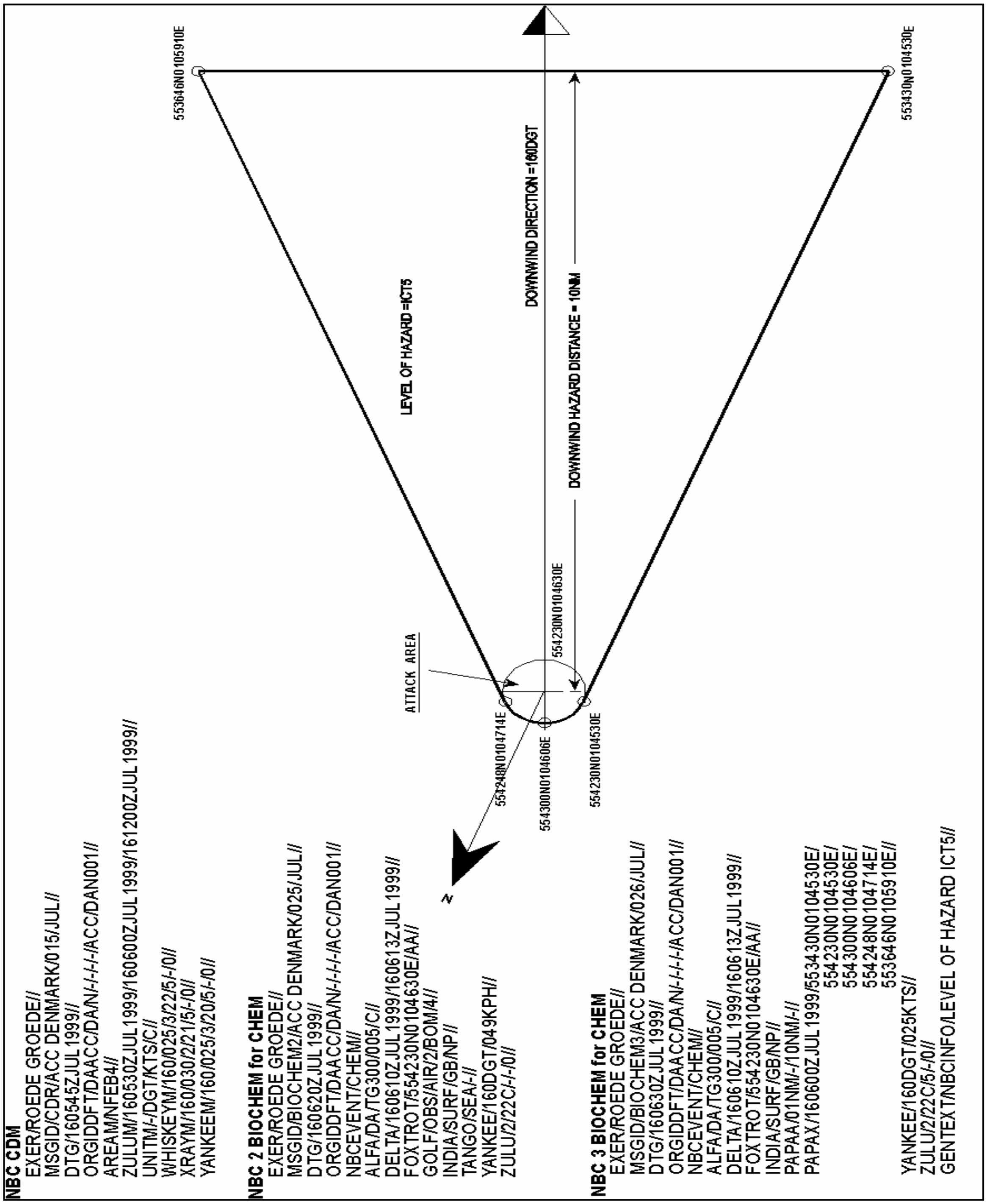


Figure E-22. Downwind Hazard Area, Type "A" Attack, Wind Speed ≥ 10 Knots

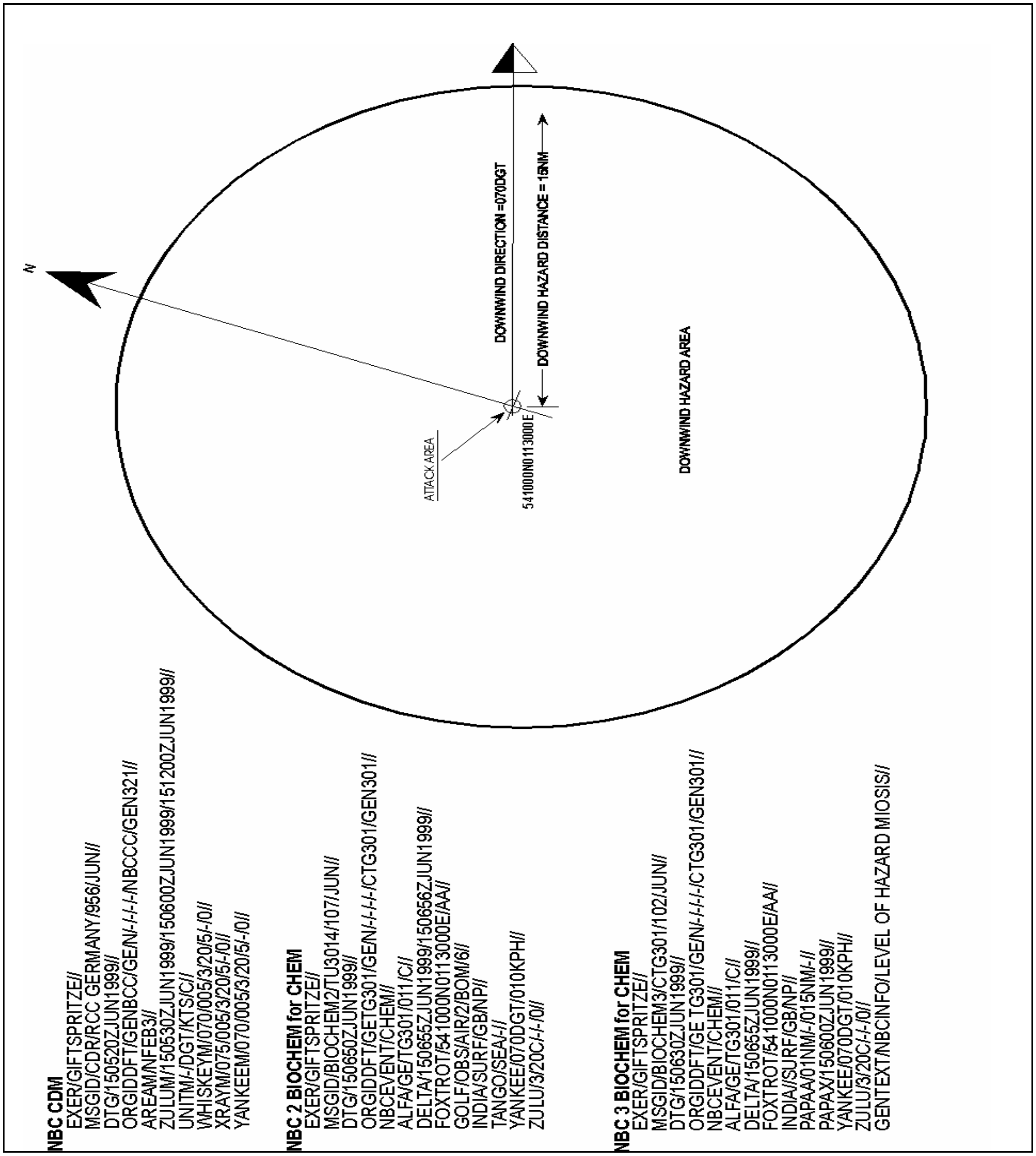


Figure E-23. Downwind Hazard Area, Type "A" Attack, Wind Speed ≤ 5 Knots or Variable

r. Change in MET Conditions.

(1) Adjustment Requirements. If the meteorological conditions change within the period of duration of the hazard, the predicted hazard area must be adjusted only if the:

(a) Stability category changes from one category to another, and/or

(b) Wind speed changes by more than 5 knots or from 5 knots or less to more than 5 knots and vice versa, or

(c) Wind direction changes by more than 20 degrees.

(2) Recalculation of Hazard. The new hazard area is determined by calculating the downwind distance that the agent cloud may have travelled at the time of the change in the meteorological conditions using the representative downwind speed. Consider this point to be the center point of a "new" attack area, and draw a circle around it with a radius equal to half the width of the hazard area at that point. From there on, repeat the steps using the procedure prescribed previously. The distance which the agent cloud may already have travelled, must be subtracted from the maximum downwind hazard distance under the new weather conditions. See Figure E-24.

(3) Agent Clouds Crossing the Coast Line. When a cloud from a chemical agent crosses the coast line from sea to land or vice versa, consider the point where the downwind direction line (downwind axis) intersects the coast line to be the center point of a "new" attack area. Follow the procedure described in paragraph f above using the appropriate tables for sea and land to determine the downwind hazard distances. When frequent changes occur, use the land procedure when working manually.

(4) Beginning and End of Hazard. In the case of air contaminating attacks (nonpersistent agent), the beginning and the end of the hazard at a given point may be determined using the:

(a) Representative downwind speed.

(b) Distance of the location from the edge of the attack area.

(c) Beginning and the end of the attack.

The following two formulas are used:

$t_B = (d_A \times 60) / (1.5 \times V_Z)$ or $t_B = (d_A \times 40) / V_Z$

and

$t_E = (d_B \times 60) / (0.5 \times V_Z)$ or $t_E = (d_B \times 120) / V_Z = 3 \times t_B$

Where

t_B = time in minutes from the beginning of the attack to the beginning of the hazard.

d_A = distance between the location and the downwind leading edge of the dissemination area (in NM).

d_B = distance between the location and the downwind trailing edge of the dissemination area (in NM).

V_Z = wind speed in knots. If necessary, the wind speed must be determined as the mean wind speed over several periods of validity of the NBC CDM.

t_E = time in minutes from the end of the attack to the end of the hazard.

Example:

Given: d_A = 5 NM, V_Z = 10 knots.

Using the formulas, t_B and t_E are calculated as follows:

t_B = (5 NM x 40) / 10 knots = 20 minutes, and

t_E = (5 NM x 120) / 10 knots = 60 minutes

(5) Hazard Arrival Time. The beginning of the hazard is expected at this location 20 minutes after the beginning of the attack and is expected to end 60 minutes after the end of the attack.

(6) Maximum Duration. The expected maximum duration of the air-contaminating hazard (i.e., when the calculated hazard is expected to be completely clear), may be obtained by using the maximum downwind hazard distance as $\mathbf{d_A}$, and calculating $\mathbf{t_E}$ from the formulas in paragraph (4) above.

(7) The CBRN Cells (must continuously check the NBC3 (CHEM) messages issued, in order to ensure that any new information (MET or CBRN) is considered. If necessary, a corrected NBC3 (CHEM) message must be transmitted.

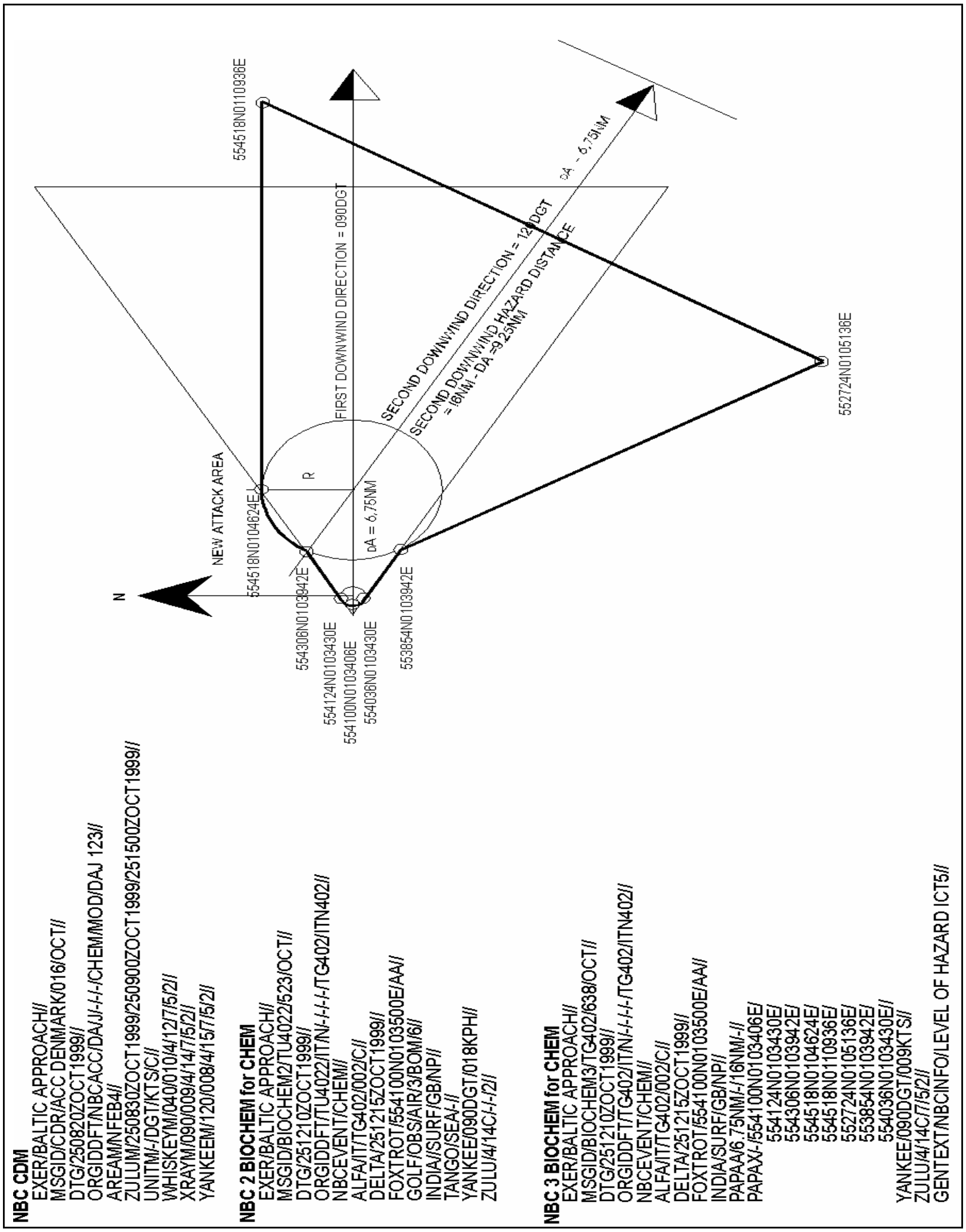


Figure E-24. Recalculation of Downwind Hazard Area, Type "A" Attack, After Change in Downwind Direction at Point B

s. NBC4 Report. When any unit detects CBRN hazards through monitoring, survey or reconnaissance, this information is reported using an NBC4 Report (see Table E-11). Separate NBC4 Reports are consolidated and then plotted on the tactical map to show where the hazard exists. If monitoring information is incomplete, a survey may be directed. Monitoring reports contain the type of agent detected (line INDIA) indicating type of chemical agent and persistency, the location of the sampling (geographical position) and type of sample (air sample, liquid sample or SICA sample) (line QUEBEC), the date-time of the detection (line SIERRA), and topography information (line TANGO).

Table E-11. Sample NBC4 (CHEM)

NBC4 (CHEM)			
Line Item	**Description**	**Cond**	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/C//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/UNK/NERV//
Q*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/-/DET//
R*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	ROMEO/20PPM//
S*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
T*	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
W	Sensor Information	O	WHISKEY/POS/POS/NO/MED//
Y*	Downwind Direction and Downwind Speed	M	YANKEE/270DGT/015KPH//
Z*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

(1) Lines QUEBEC, ROMEO, SIERRA and TANGO are a segment. With exclusion of lines ROMEO, this segment is mandatory. Lines/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

(2) If no chemical agent is detected, this should be reported by entering NIL into line INDIA. When all hazards from one attack are gone, the responsible CBRN Cell should report this in a NBC4 (CHEM) by entering NIL into line INDIA, and by entering "CHEMICAL FREE ATTACK" into line GENTEXT/CBRNINFO. To be able to identify the attack, the strike serial number (line ALPHA from the NBC2) must be included into the report.

(3) For detailed information regarding chemical reconnaissance refer to *Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical Reconnaissance.*

t. NBC5 Report. The NBC5 Report is prepared from the contamination plot. This report is last in order because it consists of a series of grid coordinates. Often this message must be sent on FM radio nets. This requires lengthy transmission. The recipient is required to plot each coordinate and redraw the plot. This report may also be sent as a map overlay.

For NBC5 (CHEM) Reports, line items INDIA (release information), OSCAR (reference time), and XRAY ALPHA (Actual Contour Information) are mandatory (see Table E-12).

Table E-12. Sample NBC5 (CHEM)

NBC5 (CHEM)			
Line Item	**Description**	**Cond**	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/C//
D	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERV/P/ACD//
O	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/201505ZSEP1997//
XA*	Actual Contour Information	M	XRAY ALPHA/LCT50/32VNJ575203/ 32VNJ572211/32VNJ560219/ 32VNJ534218/32VNJ575203//
XB*	Predicted Contour Information	O	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

* Line items are repeatable up to 50 ti mes to represent multiple contours

u. NBC6 Report. NBC6 Reports summarize information concerning CBRN and ROTA events. NBC6 Reports consist mainly of general text which gives information on the event (see Table E-13, page E-58).

Table E-13. Sample NBC6 (CHEM)

NBC6 (CHEM)			
Line Item	**Description**	**Cond**	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/C//
D	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack and Qualifier	O	FOXTROT/32UNB058640/EE//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/AIR/NERV/P/ACD//
Q	Location & Type Reading /Sample /Detection	O	QUEBEC/32VNJ481203/-/DET//
S	Date-Time-Group of Reading	O	SIERRA/202300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/CBRNINFO/SICA LAB REPORT HAS IDENTIFIED THE AGENT AS VX//

Appendix F

BIOLOGICAL CONTAMINATION AVOIDANCE TACTICS, TECHNIQUES AND PROCEDURES

As with all other forms of CBRN attacks or ROTA, an effective means of communication must be trained and rehearsed for the avoidance of biological contamination to be successful. Once a unit is aware that it may have been in a biological attack or is within a possible hazard area, the avoidance procedures throughout this manual can and should be initiated. The CBRNWRS should be used to relay information about the biological agents and hazards. As with all other forms of attack or ROTA, this must be done in an efficient and timely manner.

Biological avoidance requires an understanding of what biological agents are, how they may be employed, and what happens to the agents after they are released.

1. Background

Biological agents are broken down into two broad categories, pathogens and toxins.

a. Pathogens are infectious agents that cause disease in man, animals, or plants. Agents that constitute antipersonnel BW threats include bacteria, viruses, and rickettsias.

b. Toxins are poisonous substances produced as by-products of microorganisms (the pathogens), plants, and animals.

2. Biological Agent Dissemination Methods

There are three general methods of disseminating biological agents: aerosol, vector and covert. Each method is designed to get the agent into the body, and each targets a specific portal of entry in order to infect the individual.

a. Aerosol Dissemination.

(1) Biological Agents. Biological agents may be disseminated by ground or air bursting munitions, aircraft spray tanks, or boat or truck mounted aerosol generators. An aerosol attack will most likely occur in a covert (or hidden) manner. Dissemination is likely to occur at altitudes of 1,000 feet or less (100-foot optimum). Estimation of the hazard areas resulting from dissemination at altitudes greater than 1,000 feet above ground level requires extensive meteorological analysis.

(2) Toxins. Toxins can be disseminated as a liquid (such as "yellow rain"). This makes the toxin highly visible, and hazard will generally be limited to the immediate area of the attack.

(3) Aerosol Cloud Travel. In a tactical aerosol attack, the aerosol cloud (after initial formation) will travel downwind at a rate determined by wind speed. The cloud will lengthen and widen as it travels downwind. The length of the agent cloud will equal about one-third of the distance traveled. Units near the release point will encounter a more concentrated cloud. However, units located farther downwind (even though exposed to a less concentrated agent cloud) will be exposed for a longer period of time, so unprotected personnel may inhale a higher total dose. The peak danger area will be located in the area where the cloud stays intact while at the same time is at its maximum width and length.

This distance is approximately the maximum downwind hazard prediction for a chemical agent; therefore, it is vital to determine whether or not the attack is biological or chemical.

(4) Casualty Production. The biological agent cloud can cause both immediate and delayed casualties. This is due to the fact that each individual will receive a different dose and the time until the onset of symptoms will be dependent on the amount of agent received and each individual's physiological makeup. The onset of illness will also be affected by the reaction time and any other forms of protection (e.g., inoculation, masking time) that were available against the agent. Biological agent casualties can occur in an area as much as two times the maximum downwind hazard distance for a chemical agent.

(5) Dispersal and Settling Out. Traveling farther downwind, the cloud is exposed to environmental elements. It is subjected to dispersal, settling and impaction on terrain features. The agent cloud will lose much of its concentration and the losses will be such that the majority of unprotected personnel will not receive an infective (pathogen) or effective (toxin) dose. Dispersal will not be uniform and casualties may occur as far as four to five times the maximum downwind hazard distance of chemical agents. The following two examples illustrate biological aerosol:

(a) Bursting type munitions. When a biological projectile or bomb bursts on the ground or in the air, the filling (either a liquid slurry or dry powder), is initially dispersed in all directions. An effective ground bursting munition will project the majority of the filling into the air to form an aerosol cloud. Air bursting munitions may also form an aerosol cloud that will behave in a similar manner to a spray attack. The agent may also be designed to fall to the ground as a surface contaminant much like persistent chemical agents. The dimensions of the aerosol cloud will be influenced by the means of delivery, the weather conditions, and the terrain.

(b) Spray Tanks/Generators. Aircraft/vehicle spray tanks, or aerosol generators, may also be employed to form an aerosol cloud. This form of attack is likely to take place as covertly as possible.

b. Vector Dissemination. Some pathogens may be delivered by use of vectors such as fleas, ticks, lice, or mosquitoes. Many of these same vectors have carried diseases since recorded history, and the avoidance procedures listed should be practiced at all times to limit the potential for infection. The following problems limit the effectiveness of vectors.

(1) Controlling Vectors. One of the major difficulties with vectors is control. Once they are released, they are basically out of control and can attack anyone. Vectors, like mosquitoes, are quite mobile and can easily leave the area where they were released.

(2) Logistical and Production Problems. Getting a live, infective, pathogen inside a vector is a difficult proposition. Getting the vector inside a delivery vehicle that will not damage or kill the vector is another difficult issue. Doing these things and then delivering sufficient quantities of vectors to be effective in producing an outbreak of disease will be difficult.

c. Covert Dissemination. Sabotage and terrorist personnel may possess a variety of aerosol and contamination/poisoning techniques for various targets. Aerosol techniques can be fairly large operations, using aerosol generators (or foggers) that produce large open-air hazard areas. These techniques also can be more limited and selective, targeting the enclosed air space of key command and control facilities, aircraft, ships, troop billets, and other similar type areas. Biological agents in liquid, powders, or spray can be placed directly into foodstuffs at harvest, processing, distribution, and preparation points. They can also be placed into the water reservoir/distribution chain.

3. Avoidance Procedures

Avoidance procedures are broken down into actions before the attack, during the attack and after the attack. For biological attack(s) these procedures will also be broken down by the different dissemination methods. The lists given, while not all encompassing, it will assist in developing unit SOP and directives.

a. Aerosol Avoidance Procedures.

(1) Before the Attack.

(a) Subordinate units are alerted.

(b) Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and the rest and nutritional needs of the troops.

(c) Gain intelligence on threat capabilities and intentions.

(d) Seek out, intercept, and destroy enemy weapon systems, production facilities and storage sites.

(e) Instruct troops on the threat, how to recognize the attack and the protective measures to be taken.

(f) Train and drill on the fitting and putting on of protective mask and clothing.

(g) Set up collective protection systems for personnel, equipment, and supplies.

NOTE: Field expedient collective protection must be airtight.

(h) Identify backup (alternate) food, water, and supply sources.

(i) Establish detection and sampling procedures.

(j) Conduct vulnerability analysis.

(2) During the Attack.

(a) Recognize the attack.

(b) Initiate personnel protective measures. Masking is the first priority, but since the attack may be chemical or toxin, MOPP4 is required initially. For maximum protection and the lowest risk of incurring casualties, soldiers should wear protective clothing and masks for at least four hours after the unit has been attacked or the agent cloud is predicted or known to have passed through the unit area. Every effort must be made to identify the exact agent, including its characteristics. If the skin is contaminated, remove contamination immediately in accordance with FM 3-11.5.

(c) Repulse or eliminate delivery vehicle or weapons.

(d) Observe for distinguishing signs between biological and chemical agent attack or mixture of conventional and biological attack.

(e) Report the attack utilizing the CBRNWRS. A biological attack that can not be immediately identified will be reported as an NBC1 (UNK).

(3) After the Attack.

(a) Estimate the downwind hazard. Significant casualties in unprotected personnel can be at least two times the maximum downwind hazard distance for a chemical agent.

(b) Begin sampling/collection procedures according to unit SOP.

(c) Consume only sealed rations and properly contained water. Outer container surfaces, if exposed, must be properly decontaminated. Call preventive medicine personnel when safety of unit level water supplies is questionable. Ensure veterinary personnel inspect food storage depots and supply points. Replenish water supplies from water purification units.

(d) Separate biological casualties. Use minimum number of personnel (to limit exposure) to provide supportive medical care until evacuation.

b. Vector Avoidance Procedures.

(1) Before the Attack.

(a) Apply insect repellant on exposed skin.

(b) Gain intelligence on threat capabilities and intentions.

(c) Seek out, intercept, and destroy enemy weapon systems and production and storage sites.

(d) Instruct troops on the threat, recognition of the attack, and protective measures.

(e) Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and the rest and nutritional needs of the troops.

(2) During the Attack.

(a) Recognize and report suspicious indications of the vector attack (the sudden appearance of large numbers or strange kinds of insects not previously encountered in an operational area or the finding of vector bomblet cages).

(b) Cover exposed skin. Balance between protection and degradation of performance. Protective overgarments will not totally exclude a determined tick. Bloused trousers and rolled down and buttoned sleeves with insect repellant properly applied will probably afford as much protection with less degradation.

(c) Apply insect repellant liberally, especially to neck, face, ankle, and wrist areas.

(d) Report the attack.

(3) After the Attack.

(a) The units should coordinate with supporting medical authority for preventive medicine assistance.

(b) Begin insecticide and other pest control measures as outlined by preventive medicine personnel. Logistical support for unit-size pest control procedures should be a coordinated effort between the CBRN staff and the supporting medical authority. Physically remove body lice, ticks, and fleas by self aid and buddy aid as necessary.

(c) Make hazard estimates. Reconnaissance and medical reports may help the CBRN staff in assessing hazard areas.

c. Covert Avoidance Procedures:

(1) Before the Attack:

(a) Maintain operational security (OPSEC).

(b) Identify covert/sabotage threat force capabilities and intentions through intelligence.

(c) Arrange for security measures to be taken based upon threat assessment.

(d) Identify alternate supply sources for high-risk items.

(e) Instruct troops to be alert to dissemination devices or signs of covert tampering as intelligence dictates.

(f) Establish and enforce preventive medicine programs to include immunizations, area sanitation, personal hygiene standards, and rest and nutrition needs of the troops. Protection of food and water may prevent successful employment of a specific biological agent.

(2) During the Attack.

(a) Report the observation of an attack, the apprehension of enemy agent(s) engaged in such activity, or the finding of signs and indications of covert attacks.

(b) Initiate personnel and collective protection. For maximum protection and the lowest risk of incurring casualties, soldiers should maintain protective posture for at least four hours.

(3) After the Attack.

(a) Warn personnel downstream, downwind, and/or down supply lines. The CBRN Cell will warn based on at-hand medical and intelligence information and analysis of NBC1 Reports.

(b) In conjunction with the veterinary and surgeon general, initiate disposal and replacement of food, water, and other supplies. The CBRN cell can coordinate inspections and medically approved replenishment sources. Actions involving disposal of major quantities of food must be coordinated with the supporting veterinary personnel. Actions involving disposal of major quantities of other non-medical supplies should be coordinated with the CBRN cell.

(c) Initiate sampling based on knowledge, consent, and special sampling requirements as directed. If a BW attack is suspected, wash surfaces with at least a 5 percent solution of bleach. Bleach is a very effective form of decontamination for most biological warfare agents.

4. Biological Contamination Reporting, Prediction, and Plotting

In order for a unit to implement its passive avoidance measures, it would need advanced warning of potential contamination. The rest of this chapter deals with the various NBC reports, preparing them and prediction of hazard areas.

NOTE: Even though the information on NBC Reports below is found within other appendices in this manual, it will still be presented here for continuity.

a. NBC1 Report. The NBC 1 Report is the most widely used report. The observing unit uses this report to provide CBRN attack data. All units must be completely familiar with the NBC1 Report format and the information needed to complete the report. This report is prepared at unit level quickly and accurately, and then sent to the next higher headquarters or NBC cell as directed by OPORDs/directives. NBC1 Reports are not routinely passed to corps or higher CBRN cells except for the initial use report. Line items BRAVO (location of observer), DELTA (DTG), GOLF (means of delivery), INDIA (release information for CB or ROTA), and TANGO (terrain, topography, and vegetation description) are mandatory entries in the NBC1 (CHEM/BIO/UNKNOWN) report.

(1) Precedence. Precedence of the NBC1 Report depends on whether or not it is an initial report. The initial use of a CBRN weapons report is *flash* precedence; all others are *immediate* precedence.

(2) Report Preparation. Individuals identified by unit SOP submit raw data to the unit CBRN defense team. NBC1 format should be used; however, a size, activity, location, unit, time, equipment or spot report may also be used and should be submitted to the unit's CBRN defense team. The unit CBRN defense team normally consists of individuals that have been trained in CBRN defense. This ensures that the report is in the proper format and is as correct as possible.

(3) Sample NBC1 Report. Sample NBC1 Reports are provided below (see Table F-1). The column "Set" refers to the line item identification. The column "Cond" will show "O" which means operationally determined (O) or mandatory (M) for each message type. Operationally determined sets listed may be added or deleted at user discretion.

Table F-1. Sample NBC1 (BIO)

CHEM, BIO, or UNKNOWN			
Line Item	**Description**	**Cond.**	**Example**
A	Strike Serial Number	Will be assigned be the servicing CBRN Cell	
B	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/BIO/BG/DET//
T	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

b. NBC2 Report. The NBC2 Report is based on one or more NBC1 Reports. It is used to pass evaluated data to higher, subordinate, and adjacent units. The CBRN Cell is usually the lowest level that prepares NBC2 Reports. However, CBRN personnel at an intermediate headquarters may prepare the NBC2 Report if they have sufficient data. These intermediate headquarters, however, will not assign a strike serial number. The CBRN cell prepares the NBC2 report, assigns it a strike serial number, and disseminates it to the appropriate units. Each subordinate unit then decides whether to disseminate the report further. Line items ALPHA (strike serial number), DELTA (DTG), FOXTROT (location of attack), GOLF (means of delivery), INDIA (release information for CB or ROTA), and TANGO (terrain, topography, and vegetation description) are mandatory entries in the NBC2 (BIO). A sample NBC2 (BIO) report is provided at Table F-2 (page F-8).

Table F-2. Sample NBC2 (BIO)

BIO			
Line Item	**Description**	**Cond.**	**Example**
A	Strike Serial Number	M	ALPHA/US/A234/001/B//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/BIO/BG/DET//
T	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

c. NBC3 Report. Area CBRN centers use the NBC2 Reports and current wind information to predict the area of hazard. This prediction is disseminated as an NBC3 Report. It is sent to all units/activities that could be affected by the hazard. Each unit/activity prepares a plot of the NBC3 Report, determines which of its subordinate units/activities are affected, and warns them accordingly. Commanders should use this report as battlefield intelligence when planning missions. The NBC3 Report is a prediction of the hazard area. This prediction is safe-sided to ensure that a significant hazard will not exist outside of the predicted hazard area. As the JWARN is developed and fielded, it's built in models will give a more realistic depiction of the actual hazard area. Units within the hazard area must adjust their MOPP level if necessary. A sample NBC3 (BIO) Report is provided as Table F-3.

Table F-3. Sample NBC3 (BIO)

BIO			
Line Item	**Description**	**Cond.**	**Example**
A	Strike Serial Number	M	ALPHA/US/A234/001/C//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	O	GOLF/OBS/AIR/1/BML/-//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/BIO/BG/DET//
PA	Predicted Attack/Release and Hazard Area	M	PAPAA/1KM/3-10DAY/10KM/ 2-6DAY//
PX*	Hazard Area Location for Weather Period	M	PAPAX/201600ZSEP1997/ 32VNJ456280/32VNJ456119/ 32VNJ576200/32VNJ566217/ 32VNJ456280//
XB**	Predicted Contour Information	C	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

(1) In order to take action to avoid contamination, the commander needs to know where the contamination is located. The biological prediction procedure provides information on the location, the extent of the hazard area and the duration of the hazard resulting from attacks with biological weapons. It provides the necessary information for commanders to warn units within the predicted hazard area. The following definitions are used in predicting biological hazards.

(a) Attack Area. This is the predicted area immediately affected by the delivered biological agent.

(b) Hazard Area. This is the predicted area in which unprotected personnel may be affected by an agent spreading downwind from the attack area. The downwind distance depends on the type of attack and on the weather and terrain in both the attack area and in the area downwind of the attack area.

(c) Contaminated Area. This is the area in which a biological hazard may remain at hazardous levels for some time after the attack. The contamination may be in solid or liquid form. The actual shape and duration can only be determined by surveys and sampling.

(2) Biological Attacks can be categorized into the follow 4 groups based upon means of delivery and windspeed (Table F-4).

(a) Type "P". Type P consists of attacks with localised exploding munitions (such as: bomb (BOM), shell (SHL), Rocket (RKT), mine (MNE), surface burst missile (MSL)), surface release spray (SPR) or surface release aerosol generator (GEN).

(b) Type "Q". Type Q consists of attacks with munitions that cover a large area such as: bomblets (BML) or air burst MSL.

© Type "R". Type R consists of attacks where the location of the attack is known, but the type of container is unknown (UNK), or the attack was from an air release SPR or GEN.

(d) Type "S". Type S consists of detection after an unobserved attack.

NOTE: A surface release SPR or GEN should be treated as Type "R" if it is mobile and releases material over a distance exceeding 1 km.

Table F-4. Types and Cases of Attacks

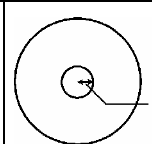
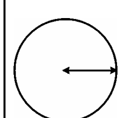
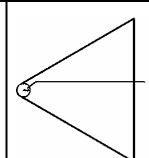
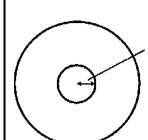
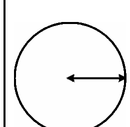
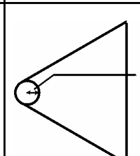
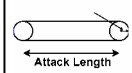
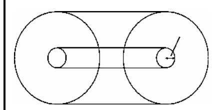
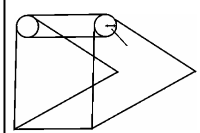
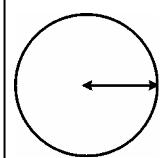
TYPE OF AGENT CONTAINER	RADIUS OF ATTACK AREA *	WIND SPEED	TYPE **	CASE	FIGURE
BOM, RKT, SHL, MNE, Surface Burst MSL, Surface release SPR, or GEN		≤ 10 KPH	P	1	
		> 10 KPH		2	
BML, Air Burst MSL		≤ 10 KPH	Q	1	
		> 10 KPH		2	

Table F-4. Types and Cases of Attacks (Continued)

Air release SPR and GEN, UNK		**≤ 10 KPH**	**R**	**1**	
		> 10 KPH		**2**	
Detection after unobserved attack **(NBC 4 BIO message)**			**S**	**1 / 2**	
NOTE: A NBC 1 may be received after an unobserved attack and should be treated as a NBC4. *** A different observed radius may be specified in GENTEXT.** **** If two types of attack are found, use the following order to determine which type of attack to use: Type "R", Type "Q", or Type "P".**					

(3) Hazard Prediction. Before a detailed prediction may be made, the CBRN staff will determine the type of BIO attack and the case. This information is crucial for the hazard prediction.

(a) Attack Location. Determine or estimate the location of the attack from the NBC1 Reports and mark it on a map overlay.

(b) Attack Areas. Determine or estimate the type of attack from the NBC1 Reports. The attack area is plotted as outlined below.

- Type P. The attack area for type "P" is drawn as a *not disclosed* (see ATP 45 (B), Annex I for actual data or use Type "A" chemical attack (Appendix E) information if Annex I is not available) radius circle, centered at the release location.
- Type Q. The attack area for Type "Q" is drawn as a *not disclosed* (see ATP 45 (B), Annex I for actual data or use Type "A" chemical attack (Appendix E) information if Annex I is not available) radius circle, centered at the release location.
- Type R. The attack area for Type "R" is defined by the line end points entered as two positions in set FOXTROT. A *not disclosed* (see ATP 45 (B), Annex I for actual data or use Type "A" chemical attack (Appendix E) information if Annex I is not available) radius circle is drawn at the center position, or at the two end positions, with tangents connecting the two circles together. If the flight direction cannot be established, assume it to be perpendicular to the wind direction. If only one position is reported in set FOXTROT, the line is *not disclosed* long centered on this point and oriented in the direction of the aircraft trajectory centered at the middle of the observed flight path.

- Type S. The attack area for Type "S" is drawn as a *not disclosed* (see ATP 45 (B), Annex I for actual data or use Type “A” chemical attack (Appendix E) information if Annex I is not available) radius circle, centered at the detection location. The attack area is unknown; this is only an initial area.

NOTE: Attack Area Enlargement or Reduction. The attack area for Types "P", "Q" or "R" may be reduced or enlarged based on available information specified in GENTEXT. In computer generated messages, this information will be formatted as RDS: XXXKM, always using three digits for the radius, e.g. RDS:045KM.

(4) Downwind Travel Distances.

(a) Downwind Travel. The downwind travel distance is defined as the distance travelled by the center of the cloud. The downwind travel distance is broken into three segments corresponding to the three time periods of the NBC CDR:

$$\mathbf{d_1 = u_1 t_1}$$

$$\mathbf{d_2 = 2u_2}$$

$$\mathbf{d_3 = 2u_3}$$

Using the following definitions:

d_1 = distance in km travelled within the NBC CDR two-hour period containing the attack.

d_2 = distance in km travelled within the next NBC CDR two-hour period.

d_3 = distance in km travelled within the third NBC CDR two-hour period.

u_1 = wind speed in KPH for the NBC CDR two-hour period containing the attack.

u_2 = wind speed in KPH for the next NBC CDR two-hour period.

u_3 = wind speed in KPH for the third NBC CDR two-hour period.

t_1 = hours remaining after the attack or detection within the NBC CDR two-hour period of validity corresponding to the attack.

(b) Special Cases:

- Wind Speed less than 10 Kmph. For any NBC CDR time periods where the wind speed is less than 10 KPH, a value of 10 KPH should be used for computations.

- Weather Data Available. Weather information may not be available for the full six-hour period after an attack. If this is the case, the hazard distances can only be calculated for the time weather is available.

(c) Calculating Downwind Travel Distance. To calculate the downwind travel distance, perform the following steps:

- If the attack or detection occurs in the first NBC CDR two hour time period, three downwind distances are calculated: d_1 using the first NBC CDR time period (set WHISKEY), d_2 using the second NBC CDR time period (set XRAY), and d_3 using the third NBC CDR time period (set YANKEE).

• If the attack or detection occurs in the second NBC CDR time period, 2 downwind distances are calculated: d_1 using the NBC CDR time during the period of attack/detection, d_2 using the third NBC CDR time period.

• If the attack or detection occurs in the third NBC CDR time period, only d_1 can be calculated.

(d) Total Downwind Distance (DA). The total DA of the center of the biological cloud is the sum of the three distances:

$$\mathbf{DA = d_1 + d_2 + d_3}$$

DA = total downwind distance in km.

(e) Leading and Trailing Edges. The leading and trailing edges for the current NBC CDR should also be computed based on the downwind distance path, using factors of 1.5 and 0.5, respectively:

DL = 1.5DA (leading edge distance in km)

DT = 0.5DA (trailing edge distance in km)

(f) Third Time Period. If only the third time period is applicable, the third time period must be extended to include the leading edge:

$$\mathbf{DE = DL - d_1 - d_2}$$

Where:

DE = extended distance in km travelled within the third NBC CDR two-hour period.

(5) Determining Initial Hazard Areas.

(a) Case “1” Attacks.

• Wind Speed. The wind speed is 10 KPH or less, so a wind speed of 10 KPH should be used.

• Radius of Hazard Area. The radius of the hazard area circle equals the attack area radius plus the product of a wind speed of 10 KPH times the time in hours remaining after the attack of detection in the corresponding CDR time period. For example, a Type “P”, Case “1” attack having a two-hour travel duration, the hazard area radius would equal:

2 hrs x 10 Kmph + 4 Km = 24 km (2 x 10 + 4)

(Time x Wind Speed + Radius for Case 1) = 24 Km

• Types “P”, “Q” and “S”. A single hazard area circle will result for Types “P”, “Q” and “S”. The area within this circle represents the hazard area.

• Type “R”. Two circles are drawn for Type “R” with tangents drawn between the hazard area circles. The total enclosed area represents the hazard area.

• Case “1” Downwind Distance. A value of zero is used for the downwind distance path, leading edge, and trailing edge computations for Case “1” attacks, since the wind direction is considered variable. The leading edge can be considered to be the edge of the hazard area circle.

(b) Case “2” Attacks “P”, “Q” and “R” Types.

- Downwind Direction. Determine the downwind direction from the NBC CDM. Draw a line through the center of the attack circle oriented in the downwind direction.

- Type “R” Release. For a Type “R” release, choose one of the attack area circles. Calculate the downwind distance fro the first period (d_1). This is accomplished in the same manner as in paragraph (4)(a), by the time x wind speed + radius of circle. The line should extend distance d_1 in the downwind direction from the center of the circle. In the upwind direction along the same line, mark a distance equal to twice the attack circle radius.

- End of (d_1). Draw a line perpendicular to the downwind direction line at the downwind distance (d_1) extending in both directions.

- Tangent Lines. Draw two lines tangent to the attack circle from the upwind point marked extending until they intersect with the perpendicular line. These lines will form a 30-degree angle on either side of the downwind direction line.

- Type “R” Release. For a Type “R” release, repeat this procedure for the other attack area circle, and connect the lower hazard area corners to enclose the combined downwind hazard area.

- Type “S” Release. For a Type “S” release, there is no hazard area plotted because the location and time of the release are unknown. A 25 km radius circle defines an area where there is a risk of being exposed to the biological agent. Informing friendly units throughout the area of this risk should be considered. Before a hazard prediction can be carried out, reports are required from units in the area or survey teams. Once more information about the attack has been obtained; type “S” attacks should then be treated as either type “P”, “Q” or “R”.

(6) Prediction of the Initial Hazard.

(a) Type "P", Case "1" Attack

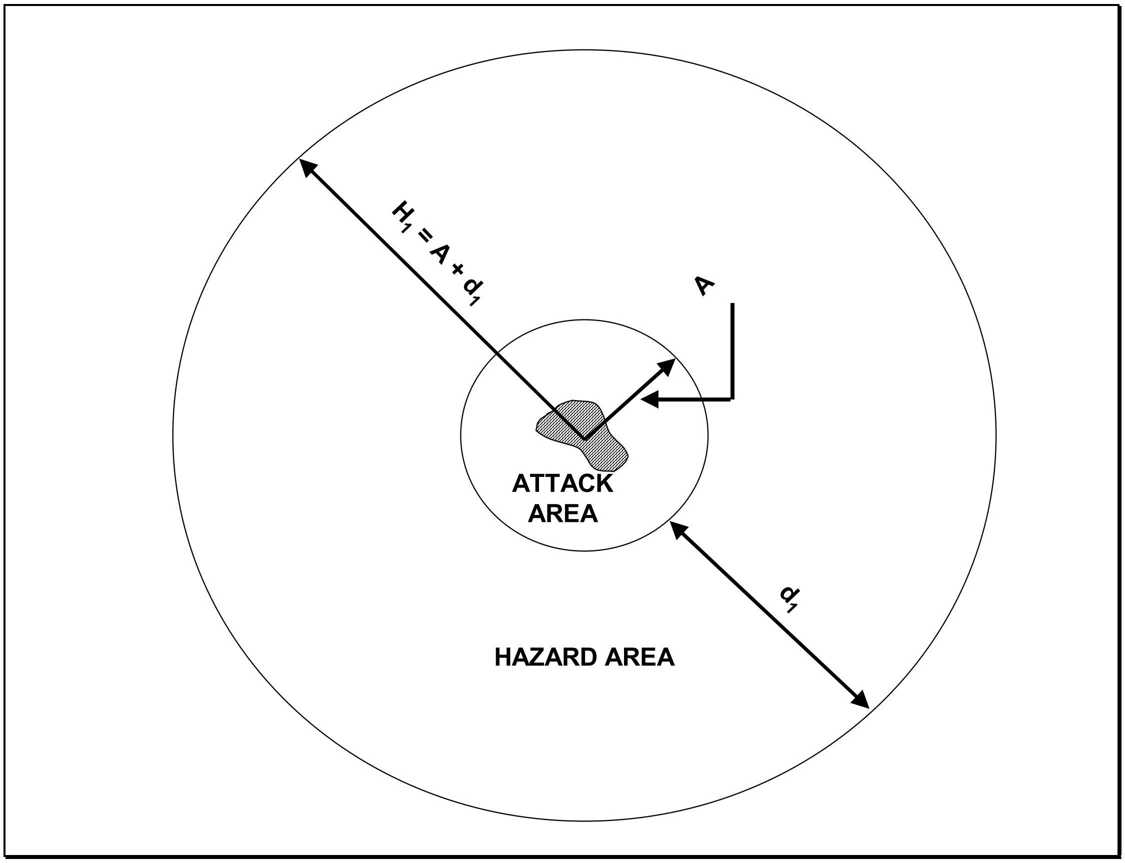


Figure F-1. Type "P", Case "1" Attack

NOTE: A = radius of attack area, H_1 = radius of initial hazard area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed (10 KPH), $H_1 = A + d_1$, $d_1 = u_1 \times t_1$

- Step 1. Obtain the location of the attack from the relevant NBC BIO message(s) (line FOXTROT) and plot it on the map (see Figure F-1).

- Step 2. Draw a circle with a radius A, around the center of the attack location. The area within this circle represents the attack area.

- Step 3. Draw a circle with a radius (H_1) that equals the radius of the attack area (4 km) plus the downwind travel distance (d_1). Distance d_1 is equal to the wind speed (u_1) for the CDR time period times the remaining time (t_1) from the attack within that CDR time period. **NOTE: For Type "P", Case "1", a wind speed of 10 KPH is assumed. This circle will represent the hazard.**

- Step 4. Prepare and transmit an NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs using the prediction in Figure F-1.

(b) Type "P", Case "2"

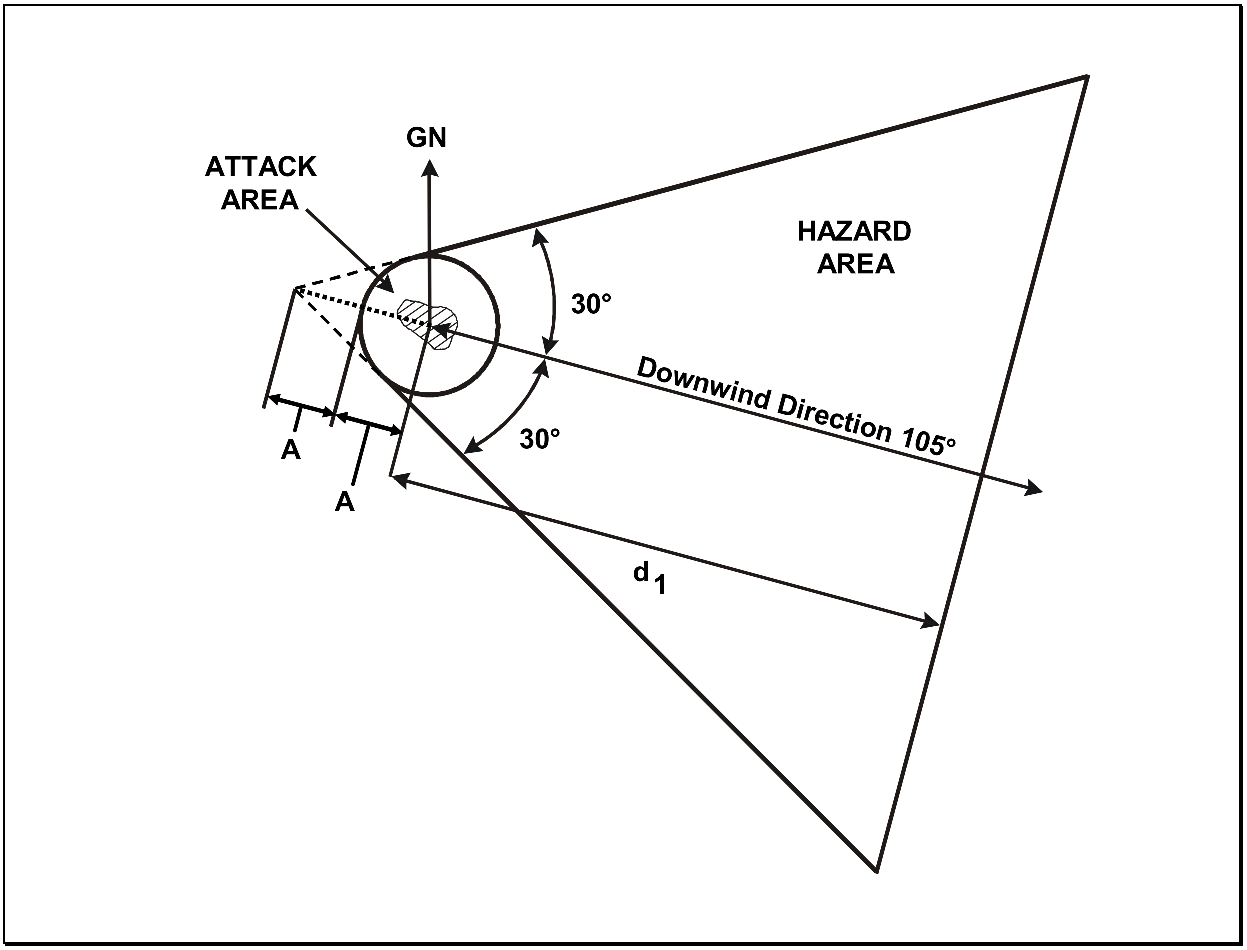


Figure F-2. Type "P", Case "2"

NOTE: A = radius of attack area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed, $d_1 = u_1 \times t_1$

- Step 1. Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map (see Figure F-2).

- Step 2. From the center of the attack location, draw a Grid North line (GN Line).

- Step 3. Draw a circle with the attack area radius around the center of the attack location. The area within this circle represents the attack area.

- Step 4. Using the valid NBC CDM, identify the downwind direction and the downwind speed.

- Step 5. From the center of the attack area, draw a line showing the downwind direction.

- Step 6. Determine the Downwind Travel Distance, d1. If d1 is less than the attack area radius set it equal to the attack area radius.

• Step 7. Plot the downwind travel distance from the center of the attack area on the downwind direction line.

• Step 8. From the downwind travel distance, draw a line perpendicular to the downwind direction line. Extend the line to either side of the downwind direction line.

• Step 9. Extend the downwind direction line twice the attack area radius upwind from the center of the attack area. This is equal to twice the radius of the attack area.

• Step 10. From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the perpendicular to the downwind direction line. These lines will form a 30° angle either side of the downwind direction line.

• Step 11. The hazard area is taken to be the area bounded by: the upwind edge of the attack area circle; the two 30° tangents; the perpendicular to the downwind direction line.

• Step 12. Prepare and transmit an NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(c) Type "Q", Case "1"

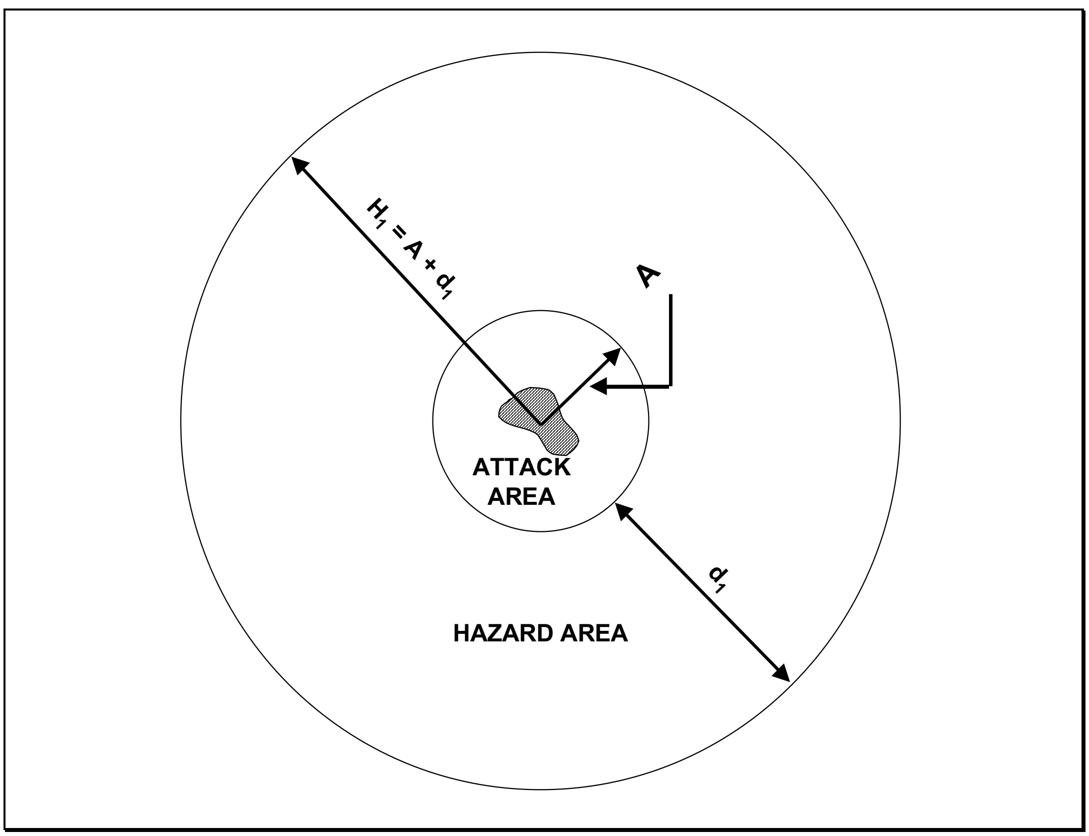


Figure F-3. Type “Q”, Case “1”

NOTE: A = radius of attack area, H_1 = radius of hazard area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed (10 KPH), $H_1 = A + d_1$, $d_1 = u_1 \times t_1$

- Step 1. Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map (see Figure F-3).

- Step 2. Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map.

- Step 3. Draw a circle with the attack area radius around the center of the attack location. The area within this circle represents the attack area.

- Step 4. Draw a circle with a radius equal to the distance d_1 (10 KPH times the travel duration) plus the radius of the attack area. This circle will represent the hazard area.

- Step 5. Prepare and transmit a NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(d) Type "Q", Case "2"

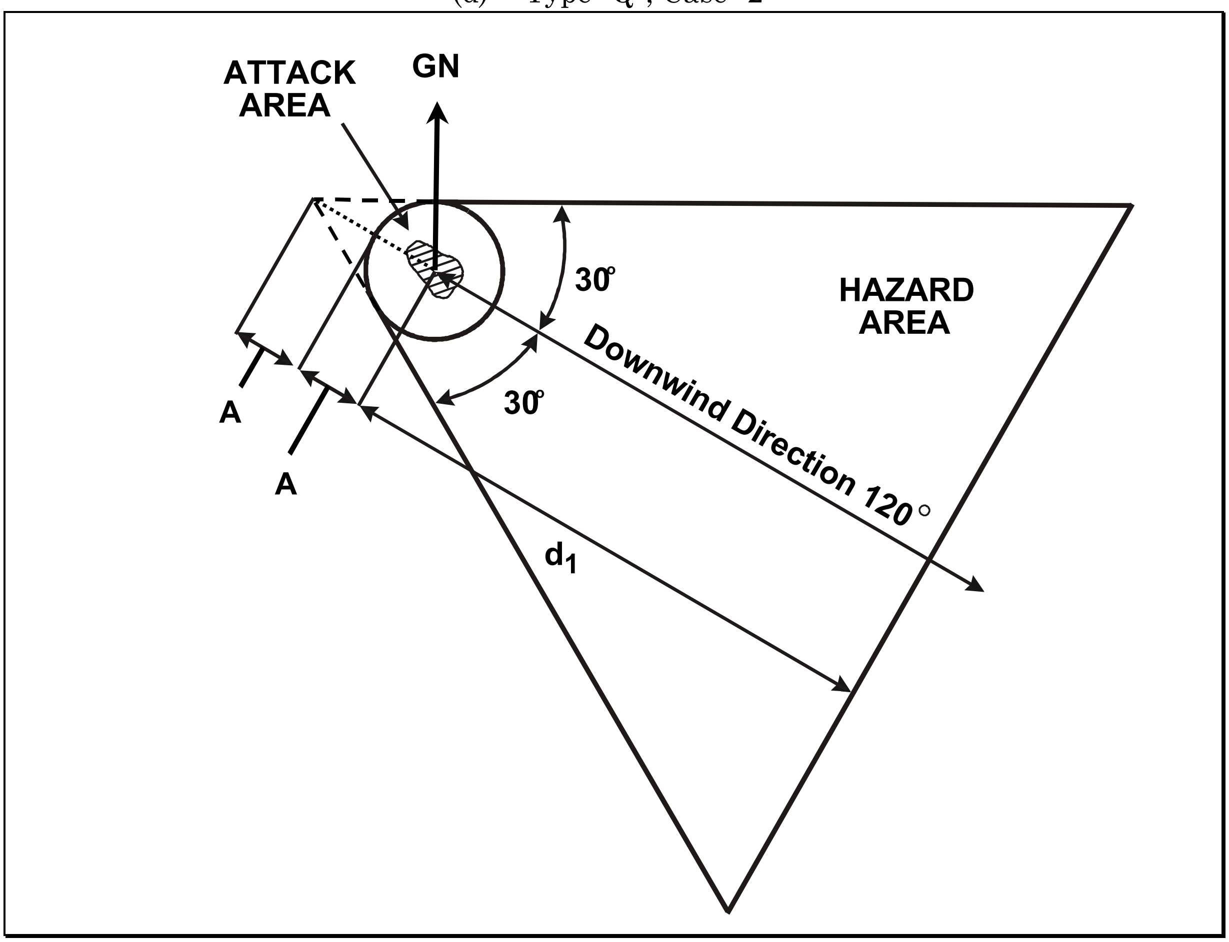


Figure F-4. Type "Q", Case "2"

NOTE: A = radius of attack area, H_1 = radius of hazard area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed (10 KPH), $H_1 = A + d_1$, $d_1 = u_1 \cdot t_1$

- Step 1. Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map (see Figure F-4).

- Step 2. From the center of the attack location, draw a Grid North line (GN Line).

- Step 3. Draw a circle with the attack area radius, around the center of the attack location. The area within this circle represents the attack area.

- Step 4. Using the valid NBC CDM, identify the downwind direction and the downwind speed.

- Step 5. From the center of the attack area, draw a line showing the downwind direction.

- Step 6. Determine the Downwind Travel Distance, d_1 [See paragraph 4.c.(7).(a)]. If d_1 is less than the attack area radius set it equal to the attack area radius.

- Step 7. Plot the downwind travel distance from the center of the attack area on the downwind direction line.

- Step 8. From the downwind travel distance, draw a line perpendicular to the downwind direction line. Extend the line to either side of the downwind direction line.

- Step 9. Extend the downwind direction line twice the attack area radius upwind from the center of the attack area. This is equal to twice the radius of the attack area.

- Step 10. From the upwind end of this line, draw 2 lines that are tangents to the attack area circle, and extend them until they intersect with the perpendicular to the downwind direction line. These lines will form a 30° angle either side of the downwind direction line.

- Step 11. The hazard area is taken to be the area bounded by: the upwind edge of the attack area circle; the two 30° tangents; the perpendicular to the downwind direction line.

- Step 12. Prepare and transmit an NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(e) Type "R", Case "1"

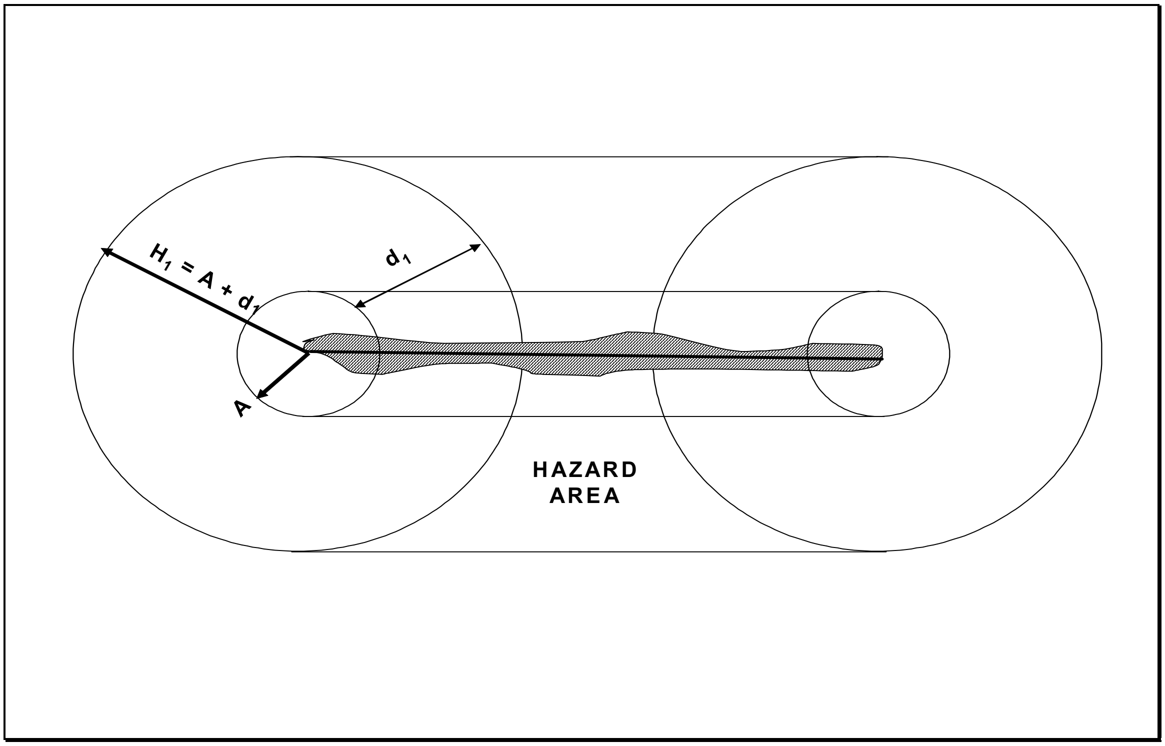


Figure F-5. Type "R", Case "1"

NOTE: A = radius of attack area, H_1 = radius of hazard area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed (10 KPH), $H_1 = A+d_1$, $d_1 = u_1 \times t_1$

- Step 1. Obtain the locations of the attack end points from the relevant NBC BIO message(s) (set FOXTROT) and plot them on the map. Connect the end points to form the attack line.
- Step 2. Draw a circle with the attack area radius around each end point.
- Step 3. Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.
- Step 4. Draw a circle with a radius equal to the distance d_1 (10 KPH times the travel duration) plus the radius of the attack area.
- Step 5. Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the hazard area (Figure F-5).
- Step 6. Prepare and transmit a NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(f) Type "R", Case "2"

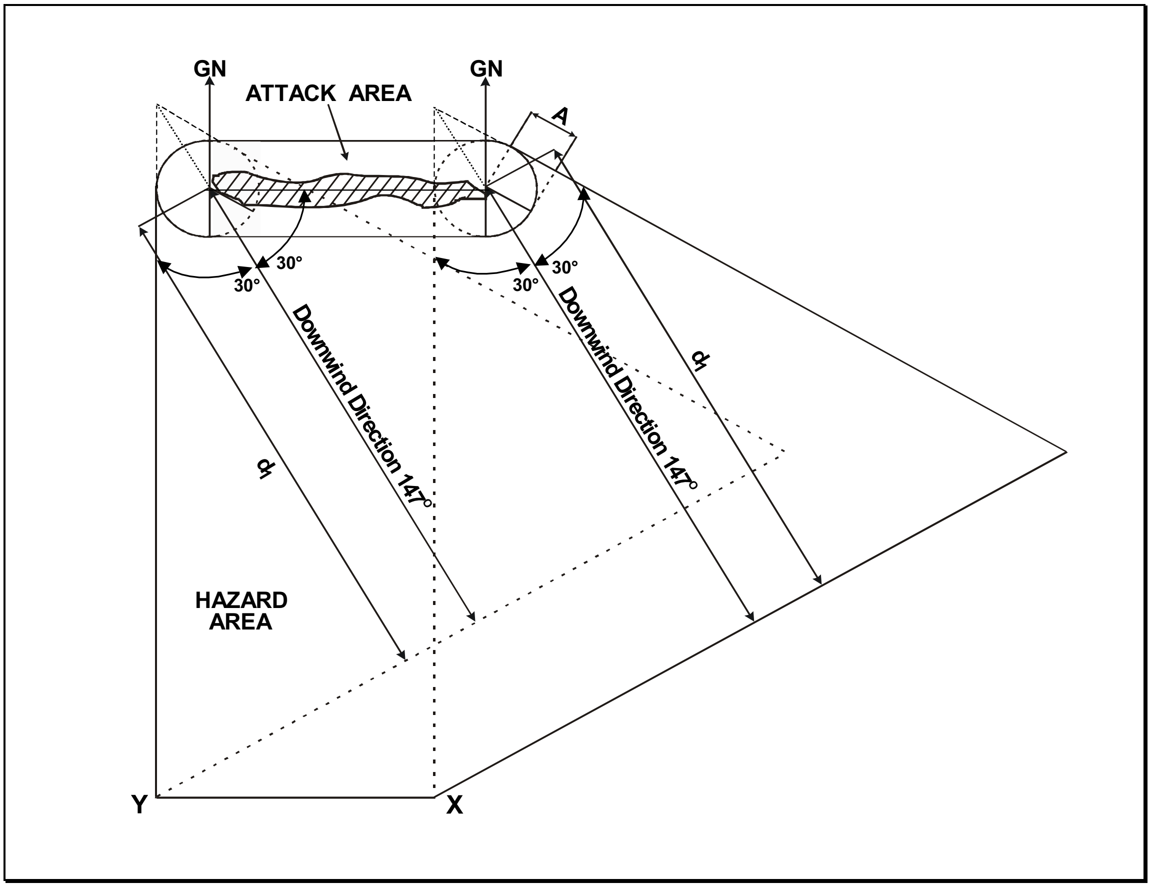


Figure F-6. Type "R", Case "2".

NOTE: A = radius of attack area, d_1 = downwind travel distance in the CDR time period, t_1 = time remaining from attack in the CDR time period, u_1 = wind speed, d_1 = u_1 x t_1

- Step 1. Obtain the locations of the attack end points from the relevant NBC BIO message(s) (set FOXTROT) and plot them on the map. Connect the end points to form the attack line.
- Step 2. Draw a circle with the attack area radius around each point.
- Step 3. Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.
- Step 4. Draw a Grid North line from the center of each circle.
- Step 5. Using the valid NBC CDM, identify the downwind direction and the downwind speed.
- Step 6. From the center of each attack area circle, draw a line showing the downwind direction.
- Step 7. Determine the downwind travel distance, d_1.
- Step 8. Plot the downwind travel distance from the center of each attack area circle on the downwind direction lines.

- Step 9. From the downwind travel distance, draw a line perpendicular to each of the downwind direction lines. Extend the lines to either side of the downwind direction lines.

- Step 10. Extend the downwind direction lines twice the attack area radius upwind from the center of each attack area circle. This is equal to twice the radius of the attack area.

- Step 11. From the upwind end of each line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the perpendiculars to the downwind direction lines. These lines will form a 30° angle either side of the downwind direction lines.

- Step 12. Draw a line connecting the downwind corners of the 2 hazard areas (Points "X" and "Y" in Figure F-6).

- Step 13. Prepare and transmit a NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(g) Type "S", Case "1" and "2"

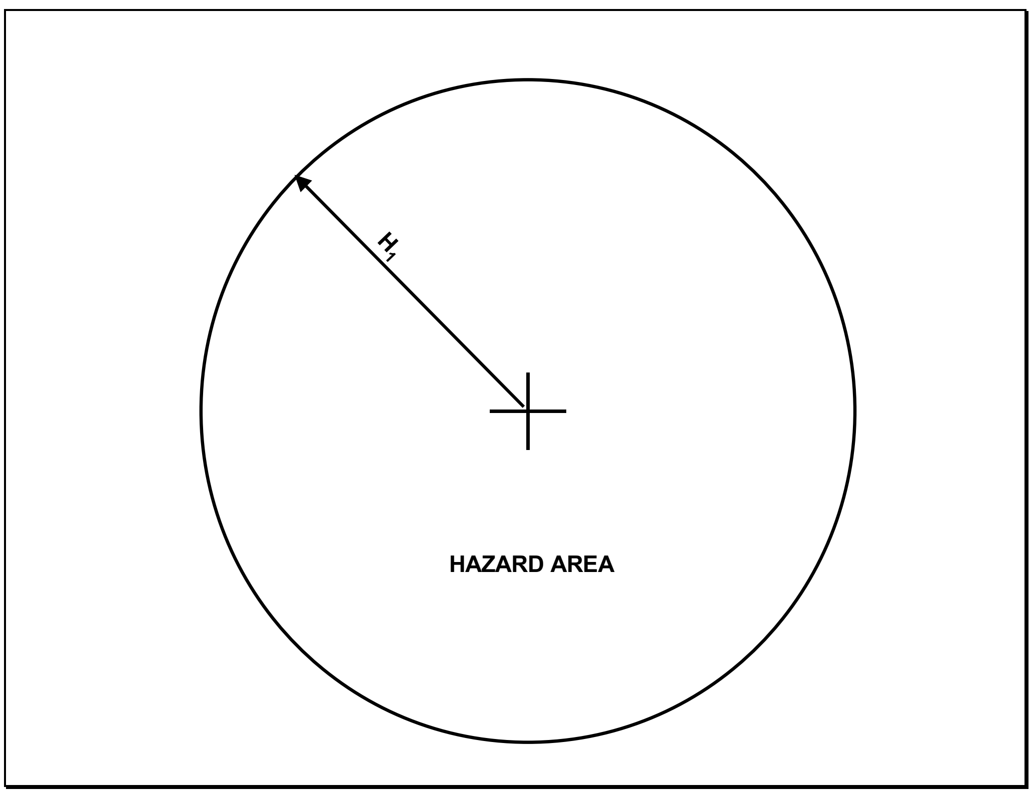


Figure F-7. Type “S”, Cases “1” and “2”

Note: H_1 = radius of hazard area

- Step 1. Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT or QUEBEC) and plot it on the map (see Figure F-7).

- Step 2. Draw a circle with the attack area radius, around the center of the detection location. The area within this circle represents both the attack area and the hazard area.

- Step 3. Prepare and transmit a NBC3 (BIO) to units and installations in the predicted hazard area in accordance with SOPs.

(7) Adjusted Hazard Prediction. When the wind direction does not change by 30 degrees or more, and does not drop below 10 KPH, the total downwind distance can be used to calculate a single hazard area as shown in Figure F-9. The leading and trailing edges should also be computed, starting at the attack location. The leading and trailing edges should be displayed with lines drawn perpendicular to the downwind distance path, extending to the tangent lines. After significant weather changes, the NBC3 report may no longer be accurate or apply. An adjusted NBC3 Report must be sent to unit/installations in the new hazard area, if possible. Also notify units who may no longer be in the hazard area. Significant weather changes are:

- Representative downwind speed of 10 kmph or more, or if the windspeed increases from less than 10 kmph to more than 10 kmph or the reverse.
- Downwind direction by 30 degrees or more.

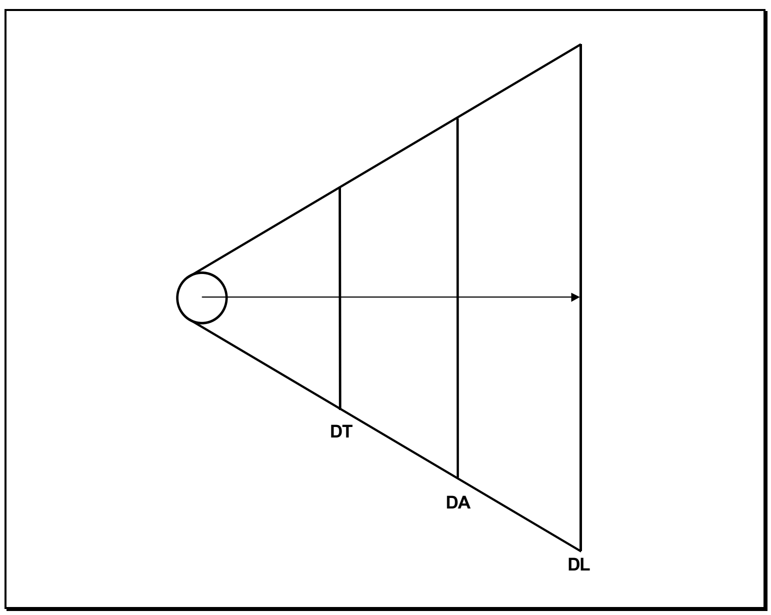


Figure F-8. Type "Q", Case "2" With Constant Wind Speed

(a) When the wind direction changes by 30 degrees or more or the wind speed changes between Case "1" and Case "2", the recalculation procedures from Appendix E. should be used for Type "A" chemical, as shown in Figure F-10.

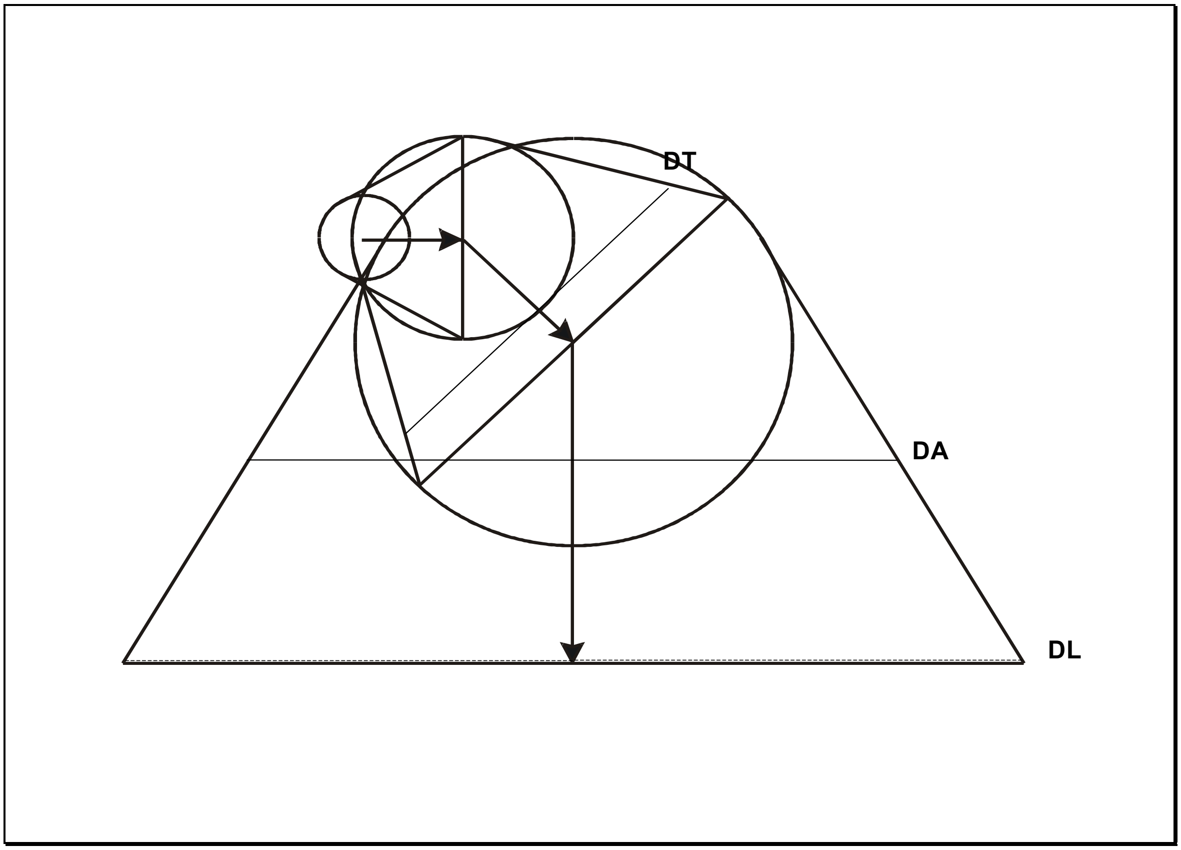


Figure F-9. Type Q, Case 2 Attack, 1 hour into CDR, Changing Downwind Direction

- Draw the attack area circle and initial hazard area for the NBC CDR time period containing the attack. For type “S” attack, draw the attack area radius circle centerd on the observation location and wait for more information.

- The hazard area at the end of that time period is drawn as a circle centerd at the downwind edge (d_1) having a radius equal to the distance along the perpendicular line from the downwind direction line to one of the tangents.

- If the next time period is Case “1” extend this circle by the distance d_2.

- If the next time period is Case “2” draw a new downwind direction line for the new time period of distance d_2 from the end of the d_1 line. Repeat the triangle procedure with the circle just drawn being the new attack area.

- Draw the circle containing the hazard area at the end of the second time period as for the end of the first time period.

- Construct the hazard area for the third time period as described for the second time period. For Case “2”, use the extended distance DE to include the leading edge.

- The hazard area for the current NBC CDR includes the combined areas drawn for the initial hazard area and hazard areas associated with the second and third time periods, if applicable.

(b) NBC3 (BIO) should be generated corresponding to the current NBC CDR time periods. The hazard area defined in set PAPAX should only include those points computed for the current NBC CDR which should be extended to 6 hours from the time of the attack. In this case, the hazard area for no more than 3 time periods of 2 hours will appear in PAPAX.

(c) The leading and trailing edges are computed along the downwind distance path, starting at the attack location. The leading and trailing edges should be displayed with lines drawn perpendicular to the downwind distance path, extending to the tangent lines for the time period containing each distance.

(d) For Type "S" attacks notice should be taken of the location of enemy positions further upwind of the hazard area, calculated in accordance with paragraph 4.c.(9).(g). The area between the enemy positions and the template should be considered as being potentially BIO contaminated, with appropriate warnings issued and protective measures taken.

(e) For Type "S" attacks, if a new detection is made outside of the hazard area, the procedures for in 4.c.(9).(g) should be repeated for the new location.

(8) Hazards spanning multiple CDM messages.

(a) Before proceeding to the next CDR, the downwind hazard area should be recalculated. The third time period for the recalculation is not to be extended to include the leading edge, e.g. distance d_3 should be used in place of distance DE; however, the leading and trailing edge distances still need to be computed and plotted as points. Distance DA is also not to be extended to result in 6 hours total time. Rather, d3 will end at the end of the current CDR (e.g., $2u_3$). If the attack occurs in the second or third CDR time period only two or one distance will result, as described in paragraph 4.c.(7).(a). If actual measured meteorological conditions have been recorded during a current NBC CDR, a better estimate of the current hazard area will be obtained.

(b) An attack circle for the end of the current NBC CDR is drawn centered at the current downwind location and then extended to the tangent lines, as described in as described in paragraph 4 a.(10)(a) second bullet. This attack circle defines the extent of the cloud at the end of the current NBC CDR. If this circle does not include both the leading and trailing edge distances, the circle radius should be enlarged around the current downwind location until both points are included.

(c) The hazard area for the next 6 hour time period should be computed when the next NBC CDR is received. If the next NBC CDR has not been received, the last time period for the current NBC CDR should be used for WHISKEYM, XRAYM, and YANKEEM. When the next NBC CDR is received, the hazard prediction should be recalculated. The hazard area should then be reported in PAPAX of a new NBC3 (BIO).

(d) Hazard areas should continue to be computed until no further contamination can be confirmed, or until the hazard duration that follows in paragraph 4.c.(12) has been reached. Attention should still be paid to the previously calculated areas, which may be contaminated until the end of agent effectiveness.

(11) Termination of Biological Hazard Assessment. For biological attack Types "P", "Q" and "R" where the NBC3 (BIO) was generated from one or more NBC1 (BIO) with biological agent UNK, the NBC3 (BIO) computations may be terminated if a chemical agent is confirmed. Otherwise, biological hazard assessment should continue until further information is available.

(9) Hazard Duration**.** Upon confirmation of a specific biological agent or toxin, the expected duration of viability of the agent should be recorded in the second field of set PAPAA. The attack area radius computed for the current NBC CDR should be entered into the first field of set PAPAA. This duration may be obtained from a database on such agents. Agents may continue to be a hazard on the ground in the contaminated area from days to potentially years.

d. NBC4 Report. NBC4 (BIO) (see Figure F-5) is the recorded result of an initial detection, reconnaissance, survey, or monitoring action at a location being checked for the presence of biological agents. Each QUEBEC/ ROMEO/ SIERRA/ TANGO/ WHISKEY/ YANKEE/ ZULU segment in every NBC4 (BIO) is a record of one contamination sample point's location, environment, time of reading, type and level of contamination, method of sampling, and local meteorological conditions. NBC4 (BIO) will often be far downwind of the attack area location as defined in the corresponding NBC2 and 3 (BIO), since biological agents will most likely be detected as airborne contamination. A NBC 4 (BIO) can be assumed to be associated with the same attack if:

- They can be placed in the hazard area for a NBC3 (BIO) between the expected earliest and latest times of arrival, or

- They are within 10 km and 2 hours of another NBC4 (BIO), which has already been assigned to an attack.

Table F-5. Sample NBC4 (BIO)Report

NBC 4 (BIO)			
Line Item	**Description**	**Cond**	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/C//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/AIR/BIO/BG//
Q*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/-/DET//
R*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	ROMEO/20PPM//
S*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
T*	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
W	Sensor Information	O	WHISKEY/POS/POS/NO/MED//
Y*	Downwind Direction and Downwind Speed	M	YANKEE/270DGT/015KPH//
Z*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
*Lines QUEBEC, ROMEO, SIERRA and TANGO are a segment. With exclusion of set ROMEO, this segment is mandatory. Sets/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.			

e. NBC5 Report. The NBC5 Report is prepared from the contamination plot. This report is last in order because it consists of a series of grid coordinates. Often this message must be sent on FM radio nets. This requires lengthy transmission. If an overlay is not sent, the recipient is required to plot each coordinate and redraw the plot. For NBC5 (BIO) reports, line items INDIA (release information), OSCAR (reference time), and X-RAY ALPHA (actual contour information) are mandatory (see Table F-6).

Table F-6. Sample NBC5 (BIO)

NBC 5 BIO			
Line Items	**Description**	**Cond**	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/C//
D	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/BIO/BG//
O	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/201505ZSEP1997//
XA*	Actual Contour Information	M	XRAYA/LCT50/32VNJ575203/ 32VNJ572211/32VNJ560219/ 32VNJ534218/32VNJ575203//
XB*	Predicted Contour Information	O	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* Sets are repeatable up to 50 times to represent multiple contours			

f. NBC6 Report. This optional NBC report is a narrative description of biological attacks that have occurred in the reporting unit's area of operation. The NBC6 (BIO) contains as much information as is known about the attacks. It is submitted only when requested.

Appendix G

NUCLEAR CONTAMINATION AVOIDANCE TACTICS TECHNIQUES AND PROCEDURES

1. Background

a. Under the threat of or in actual nuclear warfare, units continually evaluate the impact that enemy use of nuclear weapons could have on the conduct of operations. They must be prepared for contingency action to reduce the disruption caused by a nuclear attack (e.g. establishing Nuclear Operational Exposure Guidance (OEG)). Casualty-producing levels of fallout can extend to greater distances and cover greater areas than most other nuclear weapon effects. Such fallout levels can, therefore, influence actions on the battlefield for a considerable period. Knowledge and understanding of the nuclear contamination aspects discussed in this appendix help the commander determine the advantages and disadvantages of each course of action open to him in the execution of assigned missions.

b. Fallout areas can be the largest contaminated area produced on the battlefield. There is one important aspect of fallout prediction: Winds aloft, as well as surface winds, determine where fallout will occur. Therefore, the actual location of fallout can differ greatly from those which might be expected from the direction of surface winds.

c. Fallout particles are often visible during hours of daylight. The arrival and settling of dust like particles after a nuclear burst should be assumed to indicate the onset of fallout unless monitoring shows no radiation in the area. Any precipitation following a nuclear attack must be regarded as rainout from the nuclear cloud.

d. The neutron-induced area is small by comparison with the fallout area produced by the same yield nuclear weapon. It is often contained within the area of greatest destruction and collateral obstacles (tree blow down, rubble, and fire). Frequently, there will be no need to enter the neutron-induced area. Units should move into neutron-induced areas only when necessary. If units are required to pass through Ground Zero (GZ), attack location, or occupy positions in the immediate vicinity of GZ, the induced radiation is operationally significant. Units will base their entry time and stay time on the radiation level present in the induced area.

e. The dose rate at any location within a contaminated area does not remain constant. The dose rate decreases with time. Therefore, in time a radiation hazard will be of no military significance. The rate at which this decay takes place also varies with time, generally becoming slower as time passes. The decay rate for contamination in an area depends upon many factors. It generally cannot be determined until several series of dose-rate readings are taken for specific locations within the contaminated area. Standard decay conditions are therefore assumed by all units until actual conditions are determined or until HHQ directs otherwise.

2. Nuclear Contamination Avoidance Procedures

Avoidance procedures are broken down into actions before the attack, during the attack and after the attack. The lists given, while not all encompassing, may assist in developing unit SOP and directives.

a. Actions taken before the attack.

(1) Evaluate/monitor enemy nuclear weapon activities; reassess threat and risk:

- Yield of nuclear weapons.
- Expected detonation height (high altitude, air surface or subsurface).
- Likely delivery systems and range.
- Nuclear weapons storage facility locations and activity or movement.
- Nuclear weapons deployed to units.
- Doctrine for use.
- Past use of nuclear weapons and likelihood of use.
- Training and exercises on nuclear warfare.
- Administering iodine tablets.
- Time of launch to notification to detonation at this location.
- Meteorological and environmental analysis associated with potential delivery means and identified nuclear weapons.
- Expected damage at this location after an attack.

(2) Determine radiological detection capabilities:

- Types of radiation to detect.
- Types of radiation unable to detect.
- Concept of operations for detectors including joint service, HN, and coalition forces assets.
- Establish normal background readings for radiological detectors.

(3) Determine how many and what types of radiation detection instruments (and support equipment) are available for use.

NOTE: Consider those instruments available for use through or by joint service, coalition, and HN forces.

NOTE: Consider both detectors that are at home station and those scheduled to arrive via the TPFDD.

(4) Determine the number and type of activities that require radiological detection:

- Shelter Operations (Detection in Main Shelter Area).
- Shelter Operations (Detection in Decontamination Area).
- Dosimeter Use (in Main Shelter Area).
- Dosimeter Use (Individual Use).
- Detection (Mobile Reconnaissance Teams).

- Detection (Patient Decontamination).

(5) Nuclear Detection-Unique Considerations.

- Use the nomograms and calculations for determining probable hazard dimensions for nuclear attacks.

NOTE: The nomograms in question are the "Yield Estimation" (taken from lines "L" and "M" on the NBC1 Report, "Stabilized Cloud and Stem Parameter" chart (for cloud radius dimensions) and "Downwind Distance of Zone I" (for Zone I and Zone II dimensions).

- Given the threat profile difference between nuclear attacks and CB attacks, there generally is no need to position radiation detectors on the perimeter. Leave these instruments in the hands of specialized reconnaissance teams and shelter managers.

(6) Direct shelter management teams and CBRN reconnaissance teams to take background readings.

- Direct shelter management teams to take readings inside the main living/shelter areas of the facility, in and around the personnel decontamination station, and in the immediate area outside of the shelter.

- Direct CBRN reconnaissance teams to take background readings at locations that may be used as reconnaissance points (normally not located near shelters) or future radiological shelters (unmanned at the present time).

(7) Develop a concept of operations for the use of radiological detection instruments. Use the following techniques as guidelines.

- Shelter teams will only take readings outside the shelter until the point is reached where a reading (however small) can be measured inside the main living/shelter area of the facility.

NOTE: Once this point has been reached, the protection factor (PF) or correlation factor (CF) of the shelter can be determined by dividing the outside reading by the inside reading. For example, the PF/CF of a shelter would be 50 if the outside reading was 1cGy/hr and the inside reading was 0.02 cGy/hr.

- CBRN reconnaissance teams will not be used to take survey readings outside unless the information is critical to mission operations

NOTE: In all cases (for individuals, CBRN reconnaissance teams, and shelter management team members), the goal will be to limit radiological exposure to the absolute minimum required to accomplish critical mission operations.

(8) Provide specific visual aids/current information to ensure all personnel are familiar with:

- Individual Protective Actions.
- Radiation Signs/Symptoms.
- Iodine tablets.

b. During the Attack.

(1) Actions for Personnel In Open Areas:

- Seek the best available protection (building, bunker).
- If a building or bunker is not available, move to a ditch, depression, or structure that provides protection from blast, fragments, and small arms fire
- If no warning is received and an attack begins, drop to the ground, crawl to closest available protection, and don IPE IAW unit SOP and OPORD.
- Use any available material to provide overhead cover (rain gear, poncho, tarps, or plastic).

NOTE: Adjust to local policies/procedures.

(2) Perform buddy checks ensuring IPE is correctly worn.

(3) Perform self-aid/buddy care while maintaining a low profile.

(4) If time allows, close doors and windows and cover items with plastic.

(5) Monitor and report attack indicators to CBRN cell:

- Detector response.
- Casualty data.
- Environmental data.

(6) Monitor CBRNWRS for reports of CBRN attacks.

c. After the Attack.

(1) Predict downwind hazard area of nuclear detonations, fallout and predict radiation intensities.

(2) Ensure personnel cover exposed skin while outside.

(3) Ensure personnel protect themselves from ingesting or inhaling radioactive particles while outside.

(4) Ensure total accumulated Gamma dose is kept under 125 centigray (cGy) per person.

NOTE: The Installation Commander may adjust this limit, as necessary, to accomplish critical mission operations.

(5) Avoid sending people outside when fallout is accumulating or radiation intensity has not reached a safe level.

(6) Monitor for radioactive fallout and forward information to the CBRN cell:

- Continuously monitor for Gamma radiation when fallout is expected.
- Identify the exact arrival time of arrival and forward to CBRN cell.
- Monitor and record intensity readings every 15 minutes until radiation peaks.
- Monitor and record intensity readings every 60 minutes after radiation peaks.

NOTE: **If an increase is noted, resume monitoring every 15 minutes until a new peak is identified.**

(6) Verify/Determine the protection factor (PF) or correlation factor (CF) of shelters by dividing the outside intensity reading by the inside intensity reading on RADIAC equipment (e.g. 300 CGy/hr divided by 30 CGy/hr = PF or CF of 10).

(7) Activate decontamination teams and proceed with decontamination, as directed.

NOTE: **Ensure decontamination teams are dispatched with dosimeters and their total radiation doses are tracked and kept to a minimum for each task.**

(8) Direct decontamination by:

- Covering - Eight centimeters (3 inches) of earth will decrease radiation dose rates by one-half because of the shielding provided by the soil.

- Brushing/Vacuuming - Effective on personnel and paved or finished surfaces. Use brooms, brushes, vacuums etc., for inside shelters and for personnel. Street sweepers are ideal for roadways and flight lines.

- Scraping - Remove firm soil and snow. Move contaminated waste as far away as possible.

- Washing - Hot water and detergent is effective on wood, roofing material, masonry products, steel surfaces, asphalt and concrete. Use a fire hose or power driven decon apparatus to loosen and flush away fallout particles. Scrubbing with brooms followed by rinsing produces excellent results on paved surfaces.

NOTE: Radioactive contamination cannot be neutralized; only removed, covered, isolated, etc.

NOTE: Items exposed to fallout do NOT become radioactive themselves.

(8) Remove the fallout and check with RADIACS to determine if an item is safe to use.

(9) Determine the radiation decay rate based on amount of time since radiation peak and current gamma radiation intensity.

NOTE: **This information is vital for planning military operations.**

(10) Monitor individual radiological records.

(11) Monitor shelter radiological logs.

(12) Direct resupply, restocking, or redistribution of:

- Munitions/ammunition.
- POL.
- First aid items.
- IPE.
- Iodine tablets.
- Food and water.
- Batteries.
- Contamination control and decontamination assets.

3. Nuclear Information Management

Managing nuclear attack information is crucial for the success of a command. To be useful, nuclear information must be collected, reported, and evaluated. Once evaluated, it can be used as battlefield intelligence. Obtaining and converting nuclear information into usable nuclear intelligence does not just happen. The volume of information that needs to be collected and reported could easily disrupt both communications and tactical operations if not properly managed. This section describes what information is available and how that information is transmitted to the person or unit requiring it.

a. Collecting Nuclear Information. The first step in managing nuclear attack information is to determine what information is available and who is available to collect it. Two types of data must be collected. Observer data provides information that a nuclear attack has occurred. Monitoring, survey, and recon data provide information on where the hazard is located. Every unit is responsible for observing and recording nuclear attacks. But every unit does not automatically forward NBC 1 Reports. Many units may observe a nuclear burst. But if every unit forwarded a report, communications would be overwhelmed. For this reason, selected units with equipment that can make accurate measurements submit NBC 1 Reports. These units are called designated observers. Additional units are selected during tactical operations based on their physical locations. The designated observer unit is discussed later in this appendix. Only selected units automatically submit NBC 1 Reports to the CBRN cell.

b. Monitoring, Survey, and Reconnaissance Data.

(1) NBC 1 Reports allow the CBRN cell to collect information of where designated observers have seen a nuclear attack. The CBRN cell then evaluates this information in the form of an NBC 2 Report. From the NBC2 Report a simplified or detailed hazard prediction can be made. This prediction (NBC3 Report) is only an estimation of the hazard area. Feedback is needed from units to determine exactly where the contamination is located. This feedback comes from monitoring, survey, and recon (NBC 4 Reports). Monitoring and recon operations give the initial location of CBRN hazards to the CBRN cell. Initial monitoring and recon reports are generally forward through intelligence channels to the CBRN cell. This information may also be sent to the CBRN cell by use of the various DST as discussed in Chapter III.

(2) The CBRN cell then plots the information on the situation map. If more information is needed, the CBRN cell directs a unit (picked because of its location and/or capability) to collect and forward the necessary data. This information could be from additional monitoring reports or a survey of the area in question. Collecting nuclear information is a joint effort of units and the CBRN cell. The unit does the actual collecting of information. The CBRN cell plans for and directs the collection effort. More detailed information concerning this collection effort is addressed in *Multiservice Tactics, Techniques, And Procedures For Nuclear, Biological, and Chemical Reconnaissance.*

c. Evaluating Nuclear Information. After nuclear data has been collected, it is evaluated. It is then used as battlefield intelligence. The CBRN cell is the primary evaluation center. Units and intermediate HQ use this raw data to develop nuclear intelligence for their own use until detailed results are available from the CBRN cell.

d. Transmitting Nuclear Information. Procedures used to transmit nuclear information to and from the CBRN cell are an important part of information management.

The method of transmitting information depends on the tactical situation and mission of the unit. Refer to Chapter III, CBRNWRS, unit SOP and OPORD for more detailed information.

e. Designated Observer System. Although all units have some information-gathering responsibilities, certain units, because of their capabilities and/or location, are chosen as designated observers for nuclear attacks. Designated observers must be as accurate as possible when providing data on nuclear bursts. Observers are selected to provide total coverage over the entire area of interest. This requires both ground and aerial observers. The designated observer system provides the essential data to prepare hazard location predictions and nuclear damage assessments. It provides raw observer data, using a standard report format. The CBRN cell specifies the primary and alternate means of communication.

(1) Designated Ground-Based Observers.

(a) Ground units are selected for the designated observer system based on the following factors:

- Battlefield location.
- Communication nets available.
- Mission (current and future) interference due to enemy action.
- Training and experience.
- Anticipated reliability of data.
- Possession of organic angle-measuring equipment.

(b) Field artillery and air defense artillery units are best suited as designated observer units. These units have organic optical equipment ideal for sighting measurements.

(c) See Service references such as FM 101-10-1 for more information on the type of units which may have this equipment. These units have organic optical equipment (See Figure G-1, page G-7) ideal for sighting measurements. These items, in order of preference, are:

- M2 aiming circle.*
- M65 or M43 battery command periscope.
- T16 or T2 theodolite.
- M2 pocket transit.

Figure G-1. Unit organic optical equipment ideal for sighting measurements

***** This equipment is preferred because it is set to grid north (GN) and measures in mils.

(d) Any other unit (for example, a mortar platoon) having this or similar equipment may be designated an observer. Radar should also be considered. Many radars can define the nuclear cloud. Field artillery and air defense artillery radars are positioned in the division and corps areas.

(2) Designated Aerial Observers.

(a) Aircraft provide excellent observer coverage for nuclear attacks. The CBRNCC coordinates with the appropriate aviation officers to have several aircraft crews designated as observers. The aviation unit commander selects the crews. Designated aircrews are instructed to report data about the type of attack and when and where it occurred. If aviators measure cloud parameters, they must also provide the location from which it was measured.

(b) Aviators have the advantage of height. They are able to see and report actual GZ locations. They also can see and estimate crater width. Such data is usually not obtainable from ground observer units.

f. Nondesignated Observers. All units are required to record (in the prescribed format) their observations concerning nuclear strikes. Nondesignated observer units that have not been specifically tasked will transmit their reports only on request. However, these units must report a nuclear attack only to the next higher headquarters according to local SOP.

g. Determining that a Nuclear Attack has Occurred.

(1) The development of nuclear clouds is divided into three stages: fireball, burst cloud, and stabilized cloud. The fireball stage exists from the instant of the explosion until the generally spherical cloud of explosion products ceases to radiate a brilliant light. During this stage, do not look at the fireball. The brilliant light can cause permanent damage to your eyes.

(2) As the brilliant light fades to a dull reddish glow, the fireball stage transforms into the nuclear burst cloud stage. At this point the cloud can be safely observed. The cloud may be either a spherical cloud (high airburst) or a mushroom-type cloud, with or without a stem (low air or surface burst). Relatively low-yield nuclear surface bursts have clouds similar to those produced by surface bursts of conventional explosives. Severe turbulence and rapid growth in cloud height and width are characteristic of this stage.

(3) When the cloud ceases to grow in height, the stabilized cloud stage begins. Height stabilization occurs from about 4 to 14 minutes after the explosion, depending upon the yield. Nuclear burst angular cloud width (line item Lima, as explained in Chapter III, for an NBC 1 report), and stabilized cloud-top/bottom angle or height (line item Mike) are measured during this stage. Figure G-2 illustrates the growth of a nuclear cloud. After height stabilization (4 to 14 minutes) the cloud continues to grow. This is due to wind, not nuclear energy. For this reason, cloud measurements are not taken after H+10 minutes. Measurements of the nuclear burst cloud are taken at H+5 minutes (line item Lima) or at H+10 minutes (line item Mike).

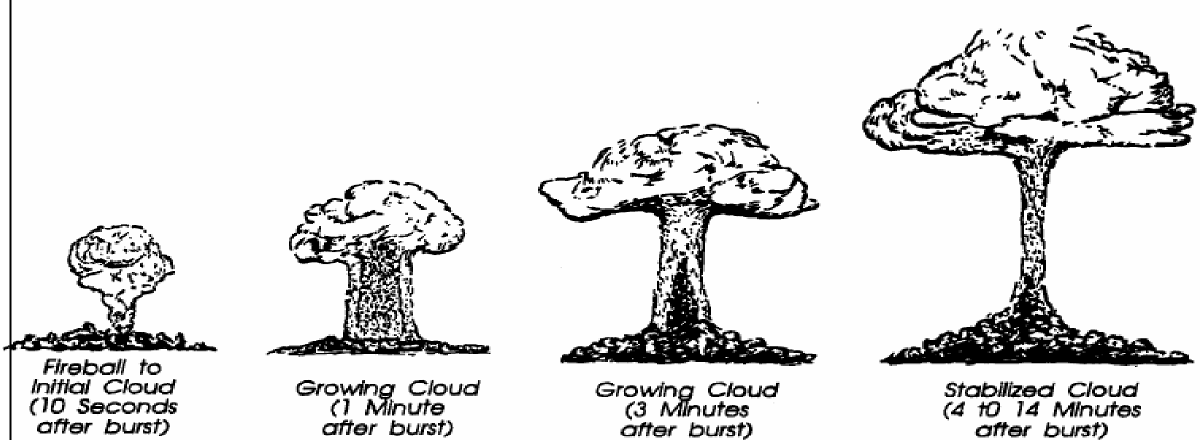


Figure G-2. Illustration of the Growth of a Nuclear Cloud

(4) Nuclear cloud measurements (parameters) have been correlated with the yield of the weapon. This information can be extracted from nomograms and the ABC-M4A1 nuclear yield calculator. Use of the nomograms and the ABC-M4A1 is described in more detail later in this appendix.

(5) Unit SOPs detail the duties and circumstances concerning when and how measurements are taken. For accuracy, the following list of measurements (in order of reliability) is provided to aid in SOP development:

(a) Nuclear burst angular cloud width at H+5 minutes.

(b) Stabilized cloud-top or cloud-bottom height measured at H+10 minutes.

(c) Stabilized cloud-top or cloud-bottom angle measured at H+10 minutes.

4. NBC1 Report

a. The NBC1 Report (see Table G-1) is the most widely used report. The observing unit uses this report to provide nuclear attack data. All units must be completely familiar with the NBC1 Report format and its information. The unit must prepare this report quickly and accurately, and send it to the next higher headquarters. Battalion (Squadron) and higher elements decide which NBC1 Reports to forward to the next higher headquarters. If several reports are received on the same nuclear attack, then a consolidated NBC1 Report is forwarded, instead of separate reports. This reduces the number of reports to a manageable level. The data in an NBC1 Report is used to locate GZ and used to determine the yield of the nuclear burst.

(1) Purpose. The purpose of the Nuclear NBC1 Report is to provide nuclear attack data.

(2) Message Precedence. The first time a nuclear weapon is used against US forces, the designated unit will send the NBC1 Report with a *flash* precedence. If a previous NBC1 Report has been forwarded, an *immediate* precedence will be used.

Table G-1. NBC1 Report

NBC1 (NUC) Report			
Line Item	**Description**	**Cond. ***	**Example**
B	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997//
F	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/SUS/AIR/1/BOM/1//
H	Type of Nuclear Burst	M	HOTEL/SURF//
J	Flash-to-Bang Time in seconds	O	JULIET/57//
L	Nuclear Burst Angular Cloud Width at H+5 Minutes	O	LIMA/18DGT//
M	Stabilized Cloud Measurement at H+10 Minutes	O	MIKE/TOP/33DGT/9KM//
PC	Radar Determined External Contour of Radioactive Cloud	O	
PD	Radar Determined Downwind Direction of Radioactive Cloud	O	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)			

b. Observer Position.

(1) Use Universal Transverse Mercator (UTM) coordinates, latitude (LAT) and longitude (LONG), or a place name. Enter this location on line item Bravo of the NBC1 Report. Line item Bravo is required on all reports from ground observers and should be

encoded. This is the location of the angle measuring equipment. It may or may not be the unit's location. Direction of attack from the observing unit is also reported on this line.

c. Date and Time of Attack.

(1) After the second shock wave has passed, uncover your eyes, and read the watch to the nearest minute. This data is entered as line item Delta of the NBC1 Report.

(2) The date and time of the attack are always reported. The time zone used is specified by FSOP/OPLAN/OPORD or is contained in other instructions. The CBRN cell conducts time checks with designated observers and converts all times to Zulu time.

d. Attack Location or Ground Zero (GZ). If the designated observer has an actual location, this will be transmitted on line item FOXTROT. If the attack location is estimated, a detailed description of how the estimation was made should be transmitted on line item GENTEXT. A detailed description of how the CBRN cell calculates the GZ location is covered later in this appendix under the NBC2 Report (evaluated data report).

e. Type of Burst. Observe the developing cloud to see if the burst was an airburst by noting the shape and color of the cloud or the absence of a stem. If the cloud is lighter in color than the stem, or if the stem is ragged or broken (does not solidly connect with the cloud), record "air" as line item Hotel of the NBC1 Report. If the stem is thick and dark, and it connects with the cloud, record "surface" as line item Hotel. When the cloud does not match any mental image for air or surface, record "unknown" as line item Hotel. "Unknown" also may be recorded whenever the attack occurs at night. A subsurface burst is recorded as "surface," only if the detonation ruptures the surface.

f. Flash-to-Bang Time. Designated observers will be assigned to report this line item. At the instant of the blue-white flash, cover eyes, hit the ground, and start counting slowly—1,000 and 1, 1,000 and 2, 1,000 and 3, and so on-until the arrival of the shock wave or bang. Make a mental note of the count on which the shock wave arrives (for example, 1,000 and 4). If the observer has a watch and can note the exact time (in seconds), then the watch can be used to record the flash-to-bang time. This data is entered as line item Juliet on the NBC1 Report. Remain where you are until debris has stopped falling. It must be noted that there will be two shock waves—one blowing in one direction, and the other blowing a few moments later in the opposite direction. If the bang is-not heard in five minutes (a count of 1,000 and 300), continue with other measurements.

g. Angular Cloud Width. The angular width of the cloud is measured five minutes after the detonation. The width of the nuclear cloud is the angular dimension, in mils or degrees, of the cloud diameter. The optical equipment operator takes this measurement at H+5 minutes. This measurement is made for nuclear clouds resulting from both air and surface bursts. All units have some ability to take this measurement. The lensatic compass should be used if the listed equipment (in Figure G-1, page G-7) is not available. Take the measurement of the angle by measuring the right and left side of the nuclear cloud. The numerical difference between these azimuths is the angular cloud width. For example, if the left side (left lateral limit) is 345^0, and the right side (right lateral limit) is 15^0; $360^0 - 345^0 = 15^0$. $15^0 + 15^0 = 30^0$ (30^0 is the angular cloud width at H + 5 minutes). This measurement is reported as line item Lima (Figure G-3).

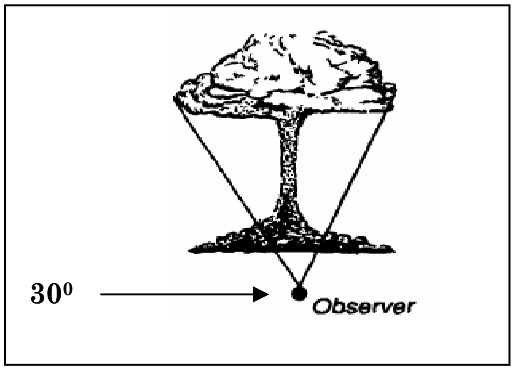


Figure G-3. Angular Cloud Width

h. Cloud-Top or Cloud-Bottom Height. Cloud-top or bottom height can only be measured by aircraft or radar. Helicopters and most small fixed-wing aircraft have a limited capability to determine cloud height. The CBRN cell may have to coordinate with other service liaison officers to make arrangements to measure cloud height. Again, CBRN cell coordination is required to establish this data source. Radar may also be helpful in resolving actual number of bursts and GZs. This measurement is taken at H+10 and reported on line item Mike in feet or meters. Figure G-4 (page G-12) (5,000 m or 5 km).

i. Stabilized Cloud-Top Angle.

(1) The cloud-top angle is the vertical measurement in mils or degrees from GZ level, or from ground level if GZ level is not known, to the cloud-top. This measurement is taken at H+10 minutes and reported as line item Mike (see Figure G-4).

(2) These measurements are less reliable than measurements made at H+5 minutes. Most units in the field cannot take cloud-bottom or cloud-top angle measurements. Therefore, they are not normally designated as observer units. These measurements cannot be made with a lensatic compass.

(3) If the angular width of the cloud cannot be measured, the designated observer unit measures the cloud-bottom or cloud-top angle. Nondesignated observer units with angle-measuring equipment can also take this measurement.

(4) The individuals specifically tasked to take cloud measurements report this data and other data specified in the unit SOP to the unit CBRN defense team. If the unit is a designated observer, the defense team will format the data into an NBC1 Report. The report is transmitted per instructions or other written directions.

j. Stabilized Cloud-Bottom Angle. The cloud-bottom angle measurement is the vertical angle (in mils or degrees) measured from GZ level (on ground level, if GZ level is not known) to the point of intersection of the stabilized cloud and the stem. Cloud-bottom or cloud-top angle measurements are not taken for airbursts. This measurement is taken at H+10 minutes and reported as line item Mike (see Figure G-4).

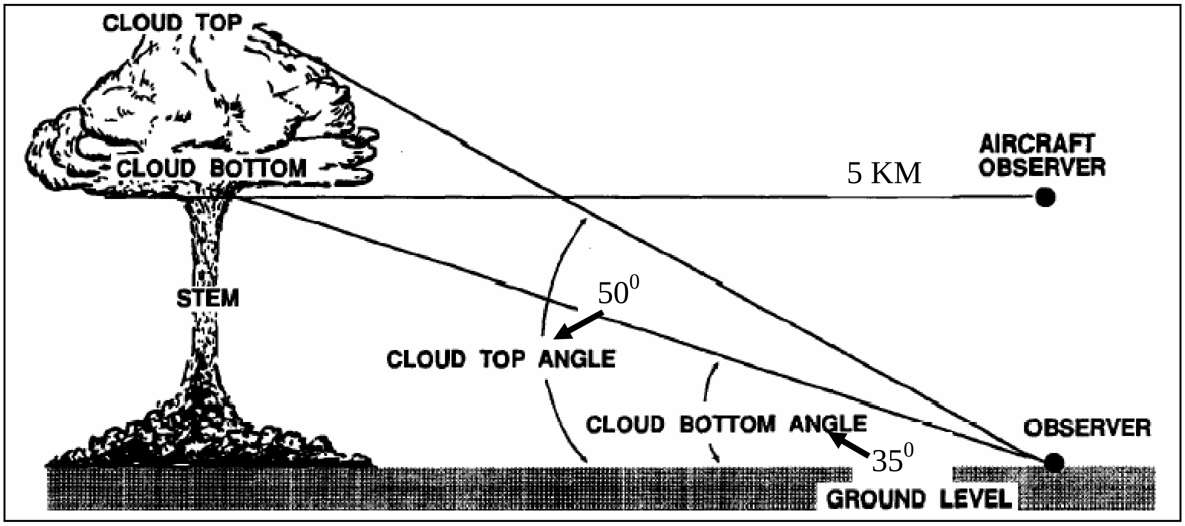


Figure G-4. Illustration of Stabilized Cloud Top, Cloud Bottom Angle and Height Measurements

5. NBC2 Report

a. The NBC2 Report reflects the evaluated nuclear burst data. It is based on one or more NBC1 Reports. NBC2 Reports are created for all bursts-air, surface, and unknown. When surface or unknown are reported as the type of burst, fallout predictions are made. Users of NBC2 Reports are not limited to the use of the line items shown in the example. (Table G-2, page G-14) Other line items, as appropriate, may be added.

(1) Purpose: The purpose of the NBC2 Report is to pass evaluated data to higher, subordinate, and adjacent units.

(2) Message Precedence: All other messages, after the initial NBC 1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally *immediate* would be appropriate.

(3) The Division (or designated higher HQ) CBRN cell, after determining the estimated yield, prepares the NBC2 Report, assigns it a strike serial number, and disseminates it to the appropriate unit (s).

(4) Subsequent data may be received after the NBC2 Report is sent. If this data changes the yield or GZ location, send this data in an NBC2 update report. Use the same strike serial number and date-time of attack.

b. Strike Serial Number.

(1) The CBRN cell serves as a focal point for all requests for information concerning nuclear strikes. It is responsible for assigning a strike serial number to each nuclear attack, friendly or enemy, that occurs within its assigned area.

Table G-2. NBC2 Report Nuclear

NBC2 (NUC) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	M	ALPHA/US/A234/001/N/55//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP2004//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/SUS/AIR/1/BOM/1//
H	Type of Nuclear Burst	M	HOTEL/SURF//
N	Estimated Nuclear Yield in KT or MT	M	NOVEMBER/15KT//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)			

(2) Once the unit receives the NBC 2 Report, the unit CBRN defense team takes the report and a current effective downwind message (EDM) (Refer to Appendix D for further information concerning EDMs), and prepares a simplified fallout.

c. Location of GZ (Line Item FOXTROT).

(1) Any unit that is not part of the designated observer system is obligated to take cloud measurements to the best of its ability and record all observed burst data. This data is recorded in the NBC1 Report in either line items BRAVO or FOXTROT and evaluated for the NBC2 Report. They do not report to higher headquarters unless specifically requested. The CBRN cell will use this data to locate GZ and to estimate yield.

(2) At unit level, GZ is located in one of three ways; direct observation, intersection or by polar plot method.

(a) Direct Observation. For small yield weapons, direct observation may provide actual GZ location. Units do not, however, reconnoiter for the GZ location. If the GZ cannot be observed, measure the azimuth from observer to the center of the stem (surface burst) or nuclear burst cloud (air burst). Enter this data in line item Bravo of the NBC 1 Report. If the GZ can be observed, determine the UTM, LAT/LONG coordinates or place name. Enter this data as line item Foxtrot (actual). (Aerial observers may provide estimated or actual GZ, depending on altitude, orientation, terrain, and visibility conditions). GZ must be observed to use line item Foxtrot (actual).

(b) Intersection (Estimation for line item FOXTROT). The principal GZ location method is a plot of intersecting azimuths sent by designated observers. The procedures are as follows:

- On the operations map overlay, locate and mark the position of each observer unit, using data on line BRAVO.

- Determine each azimuth to be plotted. This information is also on line Bravo. Convert all magnetic azimuths to grid azimuths.

- Using a protractor, mark each azimuth from each observer position.

- Extend each azimuth to the distance necessary for observer's positions to intersect.

- Post any data that assists in the determination of GZ location (e.g., radar, pilot reports, etc).

- Evaluate the data. The result of intersecting azimuths is an estimation of the location of GZ. GZ location is reported on the NBC2 Report on line item FOXTROT, qualified with the word "estimated", unless FOXTROT (actual) information is used in the determination.

- Disregard azimuths that do not intersect with other azimuths.

- Whenever azimuths do not cross to form a clear GZ location, the center of the plot is taken as the estimated GZ location.

(c) Polar Plot (Estimation for line item FOXTROT). Polar plot techniques are based on flash-to-bang time and the speed of sound (350 m per second or 0.35 km per second). Procedures are as follows: (See Fig G-5, page G-16)

- The CBRN cell makes an approximation of the distance between GZ and the observer, in kilometers by multiplying the flash-to-bang time (data on line item JULIET of the NBC1 Report) by 0.35 kilometers per second.

- Distance between GZ and observer = flash-to-bang time (sec) x 0.35 km/sec.

- On the situation map, plot the observer's location. This is line item BRAVO on the NBC1 Report.

- Using a protractor, mark the azimuth from the observer's position to the attack location. Convert magnetic azimuth to grid azimuth.

- Draw this azimuth to the length previously calculated as the distance between GZ and the observer.

- Read the grid coordinates of the place where the azimuth line, in previous step, ends. This is an approximate plot of the GZ location (estimated).

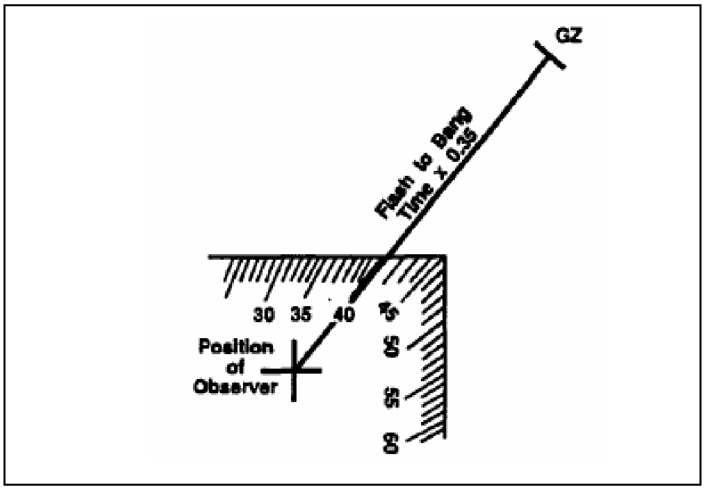


Figure G-5. Polar Plot Method.

d.. Methods of Determining Yield (Line Item NOVEMBER). Before the yield can be estimated, you must know the location of GZ, the position of the observer, and when the cloud measurements were taken. Nuclear burst parameters are presented in nomograms. Each nomogram is an independent means of estimating yield. All nomograms are designed to provide approximate yields. The following are methods for determining yield from most accurate to least accurate:

(1) The distance in kilometers between GZ and the observer, in conjunction with line "L" or "M" information, represents the best method of estimating the yield.

(2) Nuclear Burst Angular Cloud Width: Use Figure G-7, page G-19 to determine yield, based on nuclear burst angular cloud width, and distance between GZ (or line item JULIET, flash-to-bang time) and the observer. Data is reported in line item "L".

(a) The right-hand scale is the nuclear burst angular cloud width in mils and degrees.

(b) The center scale is the distance in kilometers between GZ and the observer.

(c) The left-hand scale is the yield in kilotons (KT).

(d) To use this nomogram: Place a hairline from the point on the right-hand scale (representing the nuclear burst angular cloud width at H+5 minutes) through the point on the center scale (representing the distance between GZ and the observer) (or line item JULIET, Flash-to-Bang time). Read the yield where the hairline crosses the yield scale (left). You must be as exact as possible.

(3) Stabilized Cloud-Top (CT) or Cloud-Bottom (CB) Height: CT or CB height, when stabilized, can be closely measured by aircraft or Air Defense Artillery (ADA) radar. Measurements, in meters or feet above the earth's surface, must be made at H+10 minutes. Data is reported in line item Mike.

(a) Use Figure G-8, page G-20 to correlate these measurements with yield. The distance between GZ and the observer is not required.

(b) The extreme left and right scales on the nomogram are yield in kilotons (KT) and megatons (MT).

(c) The scale second from the second from the left is the cloud is the cloud-top height at H+10 minutes in thousands (10^3) of meters or feet.

(d) The scale third from the left is the cloud-bottom height, also at H+10 minutes. It, too, is graduated in thousands (10^3) of meters or feet.

(e) The other scales on the nomogram, (2/3 stem height, cloud radius and time of fall) are not used in yield estimation. These scales are used in detailed fallout prediction.

(f) To use the nomogram: Determine stabilized cloud-top or cloud-bottom height from line item MIKE of the NBC1 Report. Place a hairline directly over the reported data and pin the hairline to the nomogram. Pivot the hairline until it crosses the outside yield scales at the same value (far left and far right). This value is the estimated yield.

(4) Stabilized Cloud-Top or Cloud-Bottom Angle. Use Figure G-9, page G-21 to determine the yield. Given the distance between GZ and the observer, and either the stabilized Cloud-Top (CT) angle or the Cloud-Bottom (CB) angle. Data is reported in line item "M".

(a) The right-hand scale gives the distance in kilometers from GZ to the observer and the flash-to-bang time in seconds counted by the observer.

(b) The center scale is the cloud-top or cloud-bottom angle in mils or degrees.

(c) The left-hand scale is actually two scales. The left side of this scale lists the yields to be read when using the cloud-bottom angle; the right side of this scale lists the yields to be read when using the cloud-top angle.

(d) To use this nomogram: Place a hairline through the point on the right-hand scale representing distance between GZ and the observer and through the point on the center scale representing either the cloud-top (CT) or cloud-bottom (CB) angle. At the point of intersection of the hairline and the left-hand scale, read the yield. If cloud-top angle was used on the center scale, read yield on the right side of the left-hand scale titled yield-cloud top (CT) (KT). If a cloud-bottom angle is used, read the yield on the left side of the left-hand scale titled yield-cloud bottom (CB) (KT).

(5) M4A1 Calculator: The M4A1 calculator is designed to provide rapid yield estimation based on any parameter except cloud-top or cloud-bottom height (see Figure G-5). The M4A1 consists of three plastic disks (front, back, middle) mounted by a rivet. The front and the back disk are opaque white plastic at the center and transparent plastic at the outer edge. The middle is opaque white plastic. NSN: 6665-01-0130-3616 (M28A1 RADIAC and nuclear yield calculator set) TM 3-6665-303-10 (Figure G-6, page G-19).

(a) M4A1 Front:

- Stabilized Cloud Bottom or Top Angle Scale Mils.
- Yield Stabilized Cloud Bottom Scale KT.
- Yield Stabilized Cloud Top Scale KT.
- Nomenclature.
- Instructions.

- Distance-to-GZ Scale KM.
- Flash-to-Bang Time Scale Seconds.
- Indexing Pointer.

(b) M4A1 Back:

- Observed Cloud Width Scale at 5 min (H+5 or "L").
- Yield Scale.
- Distance-to-GZ Scale KM.
- Flash-to-Bang time Scale Seconds.
- Indexing Pointer.
- Instructions.

(c) The M4A1 calculator is a round nomogram with a fixed hairline. Because of this, there are situations in which the yield pointer may go off scale on the high or low ends of the yield scale.

Example: Nuclear cloud is 20 mils wide and flash-to-bang time was 10 seconds. This is a small cloud that is very close to the observer, indicating a small yield. The calculator shows a yield of 1,000 kilotons, but the actual yield is less than 0.02 kiloton.

(d) To Use the M4A1. Determining Yield Utilizing Flash-to-Bang Time and Angle to Cloud Top:

- Situation: An observer reports a flash-to-bang time of 100 seconds and the elevation of the cloud top to be 300 mils at stabilization time.
- Task: Using the calculator, determine the yield from the burst.
- Solution: Align 100 seconds on the Flash-to-Bang Time Scale, with 300 mils on the Stabilized Cloud Bottom or Top Elevation Angle Scale (H+10/"M" info). Read the yield on the Yield-Stabilized Cloud-Top Scale that falls under the indexing pointer. The yield of the observed weapon is 20 KT.

(e) Yield from Flash-to-Bang Time and Angle to Cloud Bottom:

- Situation: An observer reports a Flash-to-Bang Time of 100 seconds and the elevation of the Cloud Bottom to be 200 mils at stabilization time.
- Task: Using the calculator, determine the yield.
- Solution: Align 100 seconds on the Flash-to-bang Time with 200 mils on the Stabilized Cloud Bottom or Top Elevation Angle Scale (H=10/"M" info). Read the yield on the Yield-Stabilized Cloud Bottom Scale that falls under the indexing pointer. The yield of the observed weapon is 20 KT.

(f) Yield from Flash-to-Bang Time and Cloud Width at 5 mins (H+5/"L"):

NOTE: **IF H+5/"L" information is reported in degrees it must be converted to MILS; degrees X 17.8 = MILS**

- Situation: An observer reports that Flash-to-Bang Time from a burst was 100 seconds and cloud width at 5 minutes was 180 mils.

- Task: Using the calculator, determine the yield.
- Solution: Align 100 seconds on the Flash-to-Bang Time scale with 180 mils on the Observed Cloud Width at 5 mins scale. Read the yield at the point where the indexing pointer aligns with the yield scale.
- The yield of the observed weapon is 50 KT.

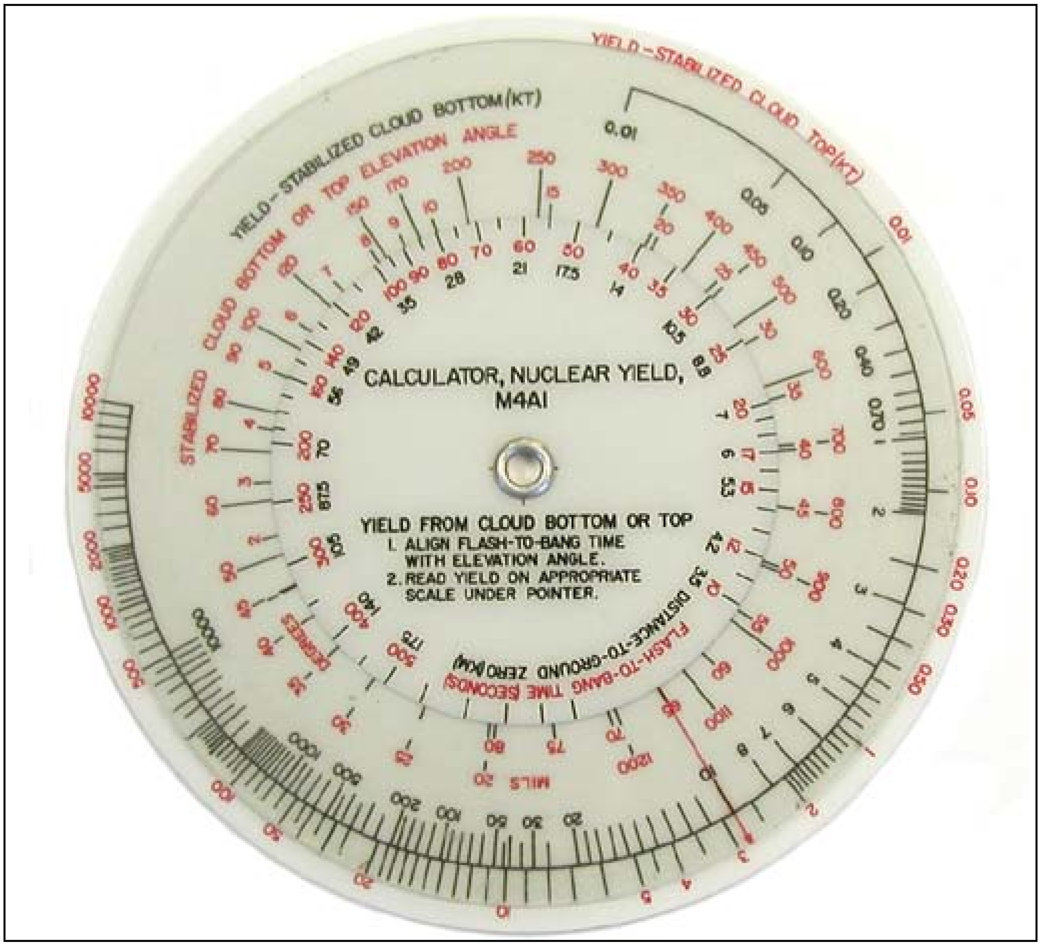


Figure G-6. M4A1 Nuclear Yield Calculator

(6) Flash-to-bang time is only used to estimate yield as a last resort.

(7) Each of the yield estimation techniques was given in order of decreasing reliability, with results providing approximate yields.

(8) When data from several observers, concerning a single attack, does not result in the same yield, add all yields together and divide by the number of observers to get the average estimated yield. This is the yield that is transmitted.

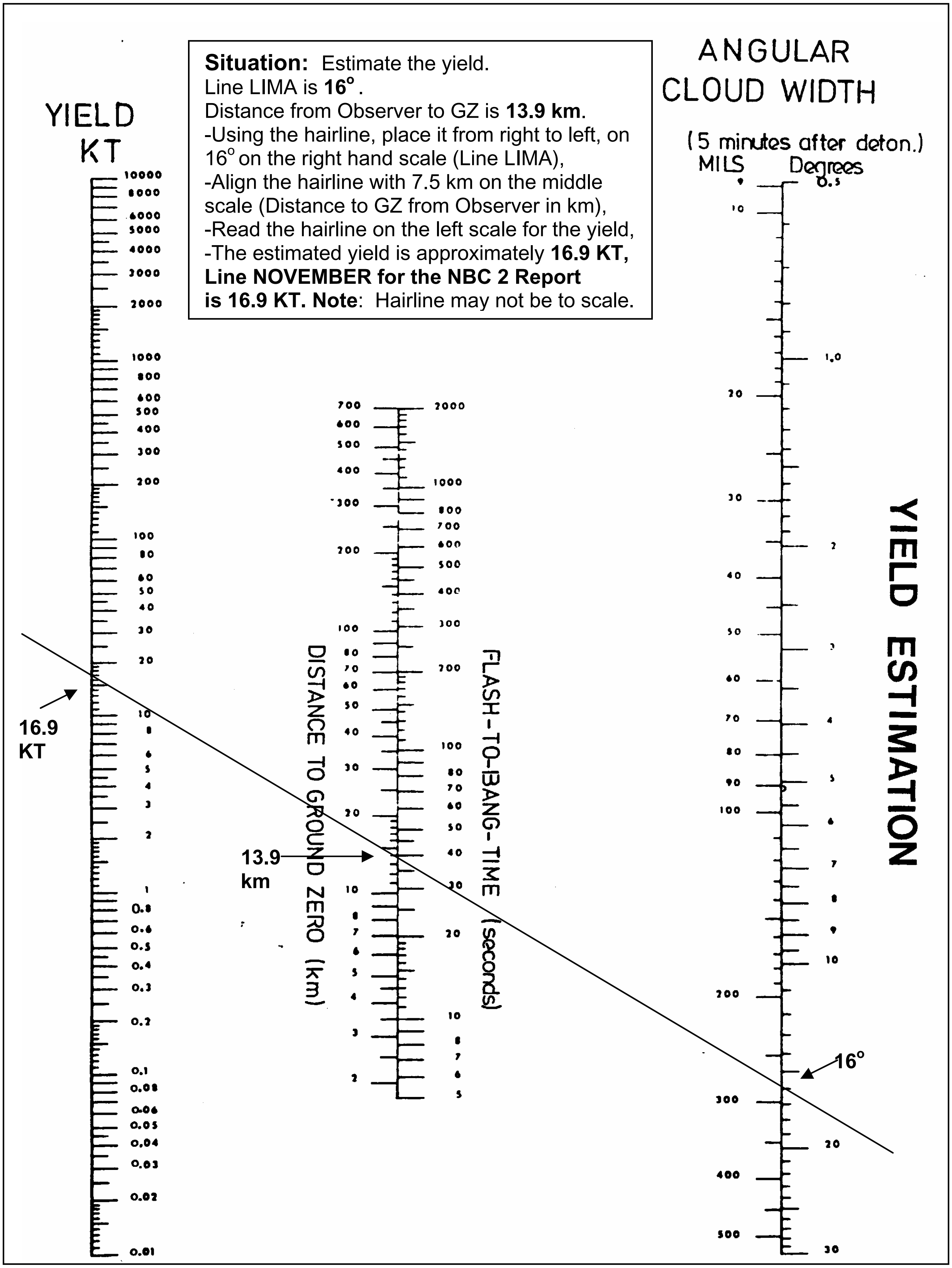


Figure G-7. Yield Estimation, Cloud Width & Flash-to-Bang-Time/Distance to GZ (Example)

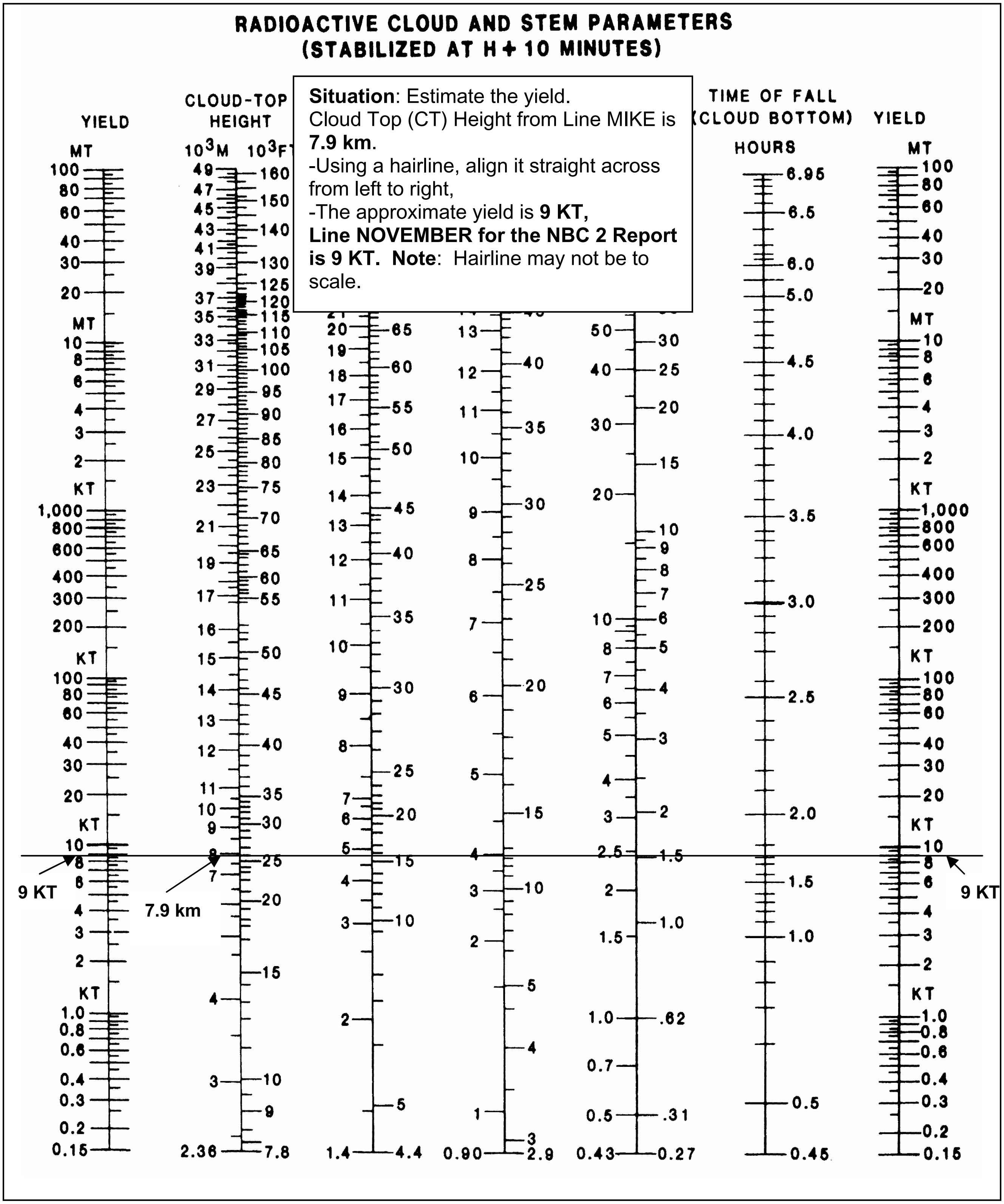


Figure G- 8. Stabilized Cloud and Stem Parameters-Cloud Top/Bottom Height (Example)

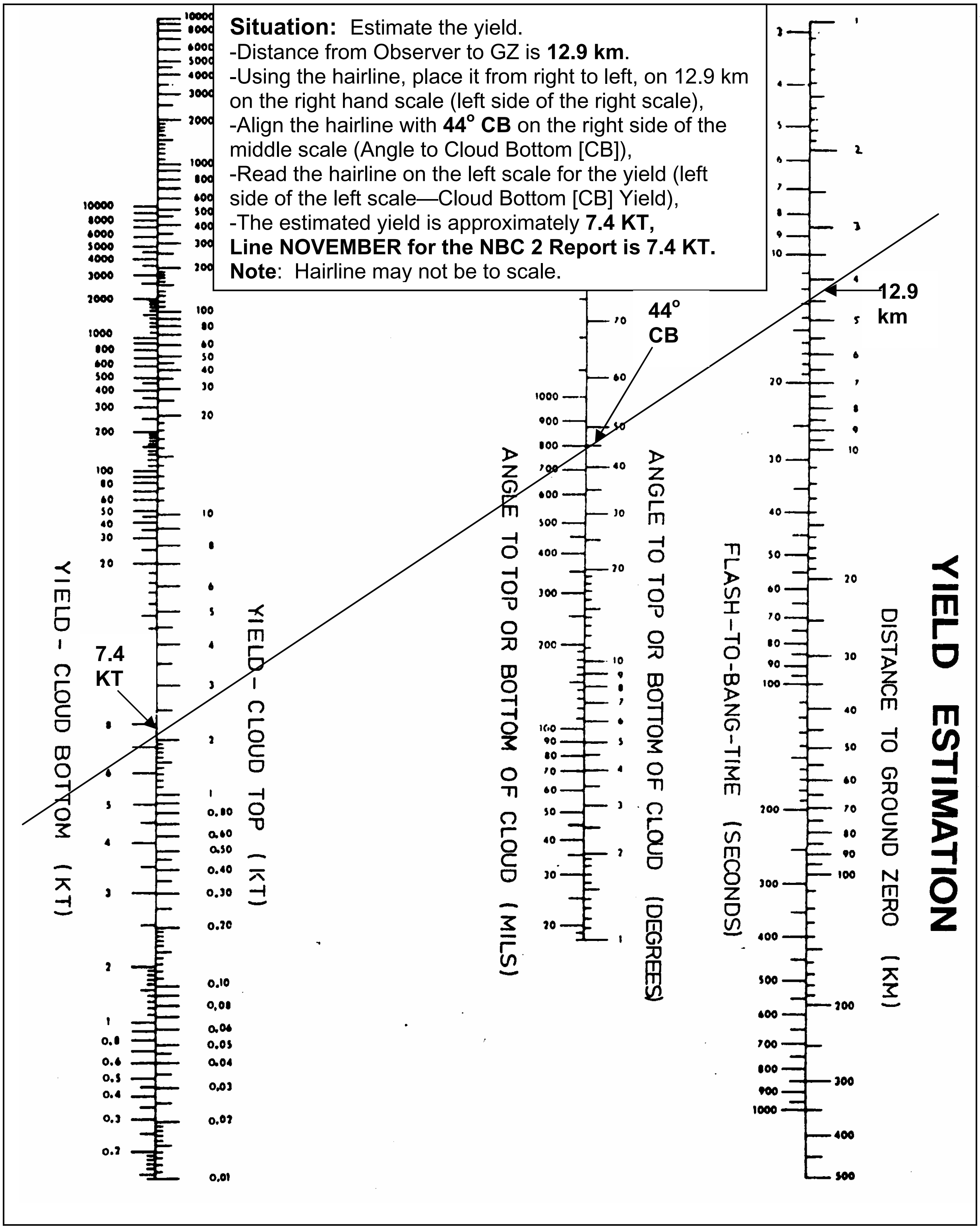


Figure G-9. Yield Estimation, Angle to Top/Bottom of Cloud and Flash-to-Bang-Time/Distance to GZ (Example)

e. General Fallout Prediction.

(1) Fallout Prediction Method For the preparation of a fallout prediction, the following must be available:

(a) Meteorological data.

(b) Ground Zero (GZ) location.

(c) Estimated yield.

(2) The necessary meteorological data will be available in the format of a NBC BWM or a NBC EDM. Refer to Appendix D for further information concerning (NBC BWMs and NBC EDMs).

(3) The method of fallout prediction consists of two procedures, the simplified procedure and the detailed procedure, both of which are used to determine the extent of the warning area. Normally the detailed procedure is used by agencies having a meteorological capability, and subordinate units use the simplified procedure. The decision as to which procedure is to be used is left to the commanders concerned. These two procedures are described in detail later in this appendix.

(4) The prediction of the fallout hazard area using the detailed procedure is more accurate. Although neither procedure precisely defines the extent of the fallout, the predicted fallout area, calculated by either method, indicates the probable limits to which fallout of military significance will extend.

(5) The boundaries of the predicted fallout area are not dose rate contour lines, nor do they imply that all points within the enclosed areas will sustain dangerous fallout.

f. Definition of Fallout Area Zones.

(1) The predicted fallout area consists of Zone I and Zone II.

(2) Zone I is of Immediate Operational Concern. Within this Zone, there will be areas where exposed, unprotected personnel may receive doses of 125 cGy or greater in relatively short periods of time (less than 4 hours after actual arrival of fallout). Major disruptions to unit operations and casualties may occur in some parts of this zone.

(3) Zone II is a Secondary Hazard. Within this Zone, the total dose received by exposed, unprotected personnel is not expected to reach 125 cGy within a period of four hours after the actual arrival of fallout. Within this zone, personnel may receive a total dose of 75 cGy or greater within the first 24 hours after arrival of fallout. Personnel with no previous radiation exposure may be permitted to continue critical missions for as long as four hours after the actual arrival of fallout without incurring the 125 cGy emergency risk dose.

(4) Outside the two Zones. Outside the two predicted Zones, exposed, unprotected personnel may receive a total dose that does not reach 75 cGy in the first 24 hours after the actual arrival of fallout.

(5) The total dose for an infinite stay time should not reach 125 cGy. Refer to Appendix C, CBRN OEG, for more details.

NOTE: Prediction of fallout is to be regarded as an estimate only. Necessary preparations should be made to avoid the hazard if tactically possible. Even within Zone I, units may not be affected by fallout at all. However, the decision to act is up to the local commander and national directives / SOPs.

g. Significance of Fallout Ashore versus that at Sea.

(1) The detailed procedure and the simplified procedure for fallout prediction are intended for use by all services. They are based upon assumed land surface bursts. It is recognised that the fallout from a sea burst may be rather different, but very little direct information is available on fallout from bursts on the surface of deep ocean water.

(2) It must be stressed that the sea acts like an absorbent of, and shield against, radioactive products, but they remain a hazard on land until they have decayed.

(3) Another important difference is that recipients of warnings ashore do not have the mobility of ships at sea. Therefore, ships will be particularly interested in the determination of the approximate area in which deposition of fallout at the surface is taking place at a given time after the burst.

(4) Ships with a meteorological capability may be able to obtain the required meteorological data for computation of NBC EDM (NAV EDM) using standard pressure level winds. Basic wind data for this purpose are generally also available from meteorological sources (airbases, MET-ships or mobile weather stations). Ships, which do not have a meteorological capability, will normally predict fallout areas by using the simplified procedure.

(5) The fallout warning system (MERWARN) for merchant ships at sea is described later in this appendix.

h. Multiple Burst Fallout.

(1) No additional prediction procedure is available in the case of multiple burst fallout. The information obtained in areas where Zones overlap is to be interpreted as follows:

(2) The hazard classification of an area where fallout prediction patterns overlap should be that of the higher classification involved. That is an overlap area involving Zone I, should be designated Zone I, and an overlap area involving nothing more than Zone II should be designated Zone II (see Figure G-11).

(3) Examples:

(a) Zone I overlapping Zone I - designated Zone I.

(b) Zone I overlapping Zone II - designated Zone I.

(c) Zone II overlapping Zone II - designated Zone II.

(d) Zone II overlapping Zone I - designated Zone I.

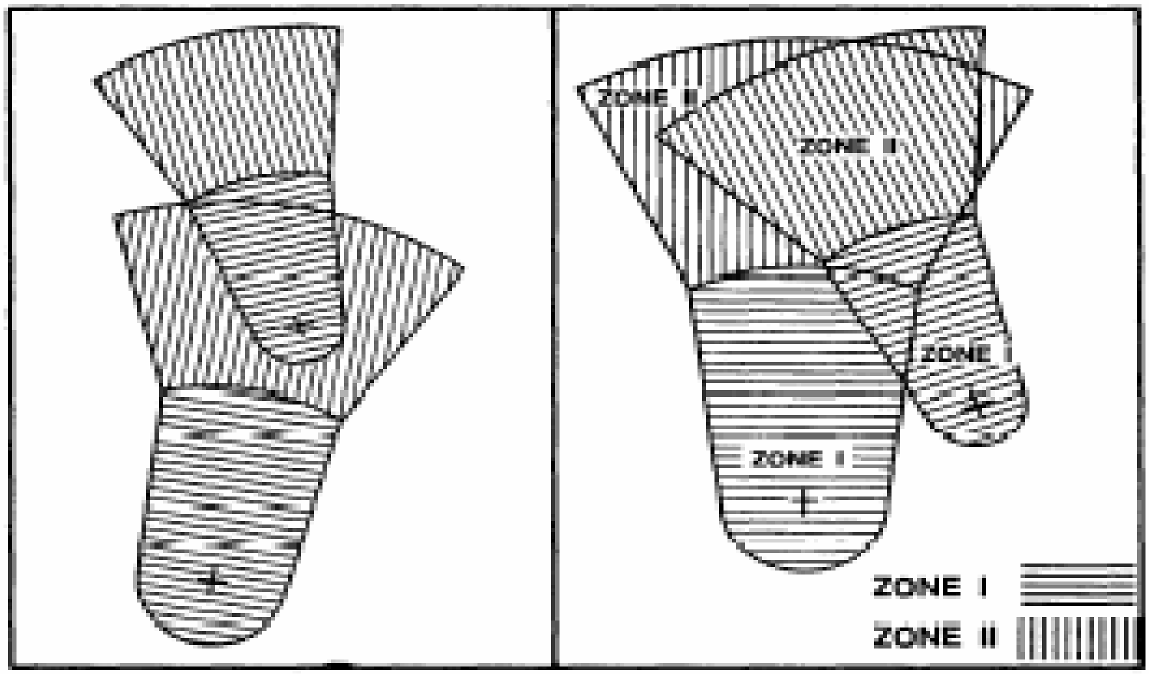


Figure G-10. (Multiple Burst Detailed Fallout Prediction-Example)

i. Simplified Fallout Prediction.

(1) Purpose: The purpose of the simplified fallout prediction system is to provide small unit commanders with an immediate estimate of the fallout hazard. The commander will use the simplified fallout prediction in the tactical decision making process.

(2) Required Items: To construct a simplified fallout prediction the unit requires the following items:

(a) Current Effective Downwind Message (EDM) (page G-25 for example or Figure G-12, p. G-30 for EDM worksheet)

(b) NBC2 Nuclear Report. (Table G-2, p. G-13)

(c) M5A2 Simplified Fallout Predictor. (Figure G-11 p. G-28 and Figure G-12, p. G-29)

(d) Downwind Distance Zone of Immediate Concern Nomogram. (Figure G-13, p. G-31)

(3) EDM Yield Groups. There are seven standard yield groups for which the EDM (see Table G-3) provides plotting information. These yield groups are listed as lines ALPHAM through GOLFM on the EDM. The information provided by the each yield group is:

(a) The first 3 digits contain the downwind direction (ddd), for the particular yield group, in degrees grid from GN.

(b) The next three digits (sss) contain the effective wind speed in kilometers per hour.

(c) The last three digits represent the expanded angle (***) in degrees between the left and right radial lines. They are only reported when the angle from the wind vector plot exceeds 40 degrees. (Last digit in ADP [NATO ADatP-3 Data Base] format)—seven (7) digit total vice nine (9) EDM line)

NOTE: The first three digits could represent the downwind distance of Zone I measured in Kilometers (KM) if the wind speed is below 8 kmph for the respective EDM Line.

Table G-3. Pre-selected Yield Groups

ALPHAM	**is**	**≤**	**2 KT**		
BRAVOM	**is**	**>**	**2 KT**	**≤**	**5 KT**
CHARLIEM	**is**	**>**	**5 KT**	**≤**	**30 KT**
DELTAM	**is**	**>**	**30 KT**	**≤**	**100 KT**
ECHOM	**is**	**>**	**100 KT**	**≤**	**300 KT**
FOXTROTM	**is**	**>**	**300 KT**	**≤**	**1000 KT (1 MT)**
GOLF M	**is**	**>**	**1000 KT**	**≤**	**3000 KT (3 MT)**

(d) To calculate the data, use the detailed procedure discussed later in this appendix with 2 KT for ALPHAM, 5 KT for BRAVOM, and 30 KT for CHARLIEM and so on.

Example EDM:

NBC EDM
AREA/RRRRR// (Area of Validity)
ZULUM/ddttttZMMMYYYY/ (Date time-group when winds were measured)
UNIT/LLL/DDD/SSS/-//
ALPHAM /-/ddd/sss/***
BRAVOM /-/ddd/sss/***
CHARLIEM /-/ddd/sss/***
DELTAM /-/ddd/sss/***
ECHOM /-/ddd/sss/***
FOXTROTM /-/ddd/sss/***
GOLFM /-/ddd/sss/***

ZULUM (ddttttZMMMYYYY) is the date and time at which the real winds for the Wind Vector Plot were measured (e.g. 020600ZJUN2004 is the 25th day of June, 2004 at 0600Z).

UNIT (LLL/DDD/SSS/-//) are the units of measurement being used e.g. LLL = (KM), DDD = Degrees Grid (DGG) and SSS = KMPH. ddd is effective downwind direction in degrees, and sss effective downwind speed in kmph (e.g. ALPHAM 080025 is a downwind direction of 080 degrees and 025 an effective downwind speed of 025 kmph, valid for yields of 2 KT or less. If ALPHAM was 004, LLL (/-/) would be the downwind distance of Zone I 4 km.

(4) M5A2 Fallout Predictor. The M5A2 fallout predictor is a transparent device used to outline the zones of hazard resulting from surface bursts for pre-selected yield groups. (Example, Figure G-11). NSN: 6665-00-106-9595, TM 3-6665-304-10.

(a) The M5A2 Fallout Predictor is composed of two simple predictors and a nomogram for determining the downwind distance of Zone I.

(b) One predictor is drawn to a scale of 1:50,000; the other predictor is drawn to a scale of 1:250,000. Each predictor contains pre-selected yield groups (A, B, C, D, E—1:50,000 and A, B, C, D, E, F—1:250,000). Each simplified predictor consists of three major parts:

- Azimuth dial for orientation.

- Semicircles depicting stabilized nuclear cloud radii drawn about GZ. This shows the area of contamination for each of the pre-selected yield groups.

- A map scale calibrated in kilometers along two radial lines extending out from the center of the azimuth dial.

(5) Types and Cases of Simplified Fallout Prediction._There are three cases for simplified fallout prediction, one is normal and two are special. They are defined by the number of digits that are contained on the specific yield group being used.

(a) Six Digits - Normal Case: Under normal conditions, the wind speed will be 8 km or more per hour. When wind speeds are 8 kmph or greater (> 8 kmph), 6 digits will be given on the EDM. These 6 digits are used to prepare the Simplified Fallout Prediction. To prepare a Simplified Fallout Prediction depicting a 6 digit Normal Case: (Figure G-10)

- Determine the yield of the weapon. This information is located on line "N" of the NBC-2 report.

- Using the yield, determine which line of the EDM will be used to prepare the Simplified Fallout Prediction.

Example: 50 KT = LINE "D" of the EDM; yield is more than 30 KT but less than 100 KT.

DELTA is > 30 KT ≤ 100 KT

- Utilizing the first three digits (ddd) from the EDM, draw a line from GZ, through the appropriate wind direction on the azimuth dial. Label this Grid North (GN). Therefore recording the downwind direction (ddd) on the M5A2.

- Utilizing the effective wind speed (sss on EDM) and the yield (not the yield group), determine the Downwind Distance Zone of Immediate Concern. Figure G-13 is used. Align the two known values; Effective Wind Speed and Yield. This will allow you to read the Zone I distance.

- Draw an arc between the radial lines of the predictor at the appropriate distance downwind from GZ for Zone I. Double this distance, and draw a second arc downwind from GZ for Zone II. Zone II is always twice Zone I. Label both Zone I and Zone II.

- Draw left and right tangents from the cloud radius line for the yield group to points of intersection of the radial lines and Zone I arc of the predictor.

- Time-of-Arrival Arcs: Draw a series of dashed arcs at distances equal to the effective wind speed (sss) within Zones I and II. For example, EWS = 15 Kmph, then H+1 (1 hour after the burst) would be drawn (dashed arc) at 15 Km, H+2 at 30 Km and H+3 at 30 Km, etc. However, if the extent of Zone II were 29 Km, then (in this example) there would be only two (2) Time-of-Arrival Arcs (H+1 and H+2). If a time-of-arrival arc coincides with a zone boundary, extend the zone boundary with a dashed line and label with the appropriate time-of-arrival (e.g. H+2 and extent of Zone II were 30 Km).

- Place the center of the azimuth dial on the predictor over the estimated ground zero on the map. Rotate the predictor around the GZ point until the Grid North (GN) line is pointing toward GN.

- The predictor is now oriented and the area predicted to be covered by fallout can now be evaluated.

(b) Three Digits - Circular Special Case: Generally, when the wind speed is less than 8 kmph fallout will not go in a definite direction and will return primarily around GZ. To prepare a Simplified Fallout Prediction depicting a 3 digit Circular Case:

- Whenever wind speeds are less than 8 kmph three (LLL) digits will appear on the EDM line item. This indicates the prediction will have a circular pattern.

- On the M5A2 predictor, at GZ, draw a circle equal to the radius reported on the EDM. Label this radius Zone I.

- Double the distance of Zone I, and draw a circle, using the same center (GZ) used for Zone I. Label it Zone II.

(c) Nine Digits - Special Case, Expanded Angles: When 9 digits (7 in ADP format) are reported in the EDM line, the angle reported is greater than 40 degrees. The prediction is plotted in the same manner as a normal case, except the left and right radial lines are expanded equally from the preset 40 degree angle to include all radioactive hazard. Radial lines are expanded from GZ to the end of Zone II.

Example: If the expanded angle is (***) 060 degrees or (*) 6, expand the radial lines 30 degrees on each side of the reference line.

(6) Time of Arrival.

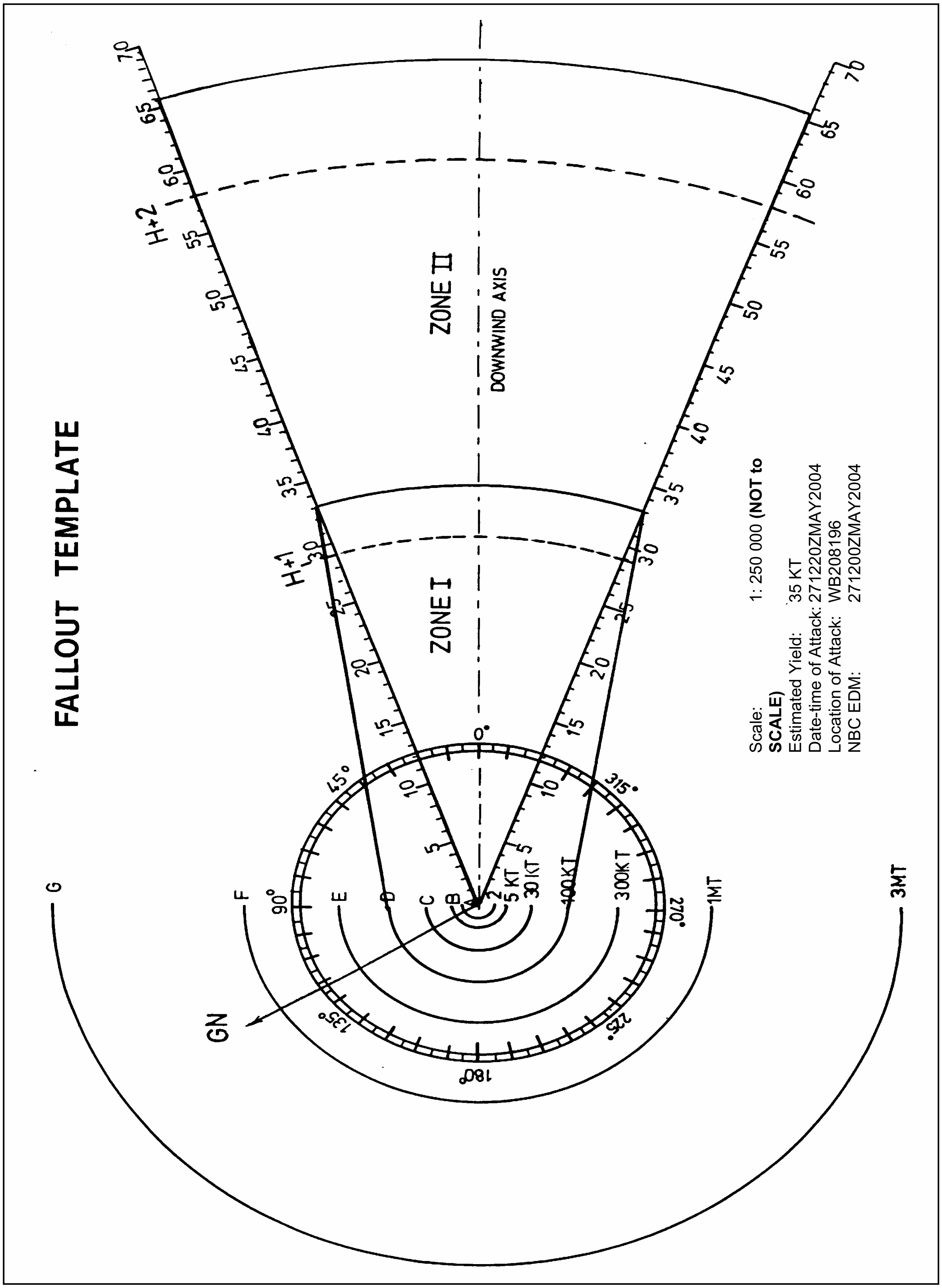
(a) Estimate time of arrival of fallout at a specific distance from GZ by dividing the distance by the effective wind speed. The formula looks like this:

$$\frac{\text{Distance from GZ (km)}}{\text{Effective wind speed in Kmph}} = \text{Time of Arrival}$$

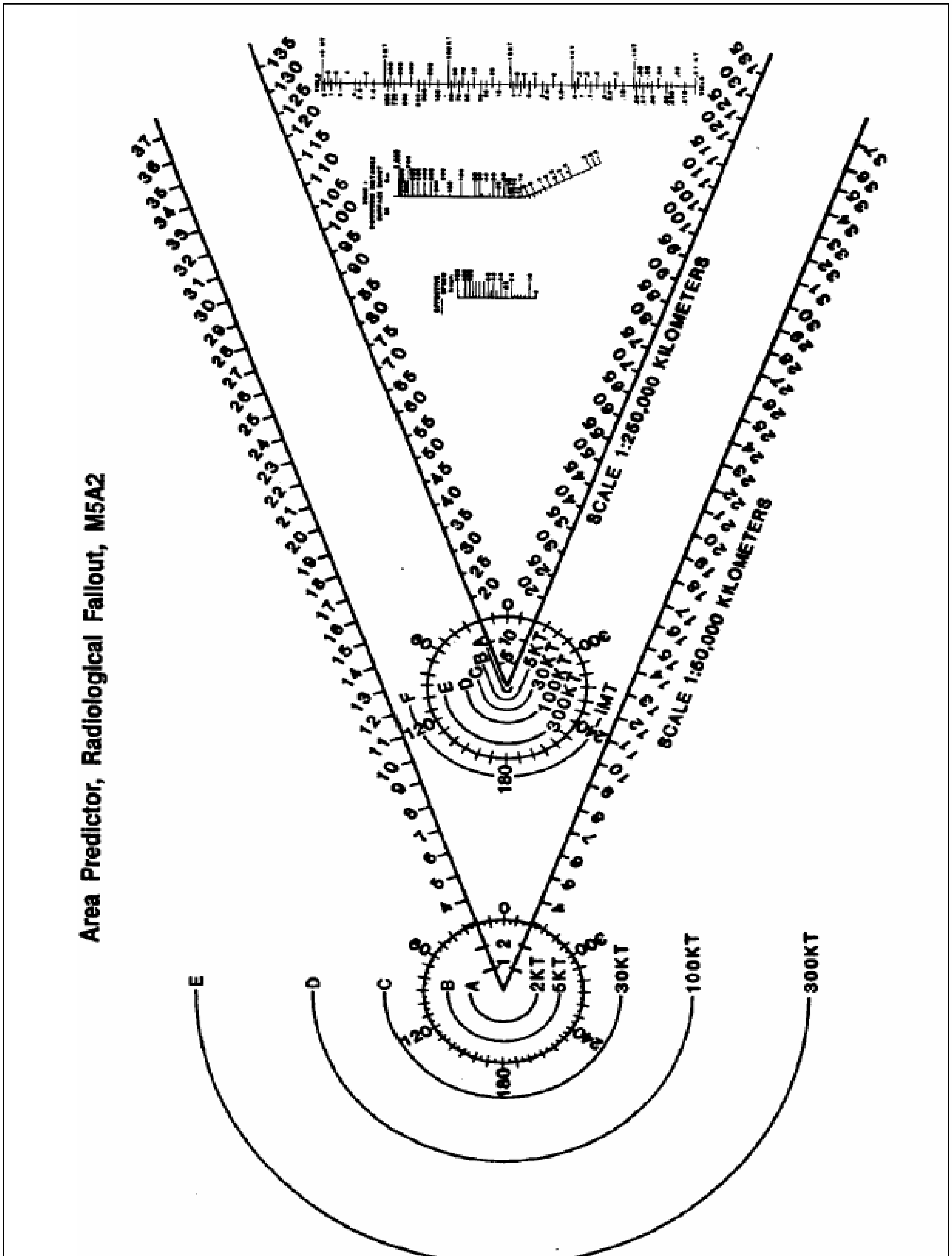
(b) For operational purposes, the following rules of thumb may be applied to the actual arrival of fallout:

- The actual arrival of fallout may occur as early as one-half of the estimated time of arrival. That is, if the estimated time of arrival of fallout is H+4 hours, actual arrival may occur as early as H+2 hours.

- If actual arrival of fallout has not occurred at twice the estimated arrival time (or twelve hours, which ever is earlier), it may be assumed that the area will not receive fallout.



1 **Figure G-11. Simplified Fallout Template with Fallout Prediction**



Plot

Figure G-12. Example, Simplified Fallout Template, M5A2

EFFECTIVE DOWNWIND MESSAGE WORKSHEET

For use of this form, see FM 3-3-1; the proponent agency is TRADOC

TIME OF WIND MEASUREMENT (DATE-TIME GROUP) D D t t t t ______

DATA AND CALCULATIONS

MESSAGE LINE	YIELD (KT)	CLOUD-TOP HEIGHT (METERS)	CLOUD-BOTTOM HEIGHT (METERS)	2/3 STEM HEIGHT (METERS)	(1) DISTANCE OF GZ/CB RADIAL LINE (KM)	EFFECTIVE WIND SPEED-sss (KMPH) (1) x 1/TIME OF FALL = sss ROUND OFF TO NEAREST KILOMETER PER HOUR	(2) AZIMUTH OF GZ/CT RADIAL LINE (DEGREES)	(3) AZIMUTH OF GZ/2/3 STEM RADIAL LINE (DEGREES)	EFFECTIVE DOWNWIND DIRECTION-ddd (DEGREES) SUM OF (2)+(3) = (2) AND (3) / 2 = ddd[1]	WARNING AREA ANGLE
A	2	4,900	2,600	1,700	____	____ X 1.136 = ____	____	____	____ = ____/2 = ____	____
B	5	7,100	4,400	2,800	____	____ X 0.758 = ____	____	____	____ = ____/2 = ____	____
C	30	11,600	7,700	5,100	____	____ X 0.455 = ____	____	____	____ = ____/2 = ____	____
D	100	14,400	9,300	6,200	____	____ X 0.385 = ____	____	____	____ = ____/2 = ____	____
E	300	16,700	11,000	7,400	____	____ X 0.333 = ____	____	____	____ = ____/2 = ____	____
F	1,000	21,600	13,500	9,000	____	____ X 0.286 = ____	____	____	____ = ____/2 = ____	____
G	3,000	26,250	15,800	10,500	____	____ X 0.250 = ____	____	____	____ = ____/2 = ____	____

EFFECTIVE DOWNWIND MESSAGE

ZULU DDtttt ___ ___ ___ ___ ___ ___
ALFA dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
BRAVO dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
CHARLIE dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
DELTA dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
ECHO dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
FOXTROT dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
GOLF dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___

[1] When the azimuth of the ground zero/cloud-top radial line (2) or the azimuth of the ground zero/2/3 stem radial line (3) falls in the first quadrant (0° to 90°) and the other falls in the fourth quadrant (270° to 360°), result of ((2)+(3))/(2) will be the back azimuth of the effective downwind direction. In this case, determine ddd by the following method: If result is greater than 180°, subtract 180°; If result is less than 180°, add 180°. Enter in the effective downwind message.

DA FORM 1971-3-R, SEP 94 — EDITION OF SEP 86 IS OBSOLETE — USAPPC V1.00

Figure G- 13. EDM Worksheet

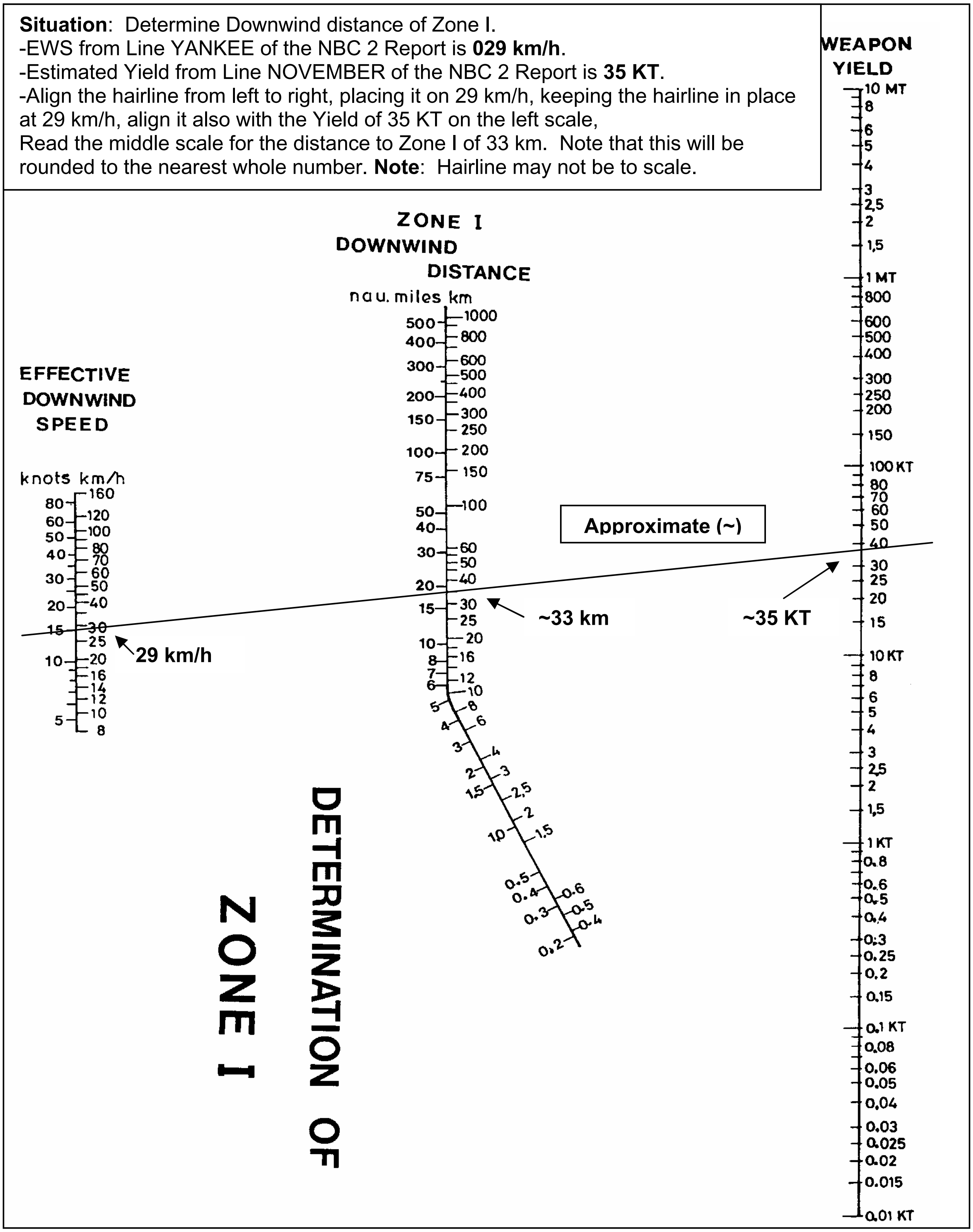


Figure G-14. Determination of Zone I, Downwind Distance (Example)

j. Ships Fallout Template. A fallout template, particularly designed for use on ships, is shown in Figure G-15, p. G-33 and Figure G-16, p. G-34. The ship's fallout template is similar to the M5A2 fallout predictor (Figure G-12) used by forces on land. The main difference is that the semicircles upwind of GZ on the ship's fallout template do not refer to preselected weapon-yield cloud radii.

(1) Safety Distance. Determining the safety distance begins with determining the fallout area at a specific time after detonation. Fallout will not occur simultaneously within the predicted fallout area. It will commence in the vicinity of GZ and maybe expected to move down the fallout pattern (downwind direction) with approximately the speed of the effective wind. The approximate zone in which deposition at the surface is taking place at a specific time after the detonation may be determined by use of the following procedures:

(a) Step 1. Multiply the effective downwind speed by time (in hours) after the detonation.

(b) Step 2. To the distance found in Step 1, add and subtract the safety distance obtained from the template (for the standard yield groups), to allow for finite cloud size, diffusion, and wind fluctuations.

(c) Step 3. On the plot (template), with GZ as center and the two distances obtained from 2, as radii, draw two arcs across the fallout pattern. The zone enclosed between these two arcs will, in most cases, contain the area of deposition at a specific time after the detonation.

(2) Fallout Plotting from NAV EDM and Observations. Worked example: a ship has received the NAV EDM. At 201332Z, a nuclear burst is observed from the ship, and based upon the observations taken from the ship, the yield is estimated to be 70 KT; estimated GZ is 56°00' N-12° 00' E. A NAV NBC 1 Report is transmitted as required; and the ship will have to prepare a fallout prediction, using the simplified procedures:

(a) Step 1. As the yield is estimated only on the basis of the ship's own observations, the yield estimation may not be accurate. So, to be on the safe side, the greatest yield of the yield group in which the estimated yield is contained should be used. Seventy KT is in yield group DELTA, and the largest yield in this group is 100 KT. Therefore, 100 KT will be used for the fallout prediction.

(b) Step 2. Select the data contained in the DELTA yield group in the NAV EDM: DELTA 122016, meaning that the effective downwind direction is 122 degrees, and the effective downwind speed is 16 knots.

(c) Step 3. On the template draw the GN line from GZ through 122 degrees on the compass rose see Figure G-15.

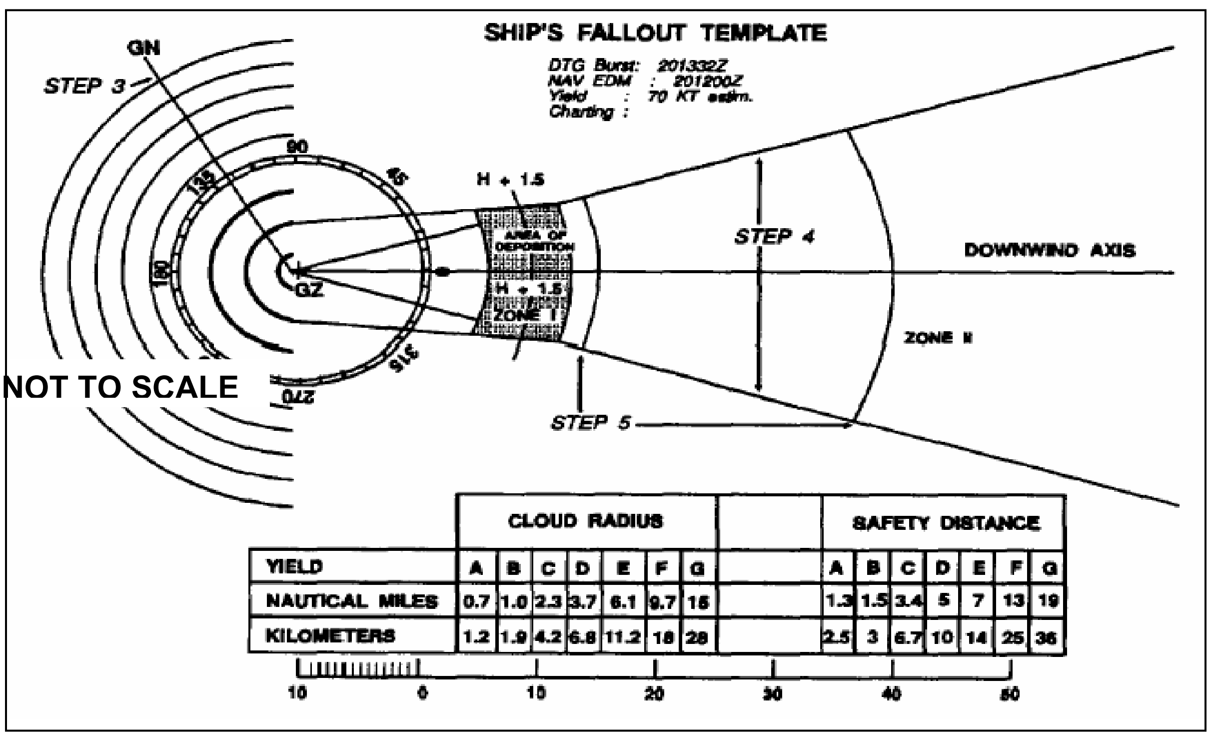
(d) Step 4. From the nomogram in Figure G-14, determine the downwind distance of Zone 1 to be 30 nautical miles. Zone II downwind distance is double this distance, or 60 nautical miles from GZ, in effective downwind direction.

(e) Step 5. Using GZ as center and the two distances, the Zone I and Zone II distances as radii (to the appropriate chart scale), draw two arcs between the radial lines. From the template read the cloud radius to be 3.7 nautical miles, and draw a semicircle upwind of GZ, using GZ as center and 3.7 nautical miles as radius. The preprinted semicircles may be helpful. From the intersections of the Zone I arc with the radial lines, draw lines to connect with the ends of the semicircle.

(f) Step 6. Determine the area where deposit of fallout is estimated to take place at a specific time after the detonation Multiply the effective downwind speed by the time (hours after detonation)—l.5 hours after the burst (H +1.5 hours): 16 knots x 1.5 hours = 24 nautical miles. With GZ as center and 24 nautical miles as radius, draw a dotted arc across the fallout plot. This arc represents the middle of the area within which fallout may be expected to reach the surface at H+1.5 hours after the detonation. To allow for finite cloud size, diffusion and wind fluctuations, a certain distance ahead of and behind this line must be added to determine the area within which, in most circumstances, the fallout will be deposited at the surface at H+1.5 hours. This is the safety distance. From the table printed on the template or from Figure 3-34, find the safety distance for yield group DELTA (100 KT) to be 5 nautical miles. Add and subtract 5 nautical miles to and from 24 nautical miles:

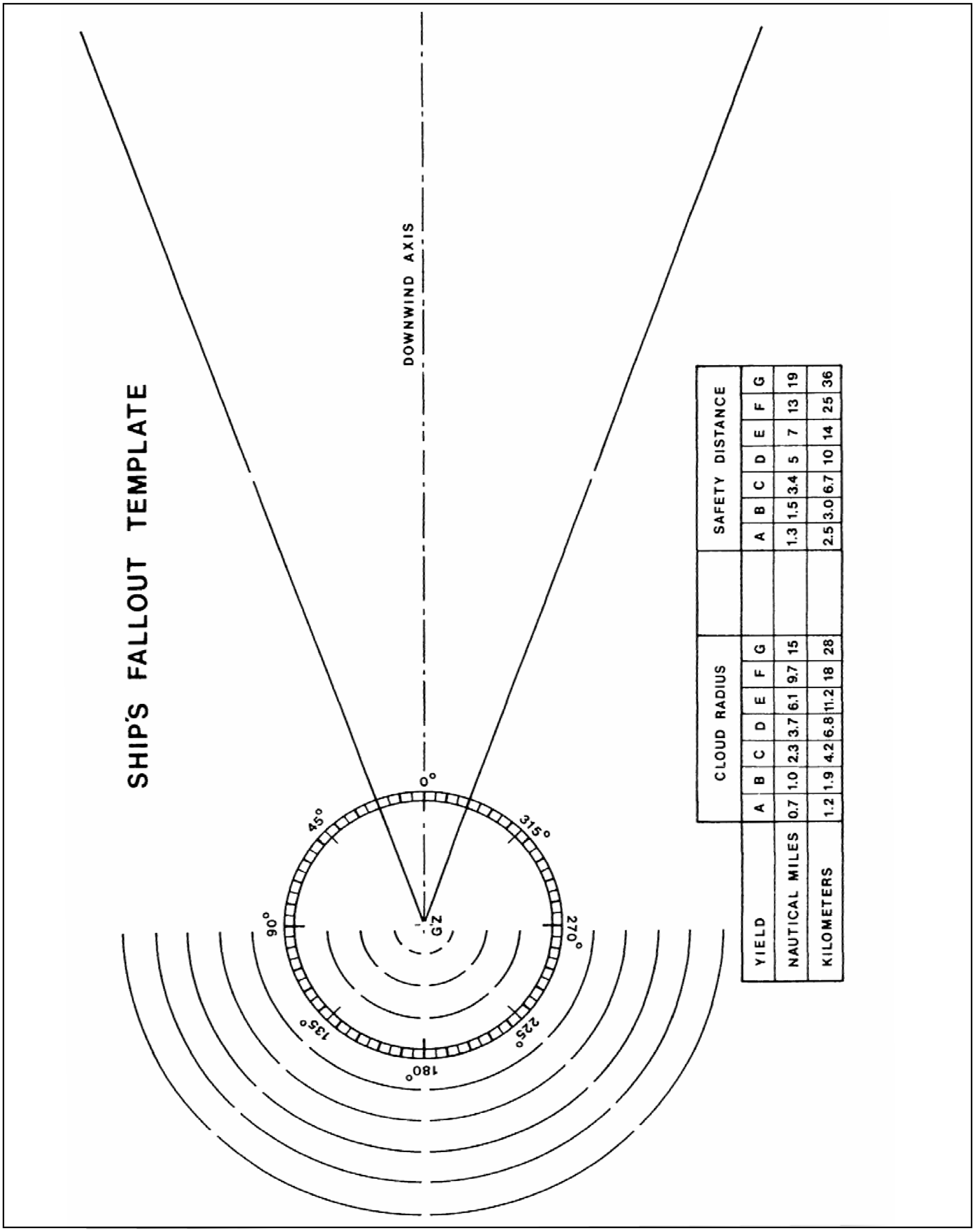
24 + 5 = 29 nautical miles, and 24-5 = 19 nautical miles

Using these two distances as radii and GZ as center, draw two arcs across the fallout pattern. The area confined by the two arcs and the cross wind boundaries of the fallout area defines the approximate area of fallout deposit at 1.5 hours after the detonation. Complete the fallout prediction plot by indicating the following on the fallout template: NAV EDM used, Yield, GZ, and Geographic chart number (scaling).



	CLOUD RADIUS								SAFETY DISTANCE						
YIELD	A	B	C	D	E	F	G		A	B	C	D	E	F	G
NAUTICAL MILES	0.7	1.0	2.3	3.7	6.1	9.7	15		1.3	1.5	3.4	5	7	13	19
KILOMETERS	1.2	1.9	4.2	6.8	11.2	18	28		2.5	3	6.7	10	14	25	36

Figure G-15. Ship's Fallout Template, Example



YIELD	CLOUD RADIUS A	B	C	D	E	F	G	SAFETY DISTANCE A	B	C	D	E	F	G
NAUTICAL MILES	0.7	1.0	2.3	3.7	6.1	9.7	15	1.3	1.5	3.4	5	7	13	19
KILOMETERS	1.2	1.9	4.2	6.8	11.2	18	28	2.5	3.0	6.7	10	14	25	36

Figure G-16. Ship's Fallout Template

k. Detailed Fallout Prediction.

(1) Purpose: The purpose of the detailed fallout prediction is to provide subordinate units immediate warning of predicted contamination resulting from a nuclear detonation. The commander will use the detailed fallout prediction in the tactical decision making process.

(2) Procedures: The CBRN cell is responsible for preparing and plotting Detailed Fallout Predictions. The Fallout Prediction Worksheet provides the CBRN cell with a standard worksheet for recording Nuclear Burst (Surface) Information data used in preparing the Detailed Fallout Prediction. Completing the Fallout Prediction Worksheet is the first step in drawing the prediction. To complete the worksheet use the below listed steps:

(a) Step 1: Obtain a Current Wind Vector Plot. Before any bursts occur Wind Vector Plots are drawn. Refer to Appendix D for detailed information regarding Wind Vector Plotting. (See Figure G-17, page G-38 for an example problem.)

(b) Step 2: Complete a Detailed Fallout Prediction Worksheet: Utilizing an NBC 2 Report, determine Nuclear Burst Information. Record this information on the worksheet. (See page G-39, Figure G-18)

- Lines "A, B and E" are transcribed from the NBC 2 Report.

- Lines "C" and "D" - Enemy Burst/Friendly Burst Data Unknown: When enemy/friendly burst information is unknown assume a worst case (100% fission yield) scenario has occurred and enter a "1" (one) on line CHARLIE. When the height of the burst is unknown, a "0" (zero) is entered on line DELTA which represents worst case height-of-burst (HOB).

- Friendly Burst With Known Data: This information will come from the Fire Support Element (target analyst) delivering the weapon. The data will include weapon yield, FY/TY ratio, HOB, GZ coordinates, date/time of attack, and strike serial number.

(c) Step 3: Determine Cloud Parameters. Utilizing the yield of the weapon from line "E" and the nomogram located on page G-40, Fig. G-19, locate the yield on either the right or left hand scale. Place a straightedge (hairline) on the yield and align the values on both scales. Read and record all cloud parameter values on lines FOXTROT through JULIET of the fallout prediction worksheet.

NOTE: The following steps are exactly the same as the steps utilized in making an EDM (Refer to Appendix D for more information regarding EDMs).

(d) Step 4: Determine Lateral Limits Of The Prediction Utilizing the Wind Vector Plot: Mark points representing the cloud-top height and two-thirds stem height. Draw radial lines from the GZ point through these height points.

NOTE: If wind vectors between the two-thirds stem height point and the cloud-top height point fall outside the radial lines drawn from GZ, expand the angle formed by these two radial lines to include these outside wind vectors.

(e) Step 5: Determine The Effective Wind speed (EWS): Mark the cloud-bottom height on the wind vector plot and measure the length of the radial line, in kilometers, from GZ. Record this value on line KILO of the work sheet. Transfer the values from line KILO and line JULIET to line LIMA. Compute the EWS using the following formula:

$$EWS = \frac{\text{Radial Line Distance From GZ to CB Height (KM)}}{\text{Time of Fall from CB (HR)}}$$

Round this number to the nearest kilometer. (Example: 21.5 = 22; 22.4 = 22)

NOTE: If the effective wind speed is less than 8 kmph, it is a special case. When the wind speed is less than 8 kmph, always use an 8 kmph wind speed in Step (6) below.

(f) Step 6: Determine The Downwind Distance Of Zones I and II. Using Fig. G-20, Pg. G-41, align a straightedge (hairline) from the yield on the right-hand scale (Obtained from line ECHO of Fallout Prediction Worksheet) to the effective wind speed on the left-hand scale (Obtained from line LIMA of the Fallout Prediction Worksheet). Where the straightedge intersects the center scale, read the downwind distance of Zone I. Record this on line MIKE of the Fallout Prediction Worksheet.

(g) Step 7: Obtain the fission yield/total yield (FY/TY) ratio from the nuclear target analyst. FY/TY can also be found in FM 101-31-2 (S). The FY/TY ratio is expressed as a percentage. It states the percent of the weapon's explosive ability that is contributed by the fission process. The remainder of the weapon's yield is derived from fusion. This is significant in fallout prediction. The fusion portion of the weapon does not create residual contamination. Thus, a weapon with a FY/TY ratio of 0.6 means that 60 percent is fission and 40 percent is fusion. A crude comparison could be that this weapon will make 40 percent less fallout than a weapon with the same size yield which is 100 percent fission. If the FY/TY ratio is known, obtain the FY/TY adjustment factor from the nomogram located on Pg. G-42, Fig. G-21. To use the nomogram:

- Lay a straightedge (hairline) from the total yield on the left- hand scale to the value of the FY/TY ratio on the right-hand scale. Where the straightedge intersects with the center scale, read the FY/TY adjustment factor. Record the FY/TY ratio on line "N" of the worksheet.

- If the FY/TY ratio is not known, assume the yield to be 100% fission and use an FY/TY adjustment factor of 1. Record the FY/TY adjustment factor on line NOVEMBER of the work sheet.

- HOB Known: If the HOB is known (as in the case of a pre-strike friendly burst), obtain the HOB adjustment factor from the nomograms located on pages G-43 and G-44, Fig. G-22 is for yields equal to or less than 100 KT. Fig. G-23 is for yields greater than 100 KT. To use the nomogram: Lay a straightedge (hairline) from the yield on the left-hand scale to the value of the HOB on the center scale. At the inter-section of the straightedge with the right-hand scale, read the HOB adjustment factor. Record the HOB adjustment factor on line "N" of the worksheet.

- HOB Unknown: If HOB is not known, assume a zero HOB and use a HOB adjustment factor of 1. Record HOB on line NOVEMBER of the work sheet.

- Obtain Adjusted Downwind Distance of Zone I: Multiply line "M" by line "N", the result will be the Adjusted Downwind Distance of Zone I, and is entered on line "O" of the worksheet.

NOTE: If the EWS is less than 8 kmph, the detailed prediction is now complete. Prepare the NBC 3 Report (line ROMEO of the worksheet) as described in step (9). If the wind speed is greater than or equal to 8 kmph, continue as follows.

(h) Step 8: Construct Left And Right Radial Lines: Measure the angle formed by the radial lines drawn from GZ to the cloud-top height and two-thirds stem height.

NOTE: If the radial lines have been expanded to include vectors between the two-thirds stem height and the cloud-top height this angle <u>must</u> be measured.

- If the angle formed is 40 degrees or greater, measure the azimuths (in mils or degrees from GZ) of the final left and right radial lines and record on lines PAPA and QUEBEC of the work sheet.

- If the angle formed is less than 40 degrees, bisect the angle (add azimuths together and divide by 2) and expand the angle formed by the two radial lines to 40 degrees (20 degrees on each side of the bisected azimuth). (See "**Note**" in Figure G-17, page G-38, for example).

(i) Step 9: Prepare The NBC 3 Report. Complete line ROMEO of the work sheet. The report will always include the following line items:

- ALPHA: This line is the strike serial number. The strike serial number is assigned by the CBRN cell at the operations center responsible for the area in which the strike occurs.

- DELTA: DDTTTTZMMMYYYY-This line is the date-time group of the burst, with *DD* (the day) and *TTTT* (H-hour) in local or Zulu time (GMT) (state which), *MMM* (month) and *YYYY* (year).

- FOXTROT: yyzzzzzz-This line is the actual or estimated (state which) coordinates of GZ. The two letters *yy* represent the appropriate 100,000-meter grid square and the letters *zzzzzz* coordinates of GZ within this grid square.

- PAPA BRAVO: sssxxxrr ddddcccc- This line is the prediction dimensions and the azimuths of the two radial lines to the nearest mil or degree from GZ. The letters *sss* represent the effective wind speed to the nearest kilometer per hour. The letters *xxx* represent the downwind distance of Zone I to the nearest kilometer. The letters *rr* represent the radius of the stabilized cloud (GZ circle) to the next higher kilometer if the value is not a whole number. The letters *dddd* represent the azimuth of the left radial line and the letters *cccc* represent the azimuth of the right radial line (mils or degrees).

  - This line will contain only three digits (***xxx***) when the special case of low winds (less than 8 kmph) exists.

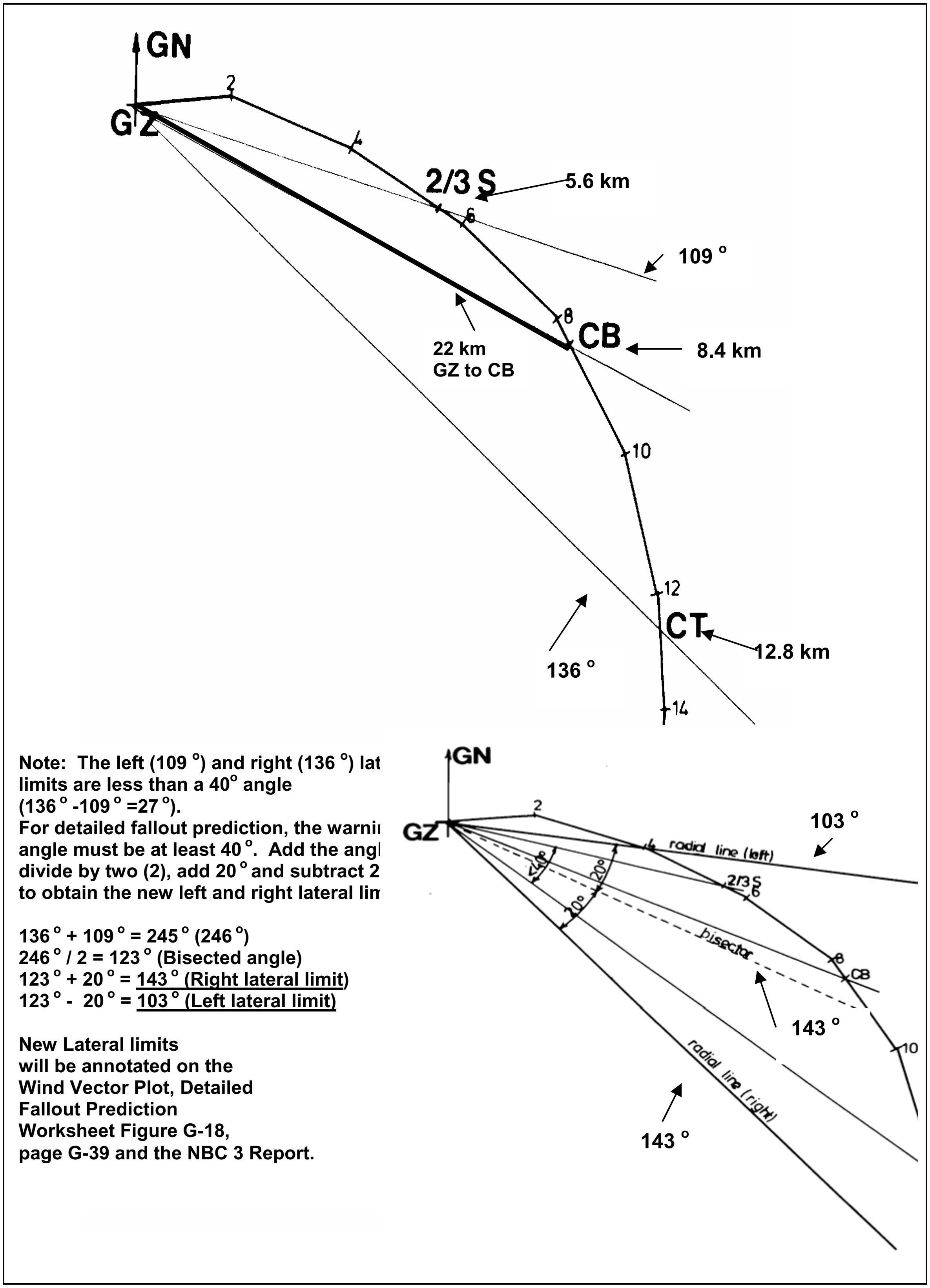


Figure G-17. Wind Vector Plot with Cloud and Stem Radial Lines (50 KT) Example

NUCLEAR FALLOUT PREDICTION WORKSHEET – SURFACE BURST

For use of this Form, see FM 3-11.3

NOTE: Complete Worksheet to determine NBC-3 (NUC) Report. (Line out unused unit of measure in far right hand column).

A.	Time of burst (date-time group) (From NBC 2 Report)	**120657ZDEC2004**	DELTA (DD TTTTZ MMM YYYY) (~~local~~ or Zulu time)
B.	Ground Zero Coordinates (GZ) (From NBC 2 Report)	**WB764766**	FOXTROT (yy zzzzzz) (~~Actual~~ or Estimated)
C.	FY/TY Ratio (from target analysis for friendly weapons only) (If known, enter #, If unknown or For enemy attack, enter “1”).	1	
D.	HOB (from target analysis for friendly weapons only) (If known, enter #, If unknown or For enemy attack, enter “0).	0	Meters
E.	Yield (From NBC 2 Report)	50	KT or ~~MT~~
F.	Cloud Top Height (Use Fig. G-19 on p. G-40.)	12.8	10^3 meters or ~~feet~~
G.	Cloud Bottom Height (Use Fig. G-19 on p. G-40.)	8.4	10^3 meters or ~~feet~~
H.	2/3 Stem (Use Fig. G-19 on p. G-40.)	5.6	10^3 meters or ~~feet~~
I.	Stabilized Cloud Radius (Use Fig. G-19 on p. G-40.)	**06**	PAPA BRAVO – rr (KM) Round up to nearest Whole Number.
J.	Time of Fall from Cloud Bottom (Use Fig. G-19 on p. G-40.)	2.38	Hours Round to nearest hundredth.

NOTE: Plot F., G. and H. on current Wind Vector Plot. Measure distance from GZ to Cloud Bottom Height.

K.	Radial Line Distance from GZ to Cloud Bottom Height	22	KM
L.	Effective Wind Speed (From NBC 2 Report) $\frac{K}{J} = \frac{22}{2.38} =$	**009**	PAPA BRAVO – sss (KM/H) Round to nearest Whole Number.
M.	Downwind Distance of ZONE I (Use Fig. G-20 or p. G-41 with E. and L.)	**022**	PAPA BRAVO – xxx (KM) Round to nearest Whole Number.
N.	Adjustment Calculation of Downwind Distance of ZONE I FY/TY Factor (C.) ____1____ x HOB (D.) _____1____ = Use Fig. G-21 on p. G-42. Use Fig. G-22/23 on p. G-43/44. (If unknown or For enemy attack, enter “1” and “1”.)	1	
O.	Adjustment of Downwind Distance of ZONE I	**022**	PAPA BRAVO – xxx (KM) Round to nearest Whole Number.

NOTE: Ensure that lateral limit angle (angle between Left and Right Radial Lines) is $\geq 40^0$. If not, then, add azimuths; divide sum by 2; add 20^0 to each azimuth. These are your NEW Radial Lines. Ensure you enter the NEW azimuths below.

P.	Azimuth of Left Radial Line	0**103**	PAPA BRAVO – dddd (~~mils~~ or degrees)
Q.	Azimuth of Right Radial Line	**0143**	PAPA BRAVO – cccc (~~mils~~ or degrees)

R. NBC 3 Report

ALPHA	(AAA)	**N001**	(Strike Serial Number)
DELTA	(DD TTTTZ MMM YYYY)	**120657ZDEC2004**	(~~Local~~ or Zulu time)
FOXTROT	(yy zzzzzz)	**WB764766**	(~~Actual~~ or Estimated)
PAPA BRAVO	(sss xxx rr) * (dddd cccc)**	009 022 06 0103 0143	(Azimuths of Radial Lines – ~~Mils~~ or Degrees)

* sss – Effective Wind Speed (KM/H) * xxx – Downwind Distance of ZONE I (KM) * rr – Cloud Radius (KM)

**dddd – Left Radial Line **cccc – Right Radial Line

Figure G-18. Detailed Fallout Prediction Worksheet (Example)

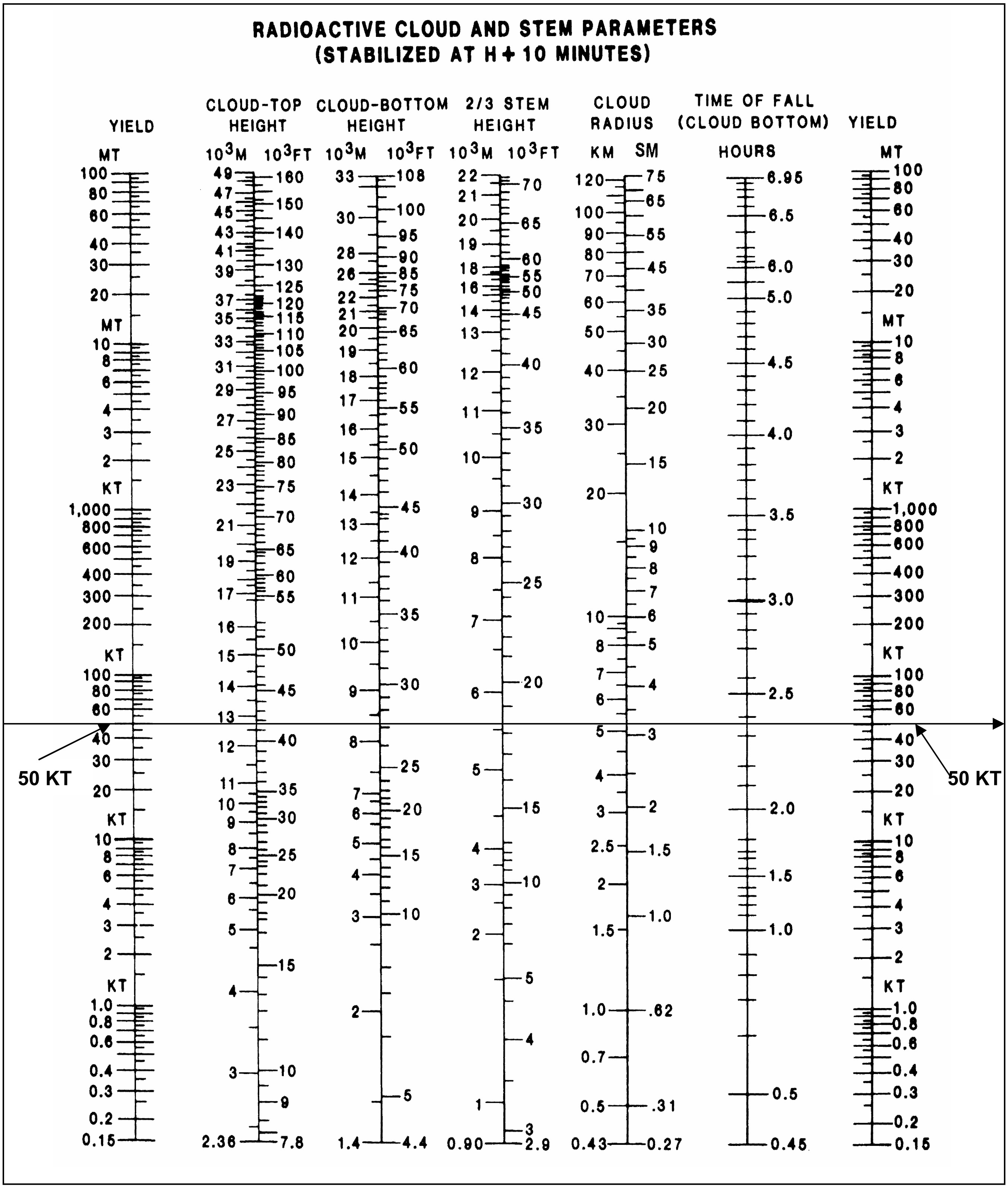


Figure G-19. Stabilized Cloud and Stem Parameters for Detailed Fallout Prediction (Example)

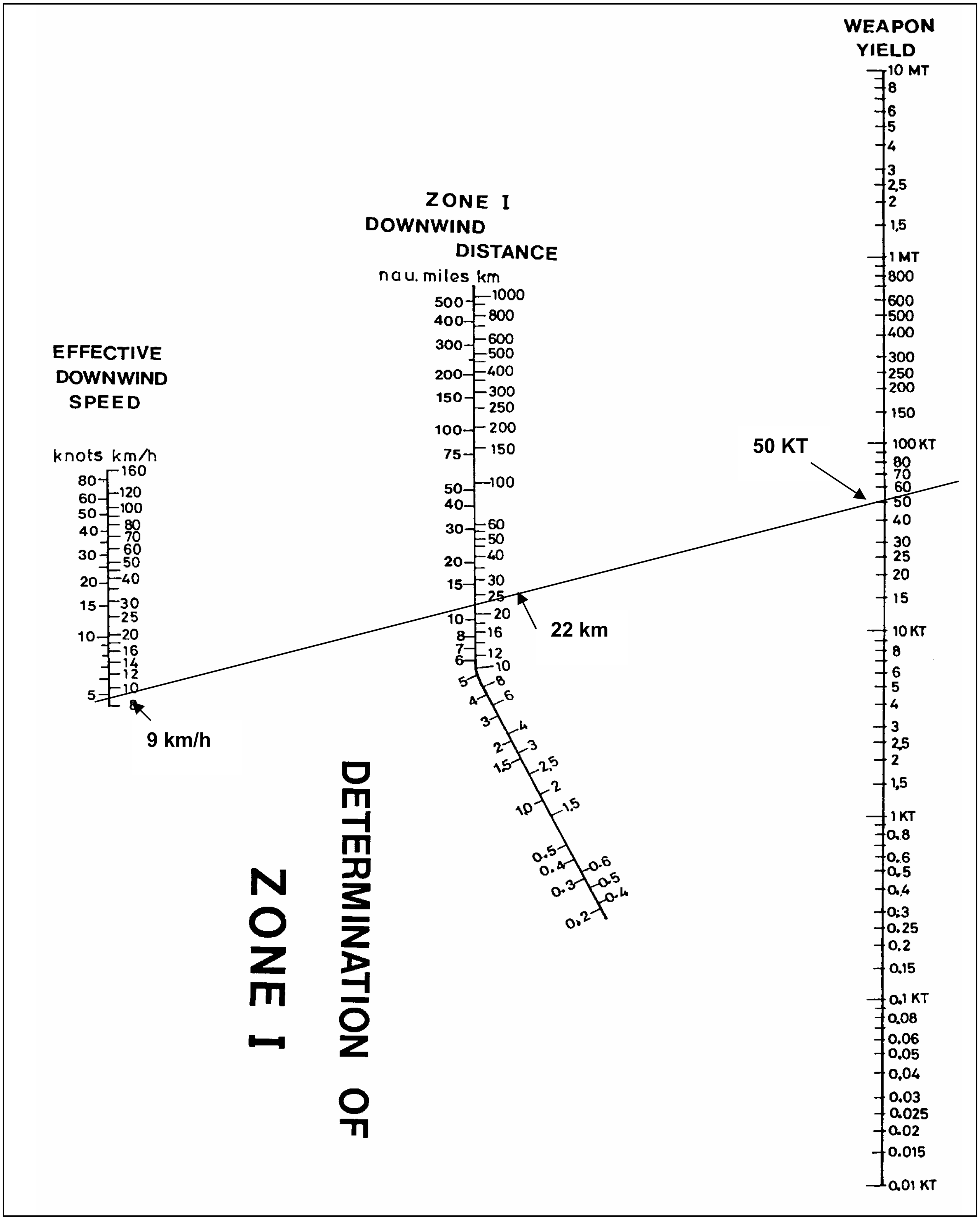
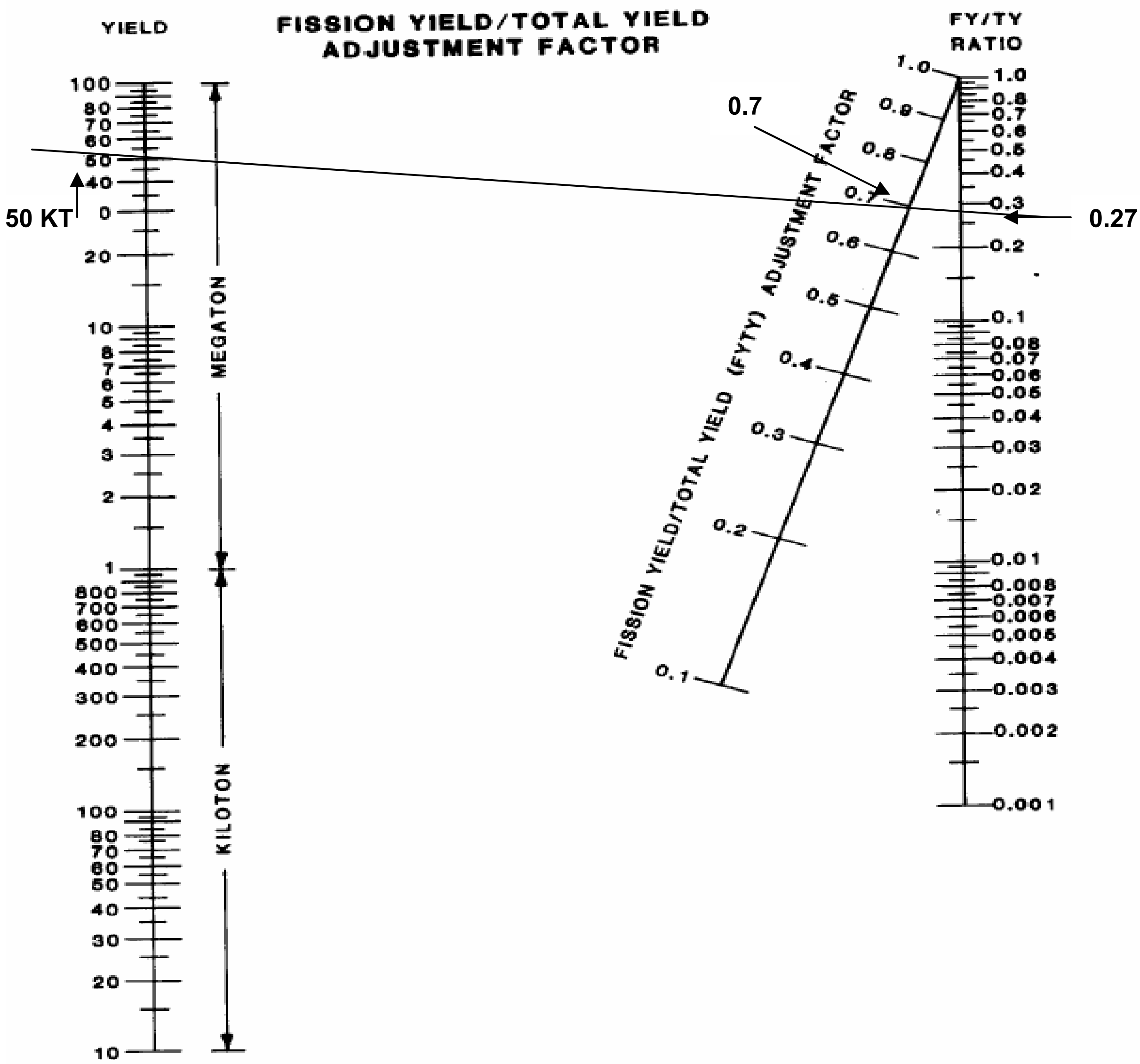
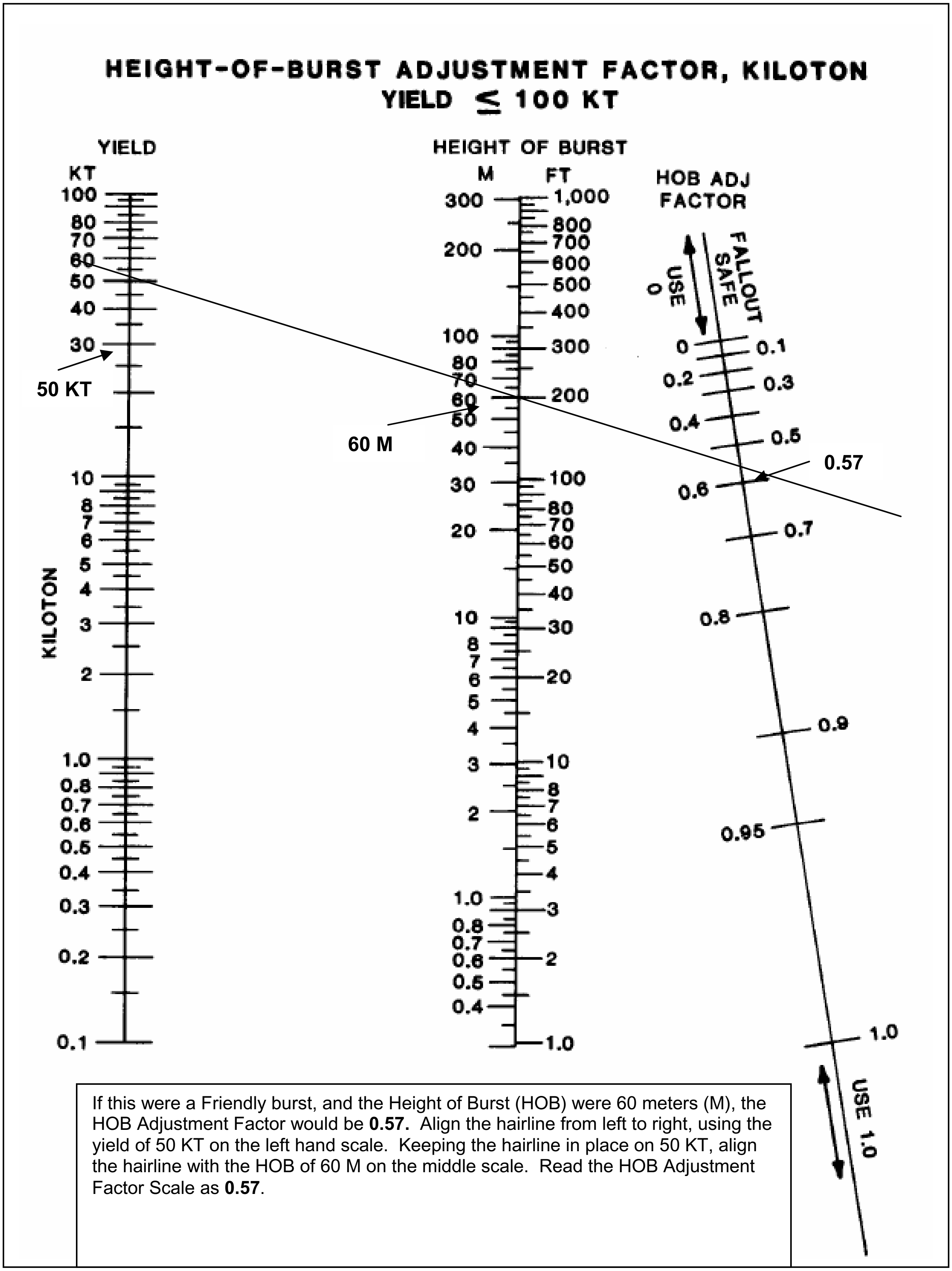


Figure G-20. Determination of Zone I, Downwind Distance (Example)

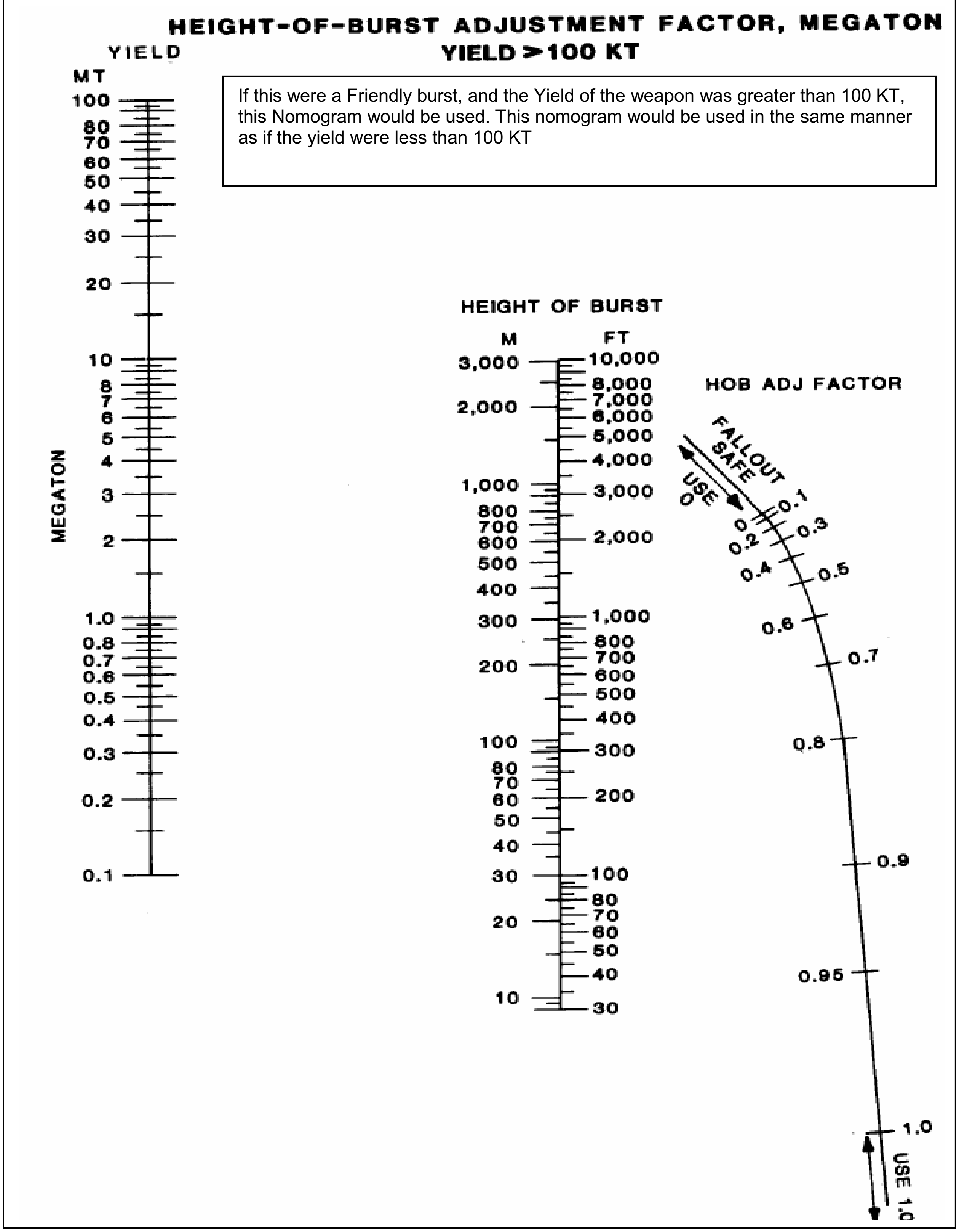


If this were a Friendly burst, and the FY/TY Ratio were **0.27**, the FY/TY adjustment Factor would be **0.7.** Align the hairline from left to right, using the yield of 30 KT on the left hand scale. Keeping the hairline in place on 50 KT, align the hairline with the FY/TY Ratio of 0.27 on the right hand scale. Read the FY/TY Adjustment Factor Scale as **0.7.**

Figure G-21. Fission Yield/Total Yield Adjustment Factor (Example)



1 **Figure G-22. Height-of-Burst [Kiloton] Adjustment Factor (Example)**



If this were a Friendly burst, and the Yield of the weapon was greater than 100 KT, this Nomogram would be used. This nomogram would be used in the same manner as if the yield were less than 100 KT

1 **Figure G-23. HOB [Megaton] Adjustment Factor (Example)**

6. NBC3 Report

a. The NBC3 Report reflects the predicted Zones of contamination for nuclear surface bursts. It is based from the NBC2 Report and a current wind vector plot. Users of NBC3 Report are not limited to the use of the line items shown in the example (see Table G-4). Other line items, as appropriate, may be added.

(1) Purpose: The purpose of the NBC3 Report is to report immediate warning of predicted contamination and hazard areas to higher, subordinate, and adjacent units.

(2) Message Precedence: All other messages, after the initial NBC1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally *immediate* would be appropriate.

Table G- 4. NBC3 Report Nuclear

NBC3 (NUC) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	M	ALPHA/US/A234/001/N//
D	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	O	GOLF/SUS/AIR/1/BOM/4//
H	Type of Nuclear Burst	O	HOTEL/SURF//
N	Estimated Nuclear Yield in KT	O	NOVEMBER/50//
PB	Detailed Fallout Hazard Prediction Parameters	M	PAPA BRAVO/019KPH/33KM/5KM/ 272DGG/312DGG//
PC	Radar Determined External Contour of Radioactive Cloud	O	PAPA CHARLIE /32VNJ456280/32VNJ456119/ 32VNJ556182/32VNJ576200/ 32VNJ566217/32VNJ456280//
PD	Radar Determined Downwind Direction of Radioactive Cloud	O	PAPA DELTA /030DGT//
XB*	Predicted Contour Information	C	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The “Cond.” column in the examples shows that each line item is either Operationally (O), Mandatory (M), or Conditional (C) determined.			

b. Plotting Detailed Fallout Predictions (NBC3) (see Figure G-24, page G-47).

(1) Step 1: Identify map scale to be used. Obtain a sheet of overlay paper or other transparent material. Mark a GZ location and GN.

(2) Step 2: Examine line item PAPA BRAVO. Starting at the GZ location, draw the left (dddd) and right (cccc) radials line measured from GZ.

(3) Step 3: From Line Item PAPA BRAVO, determine the downwind distance of Zone I (xxx).

(a) Starting from GZ, draw an arc between the radial lines with a radius equal to the distance of Zone I. Label this area Zone I.

(b) Draw a second arc between the radial lines at twice the radius as the downwind distance of Zone II. Label this area Zone II.

(4) Step 4: From line item PAPA BRAVO, determine the size of the cloud radius (rr). Using GZ as the center, draw a circle with a radius equal to the stabilized cloud radius.

(5) Step 5: Draw tangent lines from the outer edge of the cloud radius to the points of intersection of the radial lines with the Zone I arc.

(6) Step 6: From Line Item PAPA BRAVO, Determine the Effective Wind Speed (sss).

(a) Beginning at GZ, draw as many dashed time-of-arrival arcs between the radial and tangent lines as will fit inside the prediction, within Zones I and II.

(b) Label the dashed arcs as hours after the burst: H+1, H+2, and so on. H+1 is the closest arc to GZ.

(c) If a time-of-arrival arc coincides with a Zone I or Zone II arc, extend the zone boundary with a dashed line.

(7) Step 7: Add marginal information to the plot. This should be all known information about the attack. (See Figure G-25, p.G-47)

(8) Step 8: Orient the prediction to the map and evaluate the hazard. (See Figure G-24, p.G-47)

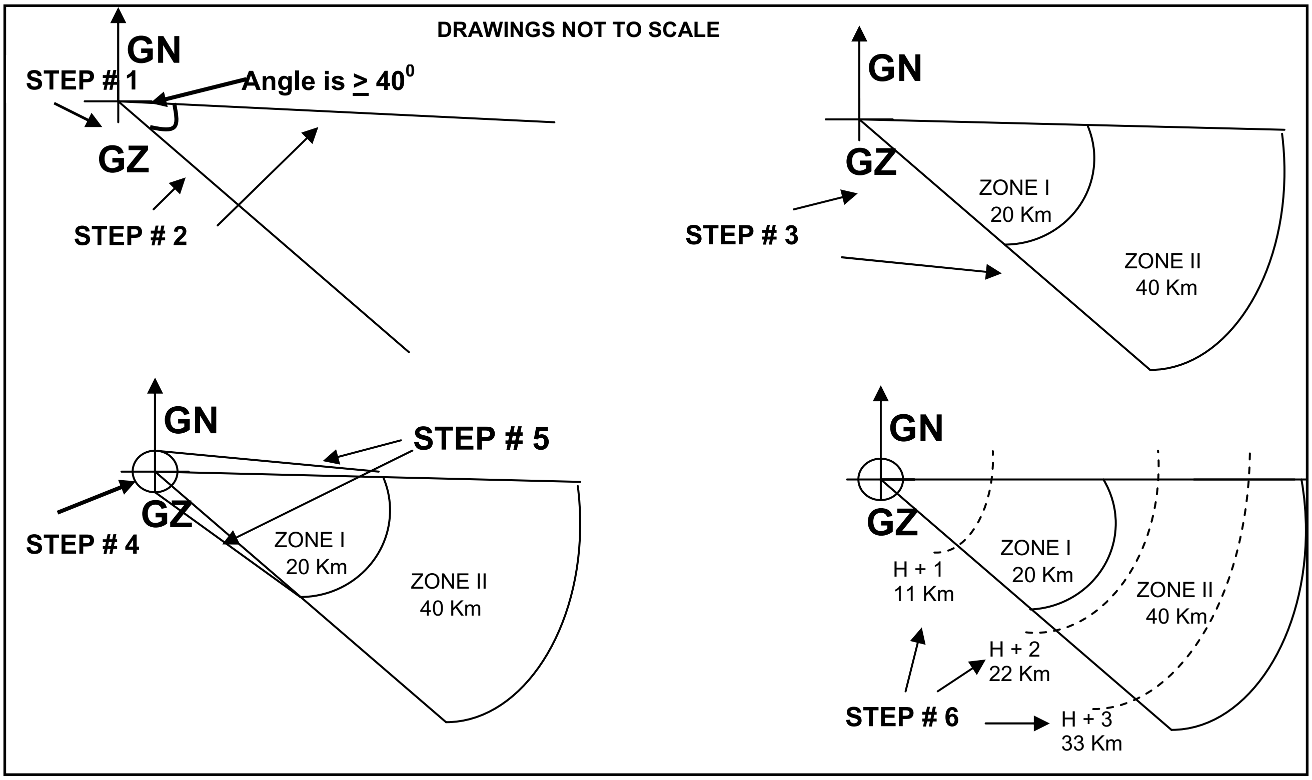


Figure G- 24. Example Step-by-Step Plotting Detailed Fallout Prediction

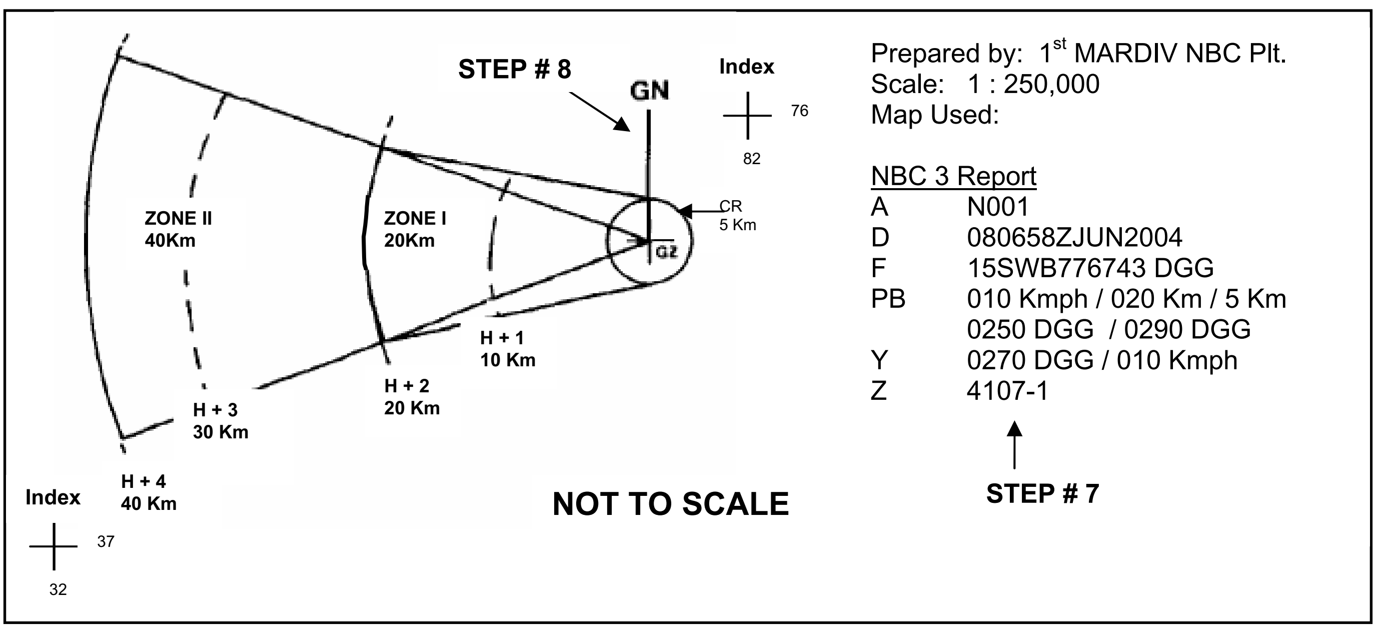


Figure G- 25 (Example Detailed Fallout Prediction—Steps #7-8)

NOTE: If the NBC3 Report (Line PAPA BRAVO) only contains Zone I (xxx), follow the following procedures (see Figure G-26, page G-48):

(1) Step 1: Identify map scale to be used. Obtain a sheet of overlay paper or other transparent material. Mark a GZ. A GN line is not necessary.

(2) Step 2: The three digits shown on line ZULU is the radius of a circle for Zone I. Using the GZ as the center, draw a circle with a radius equal to Zone I distance. Label this area Zone I. Draw a second circle at twice this radius for Zone II. Label this area Zone II.

(3) Step 3: Add marginal information to the plot. This should be all known information about the attack.

(4) Step 4: Orient the prediction to the map and evaluate the hazard.

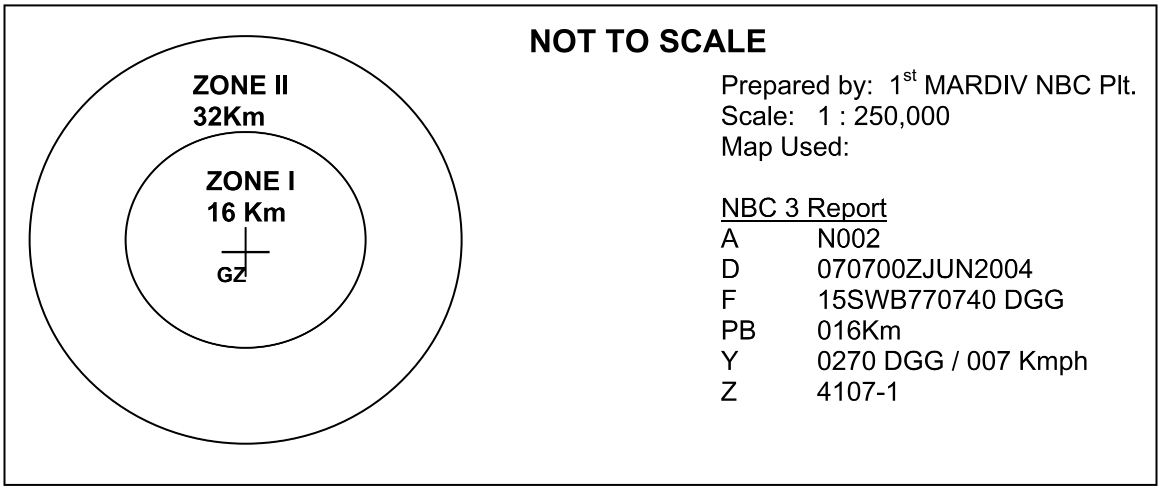


Figure G-26. Example Detailed Fallout Prediction with Wind Speed Less Than 8 KMPH

c. Contamination Prediction System for Merchant Ships at Sea.

(1) Significance of NBC Warnings:

(a) Radioactive fallout from nuclear explosions on sea and land targets, particularly from the latter, may affect large areas of adjacent waters.

(b) The areas affected will depend upon the prevailing wind conditions, and any ship close to or approaching these areas will be in grave danger. It is therefore essential that shipping should be warned of the fallout hazards and contamination in order that:

- Passive defense measures, such as switching on washdown systems, may be taken.
- Course may be altered, if necessary, to avoid the dangerous zones.

(2) The MERWARN System, Warnings to Merchant Ships at Sea:

(a) A simplified contamination warning system has been established throughout NATO for broadcasting, via MERCOMMS and coastal radio stations, warnings of contamination dangerous to merchant shipping. This system calls for the origination, by NATO naval authorities.

(b) MERWARN NBC3 Report: will be issued after a nuclear attack producing fallout, and gives fallout data for a specific explosion or series of explosions, which will be identified in the message. These messages are issued as soon as possible after the attack, and at six hour intervals (to the nearest hour) thereafter, for as long as the fallout danger exists. They contain information, which enables the ship to plot the danger area.

(c) The standard format of MERWARN NBC3 Report contains the line items ALPHA, DELTA, FOXTROT and PAPA BRAVO of the military NBC3 Report (see Appendix D for additional MERWARN information).

(d) The MERWARN NBC3 Report has the following structure:

- MERWARN NBC3 Report

  ALPHA: Strike serial number (as defined by the naval authority)

  DELTA: DTG of detonation (GMT)

  FOXTROT: Location of attack (latitude and longitude, or geographical place name).

  PAPABRAVO: Effective wind speed (3 digits and unit of measurement), downwind distance of Zone I (3 digits and unit of measurement), cloud radius (2 digits and unit of measurement), left and right radial line of the predicted fallout hazard area (3 digits and unit of measurement each).

  Example:

  MERWARN NBC 3 Report

  ALPHA/US/NBCC/02-001/N//

  DELTA/021405ZSEP1999//

  FOXTROT/451230N014312E/AA//

  PAPA BRAVO
  /012KTS/028NM/02NM/272DGT/312DGT//

- MERWARN NBC 3 Report, Plain Language Format: The MERWARN NBC 3 standard format may not be suitable after a multiple nuclear attack which produces fallout from several bursts in a large or complex target area. In such cases warnings will be plain language statements of a more general nature, indicating area affected and expected movement of the fallout.

  Example:

  MERWARN NBC 3 Report

  ALPHA/UK/02-001/N//

  DELTA/021405ZSEP1999//

  Fallout extends from Glasgow area to eastern Ireland at 021405Z and is spreading westwards with 12 Knots. Irish Sea is likely to be affected within an area of 60 nautical miles of the British coast.

(e) MERWARN DIVERSION ORDER.: This is a general diversion order, based upon the fallout threat, whereby merchant ships proceeding independently are passed evasive routing instructions of a general nature.

- In addition to the origination of MERWARN NBC 3 messages, naval authorities may, if circumstances dictate, broadcast general diversion orders, based upon the fallout threat, whereby merchant ships proceeding independently will be passed evasive routing instructions of a more general nature, using the standard Naval Control of Shipping (NCS) identifier MERWARN DIVERSION ORDER.

Example:

MERWARN DIVERSION ORDER

English Channel closed. All shipping in North Sea remain north of 052 degrees N until 031500ZSEP1999.

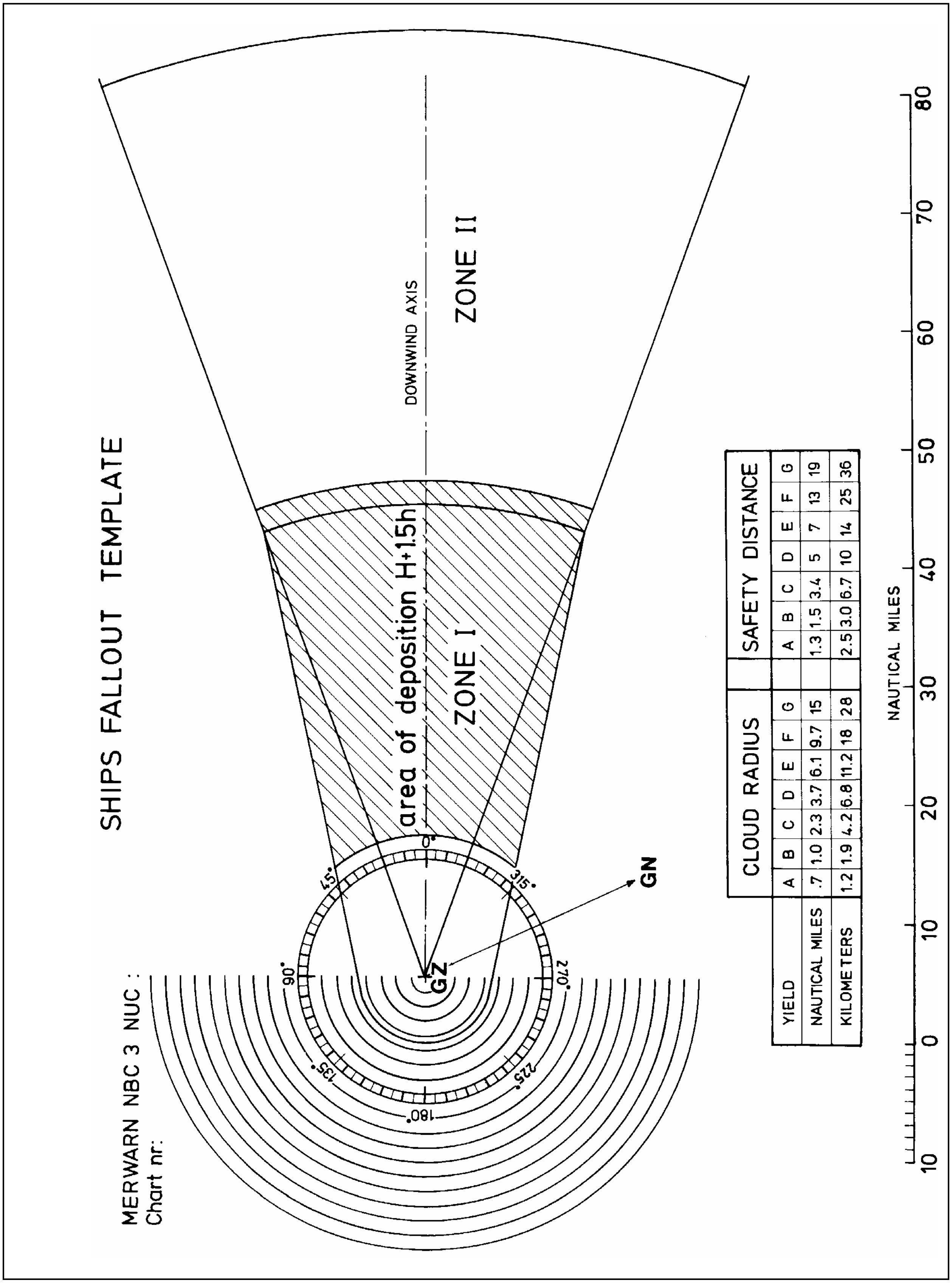
- In some cases it may be better to provide warning of contamination by means of general plain language messages rather than by the formats above.

(3) Precedence of NBC Messages: All MERWARN NBC messages should be given the precedence FLASH (Z) to ensure rapid handling on any military circuit between the originating authority and the MERCOMMS and/or coastal radio stations. This precedence should not be used where the rules for the use of the International Safety Signal (TTT for CW and Security for voice circuits) apply.

NOTE: Adjacent MERWARN originators are responsible for relaying to CES/CRS under their control as necessary.

(4) Danger Zones: All shipping in waters out to 200 nautical miles from any coast at the outset of war must be regarded as being in an area of possible fallout danger from nuclear attacks on shore.

(5) Plotting MEWARN NBC3 Report: Plot in the same manner as "Fallout Plotting from NAV EDM and Observations" using the Ship Fallout Template on page G-51, Figure G-27



1 **Figure G-27 (Shipboard Fallout Template, Example)**

d. Time of Completion of Fallout.

(1) Most contaminated particles in a radioactive cloud rise to considerable heights. Therefore, fallout may occur over a large area. It may also last for an extended period of time. A survey conducted before fallout is complete would be inaccurate, because contaminants would still be suspended in the air. For this reason, as well as the hazard to surveying personnel, nuclear surveys are not conducted before completion of fallout.

(2) An estimate of the time of completion (T_{comp}) of fallout for a particular location may be determined using a mathematical equation. The time in hours after burst when fallout will be completed at any specific point is approximately 1.25 times the time of arrival of fallout (in hours after burst). Add the time in hours required for the nuclear cloud to pass over. This is expressed by using the formula:

$$T_{comp} = (1.25 \times T_{arrival}) + \frac{(2 \times \text{Cloud Radius (CR)})}{\text{Effective Wind Speed (EWS)}}$$

Example: For a given location, the following data has been determined:

- Time of detonation = H
- Time of arrival = H+2 hours
- (Time of arrival is determined by dividing the distance from GZ to the given point by the effective wind speed)
- Cloud diameter = 4 km (equals 2 x cloud radius)
- (Cloud diameter/radius (rr) is determined either from Figure G-18, p. G-39 or from line item PAPA BRAVO of the NBC 3 Report)
- Effective wind speed = 20 KPH (EWS (sss) is determined either from Figure G-17 or from line item PAPA BRAVO of the NBC 3 Report).

$$T_{comp} = (1.25 \times 2\text{ hr}) + \frac{4\text{ Km}}{20\text{Kmph}}$$

$$T_{comp} = 2.5\text{ hr} + 0.2\text{ hr}$$

$$T_{comp} = 2.7\text{ hr}$$

Therefore, fallout for the given location is expected to be complete by H + 2.7 hours.

NOTE: To convert 2.7 hours into clock time, multiply .7 by 60. The product in this example is 42. Therefore, T_{comp} is 2 hours and 42 minutes.

(3) Actual completion of fallout can be determined if a peak NBC 4 Report is received from the area of interest. For detailed information regarding Nuclear Reconnaissance, Monitoring and Survey, refer to *Multiservice Tactics, Techniques, and Procedures for Nuclear, Biological, and Chemical Reconnaissance.*

7. NBC4 Report

a Locating and Reporting Nuclear Contamination.

(1) Fallout predictions provide a means of defining possible areas of nuclear contamination. Military significant fallout is expected to occur only within the predicted area. However, the prediction does not indicate exactly where the fallout will occur or what the dose rate will be at a specific location. Rainout or washout can also increase nuclear

contamination on the ground creating local hot spots. Areas of neutron induced radiation also can be caused by low air bursts.

(2) Before planning operations in a nuclear environment, commanders must be aware of these residual contamination hazards. The information required for such planning is derived from the equations and nomograms given in the following sections and in Appendices J and K. The basic information needed is contained in NBC 4 Reports. They provide information on actual measured contamination in the form of dose rates.

b. Purpose: Report for reporting detection data and passing monitoring and survey results. This report is used for two cases. Case one; used if an attack is not observed, and the first indication of contamination is by detection. Case two, used to report measured contamination as a part of a survey or monitoring team.

c. Message Precedence: All other messages, after the initial NBC 1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE would be appropriate (see Table G-5).

Table G-5. NBC4 Report

NBC4 (NUC) Report			
Line Item	**Description**	**Cond***	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/N//
K	Crater Description	O	KILO/UNK//
Q	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/GAMMA/-//
R	Level of Contamination, Dose Rate Trend and Decay Rate Trend	M	ROMEO/7CGH/DECR/DN//
S	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
W	Sensor Information	O	WHISKEY/POS/POS/YES/HIGH//
Y	Downwind Direction and Downwind Speed	M	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).			

(1) The location is sent as UTM or LAT/LONG grid co-ordinates; the level of contamination reading is expressed in cGy/h.

(2) Line items QUEBEC, ROMEO, and SIERRA may be repeated as many times as necessary to give a specific picture of the contamination throughout an area. A

"zero" dose rate may also be reported on line item ROMEO, and is an extremely valuable piece of information in determining the extent and duration of contamination.

(3) Only outside dose rates are reported by the unit, and the date time group is reported in ZULU time. Certain abbreviations are associated with the dose rate to describe the circumstances surrounding the contamination. Note that the definition of line item ROMEO includes information on the dose rate trend and the relative or actual radiation decay rate. The dose rate must be reported while the latter two items are optional. They require evaluation, which may be done above unit level. A monitor cannot provide this information.

d. Shielding. Shielding reduces the effects of gamma radiation on personnel and equipment. The more dense the material-the better the shield. Low-density materials are as effective as higher density materials, when the total thickness of the low density material is increased. It is not possible for gamma radiation to be completely absorbed. However, if enough material is placed between the individual and the radiation source, the dose rate can be reduced to negligible proportions.

(1) Shielding Principles:

(a) Density: Density is defined as the number of molecules, or mass, per unit of volume.

(b) Half-thickness: The amount of material required to reduce the dose rate by one-half.

(c) Total thickness: This is the actual thickness of the shielding material.

(d) Position of the shield: The closer the shield is to the source, the better.

(e) Dose rate buildup: This is produced by the shield. The shield causes radiation to scatter; therefore, the closer you are to the shield, the higher the dose rate you are exposed to.

(2) Shielding Materials:

(a) Earth: The most common shielding material. About one foot of earth makes a very adequate shield.

(b) Concrete: About 6 to 8 inches of concrete makes a good shield.

(c) Steel: Tanks and Amtracks are very good shields against radiation.

(d) Buildings: Wood or brick buildings make good shields.

(3) Effectiveness: The effectiveness of a given material in decreasing radiation intensity is measured in units of half-value-layer thickness, or half-thickness. This unit is defined as the thickness of any material which reduces the dose rate of gamma radiation to one-half its unshielded value.

NOTE: If a Service member is surrounded by a 6 inch concrete wall (half-thickness) and the gamma radiation outside is 200 cGyph, he or she would receive gamma radiation at the rate of 100 cGyph. The addition of another 6 inches reduces the rate to 50 cGyph. Each succeeding half-thickness of concrete would reduce the radiation dose by one-half.

(a) Situation: How many half thicknesses of the above concrete will reduce the radiation dose to 25 cGyph?

(b) Solution: Beginning with the rate of 200 cGyph, the first half thickness reduces it to 100 cGyph. The second half thickness reduces the dose rate to 50 cGyph, and the third half thickness reduces the dose rate to 25 cGyph. Therefore; 18 inches or three half thickness of concrete meets the requirement of reducing the dose rate to 25 cGyph.

(4) Determining Shielding Requirements: The below symbols represent unknown values used in determining shielding requirements. The definition of each symbol accompanies each to allow a better understanding of what each represents.

(a) Symbols used in Shielding:

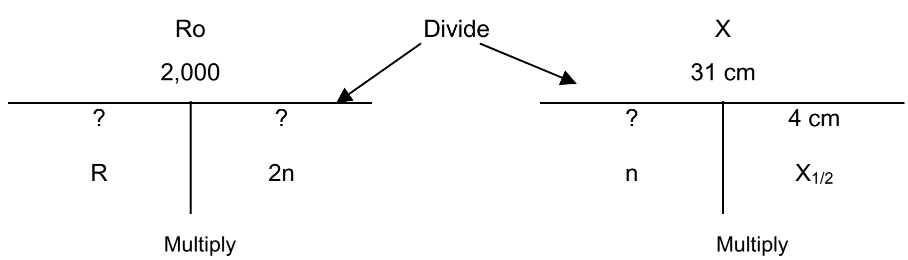
- Ro = Unshielded dose rate (Ro = 2n x R)
- R = Shielded dose rate (R = Ro x 2n)
- X = Total thickness (X = n x $X_{1/2}$)
- $X_{1/2}$= Half thickness (X 1/2 = X x n)
- n = The number of half-thicknesses contained in X, the total thickness of material. (2n = Ro R)

NOTE: To simplify the mathematical process to determine shielding requirements, see Table G-7 on page G-57.

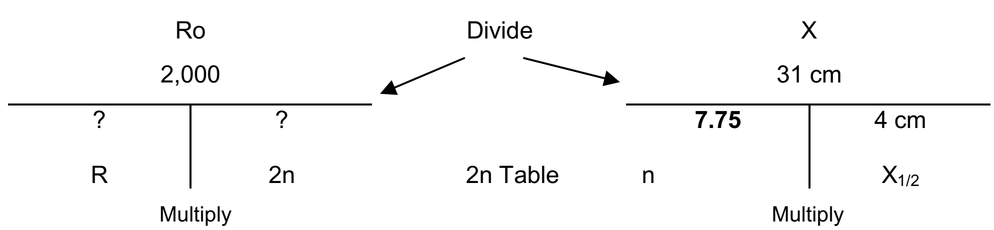
(b) To determine the shielding requirements use the following steps:

- Problem: Find the final dose rate with a known amount of shielding.
- Situation: You are in a bunker after a nuclear detonation and need to know what final dose rate you will receive. The initial dose rate with no shielding material (Ro) is 2,000 cGyph. The total thickness of the shielding material (X) is 31 centimeters. The half-thickness (X 1/2) of the shielding material is 4 centimeters. What is the final dose rate resulting from shielding?

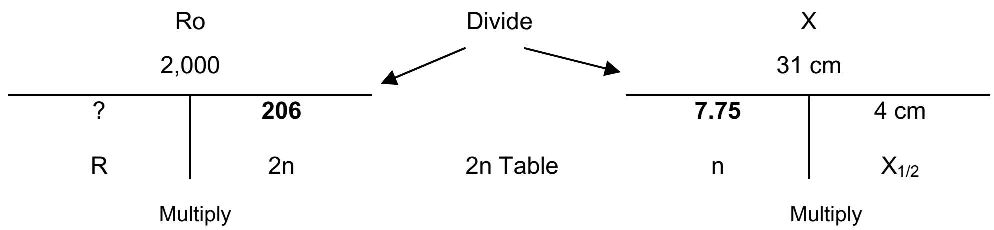
  - Step 1: Determine known and unknown values, and place in the appropriate section.



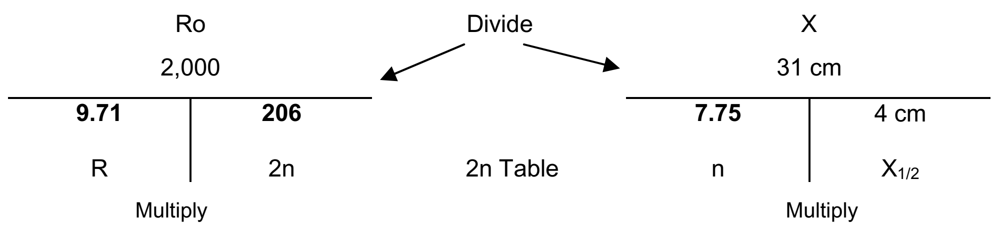
Step 2: Divide the total thickness by the half-thickness.



- Step 3: Using the 2n/n, Table G-7, p. G-57 , find either the unknown 2n or n.



- Step 4: Divide the Ro by the 2n and round to the nearest hundredth.



- Solution: 9.71 cGyph would be the final dose rate.

Table G-6. Half-Thicknesses (X 1/2) of Certain Materials

Material	Half-Thickness (inches)
Steel	0.7
Concrete	2.2
Earth	3.3
Wood	8.8

Table G-7. 2n Values and Guide for Safe Siding 2n Values

Unknown	Enter 2n Table With	Select	Leave 2n Table With
$X_{1/2}$	2n	Smaller 2n	n
X	2n	Larger 2n	n
R	n	Smaller n	2n
R	n	Larger n	2n

n	2n	n	2n	n	2n	n	2n	n	2n
0	1	4.5	22.6	9	512	13.5	11,600	18	262,000
0.1	1.07	4.6	24.2	9.1	550	13.6	12,900	18.1	279,000
0.2	1.15	4.7	25.9	9.2	580	13.7	13,300	18.2	299,000
0.3	1.23	4.8	27.8	9.3	630	13.8	14,200	18.3	320,000
0.4	1.32	4.9	29.8	9.4	680	13.9	15,400	18.4	327,000
0.5	1.42	5	32	9.5	720	14	16,384	18.5	369,000
0.6	1.51	5.1	34.2	9.6	770	14.1	17,600	18.6	395,000
0.7	1.63	5.2	36.7	9.7	830	14.2	18,850	18.7	426,000
0.8	1.74	5.3	39.2	9.8	890	14.3	20,200	18.8	456,000
0.9	1.87	5.4	42.1	9.9	950	14.4	21,800	18.9	492,000
1	2	5.5	45.2	10	1,024	14.5	23,200	19	525,000
1.1	2.15	5.6	48.4	10.1	1,100	14.6	24,800	19.1	564,000
1.2	2.3	5.7	52	10.2	1,180	14.7	26,600	19.2	594,000
1.3	2.47	5.8	56	10.3	1,260	14.8	28,500	19.3	646,000
1.4	2.57	5.9	60	10.4	1,350	14.9	30,600	19.4	696,000
1.5	2.83	6	64	10.5	1,455	15	32,768	19.5	738,000
1.6	3.03	6.1	68	10.6	1,566	15.1	35,100	19.6	788,000
1.7	3.25	6.2	74	10.7	1,670	15.2	37,600	19.7	852,000
1.8	3.48	6.3	78	10.8	1,780	15.3	40,200	19.8	903,000

Table G-7. 2n Table – Shielding Values (Continued)

n	2n	n	2n	n	2n	n	2n	n	2n
1.9	3.73	6.4	84	10.9	1,920	15.4	43,200	19.9	974,000
2	4	6.5	90	11	2,048	15.5	46,400	20	1,050,000
2.1	4.28	6.6	97	11.1	2,200	15.6	49,600		
2.2	4.59	6.7	104	11.2	2,360	15.7	53,300		
2.3	4.95	6.8	112	11.3	2,530	15.8	57,400		
2.4	5.28	6.9	119	11.4	2,640	15.9	61,600		
2.5	5.65	7	128	11.5	2,900	16	65,536		
2.6	6.05	7.1	136	11.6	3,110	16.1	69,700		
2.7	6.5	7.2	146	11.7	3,330	16.2	75,800		
2.8	6.95	7.3	157	11.8	3,560	16.3	80,000		
2.9	7.45	7.4	170	11.9	3,820	16.4	86,200		
3	8	7.5	181	12	4,096	16.5	92,300		
3.1	8.55	7.6	194	12.1	4,390	16.6	99,500		
3.2	9.18	7.7	206	12.2	4,700	16.7	107,000		
3.3	9.85	7.8	220	12.3	5,070	16.8	115,000		
3.4	10.6	7.9	240	12.4	5,420	16.9	122,000		
3.5	11.3	8	256	12.5	5,790	17	131,072		
3.6	12.1	8.1	272	12.6	6,200	17.1	139,000		
3.7	13	8.2	292	12.7	6,760	17.2	150,000		
3.8	13.9	8.3	312	12.8	7,120	17.3	162,000		
3.9	15	8.4	338	12.9	7,630	17.4	174,000		
4	16	8.5	360	13	8,192	17.5	186,000		
4.1	17.2	8.6	385	13.1	8,760	17.6	199,000		
4.2	18.4	8.7	415	13.2	9,410	17.7	211,000		
4.3	18.7	8.8	445	13.3	10,100	17.8	228,000		
4.4	21.2	8.9	480	13.4	10,870	17.9	246,000		

e. Measuring Nuclear Data.

(1) Measurements of nuclear data must be taken in accordance with the unit's SOPs. Measurements can be taken directly from an unshielded position if dose rates are low enough, or from a shielded position such as a shelter or vehicle.

(2) When the indirect technique is used, most of the readings are taken inside the vehicle or shelter. However, at least one outside reading is necessary to determine the transmission factor, which relates the readings inside to the unshielded values outside. The latter are to be reported since they are necessary for further calculations pertaining to troops in the open, or other vehicles, or shelters.

(3) To determine the transmission factor both the inside and outside readings must be taken after fallout is complete. Calculate the transmission factor using the following formula:

$$\text{Transmission Factor(TF)} = \frac{\text{Inside Dose (ID) rate}}{\text{Outside Dose (OD) rate}}$$

$$TF = ID / OD$$

NOTE: TF is always less than 1. It can be determined from the measurement of the dose as well.

(4) The readings taken inside the vehicle or shelter represent inside shielded dose rates (ID). These readings must be converted to outside, unshielded dose rates (OD) before reporting. Readings are converted using the following formula:

$$OD = ID / TF$$

(5) A pre-calculated list of TF is contained in national manuals, an example of which is shown in Table G-8, P. G-60. This information is <u>not</u> used by the unit CBRN defense personnel when calculating or reporting outside dose rates. Its principal use is to establish the relative shielding ability of one shelter, structure, or vehicle as compared to another. It is also used for instructional and practice purposes.

(6) These factors are for the most exposed occupied location. They are not based on dose rates from fallout; they are based on gamma radiation from cobalt-60. Since cobalt-60 radiation is almost twice as strong as the radiation from fallout, actual TF should be much lower (more protection).

(7) In some cases the term correlation factor (CF) is used. It is always the reciprocal of the transmission factor.

$$CF = \frac{1}{TF} = \frac{OD}{ID}$$

Table G-8. Transmission Factors (TF) // Correlation Factors (CF)

Environmental Shielding	TF	CF	Environmental Shielding	TF	CF
Vehicles			**Engineer Equipment**		
M1 tank	0.04	25	M9 ACE	0.3	3.33
M48 tank	0.02	50	Grader	0.8	1.25
M60 tank	0.04	25	Bulldozer	0.5	2
M2 IFV	0.2	5	Scraper	0.5	2
M3 CFV	0.2	5	**Structures**		
M93 NBC Reconnaissance Vehicle	0.2	5	Frame house	0.3 - 0.8	3.33-1.25
M113 armored personnel carrier	0.3	3.33	Basement	0.05 - 0.1	20-10
M109 self propelled howitzer	0.2	5	**Multistory Building (Apartment Type)**		
M548 cargo vehicle	0.7	1.43	Upper stories	0.01	100
M88 recovery vehicle	0.09	11.11	Lower stories	0.1	10
M577 command post carrier	0.3	3.33	**Concrete Blockhouse Shelter**		
M551 armored recon airborne assault vehicle	0.2	5	9-in. walls	0.007–0.09	142.86-11.11
M728 combat engineer vehicle	0.04	25	12-in. walls	0.0001–0.03	10000-33.33
Helicopters (parked)			24-in. walls	0.0001–0.002	10000-500
OH-58	0.8	1.25	**Shelter, Partly Above Ground**		
UH-60	0.7	1.43	With 2-ft earth cover	0.005–0.02	200-50
CH-47	0.6	1.67	With 3-ft earth cover	0.001–0.005	1000-200
Trucks			Urban Areas (in open)	0.7 *	1.43*
HMMWV	0.5	2	Woods	0.8 *	1.25*
¼ - ton	0.8	1.25	Underground Shelters (3-ft earth cover)	0.0002	5000
¾ - ton	0.5	2	Foxholes	0.1	10
CUCV	0.5	2	* These factors apply to aerial survey dose rates.		
2 ½ - ton	0.5	2			
4-ton to 7-ton	0.5	2			
NOTE: For vehicles in which AN/VDR2s have been installed, the users need only verify that the correct attenuation factor (equivalent to the CF) has been entered (IAW TM 11-6665-251-10) and then read the outside dose directly off the display. The attenuation factor is the mathematical inverse of the transmission factor (TF). If the attenuation factor has not been set properly, refer to TM 11-6665-251-20.					

f. Surveys.

(1) Air-Ground Correlation Factors (AGCF). AGCF is required for calculation of surface dose rates from aerial dose rates taken in an aircraft during a survey. The air ground correlation factor relates a ground dose rate reading to a reading taken at approximately the same time in an aircraft at survey height over the same point on the surface.

(2) The AGCF is calculated as shown below:

$$AGCF = \frac{\text{Ground dose rate}}{\text{Aerial dose rate}}$$

Example: Surface dose rate = 20 cGy/h

Aerial dose rate = 5 cGy/h

(200 feet survey height)

$$AGCF = \frac{20\ cGy/h}{5\ cGy/h}$$

AGCF = 4

(3) By multiplying the readings taken in the aircraft at a survey height by the AGCF, the surface level reading can be approximated. These values are to be reported in the NBC 4 Report.

Ground dose rate = Air dose rate x AGCF

g. Reporting Instructions. Monitoring data to be sent to other units/HQs is transmitted in the NBC4 Report format .

(1) Automatic Reports. In accordance with SOPs units in the contaminated area submit certain monitoring reports automatically. These provide the minimum essential information for warning, hazard evaluation, and survey planning. Reports are sent through specified channels to reach the CBRN cell. The automatic reports are the initial, peak, and special reports specified by the CBRN cell or required by commanders for operational purposes.

(2) Initial Report. After noting a dose rate of 1 or more cGy/h outside, defensive measures in accordance with SOPs are implemented, and the unit formats an NBC 4 Report containing the code "INIT" for initial in line item ROMEO. The first report is used at the CBRN cell to confirm the fallout prediction. The dose rate cannot be converted to H+1 at this time.

(3) Peak Report. After the initial contamination is detected the unit monitor continuously records dose rates according to the time intervals specified in unit SOPs. The dose rate rises until it reaches a peak, and then it decreases. In some cases, the dose rate may fluctuate for a short time before beginning a constant decrease. When the measurement continues to decrease, the monitor takes an inside reading and then an outside reading for the TF calculation. First, the inside reading is recorded. Within three minutes, the monitor goes to the outside location. After all information is recorded, the CBRN defense team calculates the TF and applies it to the highest dose rate. It then formats the NBC4 Report. The word, *peak* is used in line item ROMEO.

(4) Special Reports. Other standing instructions may establish the requirement for special NBC4 Reports. The CBRN cell evaluates these special reports. They invite command attention to areas or conditions of serious concern. The operational situation, unit radiation status, and similar considerations determine the criteria for these special reports, which cannot be specified here. Generally, this report may be required when the surface dose rate goes above a specified value. When the dose rate increases after showing continuous decrease, a special report must be sent. Special reports may be required after a specified period of time if the unit remains in the area.

(5) Directed Reports. Selected units in the contaminated area will be directed to submit additional NBC4 Reports. The CBRN cell uses these reports to evaluate a nuclear contamination hazard - the decay rate of fallout and how long this decay rate (and the contamination overlay) will remain valid. They are used to determine the H-hour (if unknown) and the soil type in neutron induced areas. Reliable calculations are directly related to the precision of the dose rate measurement. Tactical decisions and personnel safety depend on the accuracy of these measurements. The assessment of further development of the contamination situation depends upon this data. An error in dose rate measurements means a similar error in all following calculations.

(6) Series Reports. A series report consists of a series of dose rate readings taken at the same location at time intervals specified in unit SOPs after the peak dose rate has been recorded. The location must remain constant. The report contains each reading and the time it was taken. The report contains the word *series* in line item GENTEXT.

(7) Summary Reports. The summary report shows the radiation distribution throughout units' area of responsibility. The locations for the readings are selected by the unit according to the distribution of its elements and the extent or variety of the area's terrain. The time each reading was taken is reported. The word, *summary* is given in line item GENTEXT.

(8) Verification. The verification report is a unit's response to a direct request. If data are lacking from a specific location near or in the unit's area the CBRN cell may request a verification report. It may also be requested to confirm abnormal readings reported earlier. A verification report is not a retransmission of the earlier report, but a check of the actual conditions of the area. The unit tasked with the submission of a verification report receives specific instructions as to the location from which a reading is desired. The word, *verify* is used in line item GENTEXT to indicate a verification report.

(9) Dose rate trends are:

(a) INIT - initial reading

(b) PEAK - peak reading

(c) DECR - decreasing since last reading

(d) INCR - increasing since last reading

(e) SAME - same

Table G-9. Examples of NBC 4 NUC Reports

NBC4 NUC	NBC4 NUC	NBC4 NUC
QUEBEC/32UNB156470/GAMMA//	QUEBEC/32UNB156470/GAMMA//	QUEBEC/32UNB156470/GAMMA//
ROMEO/1CGH/INIT//	ROMEO/35CGH/PEAK//	ROMEO/25CGH/DECR//
SIERRA/021200ZAUG1999//	SIERRA/021400ZAUG1999//	SIERRA/021530ZAUG1999//

8. Evaluation of Nuclear Information.

After NBC4 Reports are available they must be evaluated with regard to the actual hazard encountered by troops in the contaminated area with the aim to predict expected dose rates and accumulated dosages for possible missions within the contaminated area. Theoretically, once a nuclear hazard has been identified, the contamination existing at any future time can be calculated using simple decay relationships and other calculations. The following calculations will be covered:

- Calculation of "H" Hour.
- Decay of Fallout.
- Decay Rate (n).
- Validity Time for Decay Rate (Tp).
- Normalization Factor (NF).
- Overall Correction Factor (OCF).

a. Calculation of "H" Hour or "Time of Burst": Calculate H-hour mathematically, using the following procedures:

- Step 1: Set up the formula as follows:

  T_1 = Time after H-hour at which reading Ra was made.

  Ta = Time peak reading was measured.

  Tb = Time last reading was measured.

  Tb - Ta = interval between readings Ra and Rb.

  Ra = Peak reading.

  Rb = Last reading.

  n = Decay Rate.

$$T_1 = \frac{Tb - Ta}{(Ra/Rb)^{1/n-1}}$$

Example: Use the following information to input into the formula:

PEAK READING (Ra) = 56 TIME OF LAST READING (Tb) = 1200

LAST READING (Rb) = 12 TIME OF PEAK READING (Ta) = 0715

DECAY RATE (n) = 1.1

- Step 2: Place numbers in formula: $T_1 = \frac{(1200 - 0715)}{(56/12)^{(1/1.1) - 1}}$ $T_1 = \frac{(4.75)}{(4.67)^{(1/1.1) - 1}}$

Step 3: Subtract 0715 from 1200; divide 56 by 12.

NOTE: Since we are given clock time you must convert clock time to percentage of an hour before subtracting. To do this divide 15 minutes by 60 minutes in an hour. This gives you 15 minutes = .25 which is the percentage 15 minutes is of an hour. Now you can subtract 7.25 hrs from 12 hrs the result will be 4.75 hrs

- Step 4: Utilizing 4.67 and the decay rate 1.1, perform the following function on the calculator:

4.67	y^x	(	1 / 1.1	)	=	- 1	=

Your answer is: 3.06

y^x is a key on a calculator. Some calculators have the X and Y inverted.

- Step 5: The formula should now look like this:

$$T_1 = \frac{4.75}{3.06}$$

- Step 6: Divide 4.75 by 3.06 and the answer is:

T_1 = 1.55

- Step 7: Now multiply 1.07 by 60 (60 represents minutes in an hour)

1.55 X 60 mins = 93 mins or 1 hr and 33 mins

- Step 8: Subtract 1 hr and 33 mins from the Ta.

Ta - T_1 = "H" hour

0715 - 1 hr 33 mins = 0542 = "H" hour

b. Determining Decay of Fallout: The dose rate at any location in a fallout area does not remain constant. It decreases with time according to the Kaufmann equation:

$$R_1 \times t_1^{\,n} = R_2 \times t_2^{\,n}$$

- Which describes the decay of fallout after it has completely settled on the ground.

- In this equation:

R_2 is the dose rate at the location at the time of reading.

R_1 is the dose rate (normalized to H+1) at the location.

t_1 is H+1.

t_2 is the time in hours after H-hour that R_2 **was measured**.

n is the decay rate.

- Dose rate and total dose calculations cannot be performed until the decay rate is known. The true decay rate will not be known immediately. Accurate determination must wait until several sets of NBC 4 Reports are available.

- The decay rate of fallout depends on many factors. Some of these factors are:

- Height and type of burst.
- Type of weapon (fission, fission-fusion, fission-fusion-fission).
- Type of active materials, as well as construction and structural materials within the weapon.
- Type and quantity of materials vaporised or sucked up into the fireball.
- "Salting" the weapon to produce a slow decay.
- When fallout overlaps fallout.
- Soil Type.

- The decay rate varies with time. Generally, the decay rate becomes slower as time passes.

- The same decay rate may not be present across the entire fallout area. The pattern as a whole will have an average value, which may vary from position to position. The amount of variation in the decay rate for fallout is expected to range from 0.2 to 2.0. The lower values are assumed for "salted" weapons.

- Decay calculations are valid only if the dose rate readings are made after completion of fallout. While fallout is still arriving, the Kaufmann equation is not valid.

- Because of the delay in determining the actual decay rate, an assumed decay rate of n = 1.2, referred to as standard decay, is used by all units until informed otherwise by the CBRN cell. When the actual decay rate has been established by the CBRN cell, it will be sent as line item ROMEO on the NBC 4 or NBC 5 Report. The assumed normal decay rate of **n** = 1.2 is used in many simplified nuclear calculation procedures. Optimum time of exit calculations are also based upon **n** = 1.2.

NOTE: **In the equations of the following sections all times are given in hours after the burst. The information given in corresponding line items of the CBRN messages (e.g., SIERRA) must be converted appropriately when moving from calculation to reporting or vice versa.**

c. Determination of Decay Rate.

(1) The 7:10 Rule: For every seven fold increase in time; radiation will decay by a factor of 10.

(2) Standard Decay_(n = 1.2): When no decay rate is given, or there is no way to determine a decay rate, the standard decay rate 1.2 will be used by the control center in their computations.

(3) Non-standard decay (n does not equal 1.2): Anything other than 1.2 is considered non-standard. Decay rates greater than 1.2 decay faster than standard. Decay rates less than 1.2 decay slower than standard. The lower the slower, the higher the faster.

(4) Determine the Decay Constant (Rate; Exponent) “n”: The decay rate, n, is a changing factor we must adjust to throughout CBRN operations. It changes as short lived fission products die off with the rate slowing down as time goes on. The decay rate may not be the same from pattern to pattern; or from one location to another within the same

pattern. There are two methods of determining the decay rate: the pocket calculator and graphical methods. We will utilize the calculator method. The Kaufman equation is the preferred method of determining the decay rate. You must have a scientific calculator.

(a) Step 1: From the Series Report, determine the Ra, Rb, Ta and Tb. Where:

Ra is the Peak Dose rate (cGyph) measured (highest dose rate measured after H+1).

Rb is the last measured dose rate (cGyph) available on the report.

Ta is the Time in hours (after H-hour) that Ra was measured.

Tb is the Time in hours (after H-hour) that Rb was measured.

(b) Step 2: Set up as follows:

$$n = \frac{\log(Ra/Rb)}{\log(Tb/Ta)}$$

(c) Step 3: Work problem. Decay rates are rounded to the nearest single decimal place (tenth).

Example : Given T.O.B = 140100ZJUN2004 and

Ra = 52 Rb = 17

Tb = 9 Ta = 3

NOTE: Information was provided from the Nuclear Data Sheet

$$n = \frac{\log(Ra/Rb)}{\log(Tb/Ta)} = \frac{\log(52/17)}{\log(9/3)} = \frac{\log(3.059)}{\log(3.000)} = \frac{0.486}{0.477} = 1.0$$

d. Determining the Period of Validity for the Decay Rate (n): The period of validity is a mathematical calculation that determines how long the decay rate is valid due to the various aspects discussed earlier regarding decay of fallout. The “Period of Validity” is calculated as follows:

(1) Step 1: From the Series Report, determine the Ta and Tb. Where:

Tp is the Period of Validity decay rate (n).

3 is a constant.

Ta is the Time in hours (after H-hour) that Ra was measured.

Tb is the Time in hours (after H-hour) that Rb was measured.

(2) Step 2: Set up the formula as follows:

$$Tp = 3(Tb - Ta) + Tb$$

(3) Step 3: Work problem.

(4) Step 4: The answer to the formula is then added to the time of burst (TOB). This will give you a “date-time group” of when the “n” is no longer valid.

TOB = 090400Z

Tp = + 24

092800 = 100400Z (DTG)

Example Problem: Given T.O.B. = 01 0100Z JUN2004 and Ta = 9 Tb = 3

NOTE: Information was provided from the Nuclear Data Sheet.

Tp = 3 (Tb-Ta) + Tb

Tp = 3 (9-3) + 9

Tp = 3 (6) + 9

Tp = 18 + 9 = 27 hours

Tp + T.O.B. = 27 hrs. + 010100ZJUN2004 = 020400ZJUN2004

Written as "Do not use after 020400ZJUN2004" in REMARKS section of the Nuclear Data Sheet.

NOTE: If the Validity Time (Tp) is 27.48 hours, then convert ".48" to minutes .48 x 60 = 28.9 = 29 minutes. Therefore, the Validity Time (Tp) 27.48 hours = 27 hours and 29 minutes

Tp + T.O.B. = 27 hrs, 29 min + 010100ZJUN2004 = 020429ZJUN2004

e. Determining the Normalizing Factor (NF)

(1) Once the decay rate (n) is determined, the nuclear reading may be normalized to H+1 readings. This normalized reading is commonly referred to as the R_1 reading. Simply stated, it is mathematically determining what the dose rate reading was at any given location, one hour after the burst.

(2) Survey teams and monitors take readings at various times after the burst. These readings may be 15 minutes or 10 hours after the burst. Any reading that is not recorded 1 hour (H+1) after a burst is commonly referred to as an Rt reading. To perform nuclear calculations and make decisions on the nuclear battlefield, all readings must be represented using the same time reference.

(3) Procedures for Determining the NF: To determine the NF mathematically use the following steps:

(a) Step 1: From the NBC 4 Report or Nuclear Data Sheet(s), determine the decay rate, dose rate reading and time measured of the reading you desire to be normalized to H+1. When normalizing readings from ground survey reports you must use "mid-time" for your computations. Mid-time is simply the middle time between the beginning and ending of the ground survey. An example is as follows: Survey starts at 1030 and ends at 1100; the mid time for calculating the NF is 1045.

(b) Step 2: Set up the formula as follows where:

$$R_1 = NF \times R_2$$

$$NF = (T_2)^n$$

R_1	is	Normalized Dose Rate Reading at H+ 1
R_2	is	Dose Rate Reading at any other time
NF	is	Normalization Factor.
T_2	is	Time reading was taken in hours after the burst.
n	is	Decay rate.

(c) Step 3: Work the problem. Round the NF to the nearest hundredth. Then multiply the unshielded dose rate(s) (R_2) by the NF and then round the converted reading to a whole number to determine (R_1). Example Problem: A peak dose rate of 100 cGyph was measured at H+2 in a fallout area where the decay rate is **1.2**. Normalize the dose rate to a reference time of H+1.

Solution: calculate: $NF = (T_2)^n$

NF = 2 (T_2) [y^x] 1.2 (n) = 2.297, round to nearest hundredth, = 2.30

Calculate: $R_1 = NF \times R_2$

R_1 = 2.30 (NF) x 100 cGyph (R_2) = 230 cGyph = Normalized Dose Rate Reading at H+1 cGyph (R_1)

f. Determining the Overall Correction Factor (OCF): When calculating survey data, combining the NF and CF reduces the number of required calculations. This additional step is called the Overall Correction Factor. To compute the overall correction factor:

- The OCF formula is: *NF x AGCF = OCF or NF x VCF = OCF*.
- The OCF is round to the nearest HUNDRETH.
- The OCF is used instead of the NF. The OCF will convert shielded readings to unshielded readings normalized to H+1; multiply the OCF by the dose rate reading. This unshielded H+1 reading (R_1) is always rounded to the nearest whole number and written in the "Do not use" column of the Nuclear Data Sheet.

9. NBC5 Report

a. Purpose. Report for passing information on areas of actual contamination. This report can include areas of possible contamination, but only if actual contamination coordinates are included in the report.

b. Message Precedence. All other messages, after the initial NBC1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally *immediate* would be appropriate.

Table G-10. NBC5 Report

NBC5 (NUC) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/N//
D	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
O	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/201505ZSEP1997//
XA*	Actual Contour Information	M	XRAY ALPHA/5CGH/32UND620475/ 32UND662522/32UND883583/ 32UND830422/32UND620475//
XB*	Predicted Contour Information	O	XRAY BRAVO /75/100CGH/32UND621476/ 32UND621477/32UND622477/ 32UND622476/32UND621476//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).			

c. Plotting Data and Producing a NBC5 Report

(1) Contaminated areas are shown on the nuclear contamination situation map, and information about them must be passed to other units and HQs. The most expeditious means for this is the nuclear contamination overlay.

(2) The preparation of such an overlay is described below:

(a) After all available information from monitoring and surveying has been plotted on a map as normalized (H+1, unshielded ground dose rates [R_1]), contour lines for standard dose rates can be drawn on a nuclear contamination overlay.

(b) When constructing the nuclear contamination overlay, there are factors that locally affect the contamination pattern.

(c) This is particularly true between points in an aerial survey. These include topographic features such as bluffs or cuts, heavily built-up or wooded areas, and bodies of water. For example, a large river will carry away any fallout landing on it, leaving its path relatively free of contamination. Also, the contamination hazard near a lake will be lower than expected. The fallout particles will sink to the bottom of the lake, and the water will provide shielding. In wooded areas or built-up areas, a measure of the reduction of dose rate can be obtained by using the TF's (see Table G-8) for these areas.

(d) Dose-rate contour lines showing the contamination hazard in an area can be drawn as follows:

- Count the number of readings taken for the route or leg. Since the aircraft flew at a constant ground speed, taking readings at equal time intervals, the distance covered between any two consecutive readings will be the same.

- If the route or leg is divided into a number of equal length segments, the total number of segments will equal the number of time intervals. Each division point on the route or leg will represent a location over which a dose rate reading was taken.

- The interval between readings equals the length of the course leg or route divided by the number of readings minus one.

For example: If seven readings are taken, the route is divided into only six segments - one less than the number of readings taken by the survey party. The formula is:

$$\textit{Interval Distance} = \frac{\textit{Route or Course Leg Distance (km)}}{\textit{Number of Readings-1}}$$

- Determine the H+1 dose-rate contour lines to be plotted (for example, 20 [30 for NATO], 100, 300, 1,000 cGyph). These contour lines may be required for NBC5 purposes or for anticipated calculations to be made from the data.

1,000 cGyph = Plotted in red.

300 cGyph = Plotted in green.

100 cGyph = Plotted in blue.

20 cGyph = Plotted in black. (NATO Forces use a 30 cGyph line)

- Determine the points on the chosen survey routes, or on course legs, and close to monitoring locations that are providing the desired dose rates.

- Connect all the points having the same dose rates with a smooth line. Use all plotted monitoring data as additional guides in constructing these contours.

- The plotter must use care and judgement in plotting these contours and must visualise the probable general shape and direction of the pattern. Any dose rates disproportionately higher than other readings in the immediate area indicate possible hot spots. When such readings are reported, that area should be rechecked. If dose rates are confirmed, these hot spots should be plotted and clearly identified. Figure G-28, page G-71 shows a typical plot, which might be developed, from survey data.

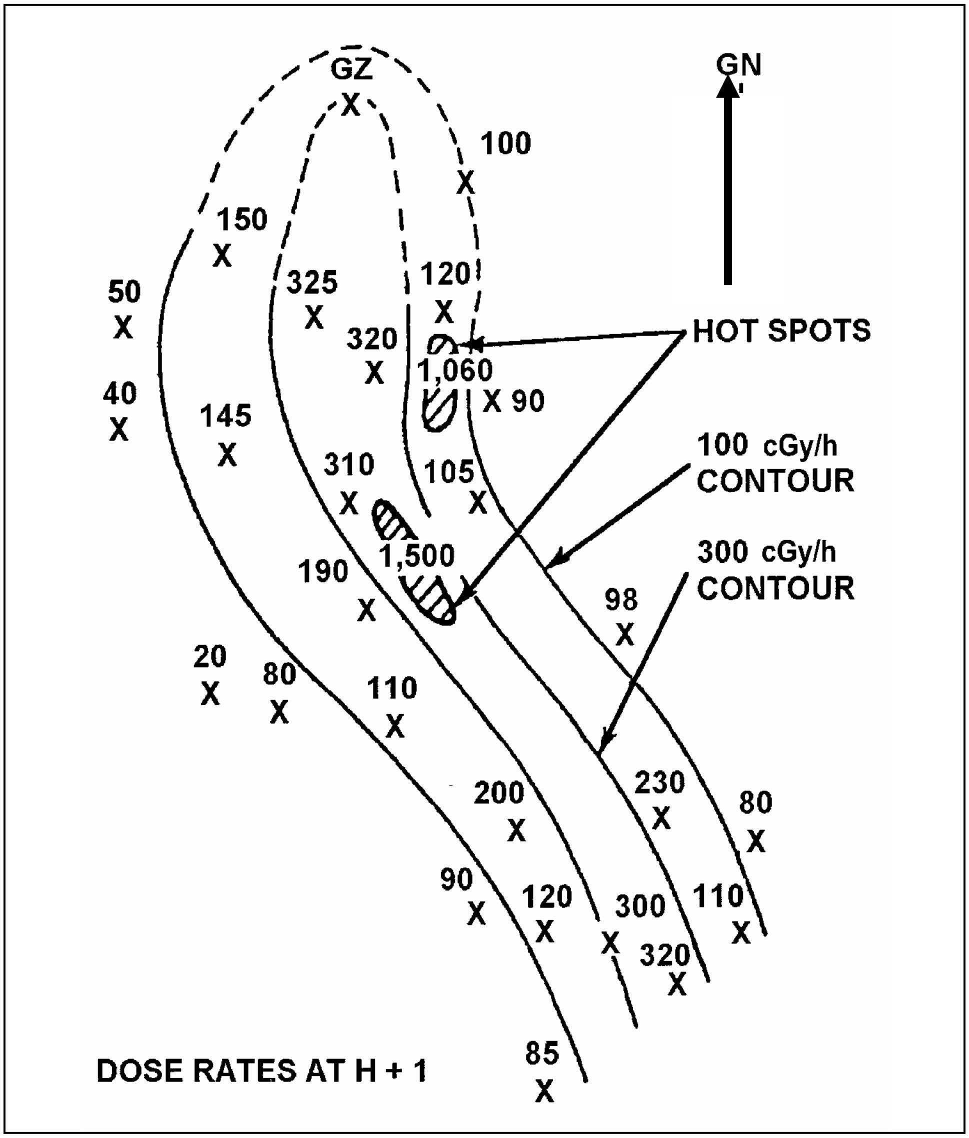


Figure G-28. Example Fallout Pattern plotted from Survey Data

- Nuclear contamination overlays (Figure G-29, page 72) used for evaluation purposes must provide the most detailed information possible. The minimum information required is:
  - Map designation and orientation data.
  - Nuclear burst and GZ identification (Line Items ALPHA and FOXTROT of the NBC 2 Report).
  - H-hour (Line Item DELTA of the NBC 2 Report).
  - Reference time (Line Item OSCAR of the NBC 5 Report).
  - Decay rate/soil type.
  - Time of preparation and validity time.

- Source of the contamination fallout or neutron induced contamination.
- Standard dose rate contour lines.
- Additional information such as time of completion lines for fallout may also be included where unit SOPs require such information.

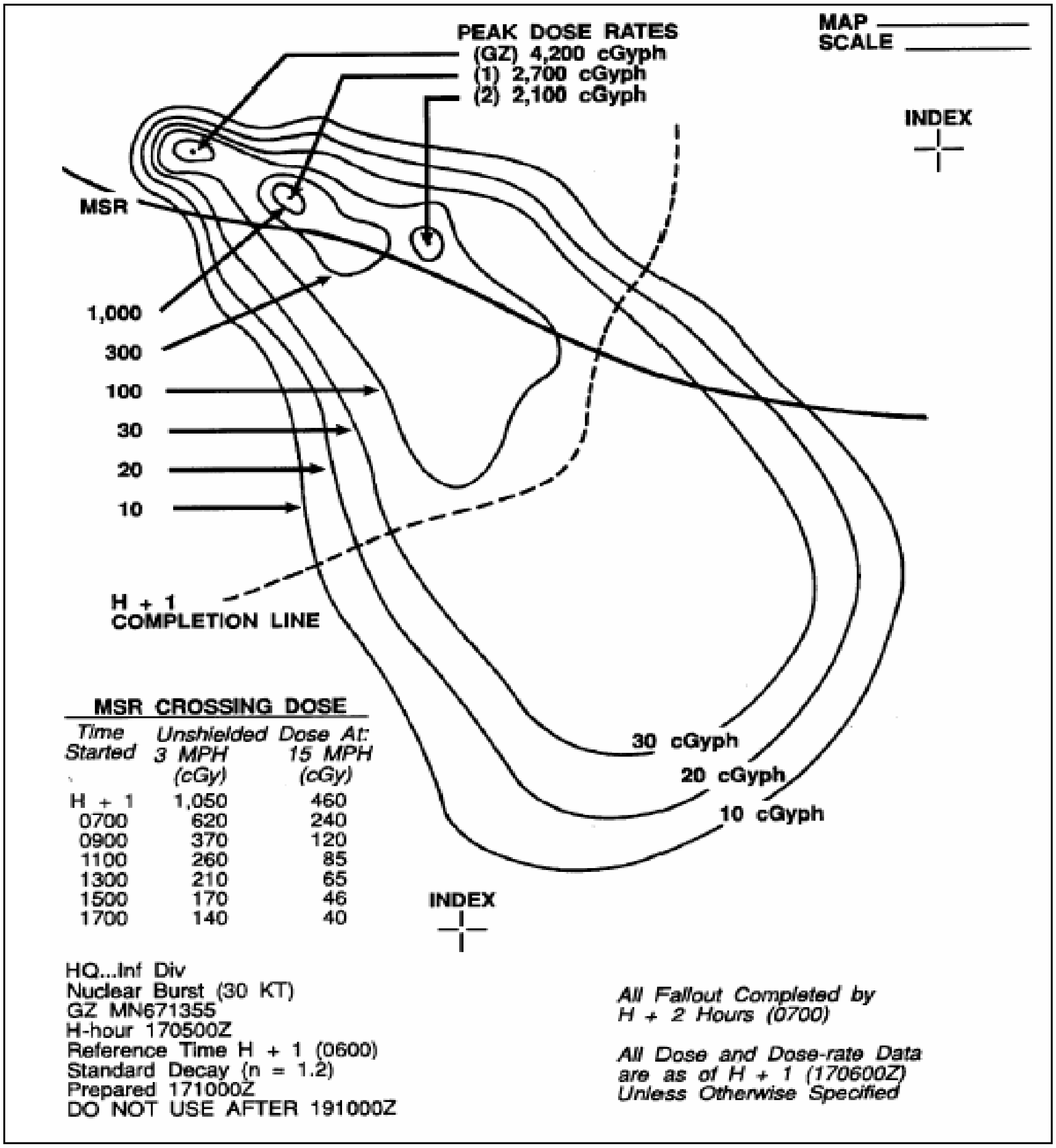


Figure G-29. NBC5 Contamination Overlay (Example)

d. Reporting Data.

(1) Electronic communications are not always available. If this is the case, the nuclear contamination overlay must be converted into a series of readings and coordinates for transmission as a NBC5 Report. This method has a disadvantage. It requires the addressee to re-plot data from the NBC5 Report and connect them to produce dose rate

contours; a time consuming process. Staff planners must consider that the shapes of dose rate contours drawn to correspond with a relatively brief series of readings and co-ordinates can vary significantly.

(2) If electronic communications of data or communications of hard copy are not available and if time and distance permit, nuclear contamination overlays are sent by messenger. Data is transmitted, manually by the NBC5 Report as a last resort.

(3) When the contamination comes from a single burst, the dose rates will be normalized to H + 1. But if there have been several detonations at different times and no single H + 1 is possible, then the dose rates are reported for a specific time.

(4) On the NBC5 Report a closed contour line on a plot, is represented by repeating the first coordinate.

(5) To calculate the dose rates along the contour lines at a later time use the procedures described in paragraph 9.e (below), and label the contour lines accordingly.

e. Determination of the Dose Rate for an Arbitrary Time. The Kaufmann equation can be used as follows:

$R_1 \times t_1^{\,n} = R_2 \times t_2^{\,n}$ can be mathematically changed to represent the missing (or objective) variable to read: $R_2 = R_1 / (t_2)^n$ *or* $R_2 = R_1 / NF$

(1) In this equation:

R_2 is the dose rate at the location at the arbitrary time.

R_1 is the dose rate (normalized to H+1) at the location.

t_1 is H+1.

t_2 is the arbitrary time in hours after H-hour.

n is the decay rate.

NF is the Normalization Factor

NOTE: If R_1 is the normalized dose rate reading at H+1, then t_1 will always be 1. Therefore the equation can be set-up as:

Example: Dose rate reading at H+1 is 600 cGyph. Determine the dose at H+12. Decay rate is 1.0.

R_1= 600 cGph; t_1 = 1 hr; t_2 = 12 hr; n = 1

(a) Step 1: Set up the formula as follows where:

$R_2 = R_1 / (t_2)^n$ *or* $R_2 = R_1 / NF$

(b) Step 2: Work the problem.

$R_2 = 600 / (12)^{1.0}$ *or* $R_2 = 600 / 12$

$R_2 = 600 / (12)$ *or* $R_2 =$ <u>*50 cGph*</u>

$R_2 =$ <u>*50 cGph*</u>

(2) The Normalization Factor Graphs found on pages J-54 through J-55 can be utilized to determine the NF for a given time if using the $R_2 = R_1 / NF$ formula only if less than H + 12 hours after the burst.

(a) Step 1. Determine the time in hours and minutes after the burst that the reading was taken. (12 hours)

(b) Step 2. Enter Figure J-47 with the time after burst. Read across to the appropriate decay exponent column and find the NF. (12 hours down and 1.0 across (decay rate down is 12.000.)

(c) Step 3. Divide the dose-rate reading by the normalization factor. The product is the arbitrary time dose-rate reading. (600 / 12 = 50 cGyph)

(3) The decay rate nomograms found on pages J-16 through J-34, can also be used to determine the dose rate at an arbitrary time:

(a) Step 1. Set up a table to properly record the information in the problem.

R_2	**t_2**	**R_1**	**n**
?	**12 hrs**	**600 cGyph**	**1.0**

(b) Step 2. Find the nomogram for fallout decay using a decay rate (n) of 1.0 (see Figure G-30, page G-75 [Decay of Fallout Nomogram, Decay Rate is 1.0]).

(c) Step 3. Line up the hairline on the value of 600 cGyph on the far right-hand R_1 column. Lay the hairline across 12 in the center Time column.

(d) Step 4. Holding the hairline straight and steady, read the value in the far left-hand R_t column (R_t is the same as R_2). This answer should be approximately 50 cGyph.

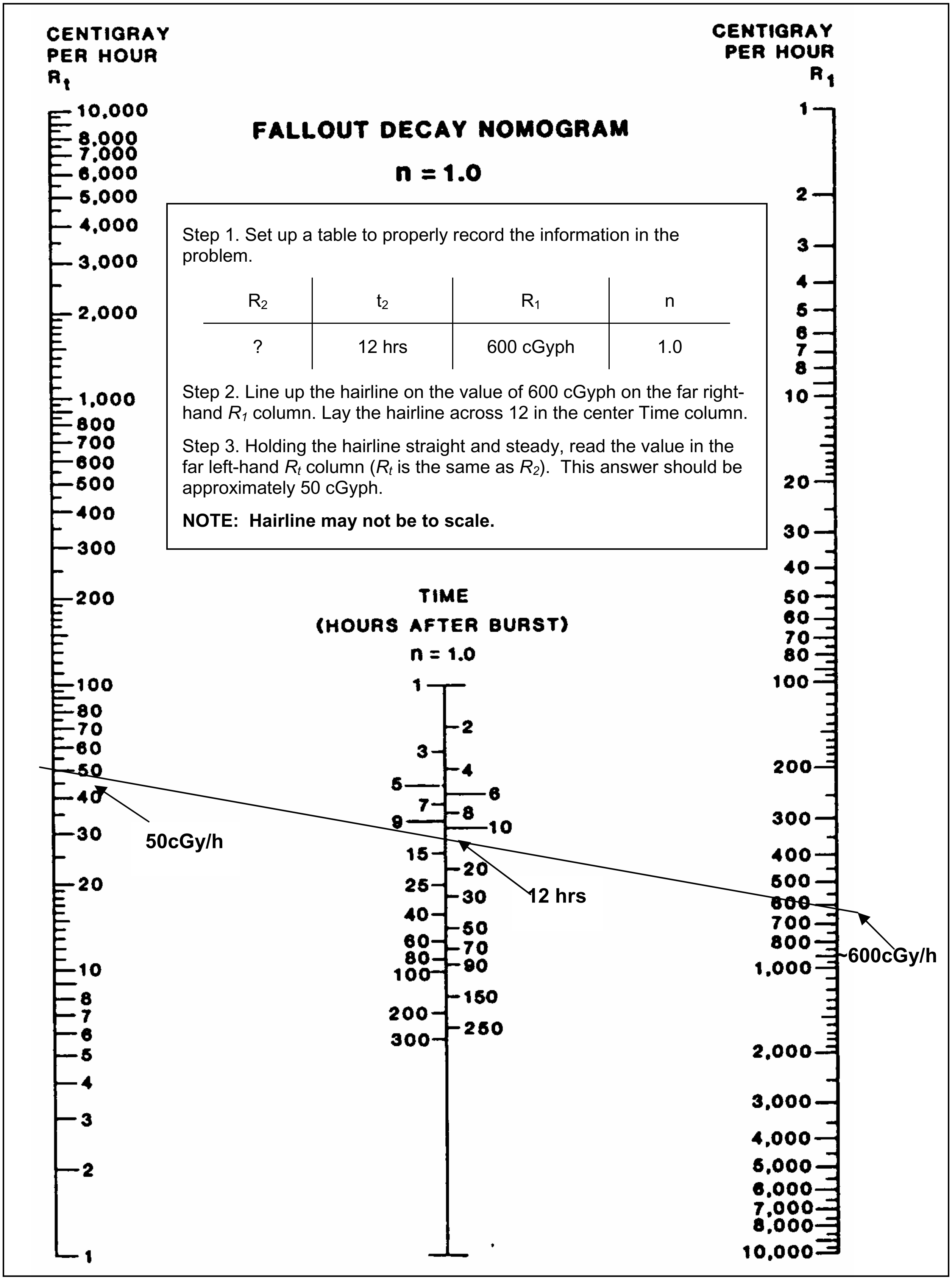


Figure G-30. Determining a Dose Rate at an Arbitrary Time (Example)

f. Determination of the Time at which a given Dose Rate is to be Expected: The Kaufmann equation can also be used as follows:

$R_1 \times t_1^n = R_2 \times t_2^n$ can be mathematically changed to represent the missing (or objective) variable to read: $t_2 = R_1 \times t_1 / R_2$

(1) In this equation:

R_2 is the dose rate at the location at the arbitrary time.

R_1 is the dose rate (normalized to H+1) at the location.

t_1 is H+1.

t_2 is the arbitrary time in hours after H-hour.

NOTE: If R_1 is the normalized dose rate reading at H+1, then t_1 will always be 1. Therefore the equation can be set-up as: $t_2 = R_1 / R_2$

Example: Dose Rate reading at H+1 is 1000 cGyph. Decay Rate is 1.0. Determine the time at which R_2 will be 500cGyph.

R_1 = 1000 cGph; R_2 = 500 cGyph

(a) Step 1: Set up the formula as follows where:

$t_2 = R_1 / R_2$

(b) Step 2: Work the problem.

$t_2 = 1000/500$

$t_2 = 2$ *hrs.*

(2) The decay rate nomograms found on pages J-16 through J-34, can also be used to determine the dose rate at an arbitrary time:

(a) Step 1. Set up a table to properly record the information in the problem.

R_2	t_2	R_1	n
500 cGyph	**?**	**1000 cGyph**	**1.0**

(b) Step 2. Find the nomogram for fallout decay using a decay rate (n) of 1.0 (see Figure J-17, [Decay of Fallout Nomogram, Decay Rate is 1.0]).

(c) Step 3. Line up the hairline on the value of 1000 cGyph on the far right-hand R_1 column. Lay the hairline across to the far left-hand R_t column (R_t is the same as R_2) with 500 cGyph.

(d) Step 4. Holding the hairline straight and steady, read the value in the center time column. This answer should be approximately 2 hours.

g. Total Dose Reduction. The primary objective of the commander is to accomplish the mission while keeping the total dose as low as possible. The total dose may be reduced in several ways.

(1) Avoid the area. When the actual measured fallout area cannot be avoided, select the route, which has the lowest dose rate. Commit the fewest number of personnel possible to the operation.

(2) Reduce exposure time. Plan operations to minimise time spent in contaminated areas. Select the route easiest to cross. This route should offer high speed advance.

(3) Delay time of entry. If possible, allow the contamination to decay.

(4) Use shielding. All vehicles should have increased shielding. Cross fallout areas on foot as a last resort.

h. Total Dose Procedures. The dose rate of radiation does not directly determine whether or not personnel become casualties. Casualties depend on total dose received. If the dose rate were constant, total dose would simply be the product of the dose rate and the time spent in the contaminated area (just as in a road movement problem, Rate x Time = Distance). But the dose rate continually diminishes because of decay. This makes the calculation more complicated. The actual dose received is always less than the product of dose rate at time of entry times duration of stay. Total dose, time of entry, and time of stay calculations in fallout areas are solved in total dose nomograms.

(1) Using the Total Dose Nomograms on pages J-35 through J-53, relate total dose, H+1 dose rate, stay time T_s, and entry time T_e. The index scale is a pivoting line. It is used as an intermediate step between D and R_1, and T_s and T_e. The index scale value can be used to multiply the R_1 to find the D. The four values on these nomograms are defined below:

D is the total dose in cGy.

R_1 is the dose rate in cGyph one hour after burst (H+1).

T_s is the stay time in hours.

T_e is the entry time (hours after H-hour).

n is the decay rate.

NOTE: **The H+1 dose rate must always be used. Never use a dose rate taken at any other time.**

R_1 must be known before the total dose nomograms can be used. If any two of the other three values are known, the nomograms can be used to find the missing piece of information.

D and R_1, or T_s and T_e are used together.

(2) When working with total dose nomograms, start the problem on the side of the nomogram where the two known values are located. If D and R_1 are given, start on the left side. If T_s and T_e are given, start on the right side. Never begin a problem by joining D or R_1 with either of the time values. Place a hairline on either side with either D and R_1 or T_s and T_e; line up the hairline with the center line "Index"; while holding the hairline in-place with the Index value, enter the nomogram with the remaining side, D and R_1 or T_s and T_e to determine the missing value.

(3) Example: Given: R_1 = 200 cGy/h.

T_e = H + 1.5 hours.

T_s = 1 hour.

n = 1.2

Find: D = ?

D	R1	Ts	Te	n
?	**200 cGyph**	**1 hr**	**1.5 hrs**	**1.2**

Solution. Answer: **90 cGy**.

Select the n = 1.2 total dose nomogram. Connect H + 1.5 hours on the T_e scale with the T_s reading of 1 hour. Pivot the hairline at its point of intersection with the index scale to the 200 cGy/h on the R_1 scale. Read D = 90 cGy on the total dose scale. See Figure G-31, page G-79 for an example.

(4) By 25 hours after the burst, the change in the rate of decay is so low that it is relatively insignificant. Therefore, a different approach is used to estimate total dose when T_e is greater than 25 hours. In this case, simply multiply the dose rate at the time of entry by the time of stay. This is written: Note: This formula can be modified to determine T_e or T_s as well.

$D = R_{Te} \times T_s$ can be mathematically changed to represent the missing (or objective) variable to read: $R_{Te} = \frac{R_1}{(T_e)^n}$

D is the total dose (cGy).

R_{Te} is the dose rate (cGy/h) at time of entry.

T_s is the time of stay (h).

Example: Given: R_1 = 300 cGy/h.

T_s = 2 hours.

T_e = H + 30 hours.

n = 1.2

Find: D = ?

(a) Step 1: Set up the formula as follows where:

$D = \frac{R_1}{(T_e)^n} \times T_s$ $D = \frac{300 \text{ cGyph}}{(30)^{1.2}} \times 2$

(b) Step 2: Work the problem.

$D = \frac{300 \text{ cGyph}}{(59.231)} \times 2$

D = 5 cGyph x 2 hrs

D = 10 cGy

Select the n = 1.2 total dose nomogram. Connect H + 1.5 hours on the T_e scale with the T_s reading of 1 hour. Pivot the hairline at its point of intersection with the index scale to the 200 cGy/h on the R_1 scale. **Read D = 90 cGy** on the total dose scale.

NOTE: **Hairline may not be to scale.**

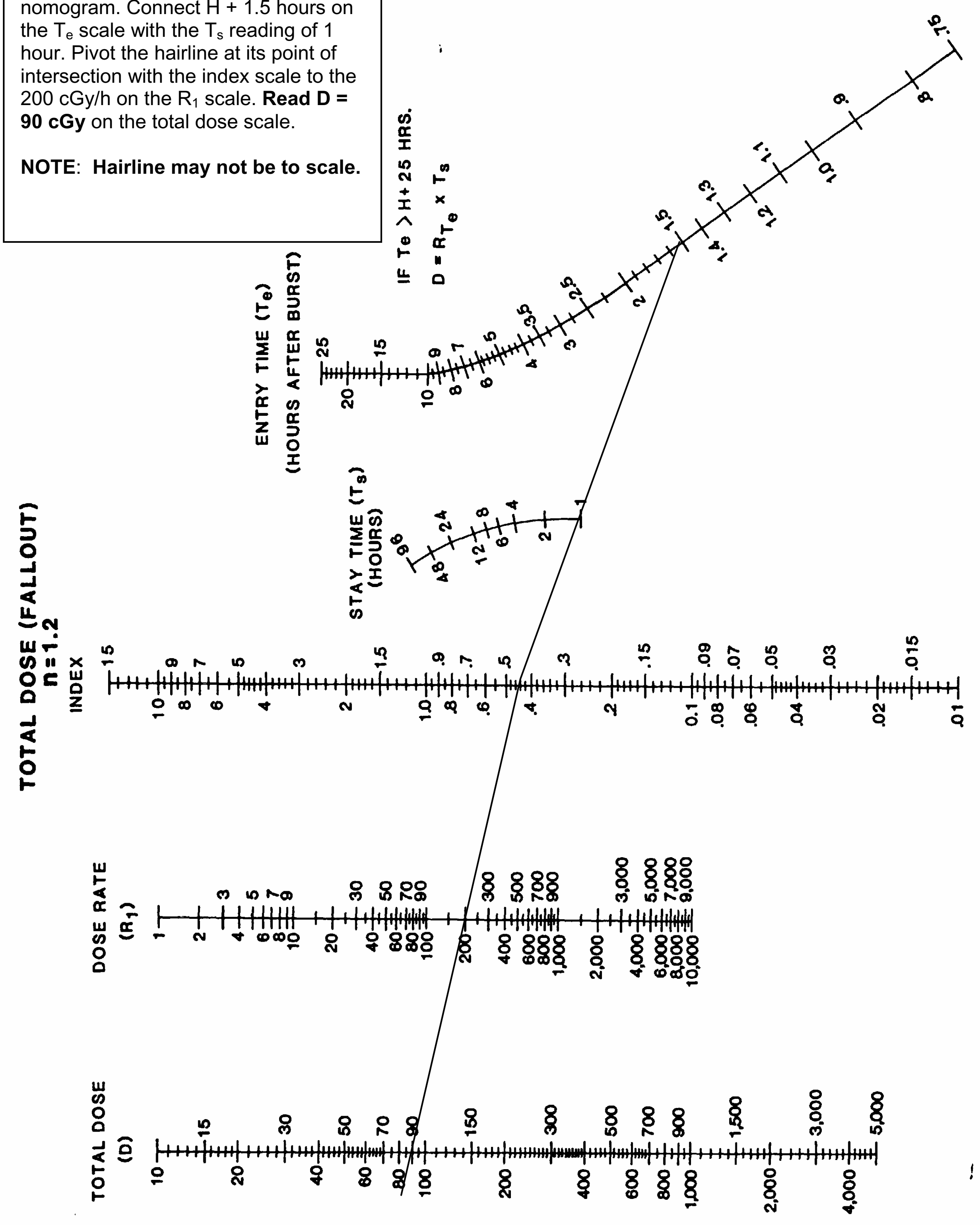


Figure G-31. Total Dose-Fallout (n=1.2) (Example)

i. Crossing a Fallout Area.

(1) In nuclear operations, it is to be expected that extensive areas will be residually radioactive. It may be necessary to cross an area where there is residual radiation.

(2) When crossing a contaminated area, the dose rate will increase as the center of the area is approached and will decrease as the far side is approached. Therefore, determine an average dose rate for total dose calculations. A reasonable approximation of the average dose rate can be determined using only one half of the highest dose rate. This is written:

$$R_{avg} = \frac{R_{\max}}{2}$$

R_{avg} = average dose rate.

R_{max} = highest dose rate encountered or expected to be encountered.

(3) This calculation is sufficient when looking for a suitable route for crossing a contaminated area or when time is critical.

(4) The effective dose rate for a crossing problem can be treated like the dose rate for a fixed point. Therefore all follow on calculations (e.g. accumulated dose, earliest time of entry) for the crossing problem can be done using the same procedures used for a fixed point described earlier. The transmission factor must also be applied as in a stationary situation.

j. Optimum Time of Exit from Fallout Areas.

(1) Nuclear fallout may present a serious hazard to units that remain in the contaminated area. Shelters such as field emplacements are the best protective measures against nuclear radiation for troops in the field. If the shelter provides any appreciable amount of protection, it will be advantageous to remain and improve it rather than to evacuate to an uncontaminated area. If the situation permits, and higher HQ's approve, the commander may decide to move out of the contaminated area. By evacuating at the optimum exit time, the radiation dose to personnel is kept to a minimum.

(2) To compute the optimum exit time from a fallout area, you must know the time of detonation, the location of an uncontaminated area, the average TF, and the time required to evacuate.

(3) When moving from an area contaminated by fallout, the unit moves into an uncontaminated location. This will necessitate waiting until fallout is complete at present positions.

(4) The average TF of the fallout shelters and the vehicles used to leave the contaminated area must be computed. Since all shelters are not the same, an average value should be used. The TF of a vehicle may be estimated. A unit moving on foot will be fully exposed and will have a TF of 1.0.

(5) The time to load vehicles and move out of the contaminated area must be estimated. In order to minimize exposure time, it may be necessary to temporarily abandon non essential items and recover them at a later time when the dose rate has decreased to an acceptable value.

The optimum time of exit (T_{opt}) is calculated as:

$$T_{opt} = MF \times T_{ev}$$

MF is a multiplication factor taken from Figure G-32, page G-83.

T_{ev} is the time required to evacuate the contaminated area.

The following abbreviations are used in the optimum time of exit calculations:

T_{FS} is the Average TF for the fallout shelters.

T_{FM} is the Average TF after leaving shelters (during movement out of the contaminated area).

TF_{Ratio} is the TF ratio.

(6) Compute the optimum exit time by the three following steps:

(a) Calculate the TF ratio, $TF_{Ratio} = T_{FS}/T_{FM}$.

(b) Determine the Multiplication Factor. Enter the vertical axis of Figure G-32, with the value obtained for TF_{Ratio}. Move horizontally along this value to the curve. Move straight down and read the Multiplication Factor (MF) from the horizontal axis.

(c) Calculate the optimum exit time. Multiply the MF by T_{ev}. The product is the optimum time, in hours after detonation, that the unit should leave its shelters and evacuates the area.

(7) Special Considerations.

(a) The unit should evacuate the fallout area as soon as possible when ratios of TF_{Ratio} are close to or greater than 0.5.

(b) If the optimum time of exit is estimated to be before the actual arrival of fallout, the unit should evacuate the area as soon as possible after fallout is complete and an uncontaminated area is available.

(c) The unit will receive the smallest dose possible if it leaves the contaminated area at the optimum time of exit. If the commander is willing to accept up to a ten percent increase in dose, he may leave the shelters any time between one half and twice the optimum time of exit.

(d) If possible, personnel should improve their shelters while waiting for the optimum time of exit. The estimate of the optimum time of exit should be recalculated if significant improvement is made in the shelters. Improved shelters mean the unit should remain in shelters for a longer period of time to minimise the dose to the personnel.

Example: Given: T_{FS} = 0.1 (foxhole)

T_{FM} = 0.6 (2½ ton truck)

T_{ev} = 1 hr

Find: Optimum time of exit.

Solution: $TF_{Ratio} = T_{FS}/T_{FM}$

$TF_{Ratio} = 0.1/0.6$

$TF_{Ratio} = 0.167$

Enter Figure G-32, page G-83 with a TF_{Ratio} of 0.167. Read across to the curved line and down to the horizontal axis (MF) to obtain the *MF* value of 2.80.

Multiplication Factor (MF) = 2.80

$$T_{opt} = MF \times T_{ev}$$

T_{opt} = 2.80 x 1 hr

T_{opt} = 2.80 hr Determine minutes: 0.8 x 60min = 48.

T_{opt} = 2 hours and 48 minutes

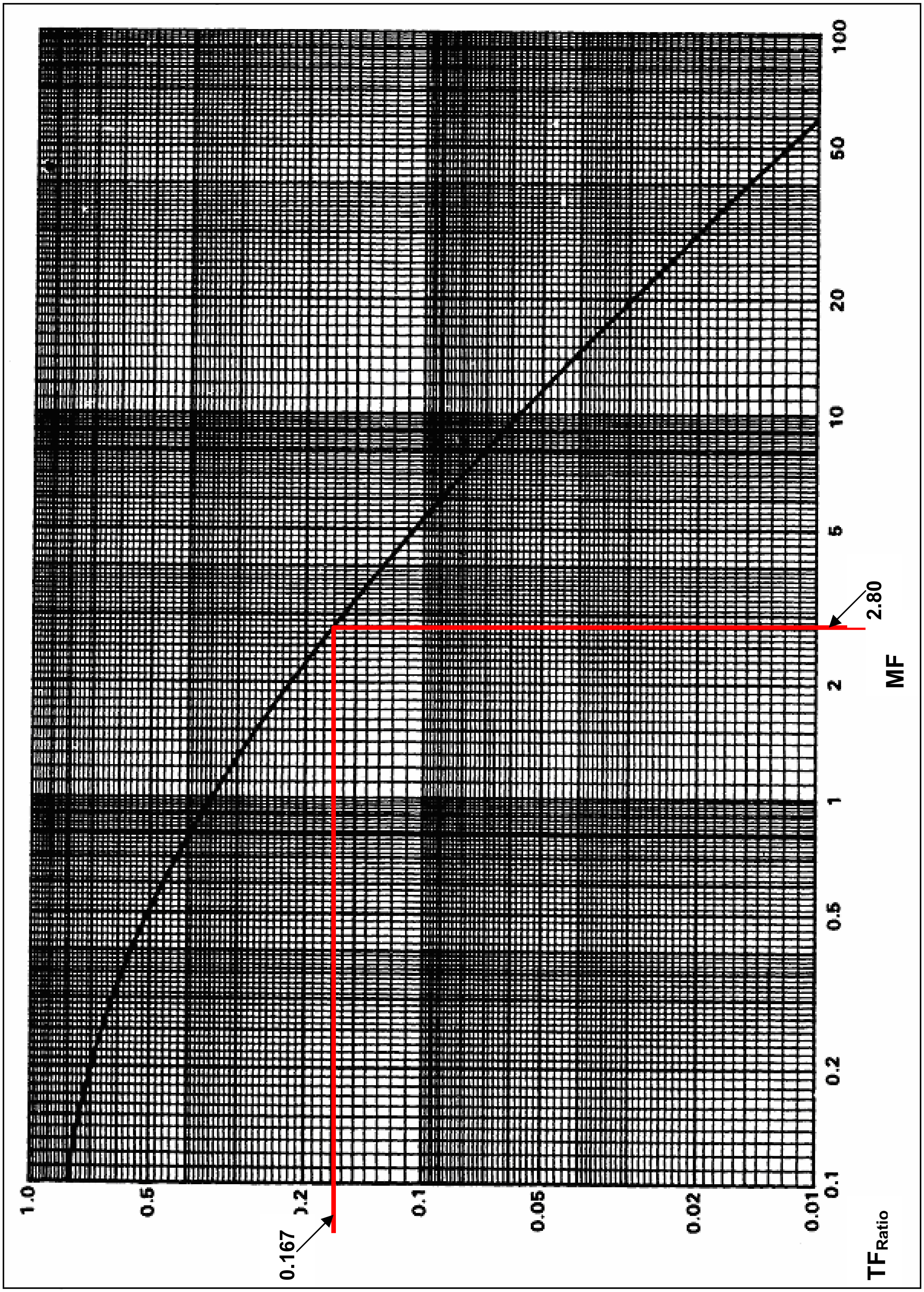


Figure G-32. Multiplication Factor (MF) (Example)

k. Neutron Induced Radiation Areas.

(1) Neutrons are produced in all nuclear weapon bursts. Some of these neutrons may be captured by the various elements in the soil under the burst. As a result, these elements become radioactive, emitting beta particles and gamma radiation for an extended period of time. Beta particles are a negligible hazard unless the radioactive material makes direct contact with the skin for an extended period of time. Beta particles can cause skin irritations varying from reddening to open sores. In contrast, gamma radiation readily penetrates the body and can cause radiation injury and even death. To determine the external military hazard posed by induced radiation, an analysis of the dose rate of the emitted gamma radiation must be determined.

(2) The location of a suspected induced radiation area created by an air burst is determined by nuclear burst data. Weather conditions have no influence upon its location or size. Surface winds will not affect the pattern. The pattern, if produced, will always be around GZ. The size of the pattern depends on the yield of the weapon and height of burst. Table G-11 shows the boundaries of the induced area for different yields. Assuming an optimum height of burst, the user enters the table with the yield of the weapon. The distance given is the maximum horizontal radius to which a 2 cGy/h dose rate will extend one hour after burst.

Table G-11. Radii of Neutron Induced Contamination

Estimated Yield (KT)	2 cGy/h dose rate at H + 1 hour Horizontal Radius (meters)
0.1	200
1	700
10	1000
100	1600
1000	2000

(a) Enter the Keller Nomogram (Fig. G-34 or G-35, pages G-86 or G-87) with the yield of the weapon to extract the horizontal radius in meters. The distance given is the maximum horizontal radius to which a 2-cGyph dose rate will extend one hour after burst.

(b) Enter the Radii of Neutron Induced Contamination Table (Table. G-11) with the yield of the weapon to extract the horizontal radius in meters. The distance given is the maximum horizontal radius to which a 2-cGyph dose rate will extend one hour after burst.

(c) The following steps should be utilized when plotting neutron- induced radiation areas.

- Obtain a clean sheet of overlay paper.

- Obtain nuclear burst information from NBC2 Report or from CBRN cell strike serial log. Record strike serial number, DTG of burst, GZ location, weapon yield, and map scale on overlay.

- Utilize Keller Nomogram or Radii of Induced Contamination table to determine the horizontal radius of the 2-cGyph line.

- Select GZ coordinate.

- Draw a circle around GZ that matches the distance extracted in Step 3 (Figure G-32).

(d) The circular area with a radius as given in Figure G-33 or Table G-11 around GZ is regarded as contaminated until actual dose rate readings indicate otherwise. The actual area of contamination is usually substantially less, depending upon actual yield and height of burst.

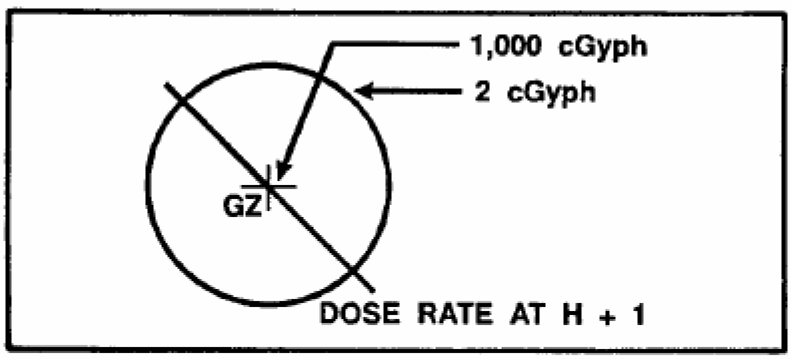


Figure G-33. Example of Plotted Neutron Induced Area

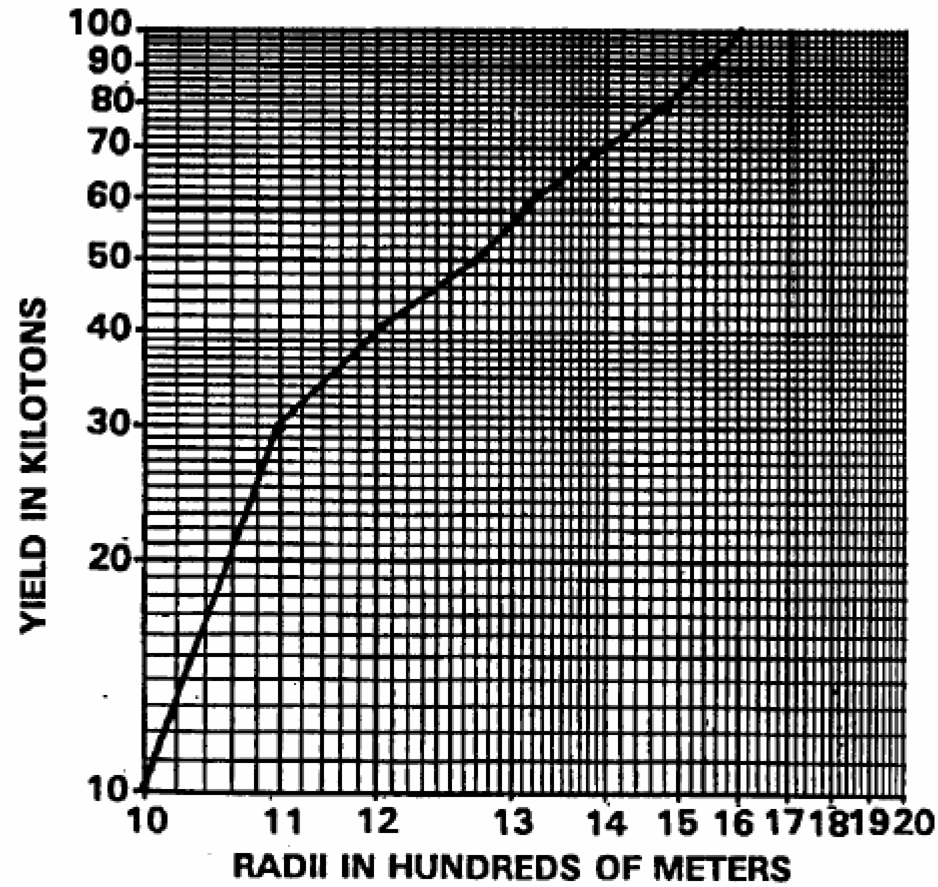


Figure G-34. Keller Nomogram for Neutron Induced areas from 10 – 100 Kilotons

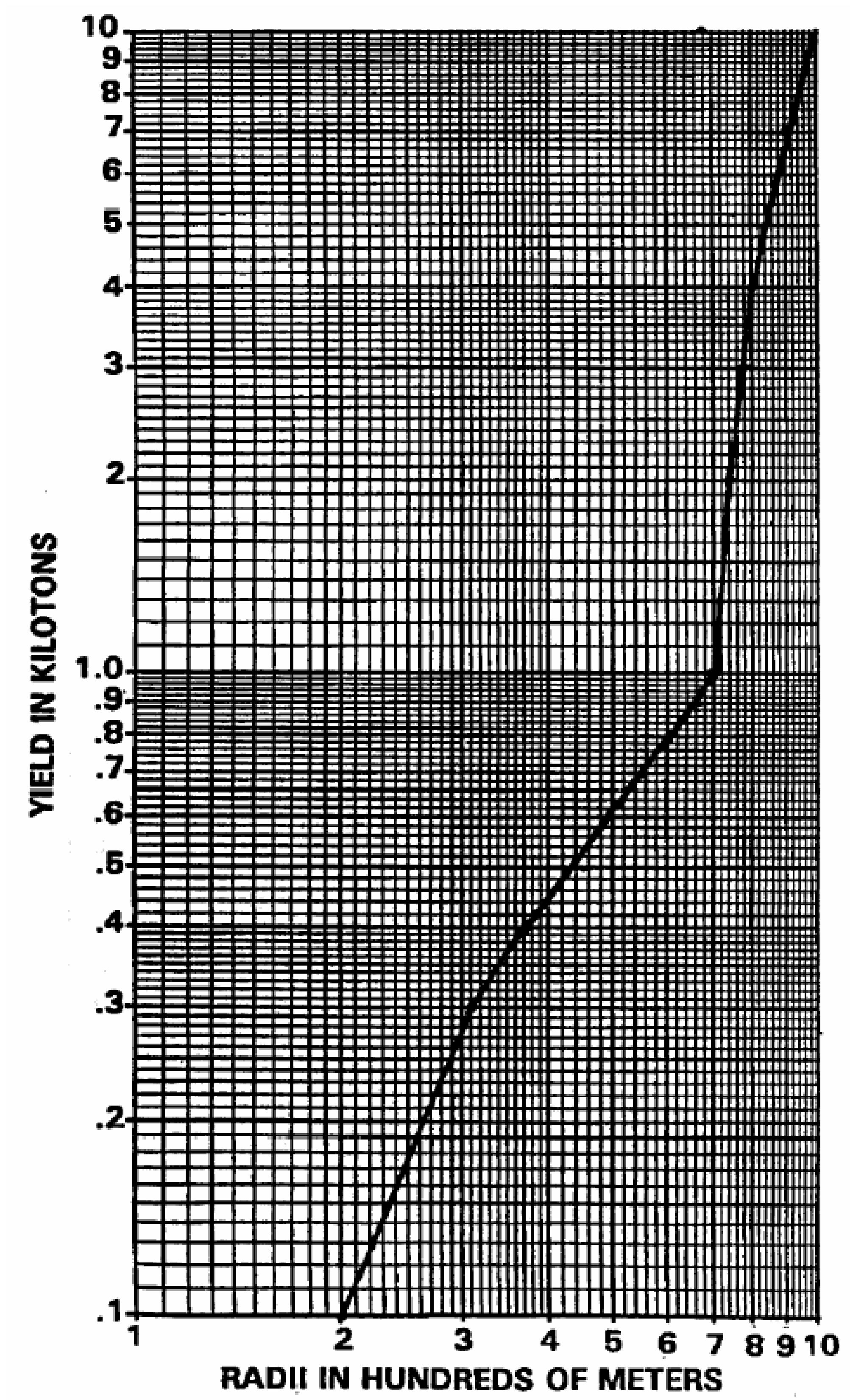


Figure G-35 Keller Nomogram for Neutron Induced areas from 0.1 – 10 Kilotons

(3) Decay of Induced Radiation.

(a) The soil in the target area is radioactive to a depth of 0.5 meters at GZ. In contrast, fallout is a deposit of radioactive dust on the surface. From this it can be seen that decontamination of the area is impractical.

(b) The decay characteristics of induced radiation are considerably different from those of fallout. Fallout is a mixture of many substances, all with different rates of decay. Induced radiation is produced primarily in aluminium, manganese, and sodium.

(c) Other elements, such as silicon, emit so little gamma radiation or decay so fast that they are less important.

(d) During the first 30 minutes after a burst, the principal contributor to induced radiation is radioactive aluminium. Almost all soils contain aluminium. It is one of the most abundant elements in the earth's surface. Radioactive aluminium has a half-life of two to three seconds. Because of this, almost all the radioactive aluminium has decayed within 30 minutes after the burst.

(e) Most soils also contain significant quantities of manganese. This element decays with a half-life of about 2.6 hours. From 30 minutes after burst until 10 to 20 hours after the burst, both manganese and sodium are the principal contributors to the radiation. After 10 to 20 hours after the burst, sodium, which decays with a half-life of about 15 hours, is the principal source of radiation.

(f) Soil composition is the most important factor in the decay of induced radiation. Its decay must be considered differently from that of fallout. For fallout, the decay rate is calculated by using the Kaufmann equation. For induced radiation, the percentage, by weight, of elements present in the soil determines the decay rate.

(g) Since soil composition varies widely, even in a localized area, you must know the actual chemical composition of the soil to determine the rate of decay of induced radiation. The soils are divided into four types. Table G-12 has been extracted from the Defense Nuclear Agency Effects Manual 1 (DNA EM-1).

(h) Since the actual soil composition will not be known, soil type II, the slowest decay, is used for all calculations until the CBRN cell advises use of a different soil type.

(i) Soil type is determined by using engineer soil maps or an NBC 4 Report and the induced decay nomograms (pages J-57 through J-60). The method is basically a process of elimination. The dose rate and the time it was measured are applied to an induced decay nomogram. This will result in an H+1 or R_1 dose rate. Then if the other dose rates and times from the series report result in the same R_1 dose rate, which is the soil type. If not, check the other nomograms until the one used results in the same R_1.

Table G-12. Soil Types for Induced Radiation Calculations

Chemical Composition of Soils				
Element	**Type I**	**Type II**	**Type III**	**Type IV**
Sodium	-	1.30	0.16	0.001
Manganese	0.008	0.01	2.94	-
Aluminium	2.89	6.70	18.79	0.006
Iron	3.75	2.20	10.64	0.005
Silicon	33.10	32.00	10.23	46.65
Titanium	0.39	0.27	1.26	0.004
Calcium	0.08	2.40	0.45	-
Potassium	-	2.70	0.88	-
Hydrogen	0.39	0.70	0.94	0.001
Boron	-	-	-	0.001
Nitrogen	0.065	-	0.26	-
Sulphur	0.07	0.03	0.26	-
Magnesium	0.05	0.60	0.34	-
Chromium	-	-	0.04	-
Phosphorus	0.008	0.04	0.13	-
Carbon	3.87	-	9.36	-
Oxygen	50.33	50.82	43.32	53.332

(4) Transmission Factors: TF for induced areas are determined in the field. The TF in Table G-13 ,should be used with the greatest reservation. Actual TF in induced areas may be lower by as much as 70 percent because of the technical characteristic of radiation.

Table G-13. Transmission Factors for Common Structures

Structure	Neutrons	Structure	Neutrons
Three Feet Underground	0.01	Concrete Shelter	
Frame House	0.8	9 inch walls	0.5
Basement	0.8	12 inch walls	0.4
Multi-Floor Building		24 inch walls	0.2
Upper Floors	1.0	Shelter (partly above ground)	
Lower Floors	0.8	2 feet earth cover	0.08
		3 feet earth cover	0.05

(a) Essentially the strength of gamma radiation is measured in million electron volts (MeV). Fallout less than 24 hours old has an average energy of 0.67 MeV. Induced radiation emitted from the three principal soil elements has a range of 0.68 MeV to 1.2 MeV.

(b) Because of the unique decay characteristics of induced radiation, TF must be recalculated frequently. Every four hours is recommended. This accounts for changes in the penetration ability of the remaining radiation.

(5) Dose Rate Calculations: The decrease in the dose rate must be calculated before total dose can be found. This is done with decay nomograms. Use the residual radiation (induced) decay nomograms in (Figures J-50 through J-53) for these calculations. They allow the user to predict the dose rate at any time after the burst.

(a) Each nomogram denotes time (hours) after the burst for one of the four soil types.

(b) In each nomogram, the $\mathbf{R_1}$ scale is at the right. This scale shows H+1 dose rates. The R_t scale is on the left. This scale shows dose rates at times t.

Example: Given: R_t = 150 cGy/h at H + 3 hours, soil type II.

Find: R_1

Answer: 190 cGyph.

Solution: Select nomogram for soil type II. Align the hairline with the 3 hour tick mark on the time (middle) scale (**t**) and the 150 cGy/h point on the $\mathbf{R_t}$ scale. Read the dose rate as 190 cGy/h at the point of intersection with the $\mathbf{R_1}$ scale.

(6) Total Dose Calculations. The nomogram in Figure J-54, page J-61, is used for predicting the total dose received in an induced area. This nomogram relates total dose, H + 1 dose rate, stay time, and entry time. The two scales to the left of the index line show total dose and H + 1 dose rate. There are two stay time scales to the right of the index line. The extreme right scale shows entry time. The index line is a pivoting line, which is used as an intermediate step between D and R_1. R_1 is found by using one of the induced decay nomograms.

(a) If soil type is unknown, assume the soil is type II. The total dose nomogram, Figure J-54, is never used to find R_1.

(b) On Figure J-54, soil types II and IV under "stay time" will be used for total dose calculations if the soil type is not known. If the soil type is known, the appropriate scale under "stay time" will be used. It is possible to find any one value on the total dose nomogram if the other three are given, as illustrated in the following examples.

-Example 1: Given: R_1=140 cGy/h.

T_e=H + 6 hours.

T_s=1 hour.

Soil type: II

Find: D

Answer: 72 cGy.

Solution: On nomogram, at Figure J-54, connect H + 6 on the T_e scale with 1 hour on the T_s scale (soil types II and IV) with a hairline. Pin the hairline at the point of intersection with the index scale. Now pivot the hairline to 140 cGy/h on the R_1 scale. Read 72 cGy on the D scale.

-Example 2: Given: R_1= 300 cGy/h.

T_e= H + 6 hours.

D= 70 cGy.

Soil Type: III

Find: T_s

Answer: 1 hour.

Solution: On nomogram, at Figure J-54, connect 70 cGy on the D scale with 300 cGy/h on the R_1 scale. Pin the hairline at the point of intersection with the index scale. Pivot the hairline to H + 6 hours on the T_e scale. Read 1 hour on the T_s scale (soil types I and III).

(7) Crossing an Induced Radiation Area: If an area must be crossed, the lowest dose rate area, consistent with the mission, is selected.

(a) In calculating total dose, it is necessary to determine an average dose rate; dose rates increase as the center of the area is approached and then decrease beyond the center of the area. The average dose rate represents a mean value the individual is exposed to during the time of stay. A reasonable approximation of the average dose rate can be obtained by dividing by two the maximum dose rate predicted to be encountered. This is written as:

$$R_{avg} = \frac{R_{\max}}{2}$$

(b) Time of stay (stay time) must be calculated for crossing problems. Use the relationship of: See Figure G-36, (page G-93-Example).

$$T_s = \frac{distance}{speed}$$

Example: Given: R_{1max} = 300 cGyph.

T_e = H + 10 hours.

T_s = ?

R_{1avg} = ?

Soil Type: II

Distance: 1 km

Speed: 10 kmph

Crossing w/ an APC with TF = 0.22

Find: ID

Answer: 1.32 cGyph or <u>1 cGyph</u>.

Solution:

Step 1. Calculate R_{1avg}:

$$R_{avg} = \frac{R_{max}}{2} \quad R_{1avg} = (300cGyph / 2) \quad R_{1avg} = 150\ cGyph$$

Step 2. Calculate T_s:

$$T_s = \frac{distance}{speed} \quad T_s = (1\ km / 10\ kmph) \quad T_s = 0.1\ hr$$

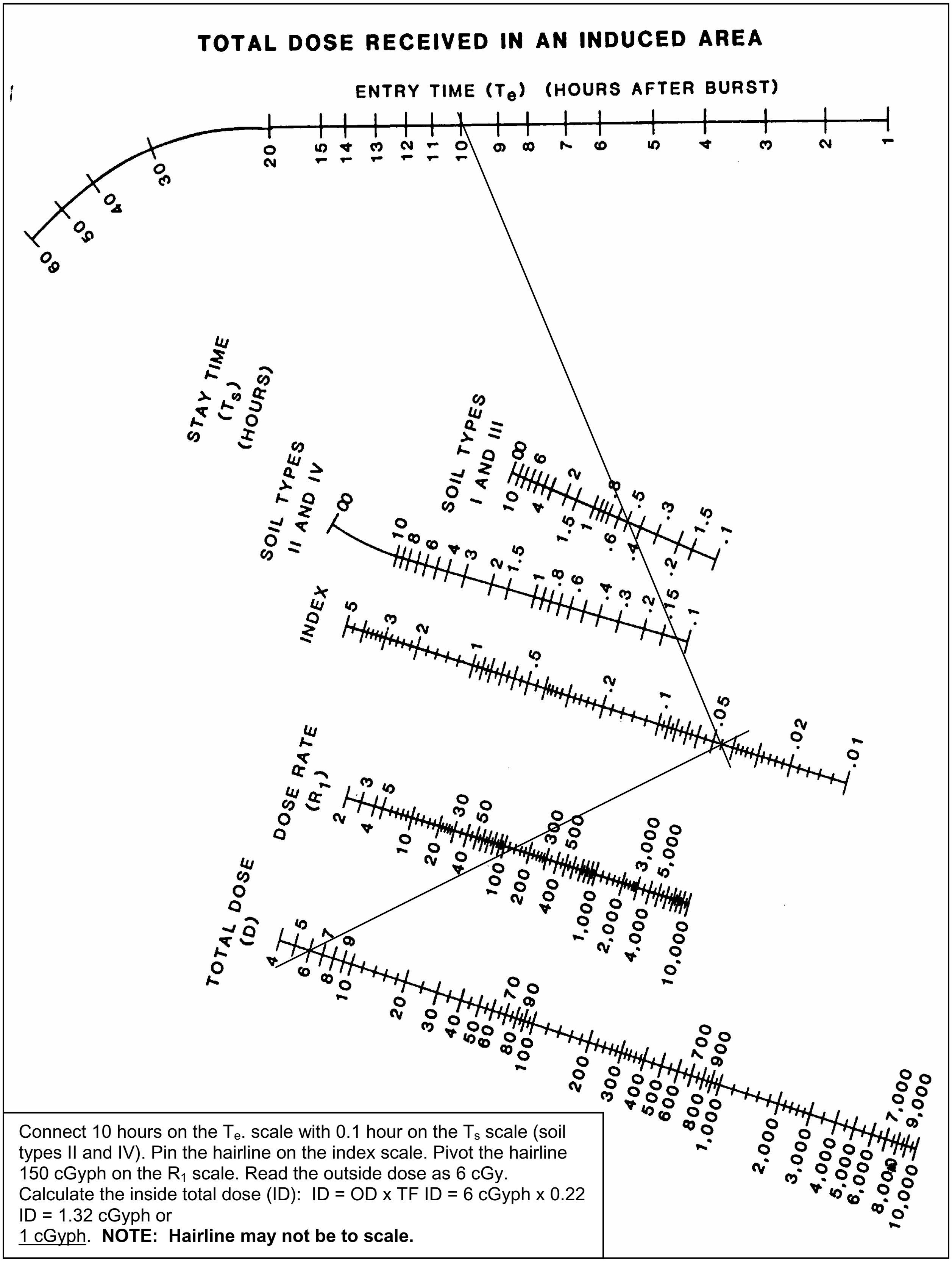
Step 3. On the nomogram in Figure G-36, connect 10 hours on the T_e. scale with 0.1 hour on the T_s scale (soil types II and IV). Pin the hairline on the index scale. Pivot the hairline 150 cGyph on the R_1 scale. Read the outside dose as 6 cGy.

Step 4. Calculate the inside total dose (ID):

ID = OD x TF

ID = 6 cGyph x 0.22

ID = 1.32 cGyph or <u>1 cGyph</u>



Connect 10 hours on the T_e. scale with 0.1 hour on the T_s scale (soil types II and IV). Pin the hairline on the index scale. Pivot the hairline 150 cGyph on the R_1 scale. Read the outside dose as 6 cGy. Calculate the inside total dose (ID): ID = OD x TF ID = 6 cGyph x 0.22 ID = 1.32 cGyph or 1 cGyph. **NOTE: Hairline may not be to scale.**

Figure G-36. Total Dose-Induced Radiation (Example)

(8) Determination of Decay Rate for Induced Radiation. Decay characteristics of induced radiation are considerably different from those of fallout. The Kaufman equation may not be applied.

(a) The decay of induced radiation depends on the elements in which it is induced. Soil contains many different elements with varying half-lives, so, the decay rate changes in time, and must be monitored constantly.

(b) The decay rate n at a fixed location can only be determined from consecutive measurements, using the following equation:

$$\frac{1}{t} x \; 1n\left(\frac{R_a}{R_a + t}\right)$$

(c) Ra is the dose rate reading in cGyph at an arbitrary time and (Ra + t) is a second reading taken at the same location after t hours..

(d) Manganese and sodium are two elements frequently found in soils with relatively long half-lives. Therefore, they are expected to be the principal sources of radiation after a burst. For sodium with its half-life of 15 hours, the decay rate is 0.046. For manganese with its half-life of 2.6 hours, the decay rate is 0.27.

(9) Determination of the Dose Rate for an Arbitrary Time: The dose rate (R_1 + t) in cGyph at an arbitrary time (t hours) after a reading is calculated as

$$R_1 + t = Ra * EXP(-n * t).$$

Ra is the dose rate at the time (t) of the reading, n is the decay rate at that time, and exp () is the exponential function (inverse or INV ().

NOTE: The following characters or character combinations indicate keys on the scientific calculator*,*EXP,Yx, INV,(* and *)*. When you encounter one of these in a formula, press the key indicated. Remember that negative n (-n) is not an indication to press the minus key.

(10) Determination of Dose Accumulated in a Neutron Induced Area: The dose D in cGy accumulated between entry to and exit from a Neutron Induced Gamma Activity (NIGA) area is found by using the formula—

$$D=R_1/n*(EXP(-n*t_{in})-EXP(-n*t_{out})).$$

R_1 is the dose rate in cGyph at the reference time, n is the decay rate at that time, t_{in} and t_{out} are the time of entry and exit from the NIGA area in hours after the reference time. EXP () is the exponential function.

(11) Determination of Time of Exit from a Neutron Induced Area Given a Maximum Dosage. If a certain limit DL for the dose accumulated during a stay in an NIGA area is given, the time tout to leave the area can be determined from the following equation:

$$T_{out} = -l/n*ln(EXP(-n*T_e)-(n*DL)/R_l$$

Where T_e is the time of entry in hours after the reference time at which the dose rate was R_1 and the decay rate was D. One n () and EXP() are the natural logarithm and the exponential function, respectively.

(12) Determination of the Earliest Time of Entry: To ensure a limiting dose DL is not accumulated during a stay in an NIGA area, the earliest time of entry tin can be determined as follows:

$$T_e = -1/n*(DL/(R*n*(l-exp(-n*T_s)))).$$

Where T_S is the time of stay in the area in hours, R is the dose rate at the reference time H + 1, and n is the decay rate at that time. One n () and EXP () are the natural logarithm and the exponential function, respectively.

10. NBC6 Report

a. Purpose: Report for passing detailed information on a Nuclear attack.

b. Message Precedence: All other messages, after the initial NBC 1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE would be appropriate.

Table G-14. NBC6 Report

NBC6 (NUC) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	O	ALPHA/US/A234/001/N//
D	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
F	Location of Attack and Qualifier	O	FOXTROT/32UNB058640/EE//
Q	Location & Type Reading /Sample /Detection	O	QUEBEC/32VNJ481203/GAMMA/-//
S	Date-Time-Group of Reading	O	SIERRA/202300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/NBCINFO/WEAPON YIELD ESTIMATED FOR EVALUATION OF COLLATERAL DAMAGE PURPOSES ONLY//
* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).			

c. This report summarizes information concerning a nuclear attack(s) and is prepared by the reporting unit level, service equivalent, or higher but only if requested by higher headquarters. It is used as an intelligence tool to help determine enemy future intentions.

d. The NBC6 Report is submitted to higher HQ. It is written in narrative form, with as much detail as possible.

Appendix H

RELEASE OTHER THAN ATTACK CONTAMINATION AVOIDANCE TACTICS TECHNIQUES AND PROCEDURES

1. Background

a. General: This appendix covers the procedures to warn and report CBRN releases other than the "traditional" military CBRN attacks resulting from offensive use of CBRN weapons. These releases, referred to as ROTA, may include, but are not limited to, CBRN or TIM releases due to damaged or destroyed storage bunkers, transport vehicles, storage or production facilities, ammunition supply sites, power plants, etc.

b. Characteristics of ROTA.

(1) Types of Hazardous Material. Most nations in the world have some form of hazardous chemical and/or biological (some may have radiological) production or storage facilities. Most of these materials are used for peaceful purposes and are considered to be in one of the following categories:

(a) Agricultural. Insecticides, herbicides, fertilizers, etc.

(b) Industrial. Chemicals or other substances (biological or radiological) used in manufacturing processes or for cleaning.

(c) Production and Research. CBRN materials used in research or are produced in a facility.

(2) Detection. Civilian chemical materials or compounds and/or biological materials may not be detectable by the standard chemical or biological detection devices of tactical units. Also, these materials may not be detectable with the human senses and may cause symptoms that are different than symptoms from CBRN agents.

(3) Definitions**.**

(a) Release Area. This is the predicted area immediately affected by the release.

(b) Hazard Area. This is the predicted area in which unprotected personnel may be affected by CBRN material spreading downwind from the Release Area. The downwind distance depends on the type of release and the weather and terrain in both the Release Area and the area downwind of the Release Area.

(c) Contaminated Area. This is the area in which CBRN material may, in solid or liquid form, remain at hazardous levels for some time after the release. The actual shape and duration can only be determined by surveys.

(d) Elevated Releases. Any release which, due to fire, momentum, or explosion, is carried above 50 m above the ground is considered an elevated release.

(e) TIM. A generic term for toxic (chemical or biological) or radioactive substances in solid, liquid, aerosolised or gaseous form. These may be used, or stored for use, for industrial, commercial, medical, military or domestic purposes. TIM may be chemical, biological or radioactive and may be described as toxic industrial chemicals (TIC), toxic industrial biologicals (TIB) or toxic industrial radiologicals (TIR).

2. Release Other than Attack Contamination Avoidance Procedures

Avoidance procedures are broken down into actions before the attack, during the attack and after the attack. The lists given, while not all encompassing, may assist in developing unit SOP and directives.

a. Before the Attack.

(1) Subordinate units are alerted.

(2) Commander(s) specify appropriate MOPP levels; establish automatic masking criteria; and, if MOPP0 is assumed, determine the location for chemical protective clothing based on METT-T(C).

(3) Unit continues the mission while implementing actions to minimize casualties and damage:

(a) Personnel, equipment, munitions, petroleum, oil and lubricants (POL), food, and water are protected from contamination.

(b) Detection paper is placed to provide visibility and maximum exposure to liquid agents.

(c) Operational security (OPSEC), dispersion, cover and concealment are practiced so the unit may avoid being targeted.

(d) Chemical detectors and alarms are checked and prepared for use.

(e) Updated CDMs are prepared for each unit.

b. During the Attack.

(1) All personnel automatically mask, sound alarm, decontaminate themselves as required, assume MOPP 4, and administer self-aid and buddy-aid.

(2) Chain of Command and communications are restored, and the unit continues with the mission.

(3) Adjacent units are immediately warned of the potential downwind vapor hazards.

(4) Unit identifies type of agent and submits an NBC 1 Report as the mission permits.

(5) For attacks that leave liquid or solid contamination on equipment, personal, or terrain, unit performs the following actions:

(a) Conduct personal wipe down and operators spray/wipe down.

(b) Warn MEDEVAC of contamination casualties. Killed in actions are wrapped and marked.

(c) Unit marks contaminated area and relocates to a clean area if the mission allows.

(d) Unit determines where and when further decontamination can be accomplished if necessary.

(e) Coordinate for decontamination and resupply protective clothing and decontaminates.

(f) Ensure contaminated battle dress overgarments are exchanged within 24 hours after being contaminated.

(g) Replace contaminated protective covers within 24 hours.

(h) For nonpersistent agents, conduct unmasking procedures, treat casualties and prepare for evacuation as the mission permits, and service detection systems to ensure operational status.

(i) Receive NBC 2 Report, plot the potential hazard area, and inform the commander.

c. After the Attack.

(1) Unit has undergone decontamination operations and casualties have been evacuated.

(2) Unit reorders CBRN defense equipment (i.e., MOPP suits, filters, decontamination kits, etc.).

(3) If unit has not yet identified what agent was used, continue effort to identify the agent/source. This will be done by the following:

- M8 Chemical Agent Detection Paper.
- M256A1 Chemical Agent Detection Kit.
- Improved Chemical Agent Monitor (ICAM) or Chemical Agent Monitor Block II (CAM II—USMC).
- Automatic Chemical Agent Detector/Alarm (ACADA).
- AN/VDR-2 RADIAC set.
- AN/PDR-56 RADIAC set.
- AN/DPR-77 RADIAC set.
- ADM-300 RADIAC set.
- DoD Biological Sampling Kit.
- Taking samples and forwarding to area lab for analysis.

(4) If unit must continue to operate in or occupy the contaminated area, the unit should:

- Continue efforts to refine the contamination hazard area and extent by continued sampling/detection.
- Adjust or improve MOPP as required.
- Mark contaminated areas and identify “hot spots”.
- Monitor contamination decay or covering to determine when natural decay may render the area safe.

- Be alert for “transient contamination”, the spreading or movement of contamination by natural sources (i.e., wind, rain, runoff, rivers) or by human sources, (i.e., vehicle traffic, rotorwash).

3. Release Other Than Attack Information Management

Managing ROTA information is crucial for the success of a command. To be useful, ROTA information must be collected, reported, and evaluated. Once evaluated, it can be used as battlefield intelligence. Obtaining and converting ROTA information into usable intelligence does not just happen. The volume of information that needs to be collected and reported could easily disrupt both communications and tactical operations if not properly managed. This section describes what information is available and how that information is transmitted to the person or unit requiring it.

a. Collecting ROTA Information: The first step in managing ROTA information is to determine what information is available and who is available to collect it. Observer data provides information that a ROTA event (either intentionally or accidentally) has occurred. Monitoring, survey, and recon data provide information on where the hazard is located. Every unit is responsible for observing and recording ROTA events. But only selected units automatically submit NBC1 (ROTA) Reports to the CBRN cell).

b. Monitoring, Survey, and Reconnaissance Data.

(1) NBC1 Reports allow the CBRN Cell to collect information of where designated observers have seen a nuclear attack. The CBRN Cell then evaluates this information in the form of an NBC2 Report. From the NBC2 Report a simplified or detailed hazard prediction can be made. This prediction (NBC3 Report) is only an estimation of the hazard area. Feedback is needed from units to determine exactly where the contamination is located. This feedback comes from monitoring, survey, and recon (NBC 4 Reports). Monitoring and recon operations give the initial location of CBRN hazards to the CBRN cell. Initial monitoring and recon reports are generally forward through intelligence channels to the CBRN Cell. This information may also be sent to the CBRN Cell by use of the various Decision Support Tools (DST) as discussed in Chapter III.

(2) The CBRN Cell then plots the information on the situation map. If more information is required, the CBRN Cell directs a unit (picked because of its location and/or capability) to collect and forward the necessary data. This information could be from additional monitoring reports or a survey of the area in question. Collecting ROTA information is a joint effort of units and the CBRN Cell. The unit does the actual collecting of information. The CBRN Cell plans for and directs the collection effort. More detailed information concerning this collection effort is addressed in *Multiservice Tactics, Techniques, And Procedures for Nuclear, Biological, and Chemical Reconnaissance.*

c. Evaluating ROTA Information. After ROTA information has been collected, it is evaluated. It is then used as battlefield intelligence. The CBRN cell is the primary evaluation center. Units and intermediate headquarters use this raw data to develop ROTA intelligence for their own use until detailed results are available from the CBRN Cell.

d. Transmitting ROTA Information. Procedures used to transmit ROTA information to and from the CBRN Cell are an important part of information management. The method of transmitting information depends on the tactical situation and mission of the unit. Refer to Chapter III, CBRNWRS, unit SOP and OPORD for more detailed information.

e. Planning for Potential ROTA Incidents. Damage or destruction of a facility or storage site, or any act that creates the unexpected release of civilian TIM into the environment, will present unique challenges to U.S. and allied forces, as well as to the citizens in the vicinity of the release. Once released, these hazards may cause immediate or delayed incapacitation or death. To safeguard friendly forces and civilians from the potential hazards, peacetime and tactical contamination avoidance principles must be carefully blended. To minimize the effects or hazards resulting from the damage or destruction of a chemical, biological, or nuclear facility, prior planning must occur.

(1) Friendly Unit Operations**.** When friendly units are required to operate in an area where such a facility exists, the operations staff must:

(a) Coordinate with the national, state, local, or HN emergency response teams. These teams may be from the HN government, the armed forces or from the facility itself.

(b) Identify what CBRN material is present, what type of contamination hazard is present, and the extent of the contamination hazard.

(c) Determine whether standard CBRN detectors will work to detect the threat TIM.

(d) Determine whether standard CBRN defense equipment (e.g. protective mask, boots, suit, gloves) will protect against the potential harmful effects of released compounds.

(e) Coordinate with HQ CBRN units for technical assistance.

(f) Coordinate with higher headquarters and HN to identify the availability of CBRN Accident/Incident Response and Assistance (CBRNAIRA) teams, TEUs, CSTs, or similar civilian agencies available to assist if required.

(g) Establish warning and evacuation procedures for noncombatants.

(h) Evaluate options and procedures for protection in place should evacuation not be possible (i.e. hospitals and schools). Procedures and required equipment for protection in place are outlined in *Multiservice Tactics, Techniques and Procedures for Nuclear, Chemical, and Biological Aspects of Consequence Management*.

(i) Identify a chain-of-command for supervision and coordination of the cleanup effort.

(2) Release of Civilian TIM**.** In the event civilian TIM are released, the following steps should be taken immediately by tactical units within the area:

(a) Assume MOPP Level 4 or appropriate level of protection (e.g. Level A, B, or C, etc). Start continuous monitoring with available detection equipment.

(b) Notify higher, lower, and adjacent units.

(c) Base hazard predictions on the procedures contained in the following paragraphs.

(3) Reporting of ROTA Events within the CBRNWRS. US and NATO forces will utilize the existing CBRNWRS and associated message formats to report ROTA events.

Initial reports of ROTA events will utilize the NBC1 Report if the release location is known; otherwise, an NBC4 Report will be generated. The CBRN Cell may use this information to develop an NBC2 Report, a simplified hazard prediction and an NBC3 Report. Additional readings from monitoring and directed surveys of the hazard area will use the NBC4 Report. The CBRN Cell will use this information to develop a plot of the actual contamination and the NBC5 Report and, finally, the CBRN cell will use the NBC6 Report to pass additional information required for detailed prediction and/or historical evidence and/or information for a planned response to possible future ROTA events.

4. NBC1 Report

The NBC1 Report is the most widely used report. The observing unit uses this report to provide ROTA data. All units must be completely familiar with the NBC1 Report format and its information. The unit must prepare this report quickly and accurately, and send it to the next higher headquarters. Battalion (Squadron), or service equivalent, and higher elements decide which NBC1 Reports to forward to the next higher HQ. If several reports are received on the same ROTA event, then a consolidated NBC1 Report is forwarded, instead of separate reports. This reduces the number of reports to a manageable level.

a. Purpose. The purpose of the NBC1 Report is to provide ROTA data.

b. Message Precedence. The first time a ROTA event occurs, the designated unit will send the NBC1 Report with a *flash* precedence. If a previous NBC1 Report has been forwarded, an *immediate* precedence will be used.

c. The report will include line items BRAVO, CHARLIE, GOLF, INDIA and TANGO and may include line items ALPHA, FOXTROT, MIKE ROMEO, YANKEE, ZULU and GENTEXT with the information as currently described for CBRN reports. Line item CHARLIE provides the same information as line item DELTA, except it indicates an observed ROTA event rather than an observed attack. Line item GOLF will include the type of delivery, if applicable, and the ROTA type of container such as bunker, waste, reactor, transport or stockpile, pressurised bottle, storage container, 200 liter drum, storage tank, if known, and the size of the release as small, large or extra large, if appropriate. Line item INDIA will indicate the observed release height and indicate the type of release as RNP, TIM or the agent name or identification number. Line item INDIA will also indicate the material persistency. Additional descriptive entries for a ROTA event can be entered into line item MIKE ROMEO. Line item TANGO will indicate a description of the terrain/topography and the vegetation. Line items YANKEE and ZULU may indicate locally observed weather. Line item GENTEXT will provide, if available, further information concerning the level of radiation detected, the specific chemical compound or the type of biological agent. (See Table H-1, page H-8).

d. Determine line items for this report utilizing the same procedures as the previous *Contamination Avoidance Tactics, Techniques and Procedures (TTP)* Appendixes per the type of attack/event (for example, for chemical, refer to Appendix E; and for biological, refer to Appendix F, and for HAZMAT refer to the Emergency Response Guidebook [ERG]).

Table H-1. NBC1 (ROTA) Report

NBC1 (ROTA) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	O	
B	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
C	Date-Time-Group of Report or Observation and End of Event	M	CHARLIE/281530ZSEP1997//
F	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/SUS/TPT/1/TNK/SML//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/ARD//
MR	Description and Status	O	MIKE ROMEO/LEAK/CONT//
T	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)			

5. NBC2 Report

The NBC2 Report reflects the evaluated ROTA data. It is based on one or more NBC1 Reports. Users of NBC2 Reports are not limited to the use of the line items shown in the example (see Table H-2, page H-8). Other line items, as appropriate, may be added.

a. Purpose: The purpose of the NBC 2 Report is to pass evaluated data to higher, subordinate, and adjacent units.

b. Message Precedence: All other messages, after the initial NBC1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally *immediate* would be appropriate.

c. The Division (or designated higher headquarters—service equivalent) CBRN cell, prepares the NBC2 Report, assigns it a strike serial number, and disseminates it to the appropriate unit.

d. Subsequent data may be received after the NBC2 Report is sent. If this data changes the yield or GZ location, send this data in an NBC2 update report. Use the same strike serial number and date-time of attack/incident.

e. Determine line items for this report utilizing the same procedures as the previous Contamination Avoidance TTP Appendixes per the type of attack/event (for example, for chemical, refer to Appendix E; for biological, refer to Appendix F, and for HAZMAT refer to the ERG).

Table H-2. NBC2 (ROTA) Report

NBC2 (ROTA) Report			
Line Item	**Description**	**Cond.**	**Example**
A	Strike Serial Number	M	ALPHA/US/WEP/001/RN//
C	Date-Time-Group of Report /Observation and Event End	M	CHARLIE/281530ZSEP1997/ 281545ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	M	GOLF/SUS/TPT/1/TNK/1//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/ARD//
MR	Description and Status	M	MIKE ROMEO/LEAK/CONT//
T	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	
* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)			

6. NBC3 Report

The NBC3 Report reflects the predicted areas of contamination. It is based from the NBC2 Report and any current relative data. Users of NBC3 Reports are not limited to the use of the line items shown in the example (see Table H-3). Other line items, as appropriate, may be added.

a. Purpose: The purpose of the NBC3 Report is to report immediate warning of predicted contamination and hazard areas to higher, subordinate, and adjacent units.

b. Message Precedence: All other messages, after the initial NBC1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally *immediate* would be appropriate.

c. The report will use the information as described in this manual for line items ALPHA, CHARLIE, FOXTROT, GOLF, INDIA, PAPA ALPHA, PAPA XRAY, YANKEE, ZULU, and GENTEXT. The hazard area location is described in line item PAPA XRAY, with the defining Release Area radius and Protective Action Distance summarised in line item PAPA ALPHA. Line item XRAY ALPHA may be used to report contours for measured areas of air contamination.

d. Determine line items for this report utilizing the same procedures as the previous Contamination Avoidance Tactics, Techniques and Procedures (TTP) Appendices per the type of attack/event. (For example, for chemical, refer to Appendix E; for biological, refer to Appendix F, and for HAZMAT refer to the ERG).

Table H-3. NBC3 (ROTA) Report

NBC3 (ROTA) Report			
Line Item	**Description**	**Cond* ****	**Example**
A	Strike Serial Number	M	ALPHA/US/WEP/001/RN//
C	Date-Time-Group of Report /Observation and Event End	M	CHARLIE/281530ZSEP1997//
F	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
G	Delivery and Quantity Information	O	GOLF/SUS/TPT/1/TNK/1//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/ARD//
PA	Predicted Attack/Release and Hazard Area	M	PAPA ALPHA/1000M/-/5KM/-//
PX*	Hazard Area Location for Weather Period	M	PAPA XRAY/081200ZSEP1997/ 32VNJ456280/32VNJ456119/ 32VNJ576200/32VNJ566217/ 32VNJ456280//
XB**	Predicted Contour Information	C	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

* Line item is repeatable up to three (3) times in order to describe three possible hazard areas corresponding to the time periods from the CDM. A hazard area for a following time period will always include the previous hazard area.

** Line item is repeatable up to 50 times to represent multiple contours

*** The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

e. The Type of Release**.** Present in any area of operation there may be chemical, biological, and/or radiological material, which will present a hazard to persons if released into the atmosphere. Releases may be accidental or intentional. The amount of material released may be small or extremely large. Such ROTA events can be divided into two (2) types based on their origin:

(1) Type N, ROTA Nuclear: Nuclear material can be released into the atmosphere from the core of a nuclear reactor, which has been damaged or which has gone out of control. Similar incidents may occur at nuclear fuel reprocessing or production facilities. Such a release can result in very high levels of radiation covering distances of hundreds of km.

(2) Type T, Toxic Industrial Materials (TIM): There are five cases of incidents under Type TIM. These sub cases include items that may be used, or stored for use, for industrial, commercial, medical, military or domestic purposes. TIM may be Chemical (TIC), Biological (TIB) or Radioactive (TIR).

(a) Case 1, Nuclear Waste or Radiological Material Storage: Damage to a nuclear or radiological material storage facility may result in release of radiological material into the atmosphere. Such a release will result in low level radiation covering a fairly short distance of danger to anyone remaining in the hazard area for extended periods of time.

(b) Case 2, Radiological Dispersion Device (RDD): Intentional release of large amounts or radiological material can result in hazard areas extending far downwind.

(c) Case 3, Biological Bunker or Production Facility: Damage to a storage bunker containing biological agents intended for use in biological warfare or to production facilities for such agents containing active agent containers will result in smaller release areas and lower quantities than if they had been dispersed from a weapon. However, due to the toxicity of such agents, and the likelihood of having an elevated plume, dispersed material may travel downwind for many hours at hazardous levels.

(d) Case 4, Chemical Stockpile or TIM Transport / Storage: Damage to stockpiled munitions containing chemical agents will result in considerably smaller quantities of agent released than intentional use of the munitions, so the downwind hazard area will usually be smaller than for a chemical attack. Damage to containers of Toxic Industrial Material (TIM) being transported by road, rail, or boat can result in large quantities released into the atmosphere. However, the toxicity and stability of these materials will be less than for chemical agents, so hazard areas will also be smaller than for a chemical attack. This category also includes small storage quantities and single munitions found leaking on the battlefield.

(e) Case 5, Bulk Chemical Storage: Toxic industrial chemicals (TIC) are stored in very large (greater than 1500 kg) quantities in large tanks, often under pressure and/or at low temperatures. A catastrophic rupture of such a tank will result in a highly toxic cloud, which usually exhibits dense gas behaviour. This type of release may also occur intentionally by a terrorist or other deliberate action. Such a cloud will not travel with the wind until after its concentration has been reduced considerably, often when it is below toxic levels. In addition to their toxicity, industrial chemicals are often corrosive, flammable, explosive, or able to react violently with air or water. These hazards may be greater than the immediate toxic effects.

f. Procedures and Constraints.

(1) Procedures.

(a) Record and update the following information:

- Weather information from relevant CBRN CDRs, which may contain both forecast data and measured data,

- Weather information from local measurements/observations, which may contain both data before and during the cloud passage period,

- A data base of local meteorology measured during the cloud passage period

(b) Record terrain features (wooded areas, mountains, plains, etc.) which may influence the direction and speed of ROTA release clouds.

(c) An NBC 3 Report may be generated and considered for distribution whenever the threat of a ROTA event is high.

(d) On receipt of an NBC 1 or NBC 2 Report, estimate the meteorological parameters for the release area and downwind of the release area.

(e) Select, in accordance with national directives, the weather information to be used and calculate the predicted downwind hazard area.

(2) Constraints.

(a) When calculating the predicted downwind hazard area from ROTA releases, many factors will affect the accuracy of the prediction. Some of these factors are:

- Type of and amount of CBRN agents/materials,
- Type of and amount of delivery or storage system(s),
- Type of and amount of agent container(s),
- Terrain composition,
- Weather (rain, clouds etc.),
- Air stability,
- Type of surface,
- Vegetation(s),
- Surface air temperature,
- Relative humidity and changes to these factors.

(b) Some of these factors are not considered when using the procedures in this Appendix (or annotated as to refer to a previous Appendix for appropriate Hazard Prediction procedures), unless evaluated and estimated manually by the user.

(c) The procedure shown in this Appendix (or annotated as to refer to a previous Appendix for appropriate Hazard Prediction procedures) are based on the limited amount of information available at the time of the ROTA event.

(d) To be able to make more accurate predictions, more information about the listed factors has to be available and more sophisticated methods have to be used for prediction. For example, utilizing the Decision Support Tools (DST) in Chapter III as automated hazard prediction modelling tools.

g. ROTA Types and Cases (Table H-4). An example decision flowchart for ROTA types and cases is Figure H-1, page H-14.

Table H-4. ROTA Types and Cases

Type of release / material type	Sub category	Type	Case	Procedures
Nuclear Reactor		N		* Refer to Appendix F (BIO TTP)
TIM	Nuclear Waste	T	1	1 km radius
	Radiological Dispersion		2	Refer to Appendix F (BIO TTP)
	Biological Bunker		3	* Refer to Appendix F (BIO TTP)
	Chemical Stockpile / TIM Transport		4	* Refer to Appendix E (CHEM TTP) and ERG
	Bulk Chemical Storage		5	2 km daytime 6 km night time
* Also refer to Hazard Prediction for Elevated Releases.				

Plot Location (FOXTROT)

What is the Delivery System/Container (GOLF)

Type N

Type N Release of Nuclear Fuel **Type T Case 3 BW Bunker or Production Facility**		**Wind Speed ≤ 10 kph**	**Wind Speed > 10 kph**
OBS	Release for ≤ 5 min	Type P	Type P
	Release for > 5 min	Type R*	Type P
	Release for > 2hrs	Type S	Type S
SUS	Unknown	Type S	

***Type R Instructions**

Point 1 is location (FOXTROT), **Point 2** is 1.5 x WS down wind direction

Type T

Case 1
Nuclear Waste or Radiological Material Storage Facilities

1 km — **Type T Case 1**

PAPAA: 01km/-/-/-//

Case 2
Radiological Dispersion Devices

SUS	**BW Type S**
Observed	**Corresponding BW Type P or R**

Case 3
Biological Agent Bunkers or Production Facilities

Case 4
Release from CW stockpile or TIM Transport/Storage

PAPAA: Release Area/-/Protective Action Distance/-//

Release Container:	Known Information	Release Area Radius	Protective Action Distance*: SML (≤ 1500 kg)	Protective Action Distance*: XLG (> 1500 kg)
CW Stockpile ≤ 200 liters **Leaking Munition,** **TIM from Transport**	UNKNOWN	915 m	11 km	22 km
	UN/NA Only	915 m	UN/NA in meters	UN/NA in meters X 2
	UN/NA & ERG	Use the UN/NA number to locate distances identified in the **GREEN** pages of the ERG. If distance not found, then the **ORANGE** pages should be consulted		
CW Stockpile >200 liters	Use CW procedures to determine distances (Appendix E)			

If the wind speed is ≤ **10 kph** then a circle is drawn with a radius equal to the Protective Action

Case 5
Bulk Storage Tank

Day: 2 km
Night: 6 km

DAY: PAPAA 01km/-/-/-//
NIGHT: PAPAA 06km/-/-/-//

Figure H-1. Example Decision Flowchart for ROTA Types and Cases

h. Hazard Prediction Methods.

(1) Type N, Releases of Nuclear Fuel from a Nuclear Reactor. Material released from a nuclear reactor incident will be mostly or all particles of nuclear fuel. Since the decay of particles from a nuclear reactor accident is different than for nuclear weapon fallout, the procedures used for hazard prediction after nuclear detonations, cannot be used.

(a) The release may be violent enough to send the nuclear fuel particles into the upper atmosphere. The hazard area prediction procedures described in Appendix F, Biological Contamination Avoidance TTP, should be used, assuming a Type ”P” attack. If the release takes more than 5 minutes, the latest arrival time may need to be adjusted for the duration of the release.

(b) Hazard areas for extended duration releases should be recalculated as a Type ”R” attack where the end points of the line are the release location and the current position of the front end of the cloud, using 1.5 times the mean wind speed. For wind speeds ≤ 10 KPH, Type “P” must be used.

(c) If the release is reported as continuous and the reported duration exceeds 2 hours or is not reported, the procedures for Type “S” should be followed.

(d) If the bulk of the material is elevated to high altitude, the wind speed and bearing at that height from the CBRN BWM or other appropriate meteorological data should be used. If the material extends continuously from near the ground to high elevation (above 50 m), the procedures for an elevated release should also be used. (See Fig H-4, page, H-20)

(2) Type T, Releases of TIM. Due to the differences in materials and/or release types, hazard prediction methodology must be broken down into five sub cases.

(a) Case 1. Releases from Nuclear Waste or Radiological Material Storage Facilities. Nuclear and radiological material is usually stored well below ground level, usually in special lead drums contained in concrete shelters. Damage to such a facility may rupture some of the drums and release the radiological material into the atmosphere over an extended period of time.

- The release area will be very localised, and the hazard area is not expected to be very large. But, the cloud may be toxic at low levels for an extended period of time.
- An exclusion zone of 1 km radius around a suspected radiological hazard should be established.

(b) Case 2. Releases from RDD. If a high level of radiation is detected as a passing cloud, the release will likely have been intentional and involve large quantities of radiological material, which may continue at toxic levels for a considerable downwind distance.

- The cloud of radiological particles will be transported like a biological agent cloud, so the biological procedures from Appendix F, Biological Contamination Avoidance TTP for a Type "S" attack should be used.
- If the radiological release is observed, the corresponding biological attack type “P” or “R” should be used.

(c) Case 3. Releases from Biological Agent Bunkers or Production Facilities. Storage facilities for biological agents usually consist of underground concrete shelters. These shelters are closer to the ground surface. Damage to such a facility may release some biological material from the shelter into the atmosphere as a jet of biological agent, smoke, dust, and soil. The release area will be localised, and the amount of viable agent dispersed will likely be less than that dispersed from an efficient biological weapon. However, since many biological agents only require a few inhaled organisms to infect a person the downwind distance of the hazard area may still be considerable.

- The biological hazard area prediction procedures in from Appendix F, Biological Contamination Avoidance TTP should be used for a Type "P" attack. If the release takes more than 5 minutes, the latest arrival time may need to be adjusted for the duration of the release. For wind speeds $\leq$ 10 KPH, Type "P" must be used.

- Hazard areas for extended duration releases should be recalculated as a Type "R" attack where the end points of the line are the release location and the current position of the front end of the cloud, using 1.5 times the mean wind speed.

- If the release is reported as continuous and the reported duration exceeds 2 hours or is not reported, the procedures for Type "S" should be followed.

- If the bulk of the material is elevated to high altitude (above 50 m), the wind speed and bearing at that height from the CBRN BWM or other appropriate meteorological data should be used. If the material extends continuously from near the ground to high elevation, the procedures for an elevated release should also be used. (See Fig H-4, page, H-20)

(d) Case 4. Releases from a Chemical Stockpile or TIM Transport/ Storage. Incidents involving release of chemical agents from a stockpile of munitions or bulk storage will usually involve only a small number of munitions. In such a case the downwind hazard will be considerably smaller than that predicted using the procedures in Appendix E, Chemical Contamination Avoidance TTP. In the case of chemical agent release from a large number of munitions or bulk storage of chemical agents, the agent quantity will be sufficient to warrant use of the Appendix E, Chemical Contamination Avoidance TTP. Because of their lower toxicity and stability, incidental release of TIM from transport vehicles is expected to affect an area considerably smaller than that predicted using the chemical agent procedures. The procedure to use is determined as follows:

- Chemical stockpile or bulk storage mass released exceeds 200 liters (LRG): Use the procedures in Appendix E, Chemical Contamination Avoidance TTP for the appropriate agent and persistency.

- Chemical stockpile mass released is Small, or Single leaking munition, or TIM release from a transport vehicle: Use the following procedure adapted from the ERG (See pages H-27 and H-28 for further information):

  - Release Area. The release area is assumed to be a circle having a radius equal to the ISOLATION distance from the ERG (Figures H-2, page H-18). The 4 digit UN/NA ID number should be annotated on line item INDIA. If the ID number or the ERG is not available, use a radius of 915 meters. If the distance is not found in the green section of the ERG, the orange section should be consulted before using the default distance. If more information is available, a different radius may be specified in GENTEXT. Draw the circle of the specified radius centred at the release location.

- Protective Action Distance. Obtain the protective action distance from the ERG using the 4 digit UN/NA ID number and the size of the spill as annotated on line item GOLF. If the size of the spill is not available, assume LRG. If the ID number is not available, use a distance of 11 km. If the distance is not found in the green section of the ERG, the orange section should be consulted before using the default distance. If the spill is greater than 1500 kg (XLG), double the protective action distance.

- Wind Speed less than or equal to 10 KPH. The wind direction is then considered to be variable, so draw another circle of radius equal to the PROTECTIVE ACTION DISTANCE, also centered at the release location.

- Wind Speed greater than 10 KPH. Draw a line in the downwind direction starting at the release location of length equal to the PROTECTIVE ACTION DISTANCE. (The remaining steps follow the drawing procedures from Appendix E, Chemical Contamination Avoidance TTP, rather than from ERG). Draw a line at the end of the downwind direction line perpendicular to the downwind direction. Extend the downwind direction line in the upwind direction a distance equal to twice the RELEASE AREA radius. Draw two lines from the upwind end of the downwind direction line to the perpendicular line at the other end which are tangent to the top and bottom of the RELEASE AREA circle (see Figure H-2, page H-18).

- If the bulk of the material is elevated to high altitude, the wind speed and bearing at that height from the CBRN BWM or other appropriate meteorological data should be used. If the material extends continuously from near the ground to high elevation (above 50 m), the procedures for an elevated release should also be used.

- Limitations. The initial hazard area is considered valid until additional information is available. When significant changes in weather conditions occur a recalculation must be carried out (see procedures in Appendix E, Chemical Contamination Avoidance TTP).

Example CBRN CDM

AREAM/NDEL1//

ZULUM/222300ZNOV1999/230000ZNOV1999/230600ZNOV1999//

UNITM/-/DGT/KPH/C//

WHISKEYM/090/011/5/20/4/-/1//

XRAYM/090/010/6/19/5/-/0//

YANKEEM/090/005/6/18/5/-/0//

Example NBC2 (ROTA)

ALPHA/US/A234/008/RC//

CHARLIE/230100ZNOV1999//

FOXTROT/32UPG387764/AA//

GOLF/OBS/-/-/TPT/SML//

INDIA/SURF/2480/NP/-//

MIKE ROMEO/SPILL//

TANGO/FLAT/URBAN//

YANKEE/090DGT/011KPH//

ZULU/5/20C/4/-/1//GENTEXT/NBCINFO/RUPTURE OF 200 LITERS DRUM DROPPED FROM FLATBED TRUCK//

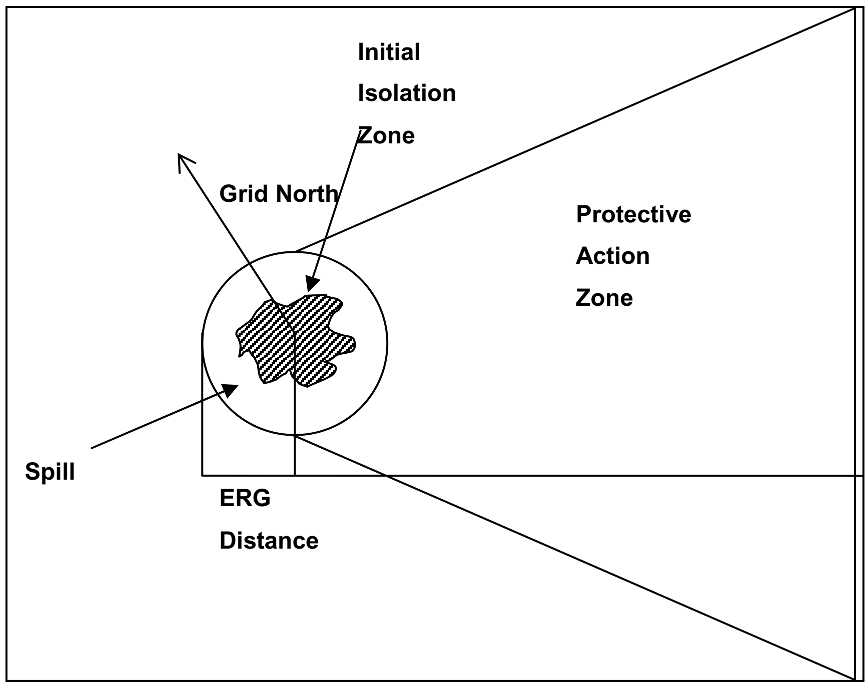


Figure H-2. Type T, Case 4. Small Methyl Isocyanate (UN/NA ID#2480) Spill at Night

(e) Case 5. Releases from a Bulk Storage Tank. Chemical storage tanks can contain thousands of liters of TIC. Many of these chemicals exist as gases under atmospheric conditions and are stored as a liquid under high pressure and low temperatures. Some of the chemicals are extremely flammable as a vapour cloud. Damage to one of these tanks can result in the stored liquid being ejected very quickly as a large pool of very cold liquid. The pool will evaporate to form a vapour cloud which is considerably denser than the surrounding air due to the lower temperature and differences in molecular weight. This cloud will initially be affected more by gravity than the wind. The cloud will begin to dilute by being mixed with surrounding air. Eventually, the cloud will no longer be denser than the air and will move with the air as any other vapour or aerosol cloud. At this point, however, the cloud concentration will most likely be low enough that it is no longer toxic. So, any prediction procedures must focus on the behaviour of the cloud before it has been diluted. This behavior will be different than that predicted by assuming the hazard area resulting from the use of the ERG. The simplified hazard areas are comprised of a circle with the release location at its center. The radius of the circle should be 2 km under daytime and 6 km under night time (Figure H-3, page H-19).

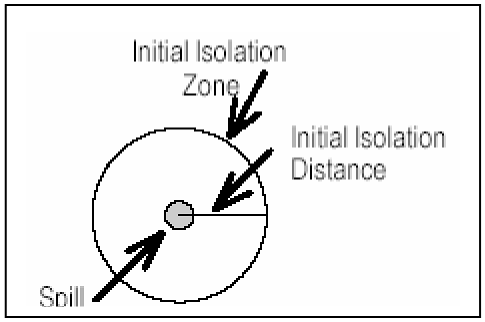


Figure H-3. Type T, Case 5

(3) Hazard Prediction for Elevated Releases:

(a) Procedure. If the release's momentum or buoyancy carries the material significantly (> 50 m) above the ground surface and the material extends continuously from near the ground to high elevation, then in addition to the calculations done using 10 m wind conditions, the hazard prediction should be repeated using the wind conditions from the CBRN BWM at 2000 m elevation. The hazard area for an elevated release is considered to be the combined hazard areas, including spaces in between (see Figure H-4).

(b) Overlap of Hazard Areas. If merging or combining hazard regions for elevated releases or changing meteorological conditions involves two triangular hazard regions having downwind directions different by more than 90 DEG, the regions to be merged should be replaced with a circle of radius equal to the larger of the downwind distances. The time of arrival at a location should be the earliest time resulting from either the BWM or CDM.

(c) Changes in meteorological conditions in following BWMs should be handled in the same manner as using CDMs.

Example CBRN CDM

AREAM/NDEL1//

ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//

UNITM/-/DGT/KPH/C//

WHISKEYM/090/020/3/15/4/-/1//

XRAYM/090/020/3/17/5/-/1//

YANKEEM/090/020/2/18/5/-/0//

Example CBRN BWM

AREAM/NDEL1//

ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//

UNITM/-/DGT/KPH/C//

LAYERM/02/315/030/04/320/035/06/345/040//

Example NBC2 ROTA
ALPHA/US/A234/008/RC//
CHARLIE/231300ZNOV1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/-/-/STK/SML//
INDIA/SURF/GB/NP/-//
MIKE ROMEO/FIRE//
TANGO/FLAT/BARE//
YANKEE/090DGT/020KPH//
ZULU/3/15C/4/-/1//
GENTEXT/CBRN INFO/ELEVATED PLUME
FROM SINGLE PALLET OF GB ROCKETS
REACHING 500 METER ELEVATION//

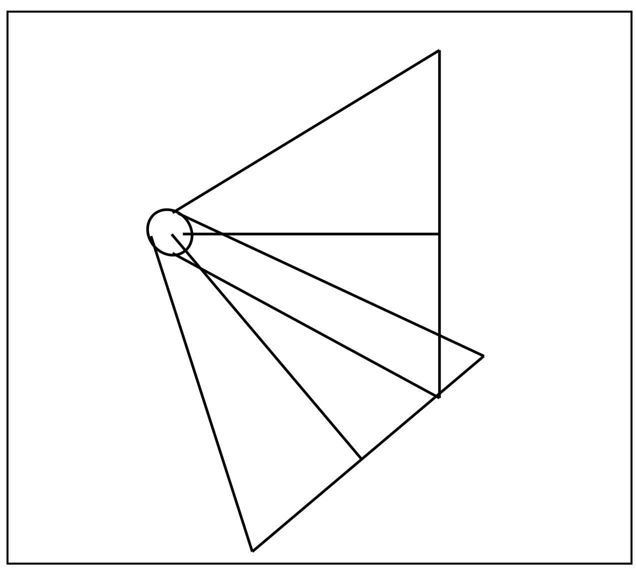


Figure H-4. Type T, Case 4. GB Rocket Stockpile Fire During the Day

7. NBC4 Report

This report is utilized either to pass subsequent off-target monitoring data or the results of a deliberate directed survey. The report will use the information as described in Chapter III for line items ALPHA, INDIA, QUEBEC, ROMEO, SIERRA, TANGO, WHISKEY, YANKEE, and ZULU. Line item GENTEXT in this message will provide the initial background reading taken by the survey team for nuclear or radiological releases. Readings for line item ROMEO will indicate readings above the initial reported background reading and measured values for chemical and biological. Decimals may be entered into line item ROMEO if readings below 1 in the relevant unit of measurement are recorded e.g. 0.123456 cGy/h.

a. Purpose: The purpose of the NBC 4 Report (Table H-5) is for reporting detection data and passing monitoring and survey results. This report is used for two cases. Case one; used if an attack is not observed, and the first indication of contamination is by detection. Case two, used to report measured contamination as a part of a survey or monitoring team.

b. Message Precedence: All other messages, after the initial NBC 1Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE would be appropriate.

c. For detailed information regarding CBRN / ROTA Reconnaissance, Monitoring and Survey, refer to *Multiservice Tactics, Techniques, and Procedures For Nuclear, Biological, and Chemical Reconnaissance.*

Table H-5. NBC4 (ROTA) Report

NBC4 (ROTA) Report			
Line Item	**Description**	**Cond****	**Example**
A	Strike Serial Number	O	ALPHA/US/WEP/001/RN//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/SURF/2978/-/SPEC//
Q*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/GAMMA/-//
R*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	ROMEO/7CGH/DECR/DF//
S*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
T*	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
W	Sensor Information	O	WHISKEY/-/POS/NO/HIGH//
Y*	Downwind Direction and Downwind Speed	M	YANKEE/270DGT/015KPH//
Z*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

* Set QUEBEC, ROMEO, SIERRA and TANGO are a segment. With the exception of line item ROMEO, this segment is mandatory. Line items/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

** The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

8. NBC5 Report

This report will outline the actual extent of the ROTA ground contamination from survey data. The report will use the information as described above for line items ALPHA, CHARLIE, INDIA, YANKEE, ZULU, and GENTEXT. Line item OSCAR indicates the time for which the contour is appropriate. Line item XRAYA will describe the level of contamination for the contour and the ground contaminated area resulting from any ROTA event whether it is radiological, biological or chemical.

a. Purpose: The purpose of the NBC 5 Report (Table H-6, page H-23) is for passing information on areas of actual contamination. This report can include areas of possible contamination, but only if actual contamination coordinates are included in the report.

b. Message Precedence: All other messages, after the initial NBC 1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE would be appropriate.

c. Plotting Data and Producing a NBC 5 Message.

(1) Contaminated areas are shown on the contamination situation map, and information about them must be passed to other units and HQ's. The most expeditious means for this is the contamination overlay.

(2) The preparation of such an overlay is described in each respective Appendix, for example, for chemical contamination overlay, refer to Appendix E, Chemical Contamination Avoidance TTP. Overlays are preferred for transmission of NBC 3 and NBC 5 Reports (Figure H-5). They offer the advantages of being readily usable, accurate, and a hard copy for future references. Overlays have the disadvantages of requiring either special equipment or messengers.

(3) Marginal information that should be included on the overlay:

(a) Map Name
(b) Map Number
(c) Scale
(d) Organization of Preparer
(e) Non-standard Symbols/Colors
(f) Type Report
(g) Lines of the Report
(h) Grid Register Marks

Example:
NBC 4 (CHEM) REPORT

H VX, NERVE
Q SH 697722, SH 698723, SH 699726,
SH 702727, SH 704725, SH 703722,
SH 701721, SH 699719, SH 697719,
SH 697722
S 130600Z

NOTE: The last reading was conducted at 130900Z MAY 01. SSN is 001, DTG of attack was 121234z May 01, and agent was nerve, VX, airburst.

NBC5 (CHEM) REPORT

A C001
D 121234Z MAY 01
H NERVE, VX, P, AIRBURST
S 130600Z
T 130900Z
X SH 697722, SH 698723, SH 699726,
SH 702727, SH 704725, SH 703722,
SH 701721, SH 699719, SH 697719,
SH 697722

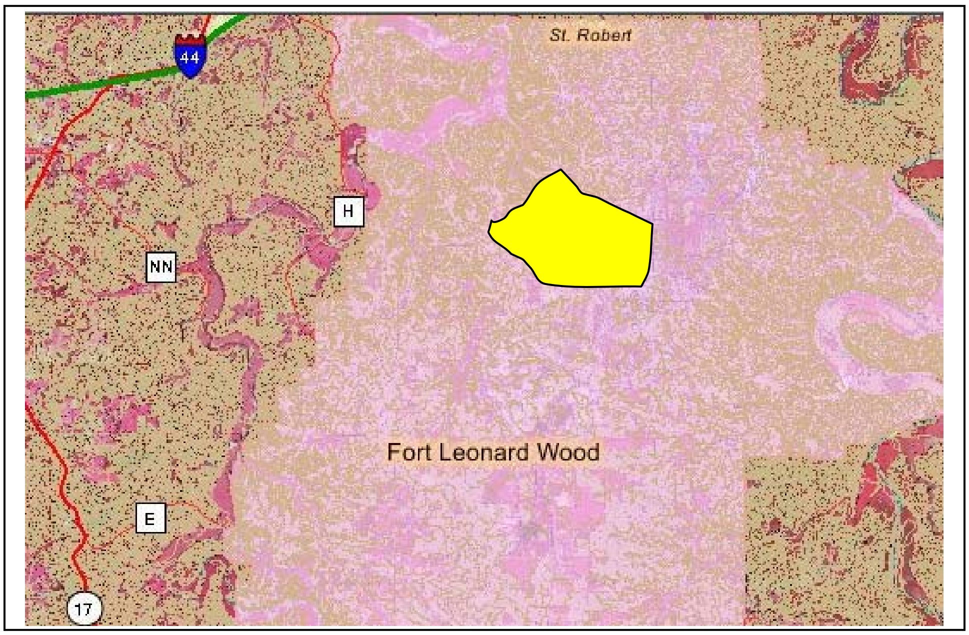


Figure H-5. Example NBC5 (CHEM) Report Overlay (Without Marginal Data)

d . Reporting Data.

(1) Electronic communications are not always available. If this is the case, the contamination overlay must be converted into a series of readings and co-ordinates for transmission as a NBC 5 Report.

(2) If electronic communications of data or communications of hard copy are not available and if time and distance permit, contamination overlays are sent by messenger. Data is transmitted, manually by the NBC 5 Report as a last resort.

(3) On the NBC 5 Report a closed contour line on a plot, is represented by repeating the first coordinate.

Table H-6. NBC5 (ROTA) Report

NBC 5 (ROTA) Report			
Line Item	**Description**	**Cond.****	**Example**
A	Strike Serial Number	O	ALPHA/US/WEP/001/RN//
C	Date-Time-Group of Report /Observation and Event end	O	CHARLIE/281530ZSEP1997//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/SPEC//
O	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/281830ZSEP1997//
XA*	Actual Contour Information	M	XRAY ALPHA /0.003CGH/334015N1064010W/ 334020N1064010W/ 334020N1064020W/ 334015N1064020W/ 334015N1064010W//
XB*	Predicted Contour Information	O	
Y	Downwind Direction and Downwind Speed	O	YANKEE/270DGT/015KPH//
Z	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Sets are repeatable up to 50 times to represent multiple contours.

** The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

9. NBC6 Report

This message will be used to provide, in line item GENTEXT, specific information required to produce a more detailed ROTA hazard prediction.

a. Purpose: The purpose of the NBC6 Report (Table H-7, page H-24) is for passing detailed information on ROTA events.

b. Message Precedence: All other messages, after the initial NBC 1 Report has been sent, should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE would be appropriate.

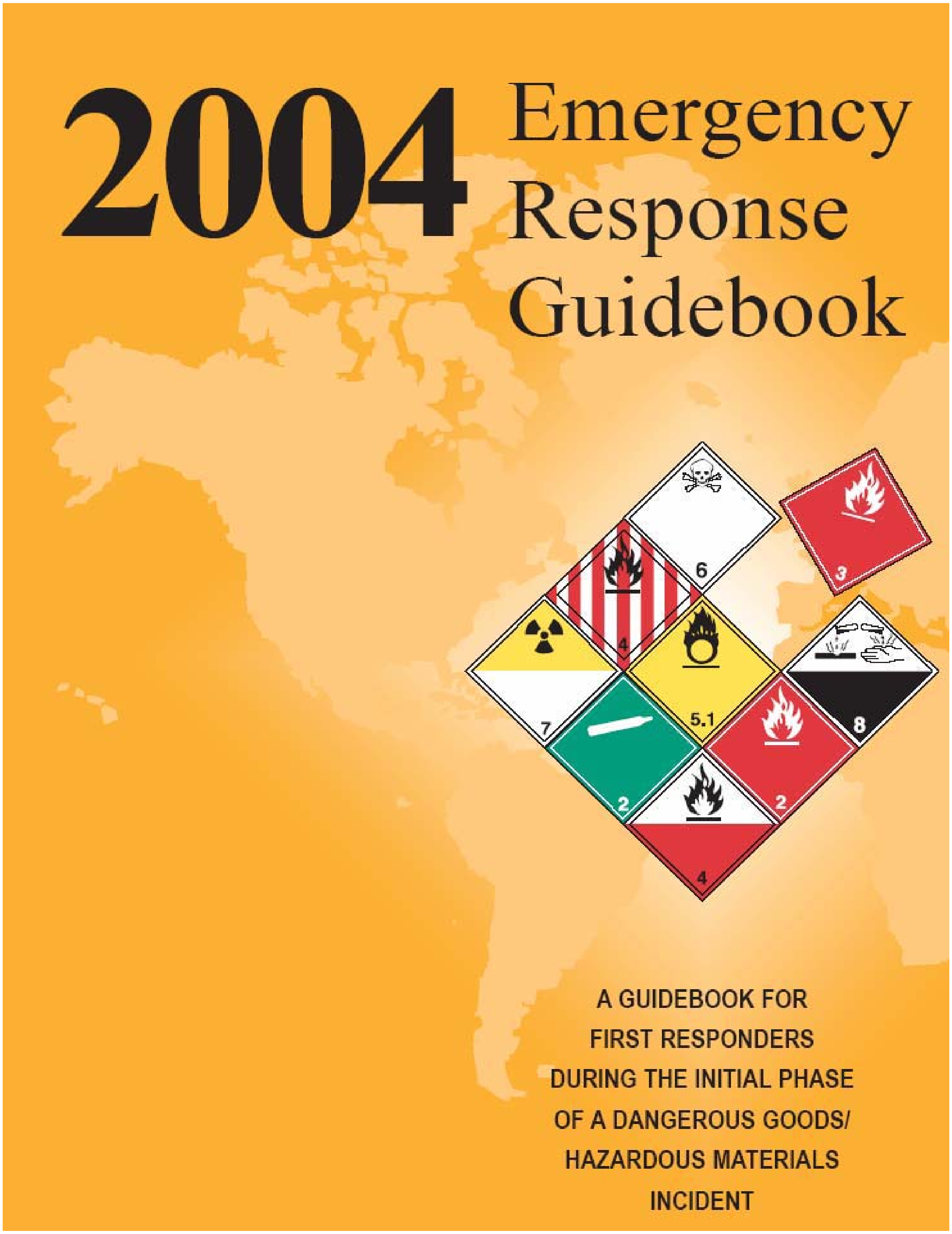
c. This report summarizes information concerning a ROTA and is prepared by the reporting unit level, service equivalent, or higher, but only if requested by higher headquarters. It is used as an intelligence tool to help determine enemy future intentions.

d. The NBC 6 (ROTA) Report is submitted to higher headquarters. It is written in narrative form, with as much detail as possible.

Table H-7. NBC6 (ROTA) Report

NBC6 (ROTA) Report			
Line Item	**Description**	**Cond.***	**Example**
A	Strike Serial Number	O	ALPHA/US/WEP/001/RN//
C	Date-Time-Group of Report /Observation and Event End	O	CHARLIE/281530ZSEP1997/ 281545ZSEP1997//
F	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
I	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/SURF/2978/-/SPEC/-//
Q	Location & Type Reading /Sample /Detection	O	QUEBEC/32VNJ481203/GAMMA//
S	Date-Time-Group of Reading	O	SIERRA/282300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/CBRN INFO/HOSPITAL VEHICLE CARRYING RADIOACTIVE WASTE OVERTURNED ON ROUTE 25//

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)



http://hazmat.dot.gov/gydebook.htm

Figure H-6. ERG

RESIST RUSHING IN !
APPROACH INCIDENT FROM UPWIND
STAY CLEAR OF ALL SPILLS, VAPORS, FUMES AND SMOKE

HOW TO USE THIS GUIDEBOOK DURING AN INCIDENT INVOLVING DANGEROUS GOODS

ONE **IDENTIFY THE MATERIAL** BY FINDING ANY **ONE** OF THE FOLLOWING:

THE 4-DIGIT ID NUMBER ON A PLACARD OR ORANGE PANEL

THE 4-DIGIT ID NUMBER (after UN/NA) ON A SHIPPING DOCUMENT OR PACKAGE

THE NAME OF THE MATERIAL ON A SHIPPING DOCUMENT, PLACARD OR PACKAGE

IF AN **ID NUMBER** OR THE **NAME OF THE MATERIAL** CANNOT BE FOUND, SKIP TO THE NOTES BELOW.

TWO **LOOK UP THE MATERIAL'S 3-DIGIT GUIDE NUMBER** IN EITHER:

THE ID NUMBER INDEX..(the yellow-bordered pages of the guidebook)

THE NAME OF MATERIAL INDEX..(the blue-bordered pages of the guidebook)

If the guide number is supplemented with the letter "**P**", it indicates that the material may undergo violent polymerization if subjected to heat or contamination.

If the index entry is highlighted (in either yellow or blue), it is a TIH (Toxic Inhalation Hazard) material, a chemical warfare agent or a Dangerous Water Reactive Material (produces toxic gas upon contact with water). **LOOK FOR THE ID NUMBER AND NAME OF THE MATERIAL** IN THE TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES (the green-bordered pages). Then, if necessary, **BEGIN PROTECTIVE ACTIONS IMMEDIATELY** (see Protective Actions on page 298). If protective action is not required, use the information jointly with the 3-digit guide.

USE GUIDE 112 FOR ALL EXPLOSIVES EXCEPT FOR EXPLOSIVES 1.4 (EXPLOSIVES C) WHERE GUIDE 114 IS TO BE CONSULTED.

THREE **TURN TO THE NUMBERED GUIDE** (the orange-bordered pages) **AND READ CAREFULLY.**

NOTES **IF A NUMBERED GUIDE CANNOT BE OBTAINED BY FOLLOWING THE ABOVE STEPS**, AND A PLACARD CAN BE SEEN, LOCATE THE PLACARD IN THE TABLE OF PLACARDS (pages 16-17), THEN GO TO THE 3-DIGIT GUIDE SHOWN NEXT TO THE SAMPLE PLACARD.

IF A REFERENCE TO A GUIDE CANNOT BE FOUND AND THIS INCIDENT IS BELIEVED TO INVOLVE DANGEROUS GOODS, TURN TO **GUIDE 111** NOW, AND USE IT UNTIL ADDITIONAL INFORMATION BECOMES AVAILABLE. If the shipping document lists an emergency response telephone number, call that number. If the shipping document is not available, or no emergency response telephone number is listed, IMMEDIATELY CALL the appropriate **emergency response agency listed on the inside back cover of this guidebook.** Provide as much information as possible, such as the name of the carrier (trucking company or railroad) and vehicle number. AS A LAST RESORT, CONSULT THE TABLE OF RAIL CAR AND ROAD TRAILER IDENTIFICATION CHART (pages 18-19). IF THE CONTAINER CAN BE IDENTIFIED, REMEMBER THAT THE INFORMATION ASSOCIATED WITH THESE CONTAINERS IS FOR THE WORST CASE POSSIBLE.

Figure H-7. ERG, Book Breakdown, Part I

1-Yellow-bordered pages: Index list of dangerous goods in numerical order of ID number. This section quickly identifies the guide to be consulted from the ID Number of the material involved. This list displays the 4-digit ID number of the material followed by its assigned emergency response guide and the material name.

For example:	**ID No.**	**Guide No.**	**Name of Material**
	1090	127	Acetone

2-Blue-bordered pages: Index list of dangerous goods in alphabetical order of material

name. This section quickly identifies the guide to be consulted from the name of the material involved. This list displays the name of the material followed by its assigned emergency response guide and 4-digit ID number.

For example:	**Name of Material**	**Guide No.**	**ID No.**
	Sulfuric acid	**137**	1830

3-Orange-bordered pages: This section is the most important section of the guidebook

because it is where all safety recommendations are provided. It comprises a total of 62 individual guides, presented in a two-page format. Each guide provides safety recommendations and emergency response information to protect yourself and the public. The left hand page provides safety related information whereas the right hand page provides emergency response guidance and activities for fire situations, spill or leak incidents and first aid. Each guide is designed to cover a group of materials which possess similar chemical and toxicological characteristics. The guide title identifies the general hazards of the dangerous goods covered.

For example: Guide 124 - Gases-Toxic and/or Corrosive-Oxidizing.

Each guide is divided into three main sections: the first section describes **potential hazards** that the material may display in terms of fire/explosion and health effects upon exposure. The highest potential is listed first. The emergency responder should consult this section first. This allows the responder to make decisions regarding the protection of the emergency response team as well as the surrounding population. The second section outlines suggested **public safety** measures based on the situation at hand. It provides general information regarding immediate isolation of the incident site, recommended type of protective clothing and respiratory protection. Suggested evacuation distances are listed for small and large spills and for fire situations (fragmentation hazard). It also directs the reader to consult the tables listing Toxic Inhalation Hazard materials (TIH) and water-reactive materials (green-bordered pages) when the material name is highlighted in the yellow-bordered and blue-bordered pages. The third section covers **emergency response** actions, including first aid. It outlines special precautions for incidents which involve fire, spill or chemical exposure. Several recommendations are listed under each part which will further assist in the decision making process. The information on first aid is general guidance prior to seeking medical care.

4-Green-bordered pages: This section contains a table which lists, by ID number, TIH materials, including certain chemical warfare agents, and water-reactive materials which produce toxic gases upon contact with water. The table provides two different types of recommended safe distances which are “Initial isolation distances” and “Protective action distances.” The materials are highlighted for easy identification in both numeric (yellow-bordered pages) and alphabetic (blue-bordered pages) lists of the guidebook. The table provides distances for both small (approximately 200 liters or less) and large spills (more than 200 liters) for all highlighted materials. The list is further subdivided into daytime and nighttime situations. This is necessary due to varying atmospheric conditions which greatly affect the size of the hazardous area. The distances change from daytime to nighttime due to different mixing and dispersion conditions in the air. During the night, the air is generally calmer and this causes the chemical to disperse less and therefore create a toxicity zone which is greater than would usually occur during the day. During the day, the chemical is generally dispersed by a more active atmosphere. The chemical will be present in a larger area; however, the actual area where toxic levels are reached will be smaller (due to increased dispersion). It is the quantity of the chemical that poses problems not its mere presence. The “Initial Isolation Distance” is a distance within which all persons should be considered for evacuation in all directions from the actual spill/leak source. It is a distance (radius) which defines a circle (Initial Isolation Zone) within which persons may be exposed to dangerous concentrations upwind of the source and may be exposed to life threatening concentrations downwind of the source. For example, in the case of Compressed gas, toxic, n.o.s., ID No. 1955, Inhalation Hazard Zone A, the isolation distance for small spills is 430 meters, therefore, representing an evacuation circle of 860 meters in diameter. For the same material, the “Protective Action Distance” is 4.2 kilometers for a daytime incident and 8.4 kilometers for a nighttime incident, these distances represent a downwind distance from the spill/leak source within which Protective Actions could be implemented. Protective Actions are those steps taken to preserve the health and safety of emergency responders and the public. People in this area could be evacuated and/or sheltered in-place. For more information, consult the INTRODUCTION TO THE TABLE OF INITIAL ISOLATION AND PROTECTIVE ACTION DISTANCES (pages 295-296).

Figure H-8. ERG Contents (Excerpt From ERG)

Appendix I

STRIKE WARNING

1. Background

This appendix addresses friendly nuclear attack warning messages and warning procedures.

2. Friendly Nuclear Attack Warning.

a. Nuclear Strike Warning (STRIKWARN). STRIKWARN is a system for the warning of friendly nuclear strikes. This system applies to nuclear strikes that may affect forces operating on land, over land, or at sea. The requirement for a standard warning message and for the delineation of notification channels is essential to ensure that friendly units get a timely warning of friendly nuclear strikes. This allows personnel and units to take appropriate measures to protect themselves and their equipment and still be prepared to exploit the weapons' effects.

b. Warning Responsibilities. Responsibility for issuing a warning rests with the coordinating commander. The coordinating commander is defined as the regional commander who coordinates the activities of nuclear delivery and supporting units. Commanders authorized to release nuclear strikes will ensure that strikes affecting the safety of adjacent or other commands are coordinated. Commanders must allow sufficient time to permit dissemination of warnings to personnel so that they can take protective measures, and prepare for exploiting the effects of weapons.

c. Warning Recipients. The commander responsible for disseminating STRIKWARN must inform the following units:

(1) Subordinate HQ whose units are likely to be affected by the strike.

(2) Any other land, air, and naval headquarters/commands, as appropriate, whose units are likely to be affected by the strike.

(3) Next higher level of command, when units not under the command of the coordinating commander are likely to be affected by the strike.

(4) Each unit concerned, down to the lowest level, will be warned by its next HHQ as to the level of safety measures it should take depending on their proximity to the target.

(5) Only that information which is of direct interest to the units concerned will be disseminated.

d. Warnings.

(1) Impending Strike Warning. Warning of impending strikes will be initiated no earlier than is necessary to complete warning of personnel. Any means of communications chosen by the staff, preferably secure, will be used to ensure all affected personnel are warned.

(2) Use of Codes. STRIKWARN messages should be classified with regard to current operational security instructions and speed of dissemination. If secure electronic

means are not available, the message should be encrypted. Only circuits and coding systems which meet appropriate security criteria will be used. Messages may be sent in the clear when the coordinating commander determines that safety warnings override security requirements. A warning message will not normally be sent in the clear earlier than 60 minutes before the strike or time on target.

(3) Precedence. Messages will be transmitted with precedence adequate to ensure timely warning of all personnel expected to be affected by the strike.

(4) Action on Canceled Attacks (Strikes). When strikes are canceled, units previously warned will be notified in the clear by the most expeditious means in the following format. The message will be authenticated. For multiple strikes, all strikes have to be canceled before disseminating cancellation messages. The Target Number or Nickname of the strike should be included.

(5) Other Warnings. Dazzle warnings are to be passed to all flying units or squadrons in the region. For dazzle warnings, only lines ALPHA, DELTA, FOXTROT ONE (Designated Ground Zero [DGZ] only), and INDIA are sent.

e. NBC3 Reports. When line HOTEL of the STRIKWARN indicates a surface or subsurface burst, an NBC3 (NUC) Report will be transmitted as soon as possible after the STRIKWARN. The development and transmission of this message is the responsibility of the coordinating commander any time that analysis indicates that fallout could affect friendly units.

f. Units of Measurement. Standard ground units of measure will be used for coordinates and distance (UTM grid, and meters). Organizations (e.g., naval) which use different units (e.g. LAT/LONG) will be responsible for converting units for retransmission to their subordinate units and for providing warning messages to land forces in ground units when effects of their weapons may be experienced by those land forces.

g. Line Items used in STRIKWARN Messages. The list of message line items on page I-3, Table I-1, provides an overview of the STRIKWARN message format and serves to give the user a total picture of the line items available for the message and the order that those line items must be used. Table I-1 gives an example of the STRIKWARN format. Table I-2 gives the definition of the specific line items used to transmit strike specific information. The Set User Formats provide a depiction of how to fill out each individual line item in the message.

Table I -1. Line Items for STRIKWARN Message

Line Item	Meaning
A	STRIKWARN Target Identifier (Target number, nickname, or code word)
D	Date-Time of Strike or Strike Cancelled (Multiple Bursts. Date-time attack will start followed by date-time attack will end. Single Burst. Date time of attack followed by date-time after which the attack will be cancelled)
F ONE	Minimum Safe Distance One (Multiple Bursts. UTM Grid coordinates of MSD 1 Box Single Burst. MSD-2, three digits, in hundreds of meters, followed by MSD-1 Box Coordinates)
F TWO	Minimum Safe Distance Two (Multiple Bursts. UTM Grid coordinates of MSD 2 Box Single Burst. MSD-2, three digits, in hundreds of meters, followed by MSD-2 Box Coordinates)
H	Number of Surface Bursts (If one or more bursts have less than 99% assurance of being an airburst, or if it is a scheduled surface or subsurface burst, number of surface bursts will be reported on this line)
I	Number of Bursts in a Multiple Strike (Not reported if only one)
AKNLDG	Acknowledge Requirement

3. Zones of Warning and Protection Requirements

a. Minimum safe distance (MSD). The MSD is equal to the radius of safety (RS) for the yield, plus a buffer distance (BD) related to the dispersion of the weapon system used. When surface burst are used, or an intended air burst having less than 99% assurance of no military significant fallout, the fallout hazard will be considered. Details will be transmitted in a subsequent NBC-3 (NUC) message if fallout will be a hazard to friendly forces.

b. Commanders will be guided to safety criteria as stated in FM 101-31-1, Staff Officers Field Manual, Nuclear Weapons Employment (or appropriate service, joint, or national manuals with the same criteria.

c. If a unit Commander is unable to evacuate Zone 1, he will immediately require maximum protection and report through his next higher headquarters to the releasing/executing Commander.

d. Negligible Risk should not normally be exceeded unless significant advantage will be gained.

e. Maximum Protection for ground forces denotes that personnel are in "closed up" tanks or sheltered in foxholes with overhead shielding.

f. Minimum Protection for ground forces denotes that personnel are prone on open ground with all skin areas covered and with an overall thermal protection at least equal to that provided by a two-layer uniform.

g. Since the Least Separation Distance (LSD) for light aircraft is exceeded by MSD-2, aircraft remaining beyond MSD-2 will avoid significant degradation of the aircraft or pilot performance (Except DAZZLE) severe enough to prevent mission accomplishment.

Table I-2. Relationship between STRIKWARN MSD and Protection

Protection Requirements (See Notes 1 and 2)		
Radius	**Corresponding To**	**Requirements**
MSD 1	Limit of negligible risk to warned and protected personnel (See Note 4)	Evacuation of all personnel (See Note 3)
MSD 2	Limit of negligible risk to unwarned and exposed personnel (See Note 4)	Protection (See Notes 5 and 6)
More than MSD 2		No protective measures except against dazzle and EMP

NOTE 1. The MSD is equivalent to the radius of safety (RS) for the yield, plus a BD related to the dispersion characteristics of the weapon system used. When surface bursts are used, or an intended airburst has less than a 99 percent assurance of no militarily significant fallout, the fallout hazard must be considered. Details will be transmitted in a subsequent NBC 3 Nuclear Report if fallout will be a hazard to friendly units.

NOTE 2. Commanders will be guided to safety criteria as stated in Joint Pub 3-12.2 (NATO), *Nuclear Weapons Employment Effects Data* (or appropriate other manuals with the same criteria), and policies for EMP protection.

NOTE 3. If a unit commander is unable to evacuate MSD 1, he will immediately initiate actions, within the scope of the current combat operation, to provide maximum personnel and equipment protection and report through his next higher headquarters to the releasing/executing commander.

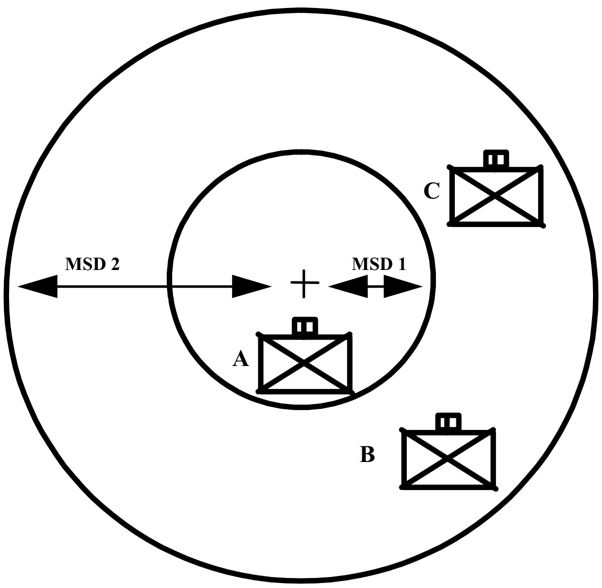
NOTE 4. Higher risks may be accepted. However, negligible risk should not normally be exceeded unless significant advantages will be gained. Negligible risk corresponds to the likelihood that one percent of personnel at this radius and protection will experience blast, radiation, or thermal injury that may cause short performance degradation and long-term combat ineffectiveness.

NOTE 5. Maximum protection for ground forces denotes that personnel are in “buttoned up” tanks or sheltered in foxholes with overhead protection. Minimum protection for ground forces denotes that personnel are prone on open round

with all skin areas covered and with an overall thermal protection at least equal to that provided by a two-layer uniform.

NOTE 6. To avoid significant degradation of the airframe or pilot performance (except against dazzle) severe enough to prevent mission accomplishment, aircraft in flight should remain beyond MSD-2 or the least separation distance for light aircraft in flight, whichever is greater.

h. STRIKWARNing and Unit Actions. When a unit receives a STRIKWARN message, the first action is to plot it on the tactical (situation) map. This identifies GZ or DGZ and how far the MSDs extend. The commander can then determine what actions to take. FigureI-1 shows a plotted STRIKWARN for a single burst.



The Alfa team in **Figure I-1** should evacuate MSD 1 if possible. Otherwise the unit will have to dismount and take cover in foxholes. Evacuation is first choice followed by seeking shelter with overhead cover. If not evacuated, Alfa team may exceed the specified risk. The other units will, as a minimum, assume a prone position and protect against dazzle and EMP. However, those not in a warned protected posture may exceed the specified risk.

Figure I-1. STRIKWARN Plot Showing MSD 1 and MSD 2, Single Burst

4. Plotting a STRIKWARN Message

a. Single Burst: (Figure I-1)

(1) Step 1: Locate GZ grid coordinates from line Foxtrot of the STRIKWARN message, then plot GZ.

(2) Step 2: Draw MSD circles around GZ. The first 3 digits of line Foxtrot is the radius of the MSD.

(3) Step 3: Label edge of circles with appropriate MSD.

(4) Step 4: Label Marginal Information on map sheet. Marginal information includes: STRIKWARN Message, NBC-3 Report, Prepared by, Unit, Map scale.

b. Multiple Bursts: (Figure I-2)

(1) Step 1: Plot GZ for each burst, from line Foxtrot of the STRIKWARN message.

(2) Step 2: Construct tangent lines from each point to form a box.

(3) Step 3: Label MSD 1and 2 along the corresponding tangent lines.

(4) Step 4: Label Marginal Information on map sheet. Marginal information includes: STRIKWARN Message, NBC-3 Report, Prepared by, Unit, Map scale.

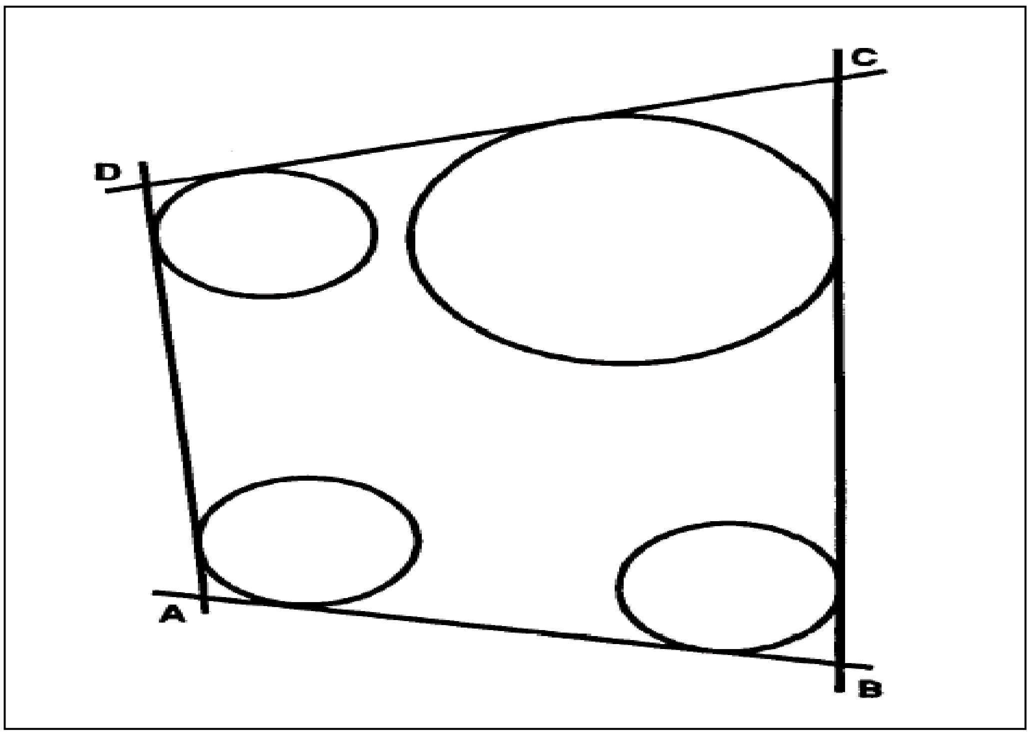


Figure I-2 (STRIKWARN Plot Showing Multiple Bursts)

Appendix J
Nomograms, Tables and Graphs

This appendix provides a single reference for nomograms, tables, and graphs. The nomograms, tables, and graphs are found in earlier appendixes as the appropriate procedures are being explained.

Table J-1. Map Distance in cm, Map Scale 1:50,000, Wind Speed in KM/H

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
km/h	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	6.8	5.8	5.2	5.0	4.8	4.4	4.2	4.0	3.8	3.8	3.6	3.4
10	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.6	7.2	6.8
15	20.4	17.6	15.6	15.0	14.4	13.4	12.6	12.0	11.6	11.2	10.8	10.2
20	27.2	23.6	20.8	20.0	19.2	18.0	16.8	16.0	15.6	15.0	14.2	13.6
25	34.0	29.4	26.0	25.2	24.0	22.4	21.0	20.0	19.4	18.8	17.8	17.0

Table J-2. Map Distance in cm, Map Scale 1:50,000, Wind Speed in Knots

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
knots	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	12.6	11.0	9.6	9.4	9.0	8.4	7.8	7.4	7.2	7.0	6.6	6.4
10	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	14.0	13.2	12.6
15	37.8	32.8	28.8	28.0	26.8	25.0	23.4	22.2	21.6	20.8	19.6	19.0
20	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2
25	63.0	54.6	48.0	46.6	44.6	41.2	39.0	37.0	36.0	34.8	32.8	31.6
30	65.6	65.4	57.6	55.8	53.4	49.8	46.8	44.4	43.2	41.8	39.4	37.8

NOTE: Above 18,000 meters, altitude layers for plotting vector diagrams continue to be at 2,000 meter intervals. However, the map distance factors vary so little that some of the columns in Tables J-2 through J-6 are combined for convenience.

Table J-3. Map Distance in cm, Map Scale 1:100,000, Wind Speed in KM/H

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
km/h	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	3.4	2.9	2.6	2.5	2.4	2.2	2.1	2.0	1.9	1.9	1.8	1.7
10	6.8	5.9	5.2	5.0	4.8	4.5	4.2	4.0	3.9	3.8	3.6	3.4
15	10.2	8.8	7.8	7.5	7.2	6.7	6.3	6.0	5.8	5.6	5.4	5.1
20	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.5	7.1	6.8
25	17.0	14.7	13.0	12.6	12.0	11.2	10.5	10.0	9.7	9.4	8.9	8.5
30	20.4	17.7	15.6	15.1	14.4	13.4	12.6	12.0	11.7	11.3	10.7	10.2
35	23.8	20.6	18.1	17.6	16.8	15.7	14.7	14.0	13.6	13.1	12.5	11.9
40	27.2	23.6	20.7	20.1	19.2	17.9	16.8	16.0	15.6	15.0	14.3	13.6
45	30.6	26.5	23.3	22.6	21.6	20.2	19.0	18.0	17.5	16.9	16.1	15.3
50	34.0	29.5	25.9	25.1	24.0	22.4	21.1	20.0	19.4	18.8	17.9	17.0

Table J-4. Map Distance in cm, Map Scale 1:100,000, Wind Speed in Knots

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
knots	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	6.3	5.5	4.8	4.7	4.5	4.2	3.9	3.7	3.6	3.5	3.3	3.2
10	12.6	10.9	9.6	9.3	8.9	8.3	7.8	7.4	7.2	7.0	6.6	6.3
15	18.9	16.4	14.4	14.0	13.4	12.5	11.7	11.1	10.8	10.4	9.8	9.5
20	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	13.9	13.1	12.6
25	31.5	27.3	24.0	23.3	22.3	20.6	19.5	18.5	18.0	17.4	16.4	15.8
30	37.8	32.7	28.8	27.9	26.7	24.9	23.4	22.2	21.6	20.9	19.7	18.9
35	44.1	38.2	33.6	32.6	31.2	29.1	27.3	25.9	25.2	24.3	22.9	22.1
40	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2
45	56.7	49.1	43.2	41.9	40.1	37.4	35.1	33.3	32.4	31.3	29.5	28.4
50	63.0	54.5	48.0	46.5	44.5	41.5	39.0	37.0	36.0	34.8	32.8	31.5

Table J-5. Map Distance in cm, Map Scale 1:250,000, Wind Speed in KM/H

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
km/h	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	1.4	1.2	1.0	1.0	1.0	0.9	0.8	0.8	0.8	0.8	0.7	0.7
10	2.7	2.4	2.1	2.0	1.9	1.8	1.7	1.6	1.6	1.5	1.4	1.4
15	4.1	3.5	3.1	3.0	2.9	2.7	2.5	2.4	2.3	2.3	2.1	2.0
20	5.4	4.7	4.1	4.0	3.8	3.6	3.4	3.2	3.1	3.0	2.9	2.7
25	6.8	5.9	5.2	5.0	4.8	4.5	4.2	4.0	3.9	3.8	3.6	3.4
30	8.2	7.1	6.2	6.0	5.8	5.4	5.1	4.8	4.7	4.5	4.3	4.1
35	9.5	8.2	7.3	7.0	6.7	6.3	5.9	5.6	5.4	5.3	5.0	4.8
40	10.9	9.4	8.3	8.0	7.7	7.2	6.7	6.4	6.2	6.0	5.7	5.4
45	12.2	10.6	9.3	9.0	8.6	8.1	7.6	7.2	7.0	6.8	6.4	6.1
50	13.6	11.8	10.4	10.0	9.6	9.0	8.4	8.0	7.8	7.5	7.1	6.8
55	15.0	12.9	11.4	11.0	10.6	9.9	9.3	8.8	8.6	8.3	7.9	7.5
60	16.3	14.1	12.4	12.0	11.5	10.8	10.1	9.6	9.3	9.0	8.6	8.2
75	20.4	17.7	15.5	15.1	14.4	13.4	12.6	12.0	11.7	11.3	10.7	10.2
100	27.2	23.5	20.7	20.1	19.2	17.9	16.9	16.0	15.6	15.0	14.3	13.6

Table J-6. Map Distance in cm, Map Scale 1:250,000, Wind Speed in Knots

WIND SPEED	ALTITUDE LAYERS (Thousands of Meters)											
knots	0-2	2-4	4-6	6-8	8-10	10-12	12-14	14-16	16-18	18-22	22-30	> 30
5	2.5	2.2	1.9	1.9	1.8	1.7	1.6	1.5	1.4	1.4	1.3	1.3
10	5.0	4.4	3.8	3.7	3.6	3.3	3.1	3.0	2.9	2.8	2.6	2.5
15	7.6	6.5	5.8	5.6	5.3	5.0	4.7	4.4	4.3	4.2	3.9	3.8
20	10.1	8.7	7.7	7.4	7.1	6.6	6.2	5.9	5.8	5.6	5.2	5.0
25	12.6	10.9	9.6	9.3	8.9	8.3	7.8	7.4	7.2	7.0	6.6	6.3
30	15.1	13.1	11.5	11.2	10.7	10.0	9.4	8.9	8.6	8.3	7.9	7.6
35	17.6	15.3	13.4	13.0	12.5	11.6	10.9	10.4	10.1	9.7	9.2	8.8
40	20.2	17.4	15.4	14.9	14.2	13.3	12.5	11.8	11.5	11.1	10.5	10.1
45	22.7	19.6	17.3	16.7	16.0	14.9	14.0	13.3	13.0	12.5	11.8	11.3
50	25.2	21.8	19.2	18.6	17.8	16.6	15.6	14.8	14.4	13.9	13.1	12.6
55	27.7	24.0	21.1	20.5	19.6	18.3	17.2	16.3	15.8	15.3	14.4	13.9
60	30.2	26.2	23.0	22.3	21.4	19.9	18.7	17.8	17.3	16.7	15.7	15.1
75	37.8	32.7	28.8	27.9	26.7	24.9	23.4	22.2	21.6	20.9	19.7	18.9
100	50.4	43.6	38.4	37.2	35.6	33.2	31.2	29.6	28.8	27.8	26.2	25.2

Table J-7. Conversion Table, Degrees to Mils

Degrees	Mils	Degrees	Mils	Degrees	Mils	Degrees	Mils
1	17.78	65	1,155.55	165	2,933.33	265	4,711.11
2	35.55	70	1,244.44	170	3,022.22	270	4,800.00
3	53.33	75	1,333.33	175	3,111.11	275	4,888.89
4	71.11	80	1,422.22	180	3,200.00	280	4,977.78
5	88.89	85	1,511.11	185	3,288.89	285	5,066.67
6	106.67	90	1,600.00	190	3,377.78	290	5,155.55
7	124.44	95	1,688.89	195	3,466.67	295	5,244.44
8	142.22	100	1,777.78	200	3,555.55	300	5,333.33
9	160.00	105	1,866.67	205	3,644.44	305	5,422.22
10	177.78	110	1,955.55	210	3,733.33	310	5,511.11
15	266.67	115	2,044.44	215	3,822.22	315	5,600.00
20	355.55	120	2,133.33	220	3,911.11	320	5,688.89
25	444.44	125	2,222.22	225	4,000.00	325	5,777.78
30	533.33	130	2,311.11	230	4,088.89	330	5,866.67
35	622.22	135	2,400.00	235	4,177.78	335	5,955.55
40	711.11	140	2,488.89	240	4,266.67	340	6,044.44
45	800.00	145	2,577.78	245	4,355.55	345	6,133.33
50	888.89	150	2,666.67	250	4,444.44	350	6,222.22
55	977.78	155	2,755.55	255	4,533.33	355	6,311.11
60	1,066.67	160	2,844.44	260	4,622.22	360	6,400.00

Table J-8. Conversion Table and Distance Conversion Factors

To convert	To	Multiply by
Kilometers	Miles	0.62
Kilometers	Nautical Miles	0.54
Miles	Kilometers	1.61
Miles	Nautical Miles	0.87
Nautical Miles	Kilometers	1.85
Nautical Miles	Miles	1.15
meters	feet	3.28
feet	meters	0.30
mph	km/h	1.61
mph	knots	0.87
mph	m/sec	0.45
mph	ft/sec	1.47
km/h	mph	0.62
km/h	knots	0.54
km/h	m/sec	0.28
km/h	ft/sec	0.91
knots	km/h	1.85
knots	mph	1.15
knots	m/sec	0.51
knots	ft/sec	1.69
m/sec	km/h	3.60
m/sec	mph	2.24
m/sec	knots	1.94
m/sec	ft/sec	3.28
ft/sec	km/h	1.10
ft/sec	mph	0.68
ft/sec	knots	0.59
ft/sec	m/s	0.30
kilograms	pounds (lb)	2.20
pounds (lb)	kilograms	0.45
gallons (US)	litres	3.79
litres	gallons (US)	0.26

Table J-9. Transmission Factors/Protection Factors

Environmental shielding	Transmission Factor (TF)	Protection Factor (PF)
Armoured Vehicles:		
M1 Tank	0.04	25
M48 Tank	0.02	50
M60 Tank	0.04	25
M2 IFV	0.2	5
M3 CFV	0.2	5
M113 Armoured Personnel Carrier	0.3	3.33
M109 Special Purpose Howitzer	0.2	5
M548 Cargo Vehicle	0.7	1.43
M88 Recovery Vehicle	0.09	11.11
M577 Command Post Carrier	0.3	3.33
M551 Armoured Recon Airborne Assault Vehicle	0.2	5
M728 Combat Engineer Vehicle	0.04	25
Trucks:		
1/4-ton	0.8	1.25
3/4-ton	0.6	1.67
2½-ton	0.6	1.67
4 - 7-ton	0.5	2
Structures:		
Multi-storey building:		
Top floor	0.01	100
Lower floor	0.1	10
Frame house:		
First floor	0.6	1.67
Basement	0.1	10
Urban Areas: (In open)	0.7 *	1.43 *
Woods:	0.8 *	1.25 *
Underground shelters	0.0002	10
Foxholes:	0.1	10
* These factors apply to aerial survey dose rates.		

Table J-10. Normalizing Factors (Correction to H + 1 hour)

Normalizing factors (Correction to H + 1 hour).								
TIME AFTER BURST	DECAY EXPONENT (n)							
	0.600	0.800	1.000	1.200	1.400	1.600	1.800	2.000
10 min	0.341	0.238	0.167	0.116	0.081	0.057	0.040	0.028
20 min	0.517	0.415	0.333	0.268	0.215	0.172	0.138	0.111
30 min	0.660	0.574	0.500	0.435	0.379	0.330	0.287	0.250
40 min	0.784	0.723	0.667	0.615	0.567	0.523	0.482	0.444
50 min	0.896	0.864	0.833	0.803	0.775	0.747	0.720	0.694
1 hr 0 min	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1 hr 10 min	1.090	1.130	1.160	1.200	1.240	1.280	1.320	1.360
1 hr 20 min	1.180	1.250	1.330	1.410	1.490	1.580	1.670	1.770
1 hr 30 min	1.270	1.380	1.500	1.620	1.760	1.910	2.070	2.250
1 hr 40 min	1.350	1.500	1.660	1.840	2.040	2.260	2.500	2.770
1 hr 50 min	1.430	1.620	1.830	2.070	2.330	2.630	2.970	3.360
2 hr 0 min	1.510	1.740	2.000	2.290	2.630	3.030	3.480	4.000
2 hr 15 min	1.620	1.910	2.250	2.640	3.110	3.660	4.300	5.060
2 hr 30 min	1.730	2.080	2.500	3.000	3.600	4.330	5.200	6.250
2 hr 45 min	1.830	2.240	2.750	3.360	4.120	5.040	6.170	7.560
3 hr 0 min	1.930	2.400	3.000	3.730	4.650	5.800	7.220	9.000
3 hr 15 min	2.020	2.560	3.250	4.110	5.200	6.590	8.340	10.560
3 hr 30 min	2.120	2.720	3.500	4.490	5.770	7.420	9.530	12.250
3 hr 45 min	2.210	2.870	3.750	4.880	6.360	8.280	10.790	14.060
4 hr 0 min	2.290	3.030	4.000	5.270	6.960	9.190	12.120	16.000
4 hr 20 min	2.410	3.230	4.330	5.810	7.790	10.440	14.000	18.770
4 hr 40 min	2.520	3.420	4.660	6.350	8.640	11.760	16.000	21.770
5 hr 0 min	2.620	3.620	5.000	6.890	9.510	13.130	18.110	25.000
5 hr 20 min	2.730	3.810	5.330	7.450	10.410	14.560	20.350	28.440
5 hr 40 min	2.830	4.000	5.660	8.010	11.340	16.040	22.690	32.110
6 hr 0 min	2.930	4.190	6.000	8.580	12.280	17.580	25.150	36.000
6 hr 20 min	3.020	4.370	6.330	9.160	13.250	19.170	27.720	40.110
6 hr 40 min	3.120	4.560	6.660	9.740	14.230	20.800	30.410	44.440
7 hr 0 min	3.210	4.740	7.000	10.330	15.240	22.490	33.200	49.000
7 hr 20 min	3.300	4.920	7.330	10.920	16.270	24.230	36.100	53.770
7 hr 40 min	3.390	5.100	7.660	11.520	17.310	26.020	39.110	58.770
8 hr 0 min	3.480	5.270	8.000	12.120	18.370	27.850	42.220	64.000
9 hr 0 min	3.730	5.800	9.000	13.960	21.670	33.630	52.190	81.000
10 hr 0 min	3.980	6.310	10.000	15.840	25.110	39.810	63.090	100.000
11 hr 0 min	4.210	6.800	11.000	17.760	28.700	46.360	74.900	121.000
12 hr 0 min	4.440	7.300	12.000	19.720	32.420	53.290	87.600	144.000

Table J-11. Determination of Stability Category

Morning (AM): Sun Elevation Angle	Morning (AM): Condition of sky – No clouds/ Less than half covered	Morning (AM): Condition of sky – More than half covered	Morning (AM): Condition of sky – Overcast	Afternoon (PM): Sun Elevation Angle	Afternoon (PM): Condition of sky – No clouds/ Less than half covered	Afternoon (PM): Condition of sky – More than half covered	Afternoon (PM): Condition of sky – Overcast
< 4°	S	S	N	> 46°	U	U	N
> 4° - 32°	N	N	N	> 35° - 46°	U	N	N
> 32° - 40°	U	N	N	> 12° - 35°	N	N	N
> 40°	U	U	N	> 5° - 12°	S	N	N
U = Unstable	N = Neutral	S = Stable		< 5°	S	S	N

Enter with:
- Time of day.
- Degree of cloud coverage.
- Sun elevation angle (night less than 4 degrees).

Note 1: The stability category found in this table must be adjusted by using Table J-11.

Note 2: The sun elevation table contains basic information. Nations may convert the table into a suitable format for their own use.

Table J-12. Stability Category Adjustment

Specific ground (terrain) and Weather influences	Stability Category from Table 15-I: U	Stability Category from Table 15-I: N	Stability Category from Table 15-I: S
Dry to slightly moist surface.	**U**	**N**	**S**
Wet surface (i.e. after continuous rain) or dew.	**N**	**N**	**S**
Frozen surface or partly covered with snow, ice or hoarfrost.	**N**	**S**	**S**
Surface completely covered with snow.	**S**	**S**	**S**
Continuous rainfall (no shower activity).	**N**	**N**	**N**
Haze or mist (visibility 1 - 4 km).	**N**	**N**	**S**
Fog (visibility less than 1 km).	**N**	**S**	**S**
Downwind speed more than 18 KPH.	**N**	**N**	**N**

Table J-I2 is used for adjustment of the stability category found from Table J-11, taking into account influences of surface and weather. All eight conditions of terrain and weather listed in Table J-12 must be checked, and in case of doubt the most stable category is to be chosen.

Table J-13. Radioactive Cloud and Stem Parameters (Stabilized at H+10 Minutes)

Yield (KT)	Cloud-Top Height		Cloud-Bottom Height		2/3 Stem Height		Cloud Radius		Time of Fall (Cloud Bottom) Hours*
	Km	1000 ft	Km	1000 ft	Km	1000 ft	Km	mi	
0.15	2.4	7.9	1.3	4.3	0.9	2.9	0.4	0.2	0.4
0.20	2.6	8.5	1.4	4.6	0.9	3.1	0.5	0.3	0.4
0.30	2.8	9.2	1.5	4.9	1	3.3	0.6	0.4	0.4
0.40	3.0	9.8	1.6	5.3	1.1	3.5	0.7	0.4	0.5
0.50	3.2	11	1.7	5.6	1.1	3.7	0.7	0.4	0.5
0.60	3.3	11	1.8	5.9	1.2	3.9	0.8	0.5	0.5
0.70	3.4	11	1.8	5.9	1.2	3.9	0.8	0.5	0.5
0.80	3.5	11	1.9	6.2	1.3	4.1	0.9	0.6	0.5
0.90	3.6	12	2	6.6	1.3	4.4	0.9	0.6	0.5
1	3.7	12	2	6.6	1.3	1.1	1	0.6	0.5
2	4.4	14	2.3	7.5	1.5	2	1.3	0.8	0.6
3	5.1	17	2.8	9.2	1.9	3.1	1.5	0.9	0.7
4	5.7	19	3.3	11	2.2	7.3	1.7	1.1	0.8
5	6.3	21	3.6	12	2.4	8	1.9	1.2	0.9
6	6.7	22	4	13	2.7	8.7	2.1	1.3	1
7	7.2	24	4.3	14	2.9	9.3	2.2	1.4	1
8	7.5	25	4.6	15	3.1	10	2.3	1.4	1.1
9	7.9	26	4.8	16	3.2	11	2.4	1.5	1.1
10	8.2	27	5.1	17	3.4	11	2.6	1.6	1.1
20	11	36	7.2	24	4.8	16	3.4	2.1	1.5
30	12	39	7.6	25	5.1	17	4	2.5	1.6
40	12	39	8	26	5.3	17	4.6	2.9	1.6
50	13	43	8.3	27	5.5	18	5	3.1	1.7
60	13	43	8.5	28	5.7	19	5.4	3.4	1.7
70	14	46	8.7	29	5.8	19	5.8	3.6	1.8
80	14	46	8.9	29	5.9	19	6.1	3.8	1.8
90	14	46	9.1	30	6.1	20	6.4	4	1.8
100	14	46	9.3	31	6.2	21	6.7	4.2	1.9
200	16	53	10	33	6.7	22	9	5.6	2
300	17	56	11	36	7.3	24	11	6.8	2.1
400	18	59	12	39	8	26	12	7.5	2.3
500	19	62	12	39	8	26	13	8.1	2.3
600	20	66	12	39	8	26	14	8.7	2.3
700	20	66	13	43	8.7	29	15	9.3	2.4
800	21	69	13	43	8.7	29	16	9.9	2.4
900	21	69	13	43	8.7	29	17	11	2.4
MT 1	22	72	13	43	8.7	29	18	11	2.4
2	24	79	15	49	10	33	24	15	2.7
3	26	85	16	53	11	35	28	17	2.9
4	28	92	17	56	11	37	32	20	2.9
5	28	95	17	56	11	37	35	22	2.9
6	30	98	18	59	12	39	37	23	3.1
7	31	102	18	59	12	39	40	25	3.1
8	31	102	19	62	13	41	42	26	3.3
9	32	105	19	62	13	41	44	27	3.3
10	33	108	19	62	13	41	46	29	3.3
20	37	121	21	69	14	46	62	39	3.6
30	40	131	23	75	15	50	74	46	3.8
40	42	138	24	79	16	53	83	52	4
50	43	141	25	82	17	55	91	57	4.1
60	45	148	26	85	17	57	99	62	4.1
70	46	151	26	85	17	57	105	65	4.1
80	47	154	27	89	18	59	111	69	4.3
90	48	158	27	89	18	59	117	73	4.3
100	49	161	28	92	19	61	122	76	4.5

NOTE: 0.1 hours equals 6 minutes.

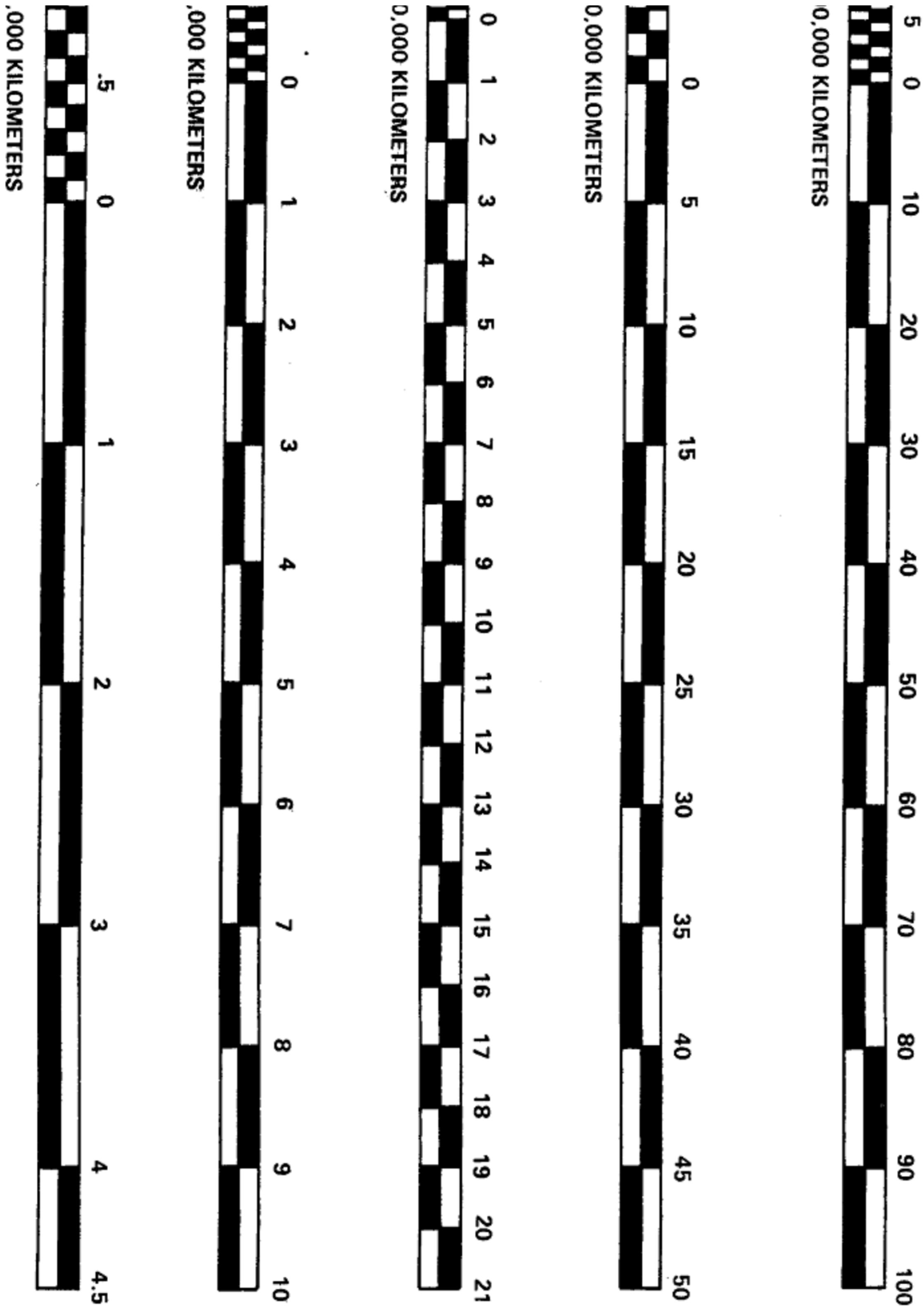


Figure J-1. Map Scales

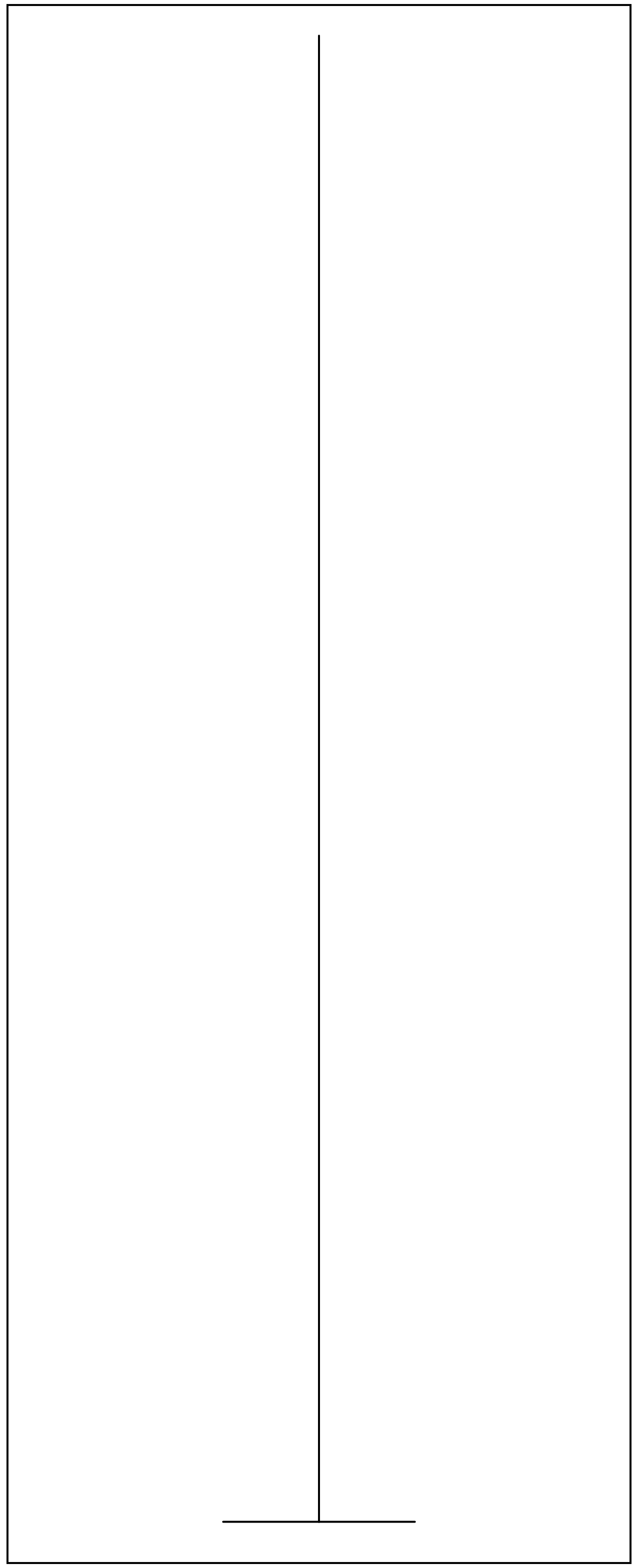


Figure J-2. Hairline

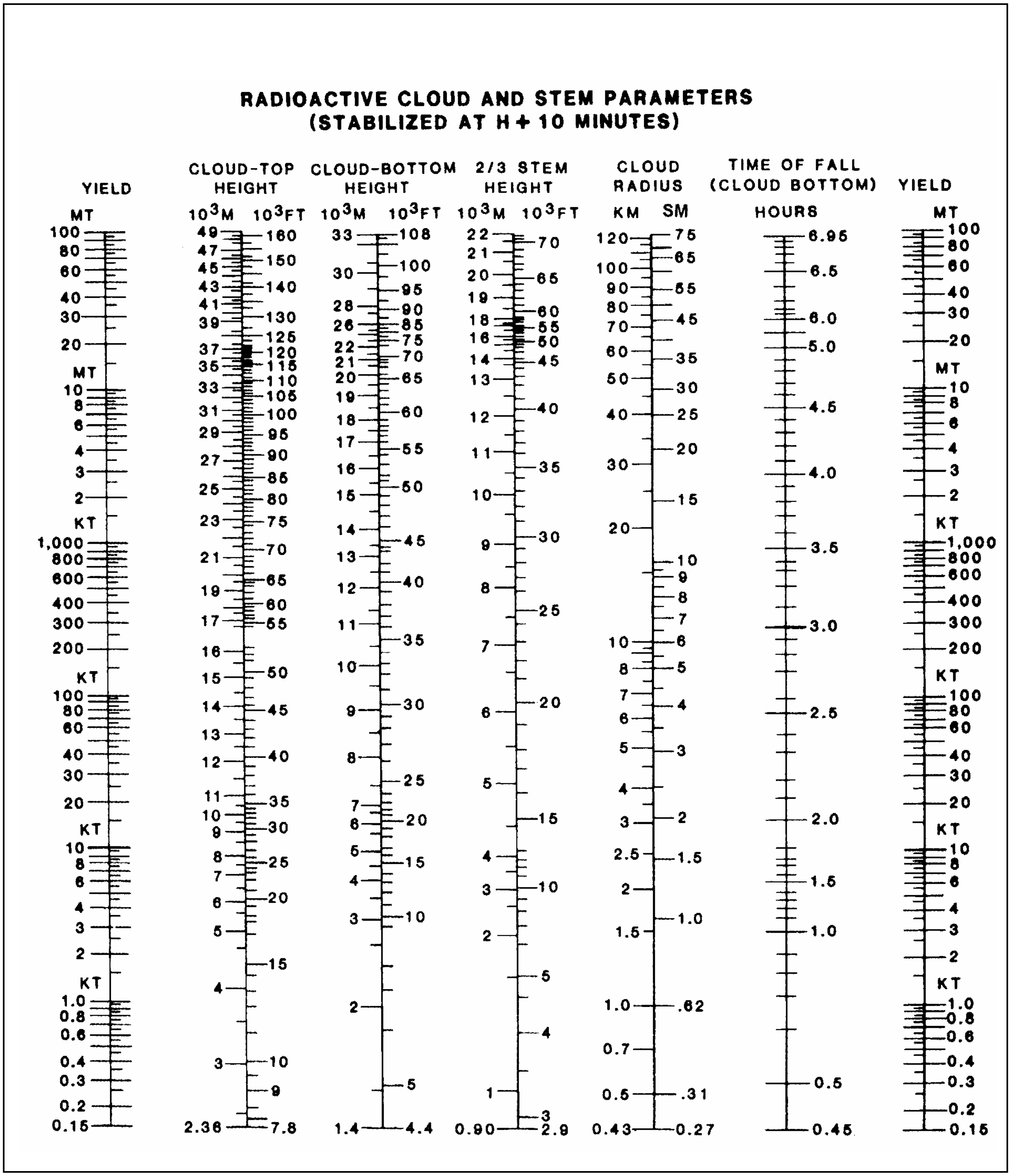


Figure J-3. Radioactive Cloud and Stem Parameters Nomogram (Stabilized at H+10 Minutes)

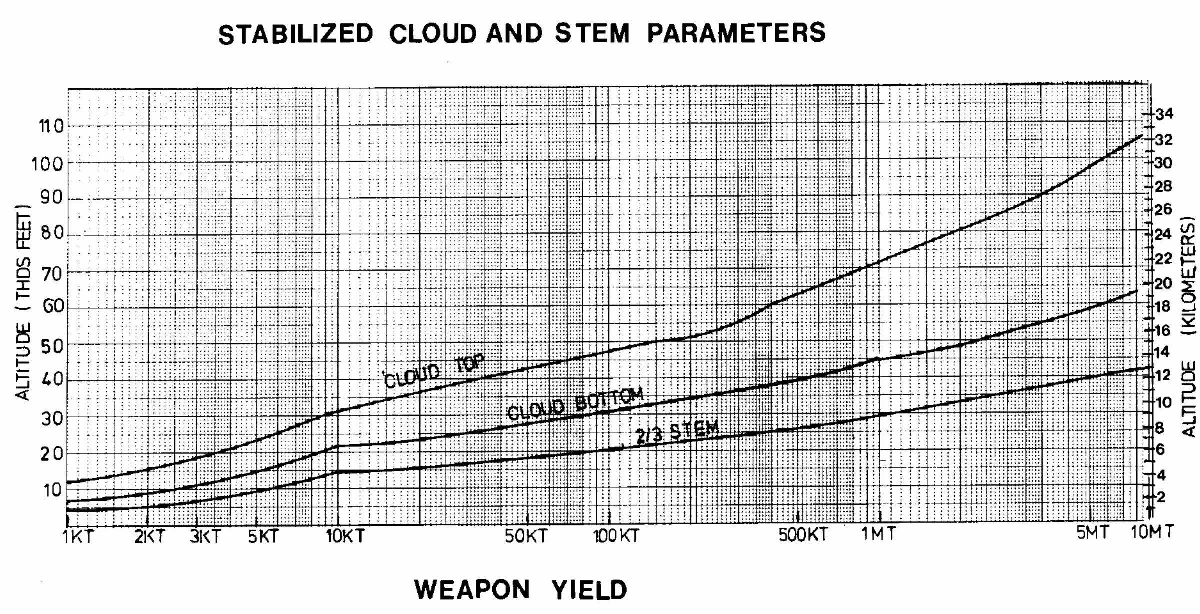


Figure J-4. Radioactive Cloud and Stem Parameters (Graph)

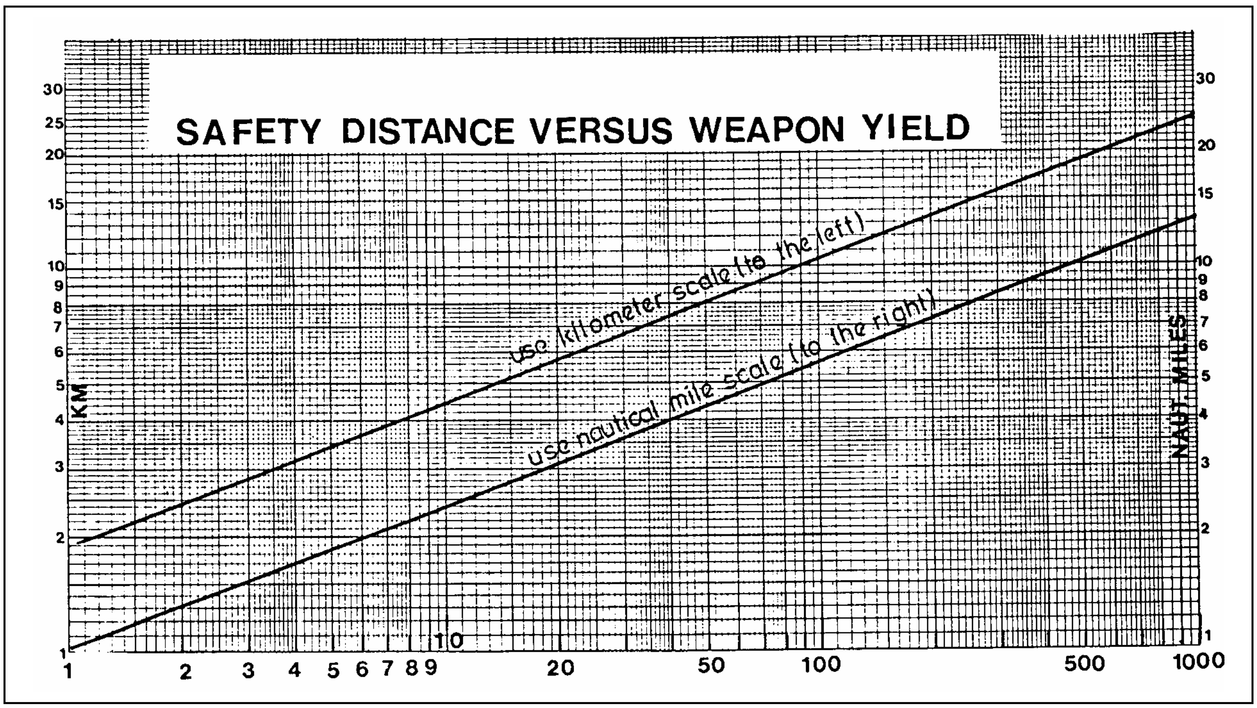


Figure J-5. Safety Distance as a Function of Weapon Yield

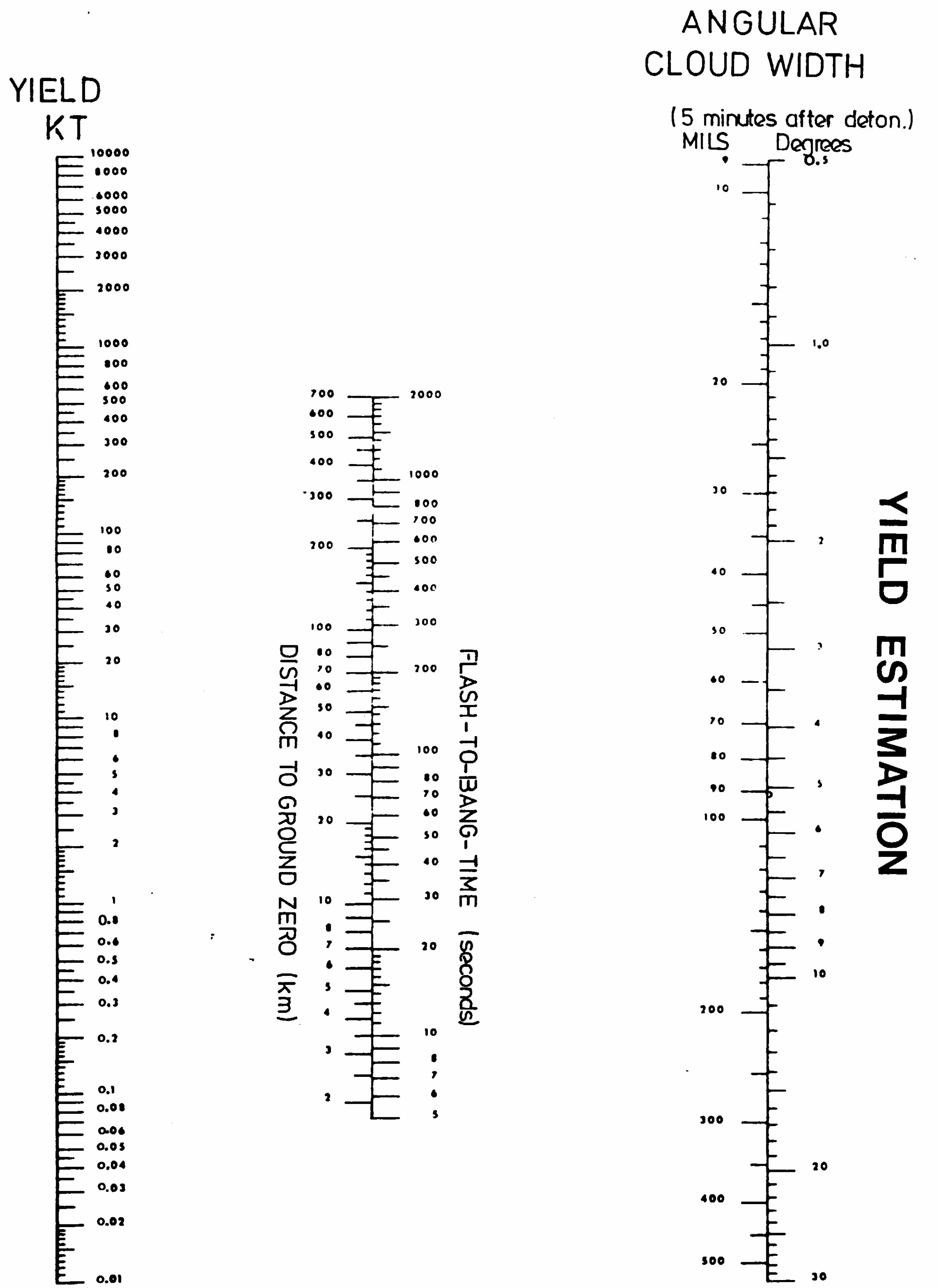


Figure J-6. Yield Estimation, Angular Cloud Width and Flash-to-Bang-Time/Distance to Ground Zero

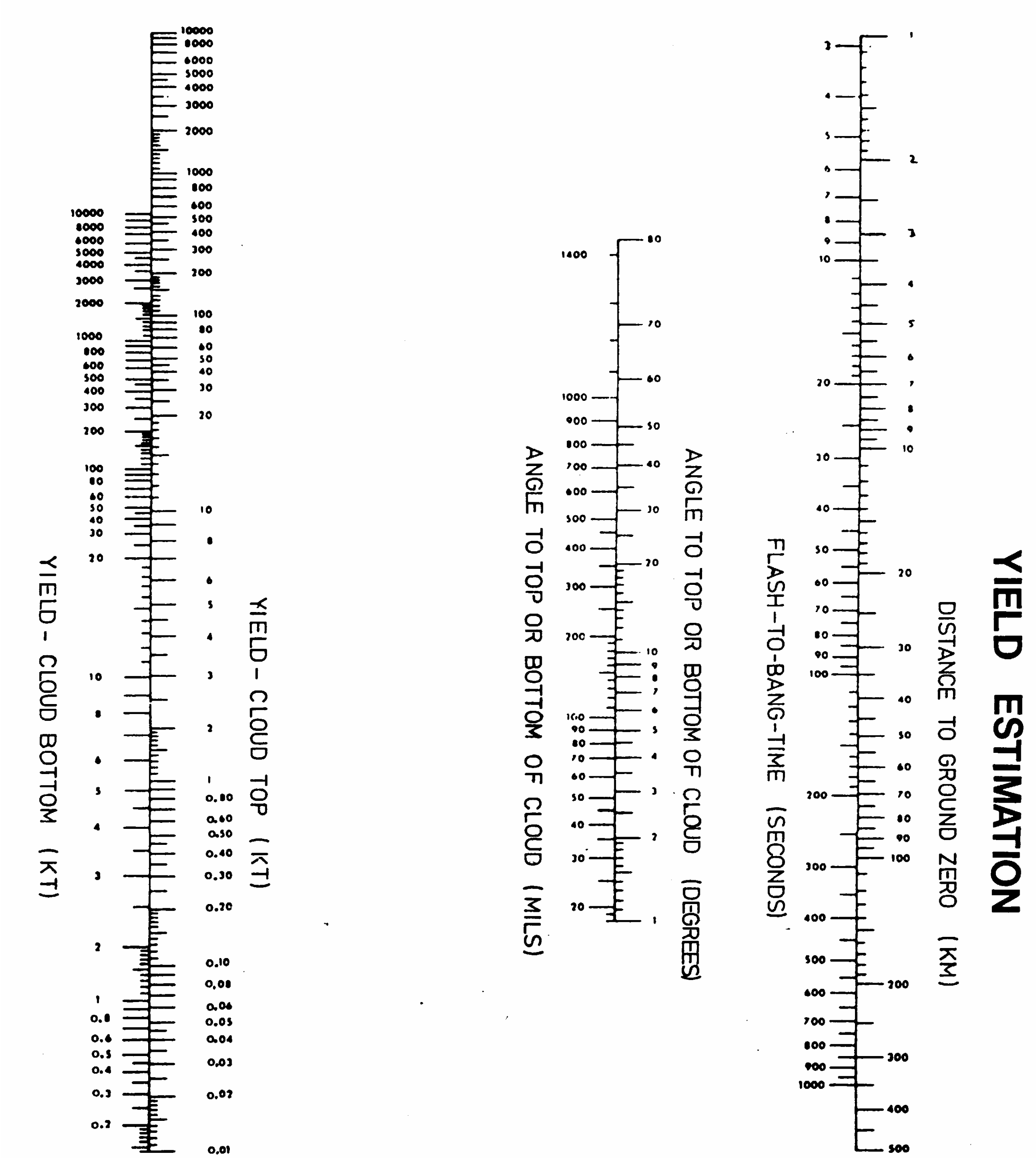


Figure J-7. Yield Estimation, Angle to Top/Bottom of Cloud and Flash-to-Bang-Time/Distance to Ground Zero

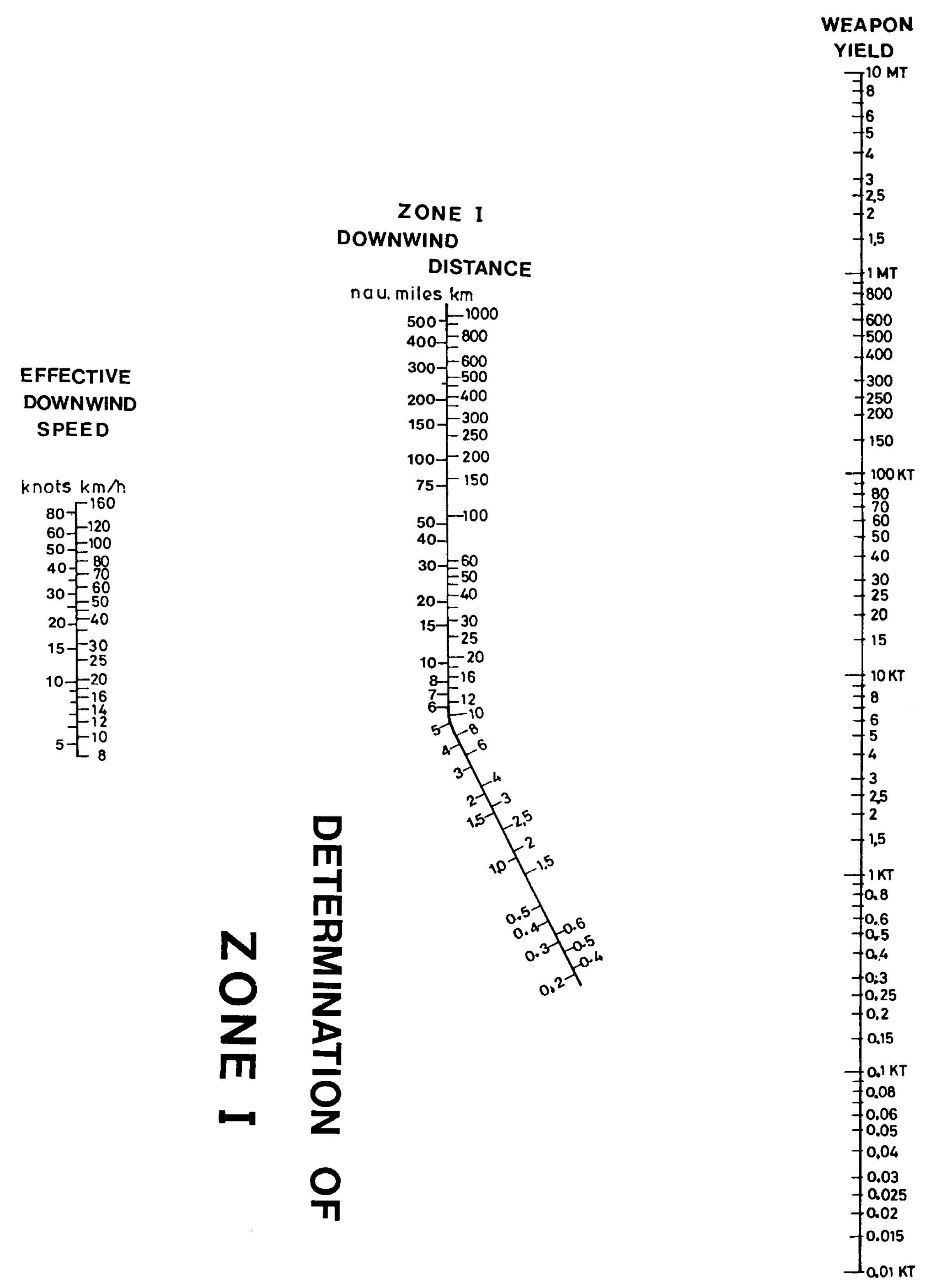


Figure J-8. Determination of Zone I, Downwind Distance

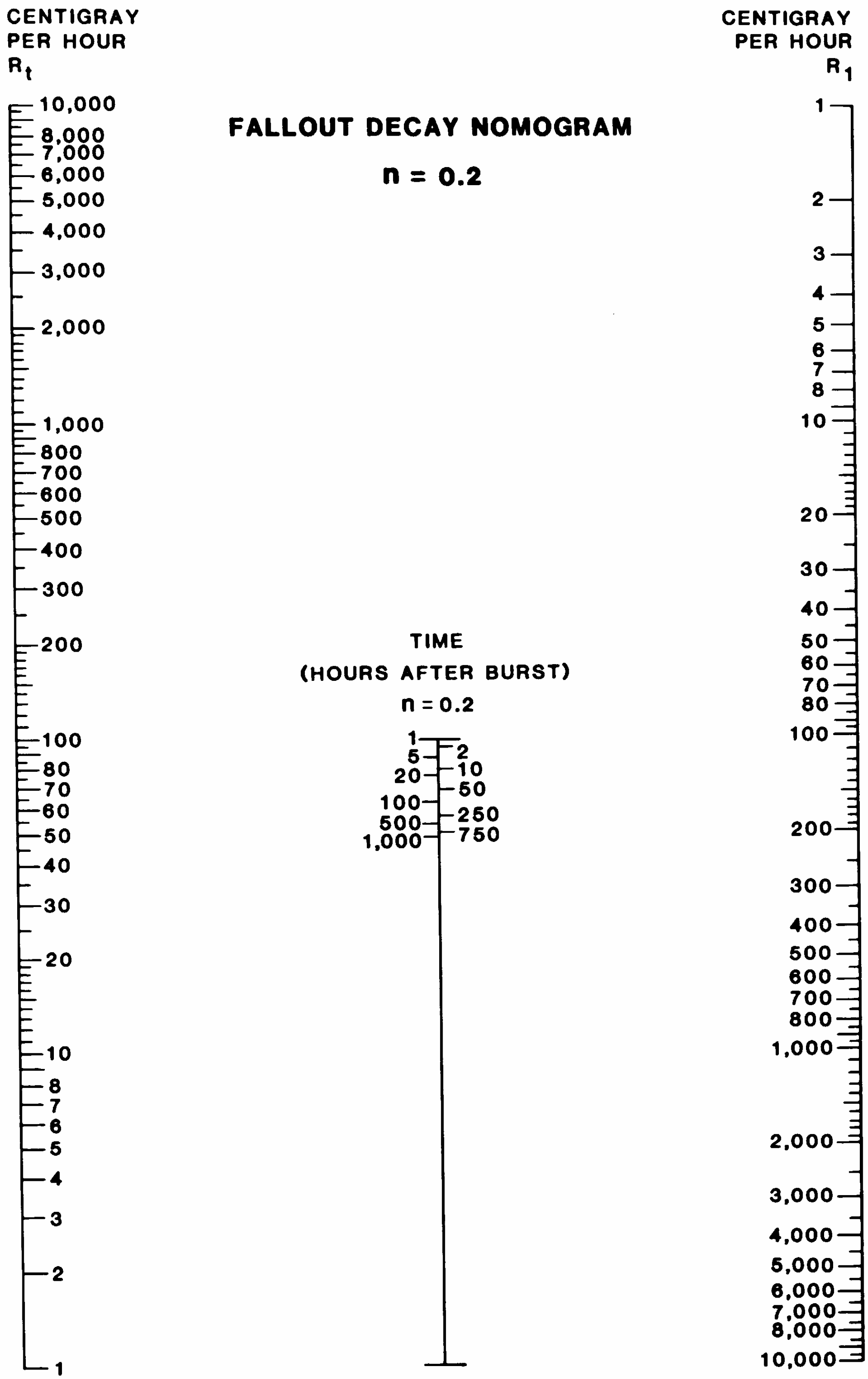


Figure J-9. Fallout Decay Nomogram (n=0.2)

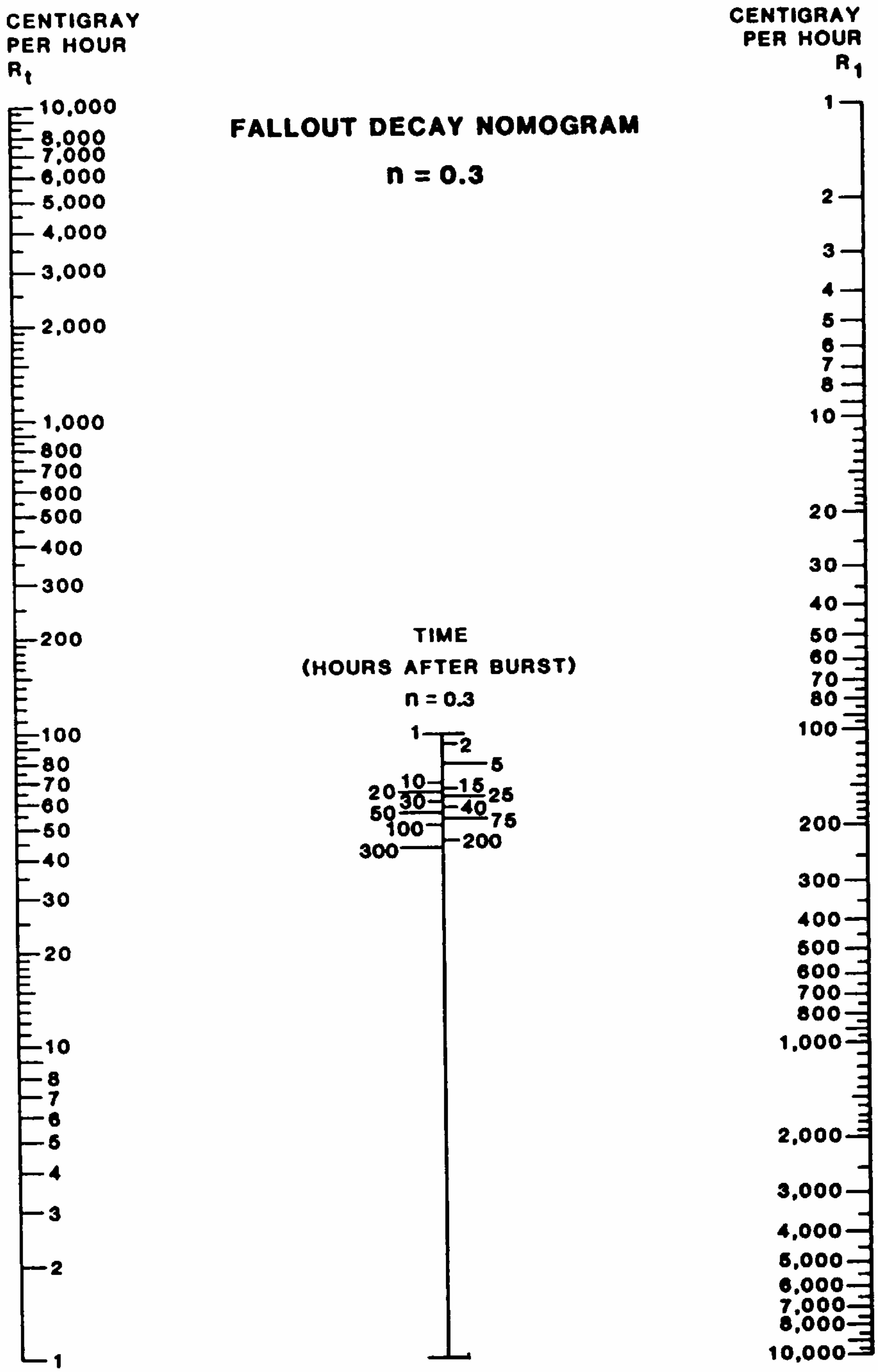


Figure J-10. Fallout Decay Nomogram (n=0.3)

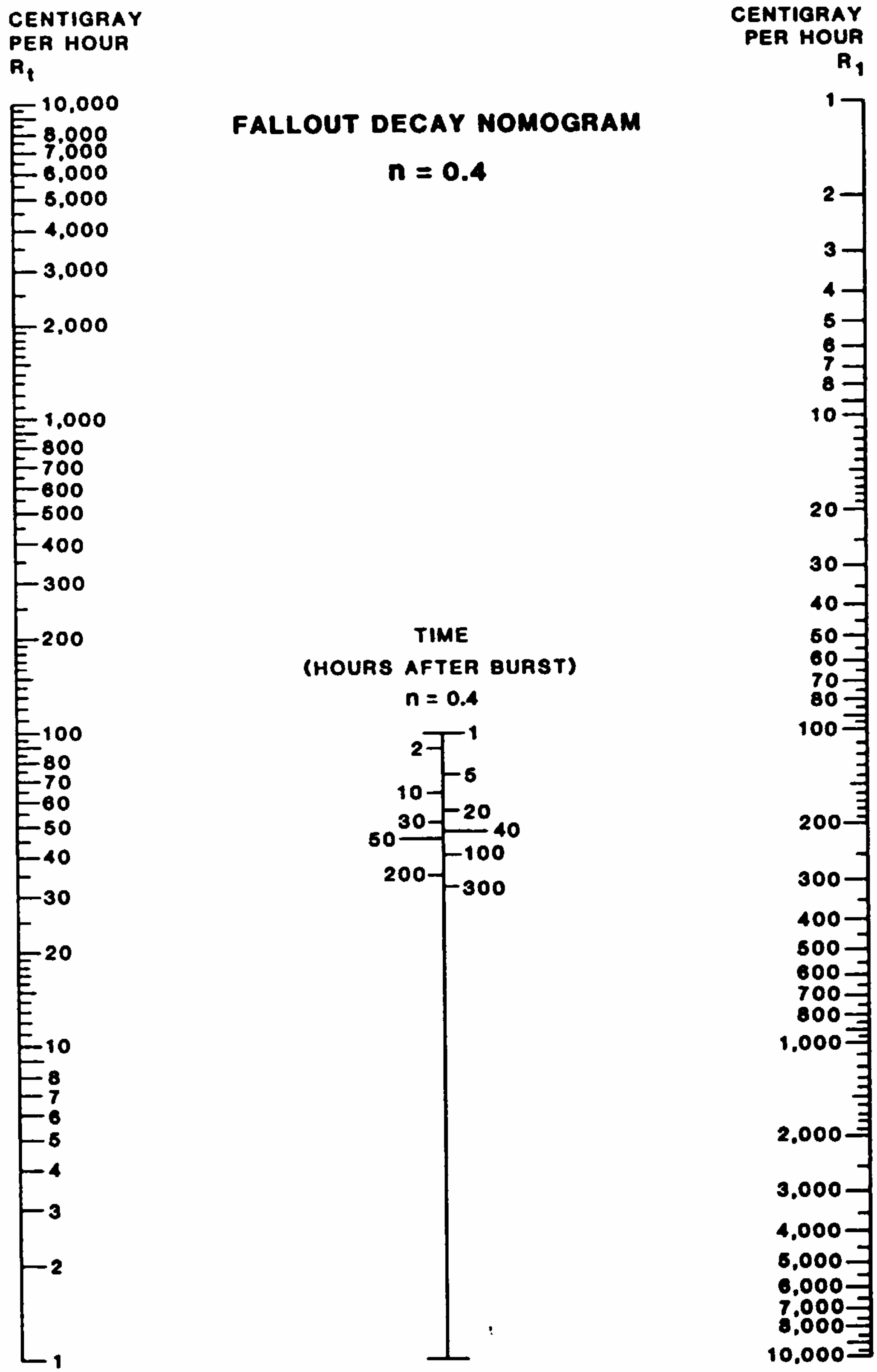


Figure J-11. Fallout Decay Nomogram (n=0.4)

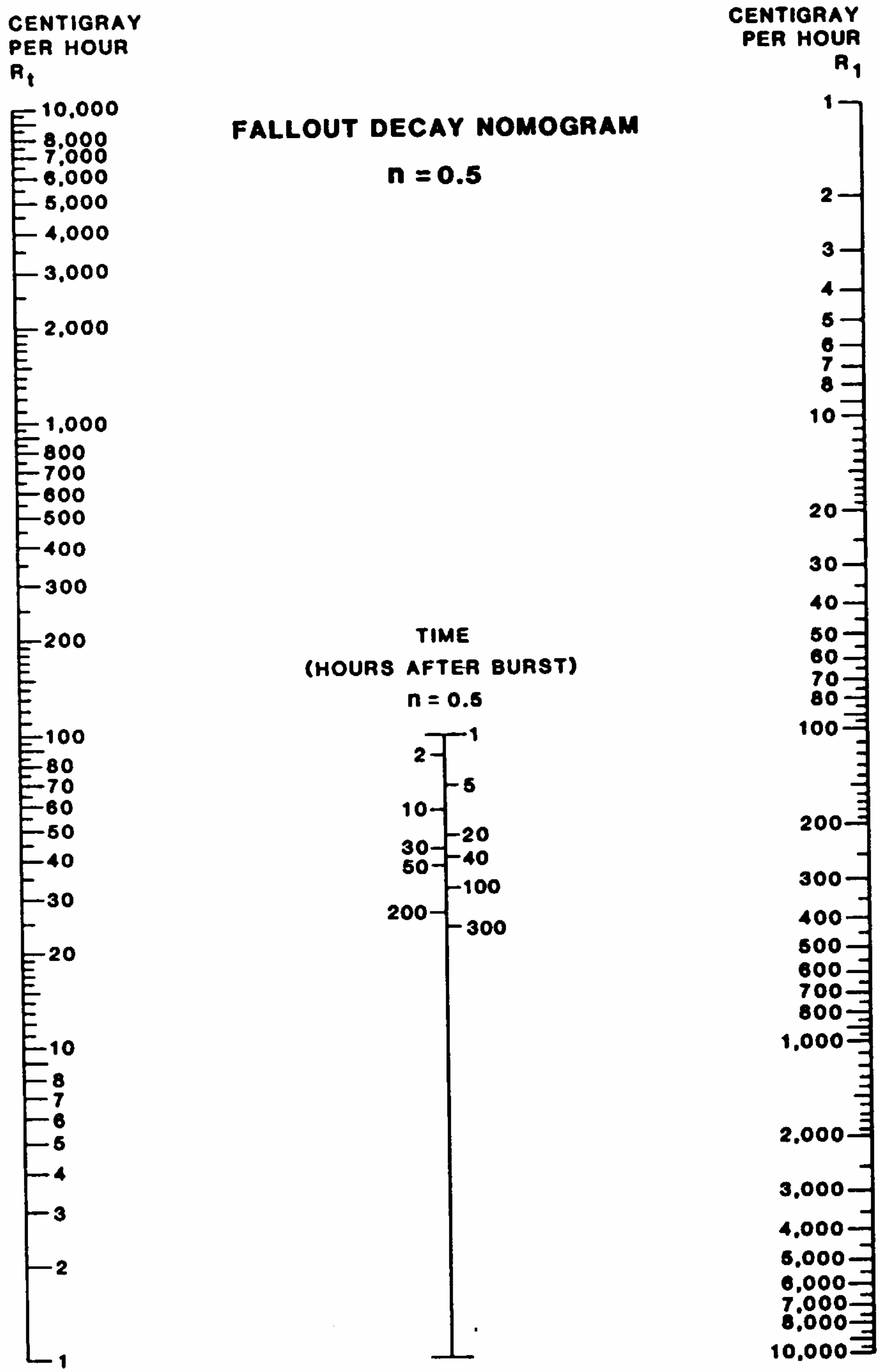


Figure J-12. Fallout Decay Nomogram (n=0.5)

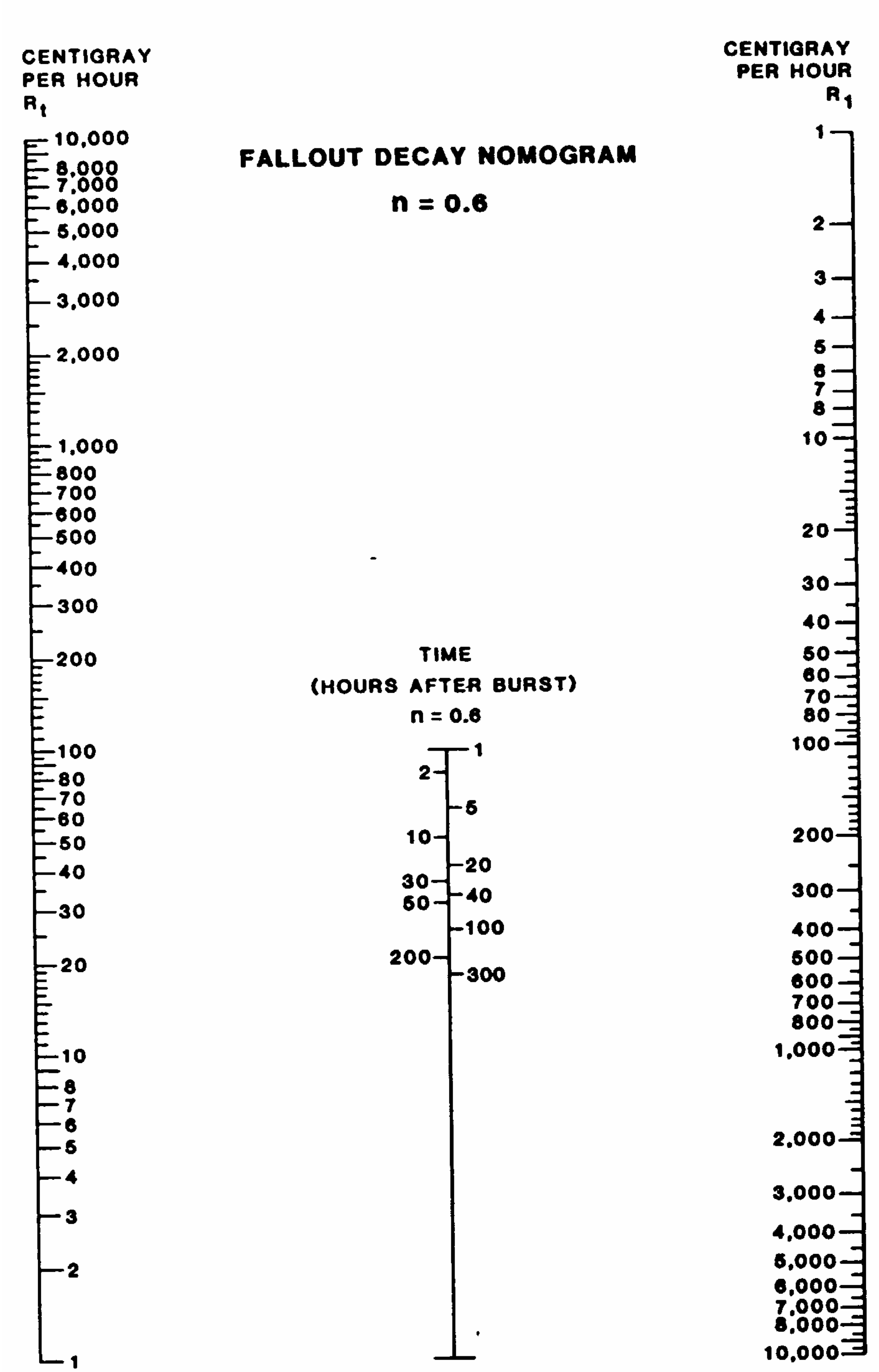


Figure J-13. Fallout Decay Nomogram (n=0.6)

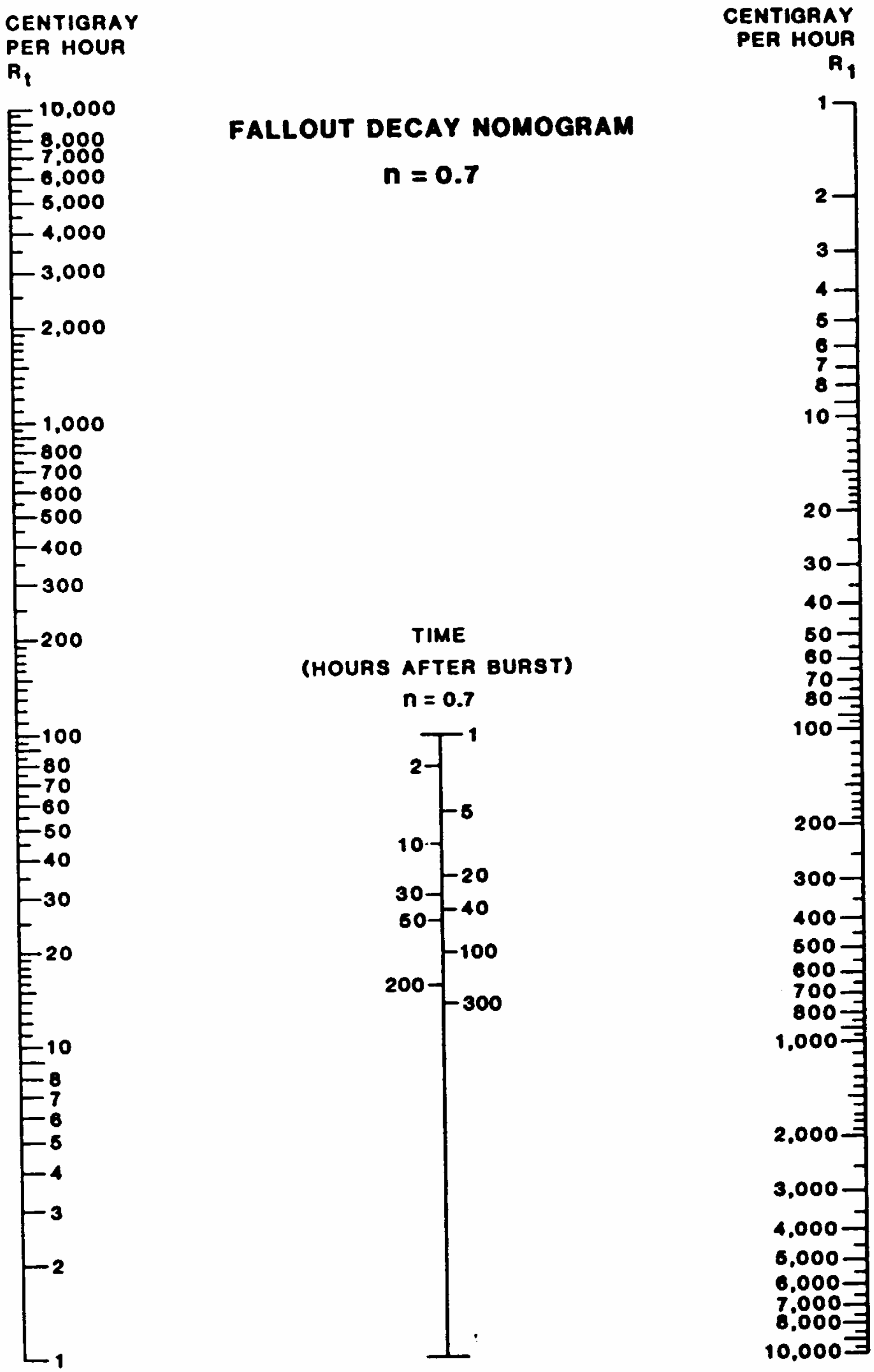


Figure J-14. Fallout Decay Nomogram (n=0.7)

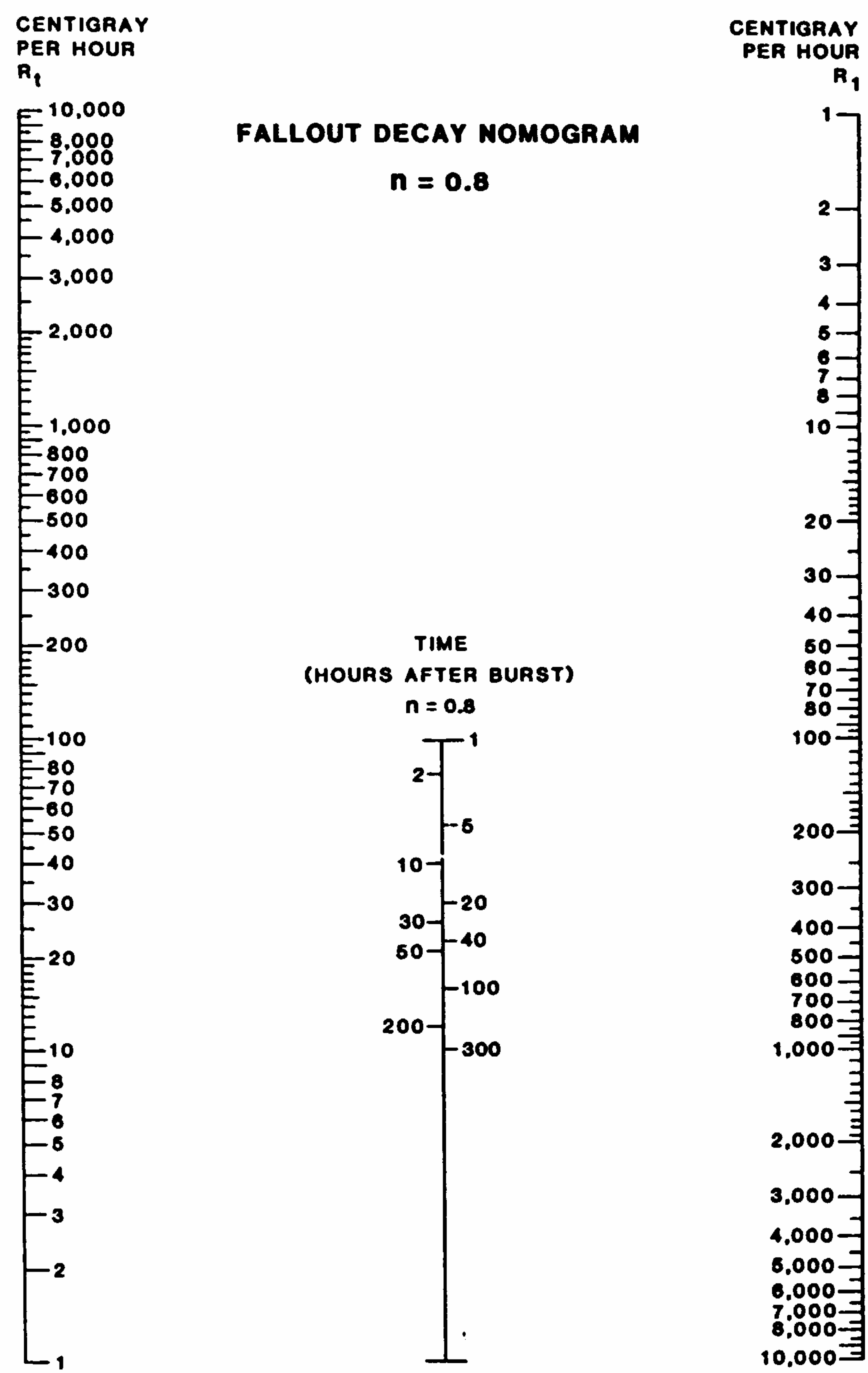


Figure J-15. Fallout Decay Nomogram (n=0.8)

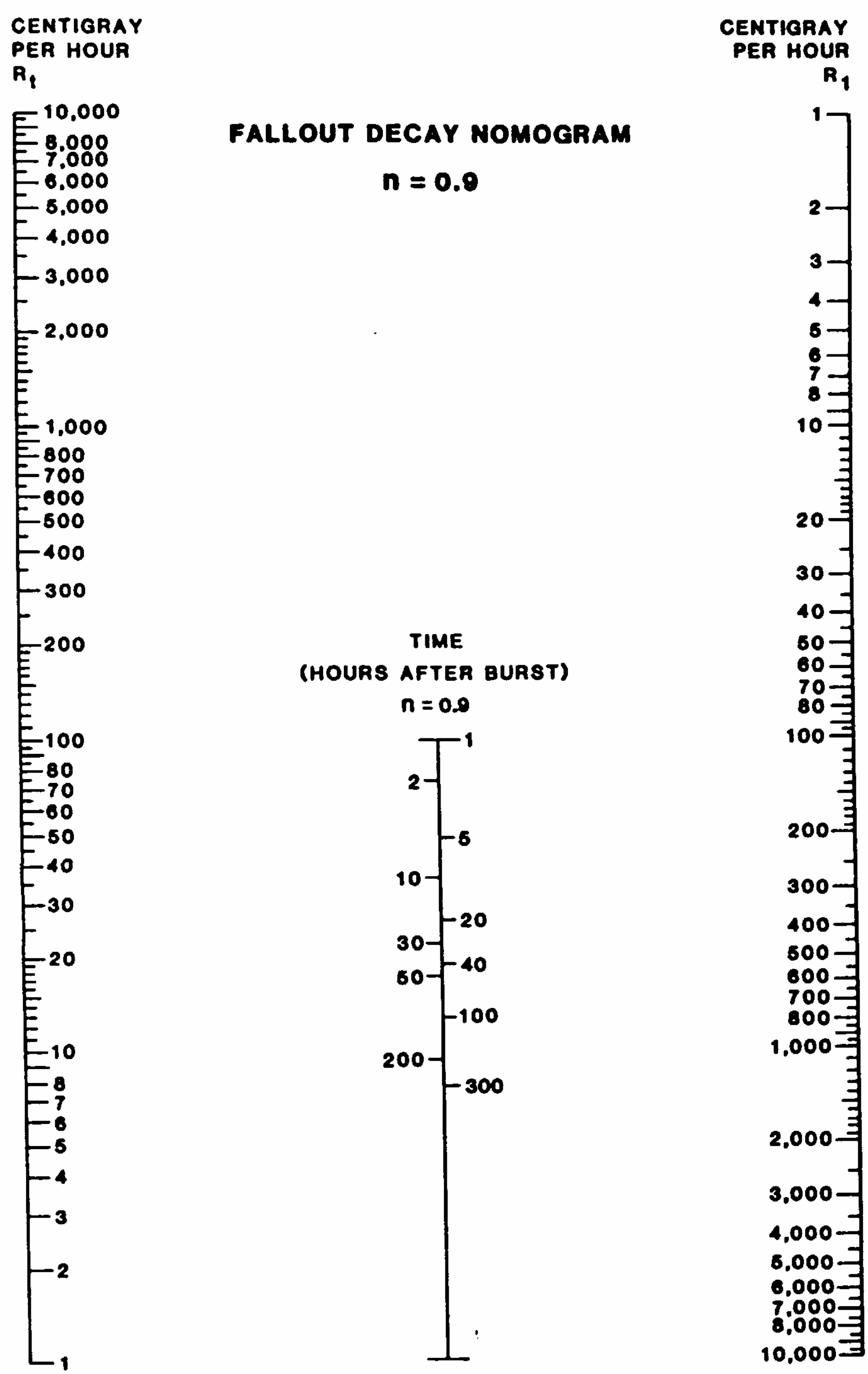


Figure J-16. Fallout Decay Nomogram (n=0.9)

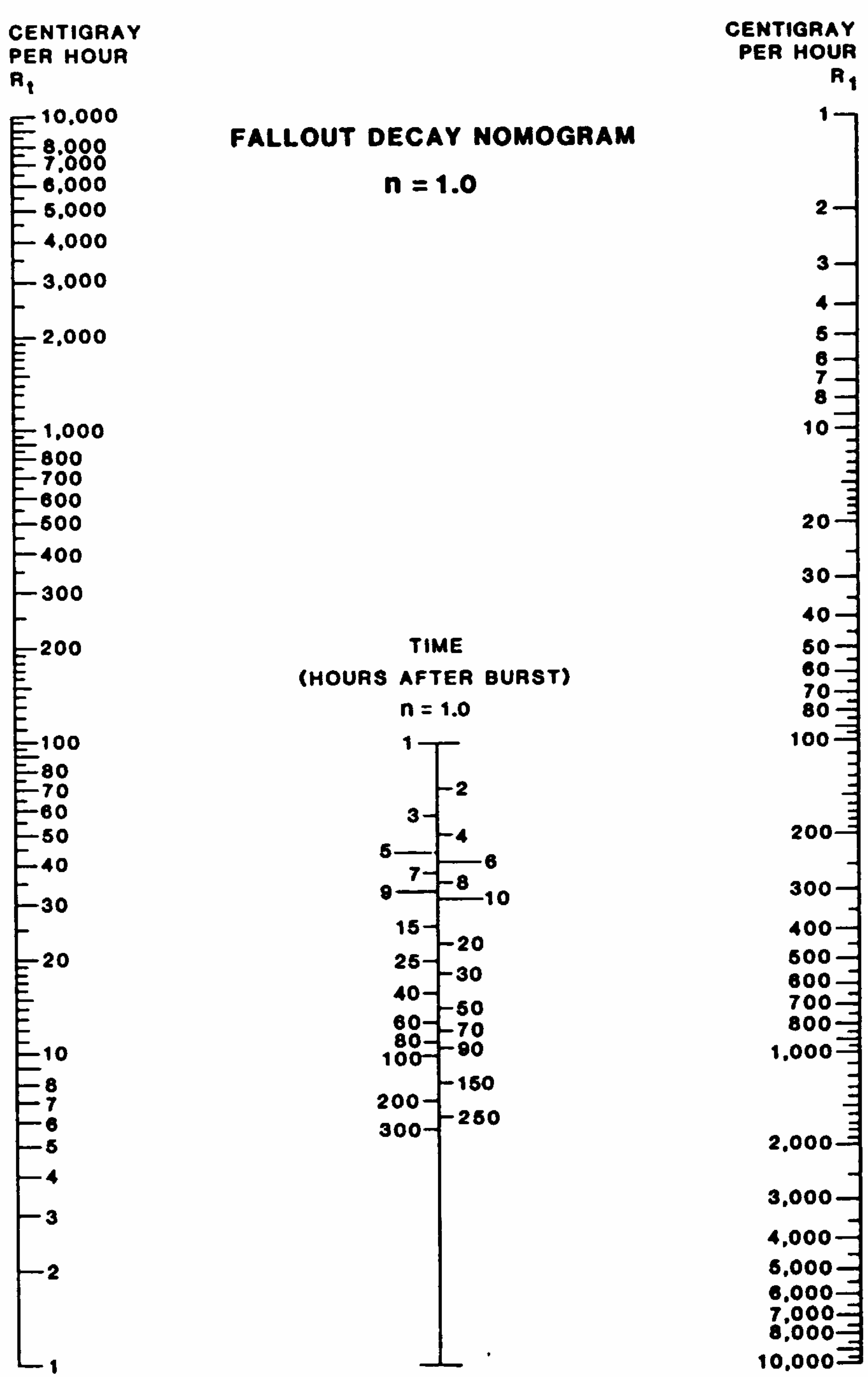


Figure J-17. Fallout Decay Nomogram (n=1.0)

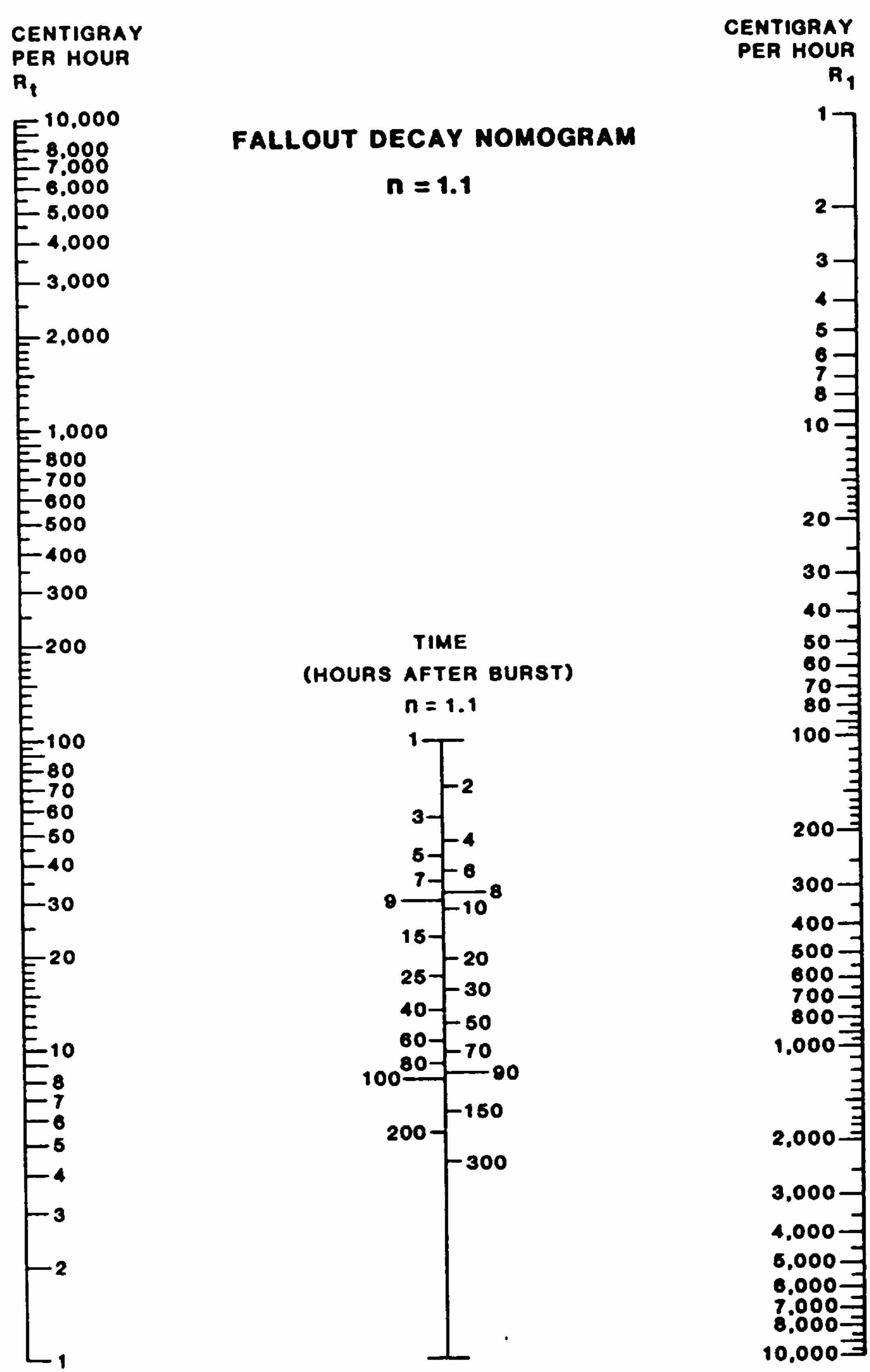


Figure J-18. Fallout Decay Nomogram (n=1.1)

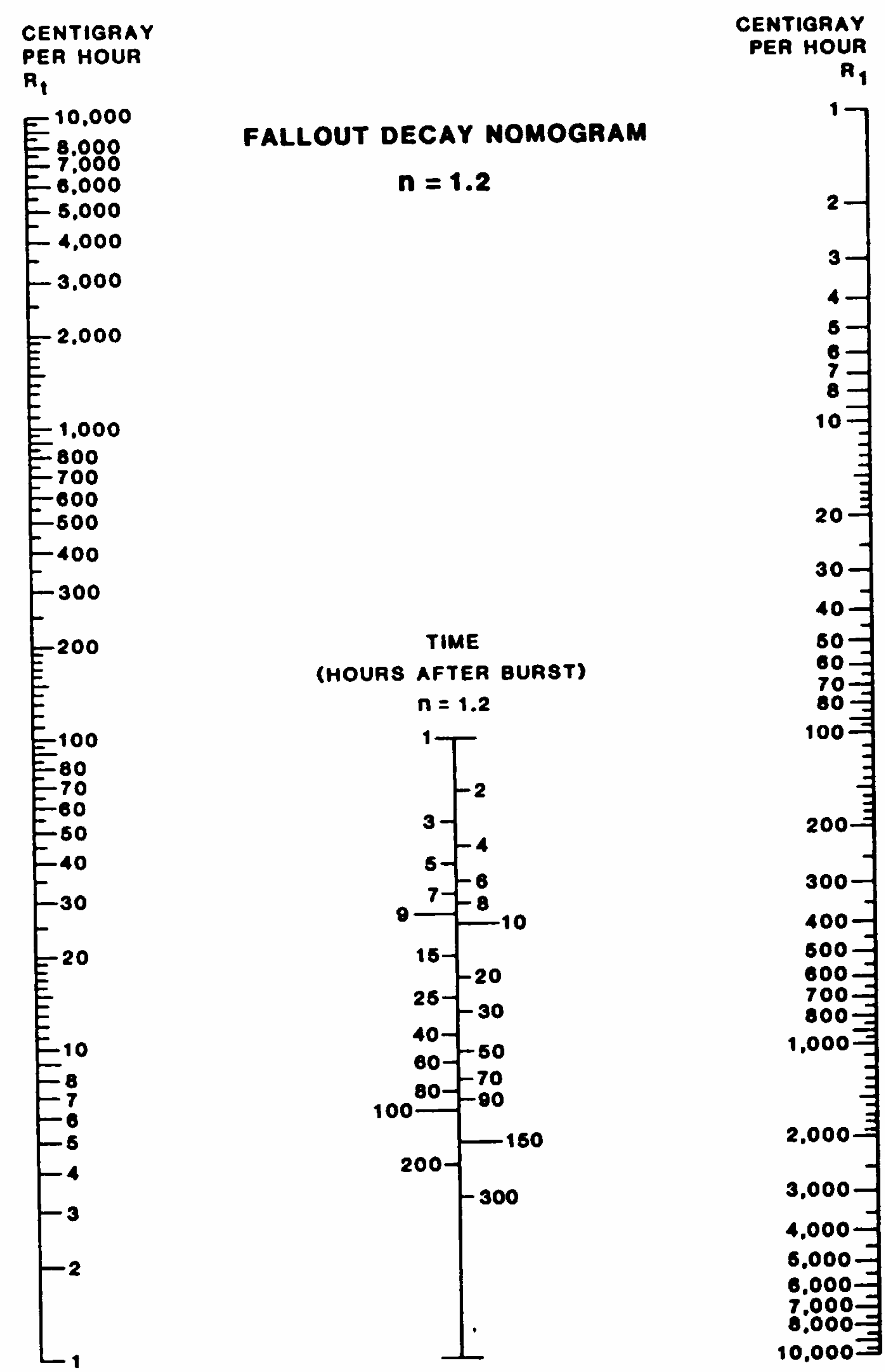


Figure J-19. Fallout Decay Nomogram (n=1.2)

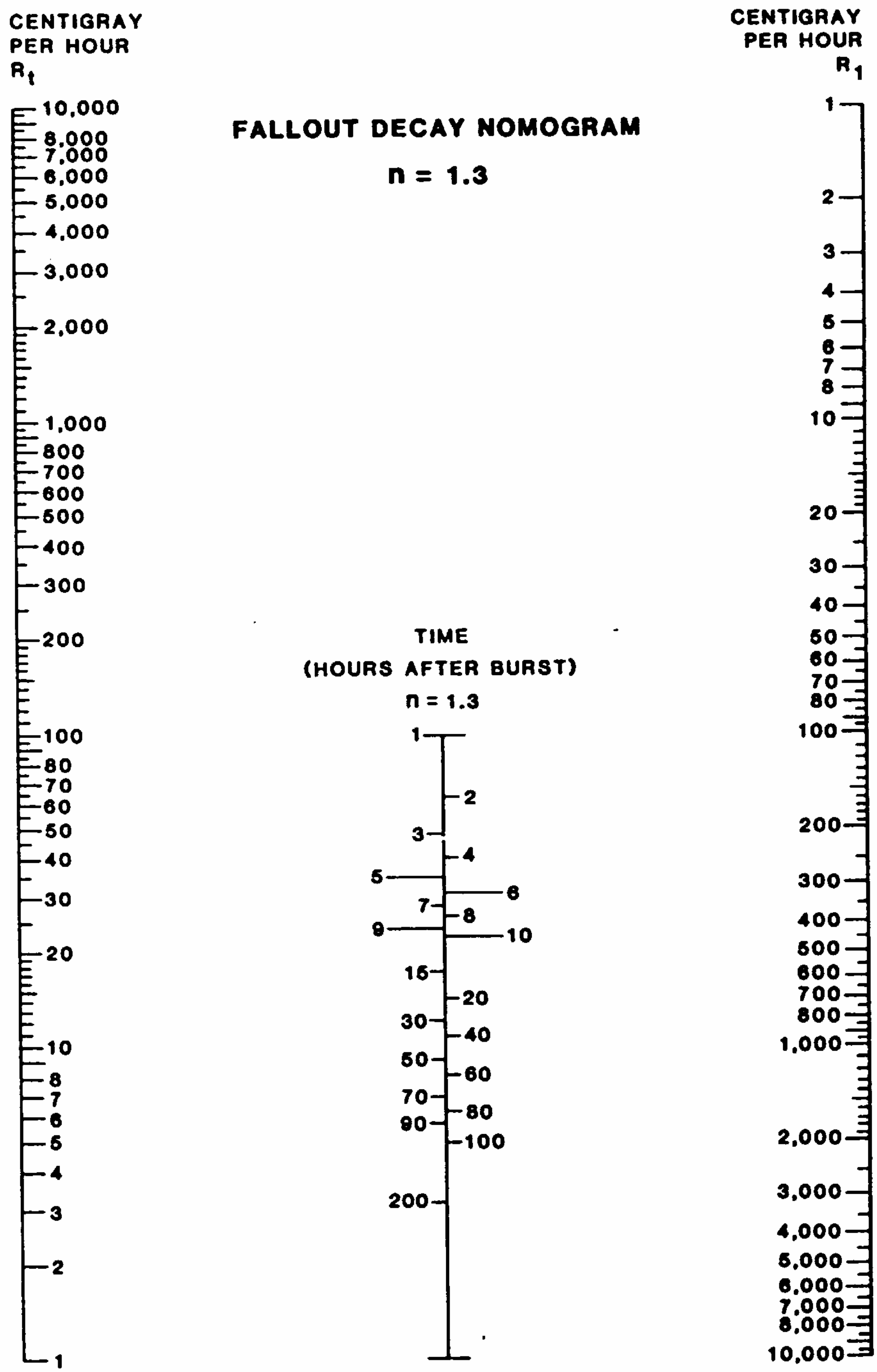


Figure J-20. Fallout Decay Nomogram (n=1.3)

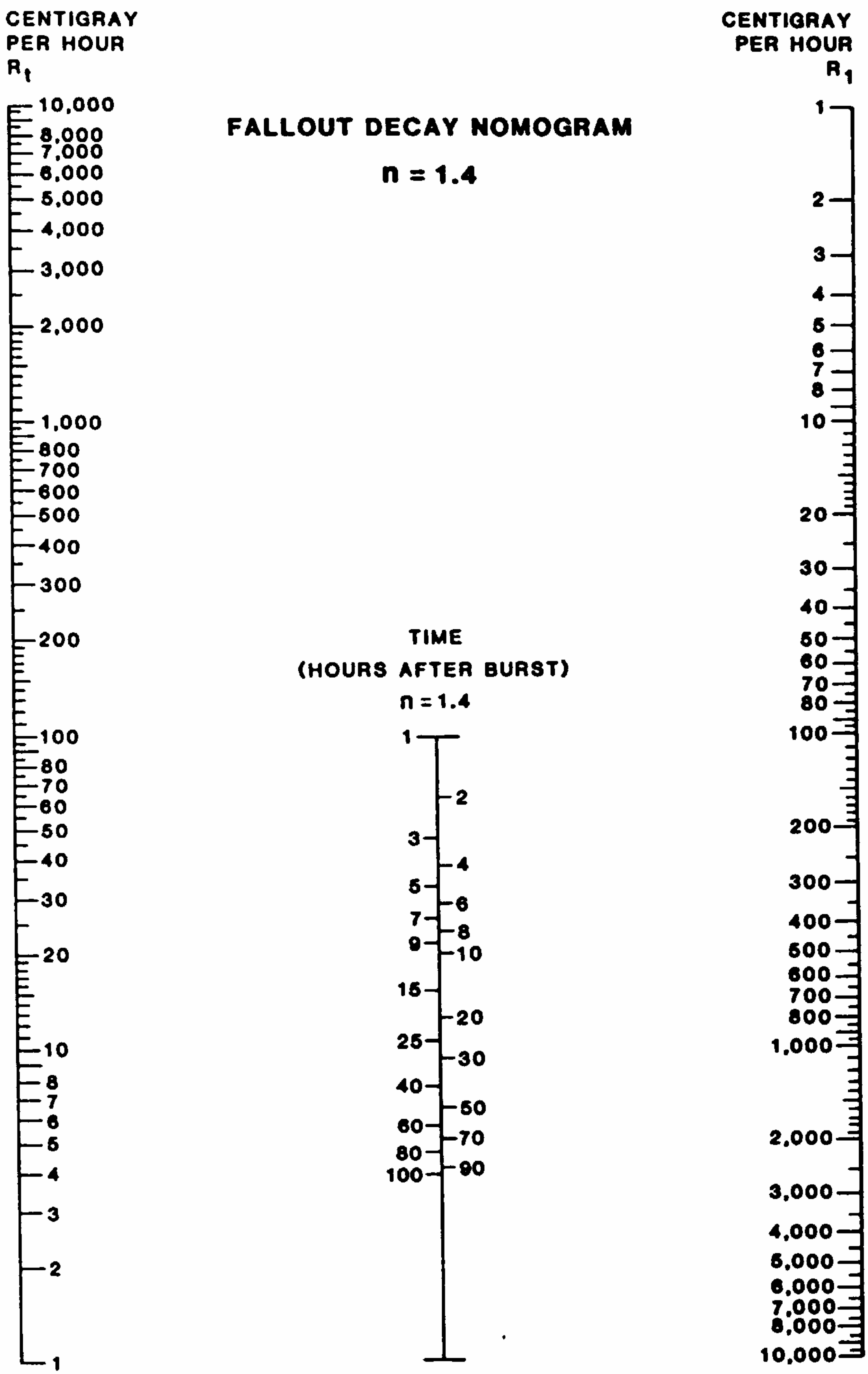


Figure J-21. Fallout Decay Nomogram (n=1.4)

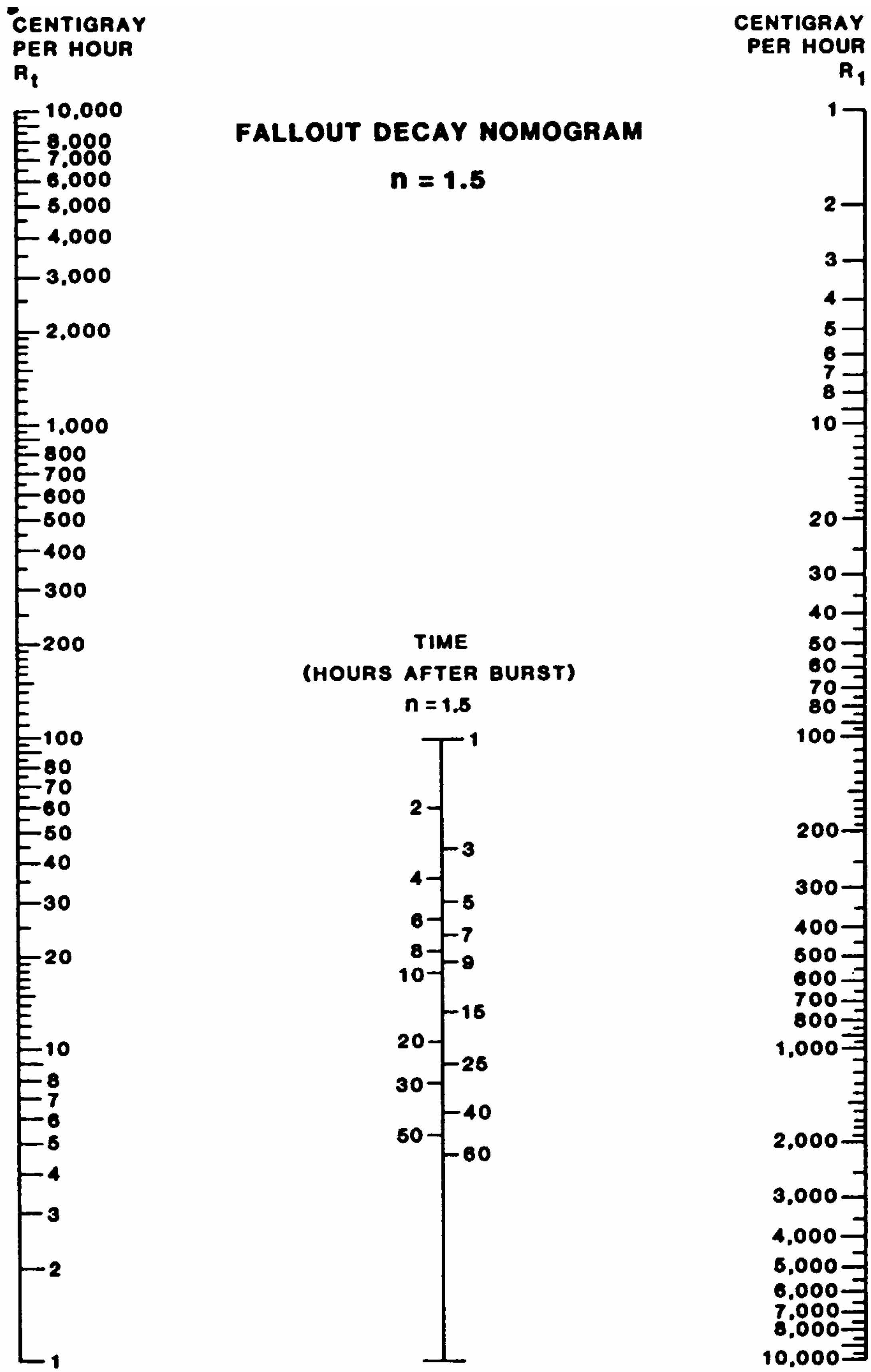


Figure J-22. Fallout Decay Nomogram (n=1.5)

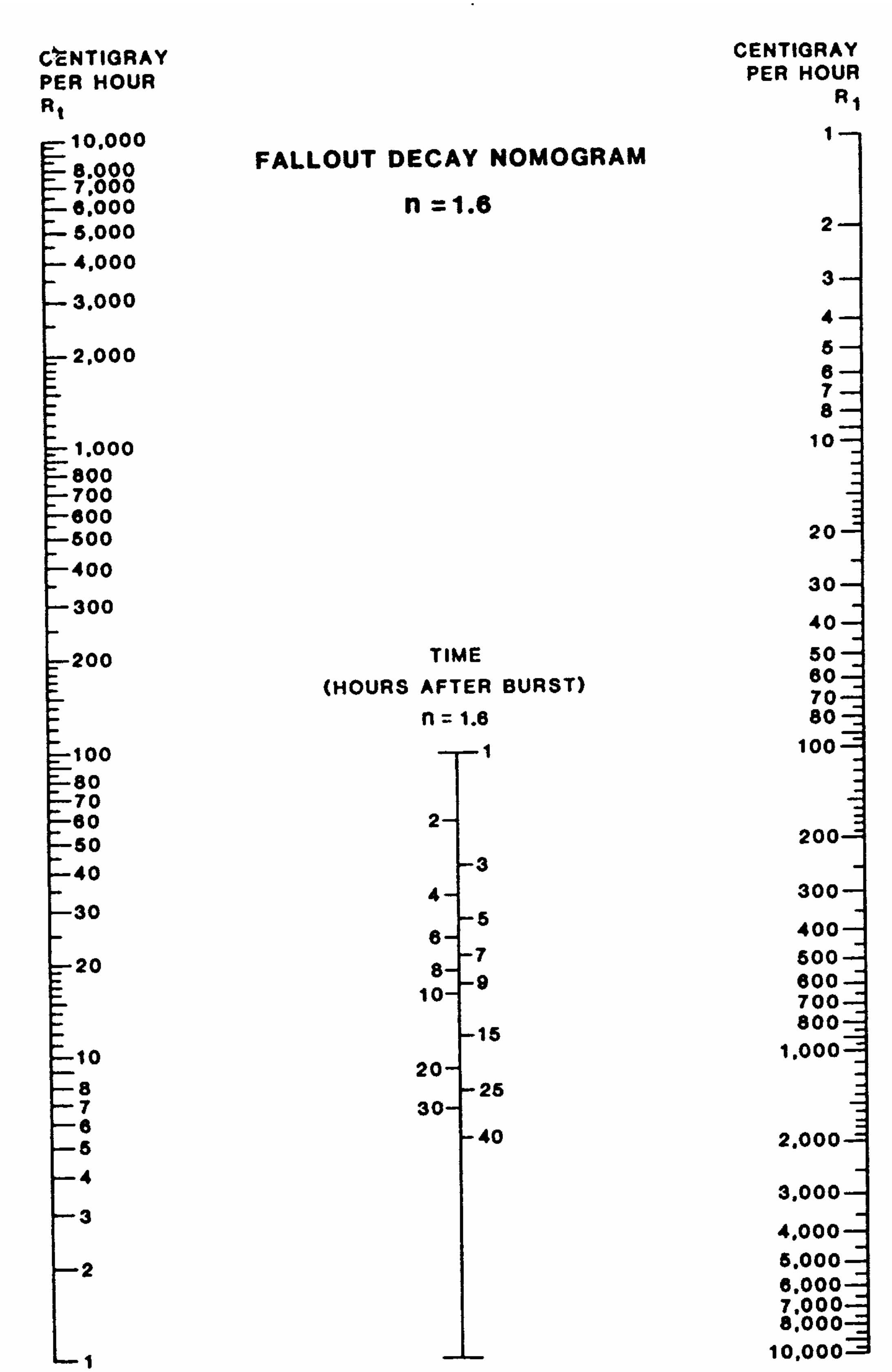


Figure J-23. Fallout Decay Nomogram (n=1.6)

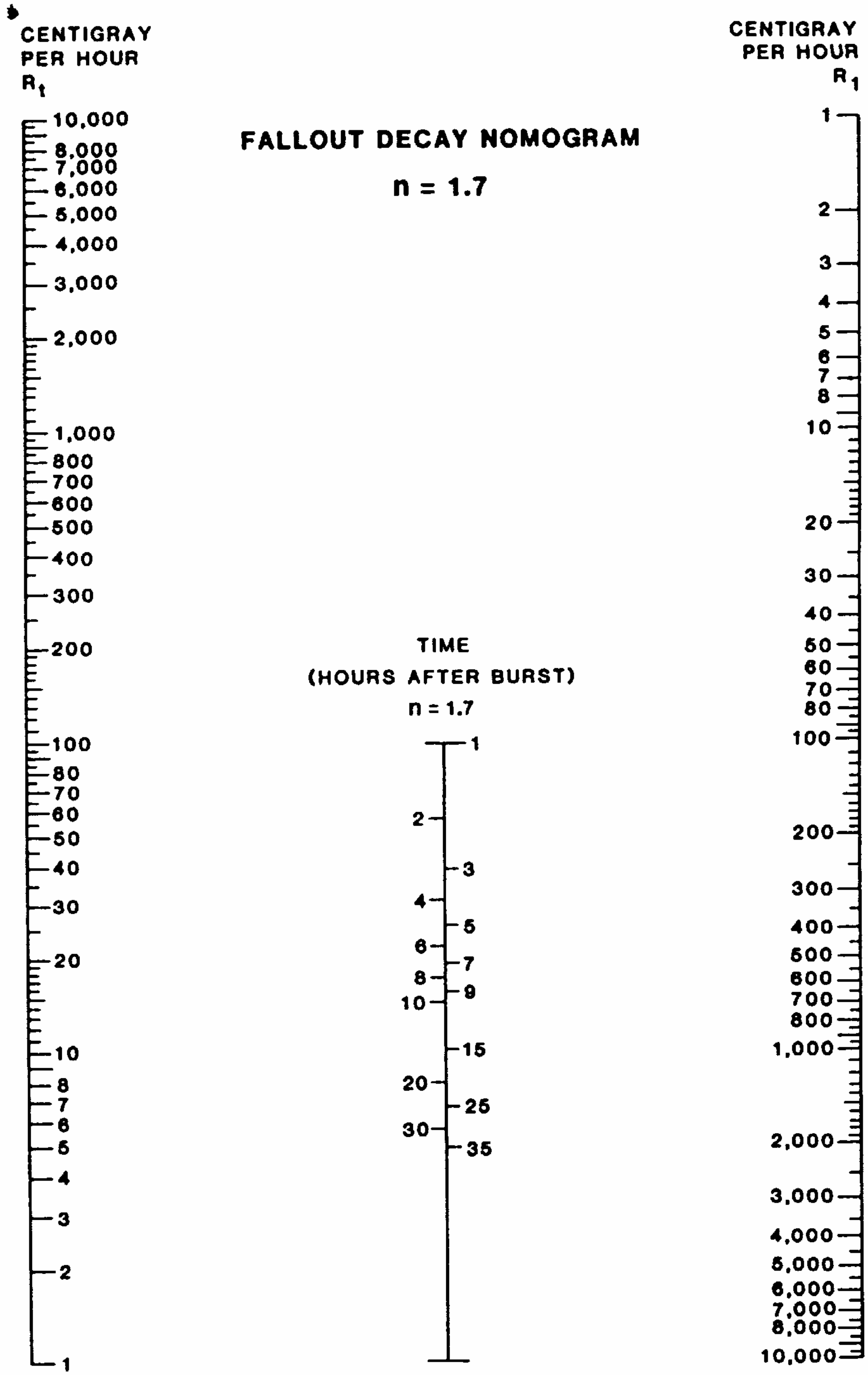


Figure J-24. Fallout Decay Nomogram (n=1.7)

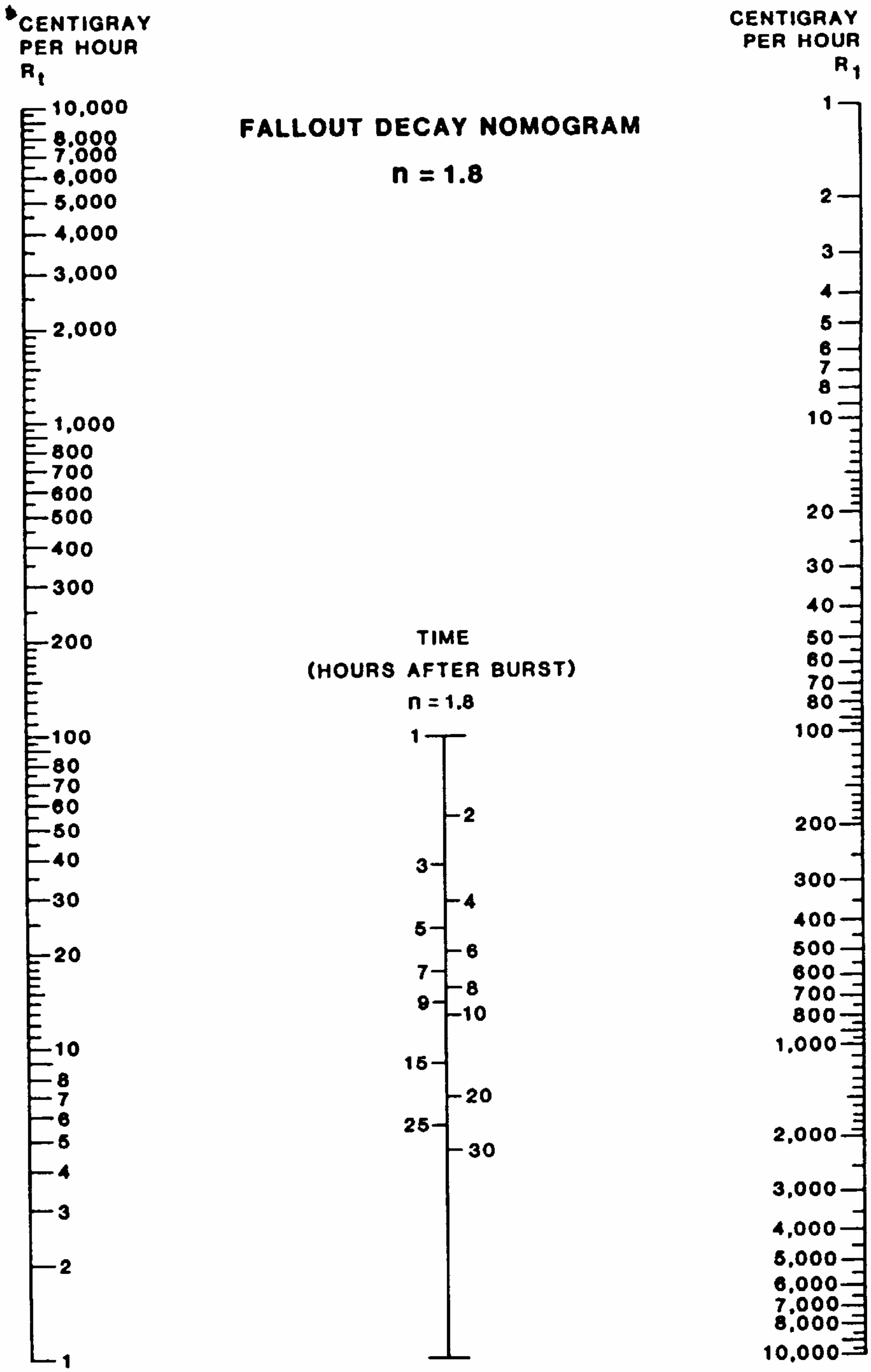


Figure J-25. Fallout Decay Nomogram (n=1.8)

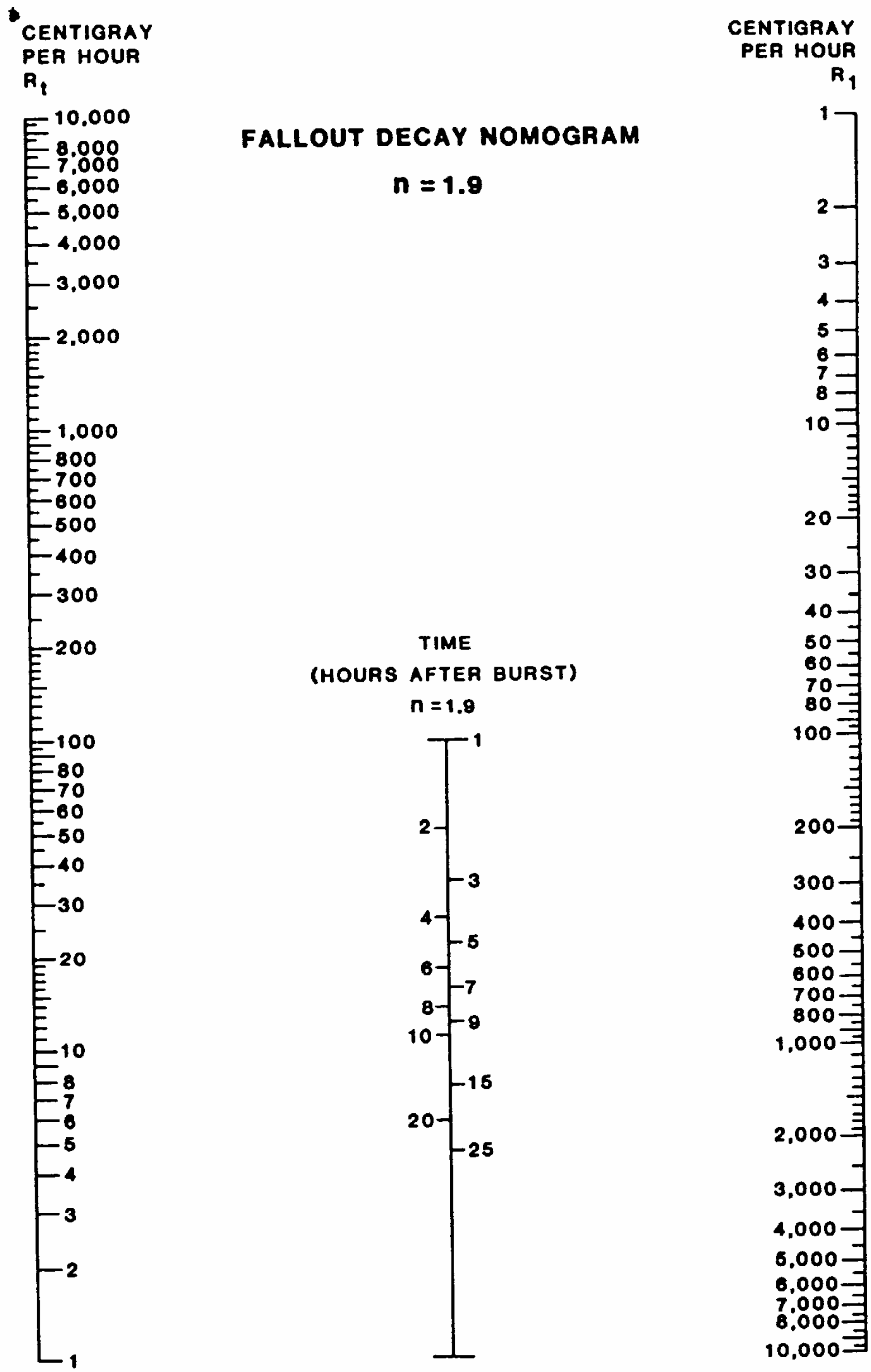


Figure J-26. Fallout Decay Nomogram (n=1.9)

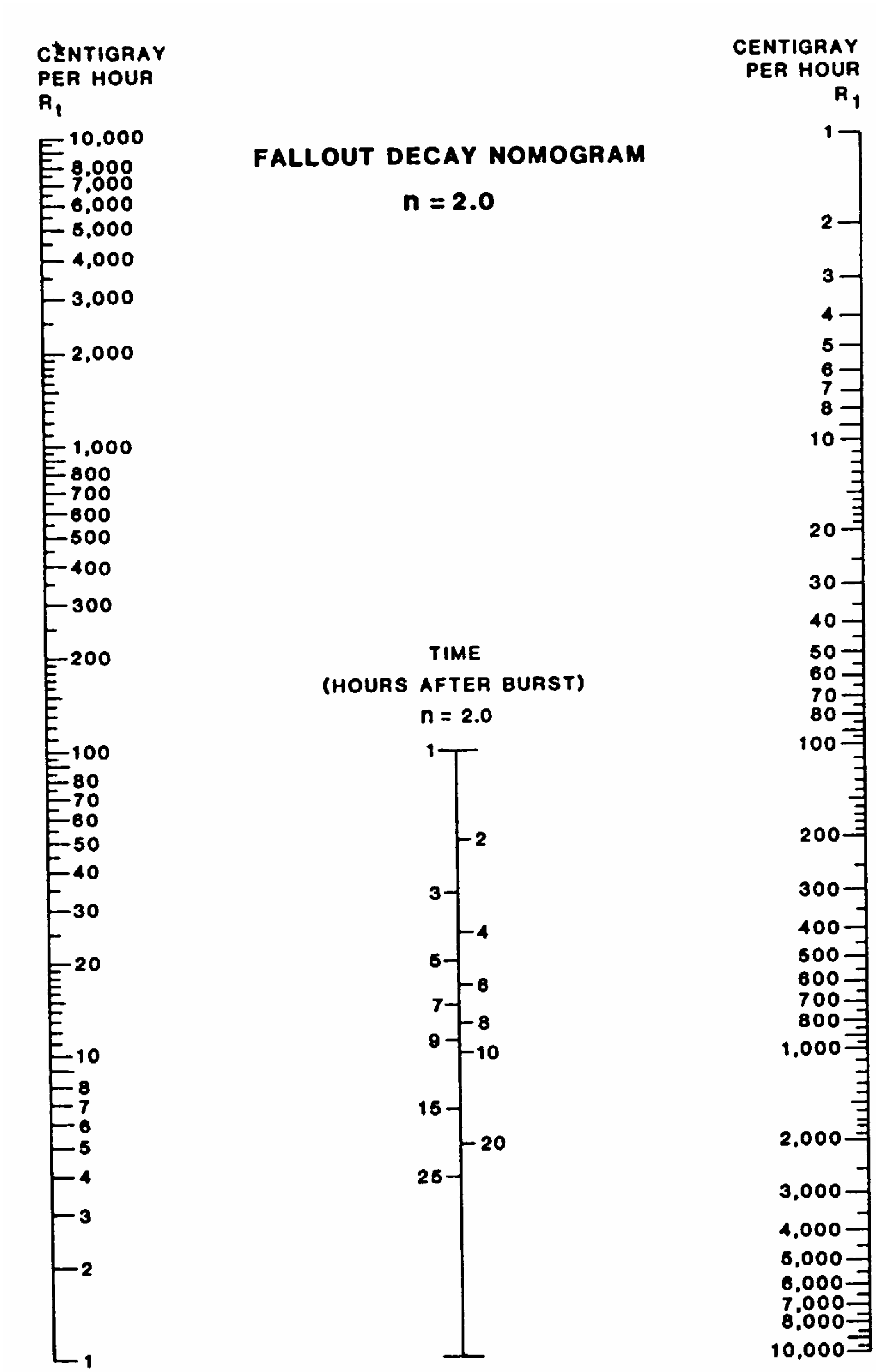


Figure J-27. Fallout Decay Nomogram (n=2.0)

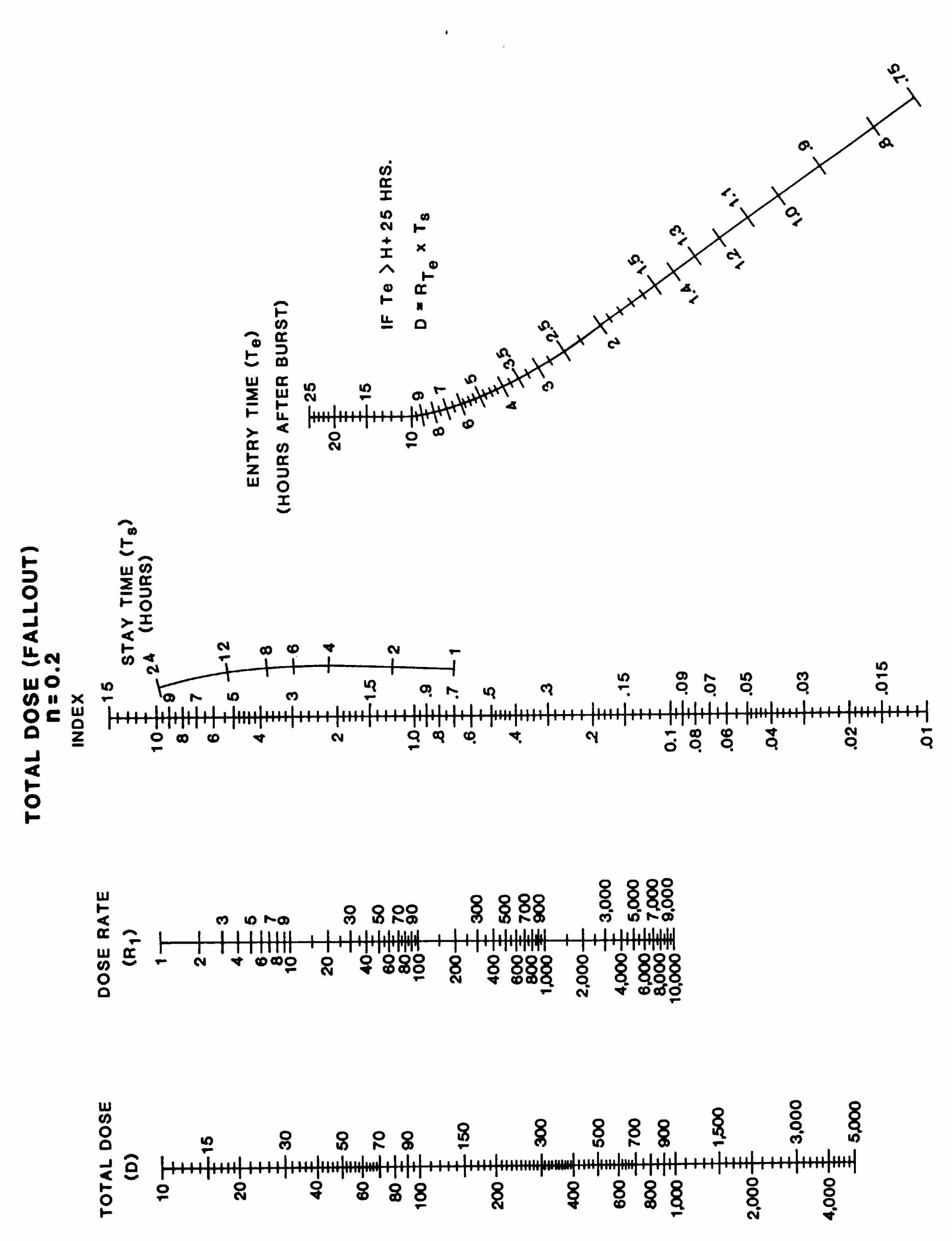


Figure J-28. Total Dose (Fallout)(n=0.2)

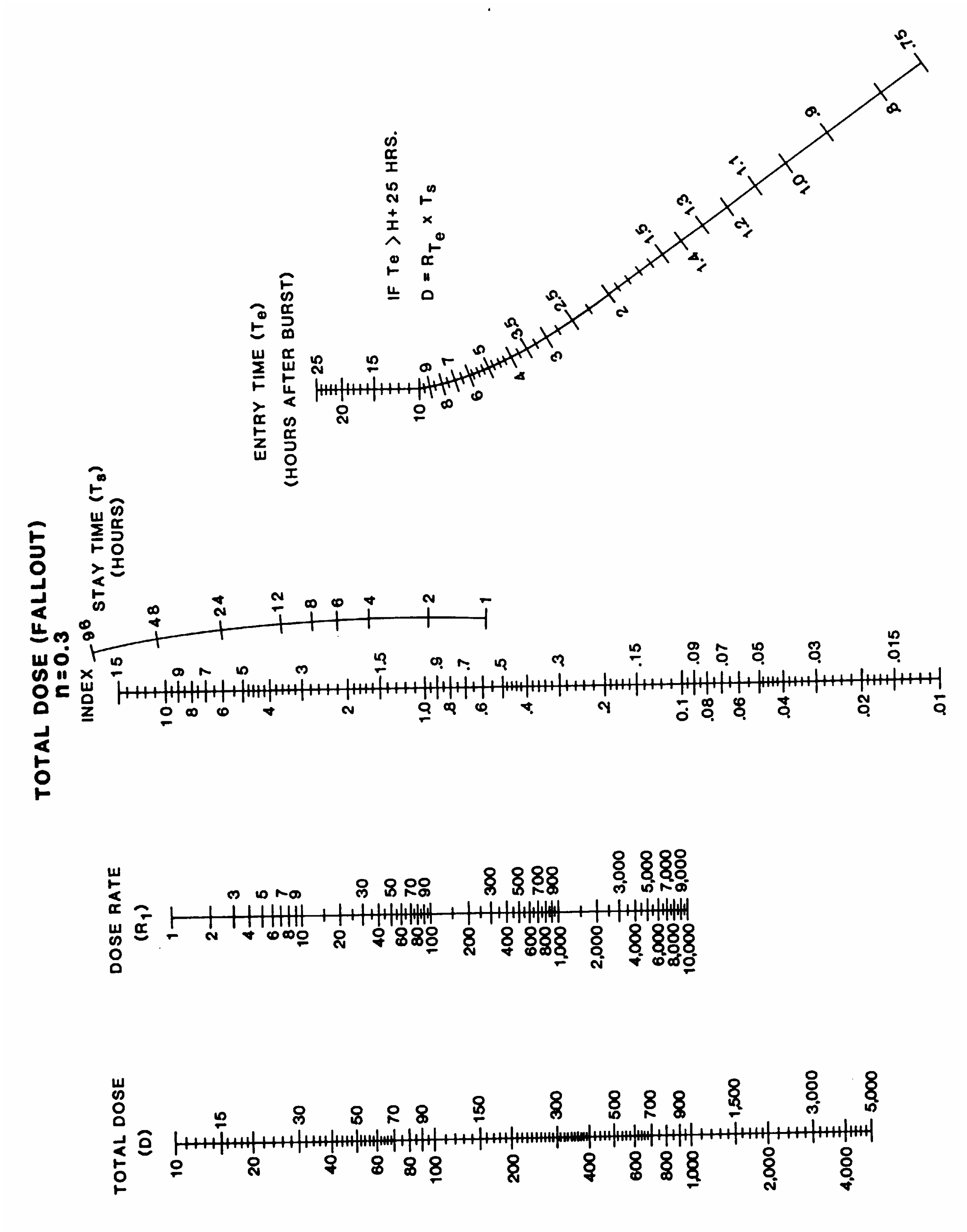


Figure J-29. Total Dose (Fallout)(n=0.3)

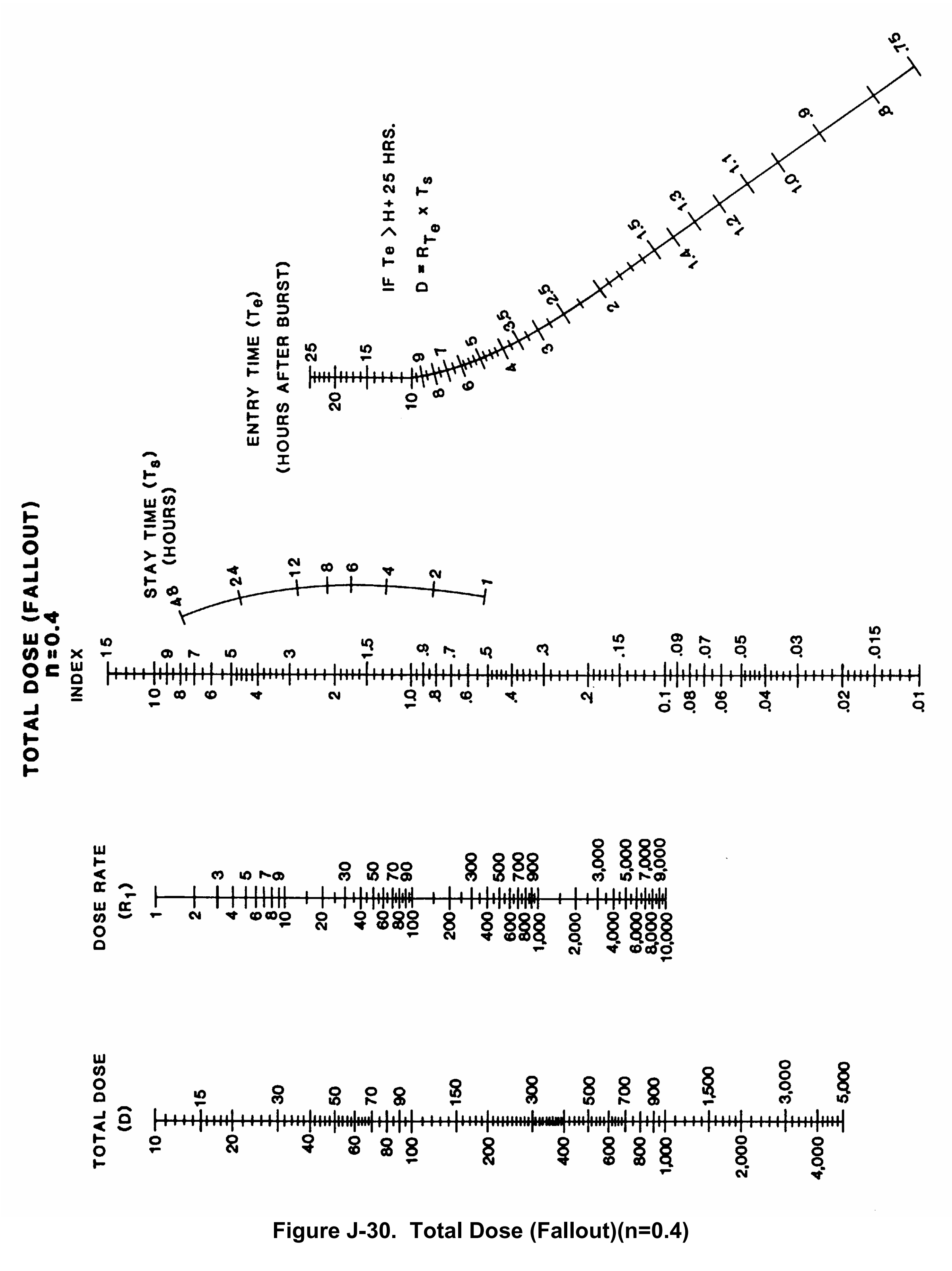


Figure J-30. Total Dose (Fallout)(n=0.4)

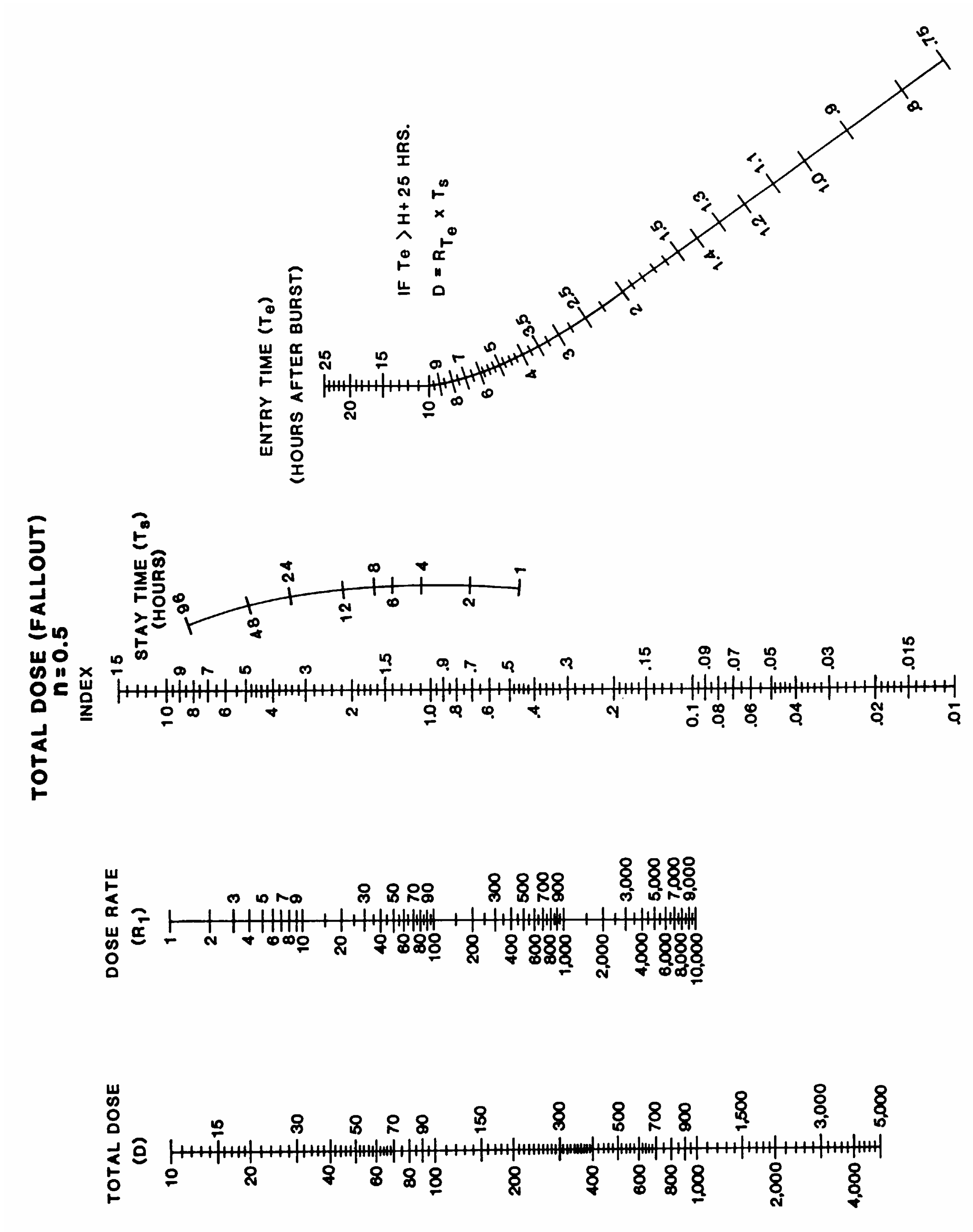


Figure J-31. Total Dose (Fallout)(n=0.5)

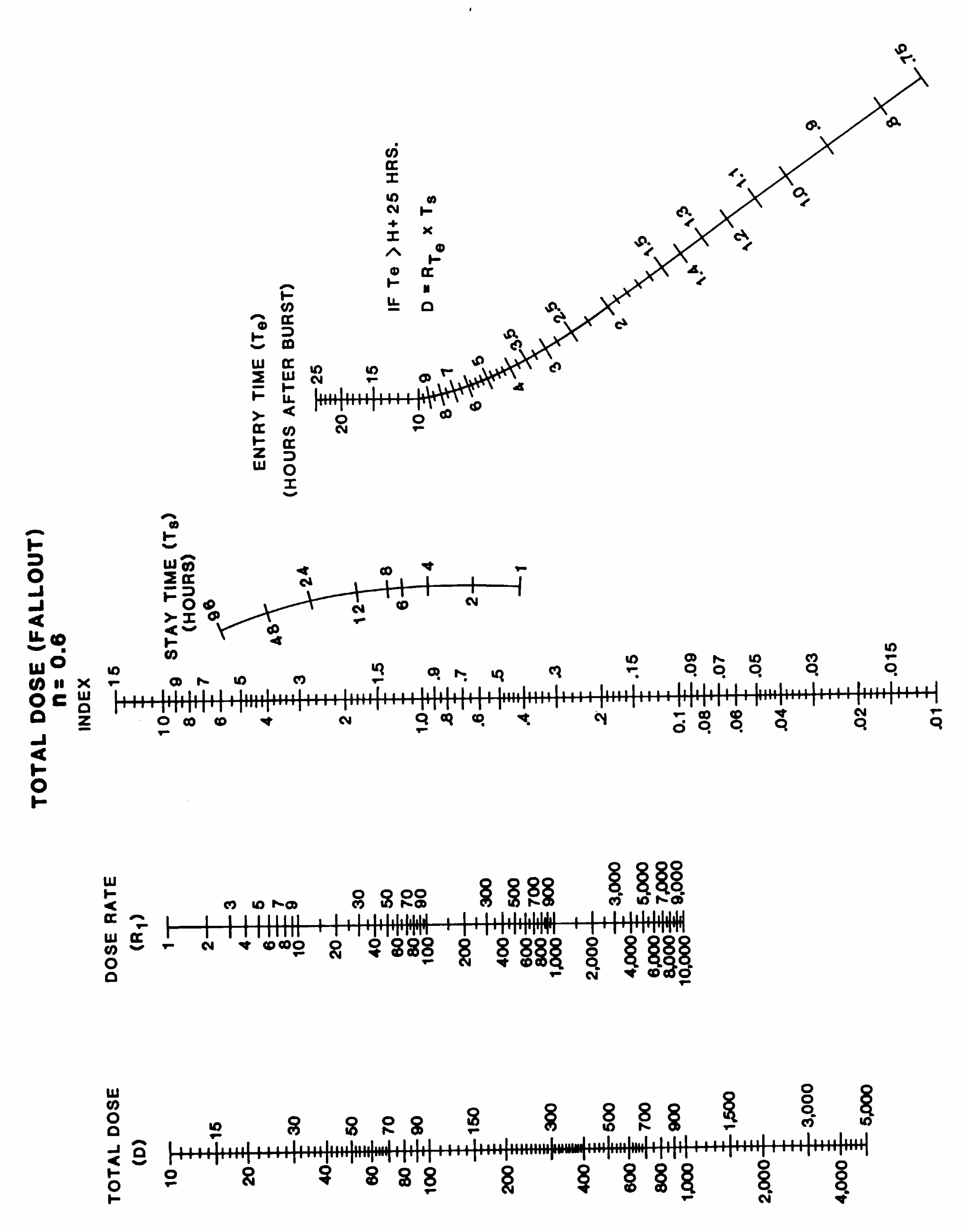


Figure J-32. Total Dose (Fallout)(n=0.6)

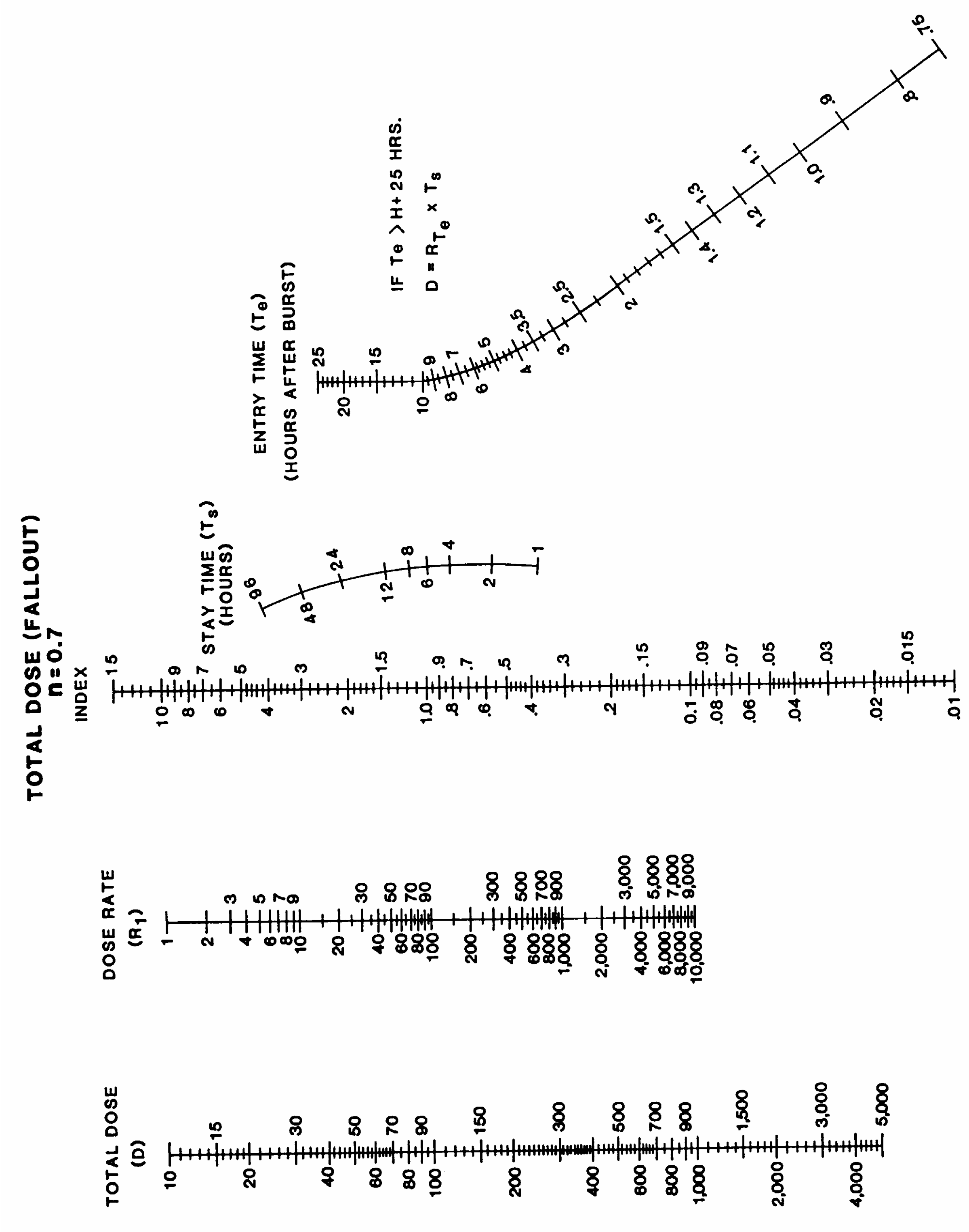


Figure J-33. Total Dose (Fallout)(n=0.7)

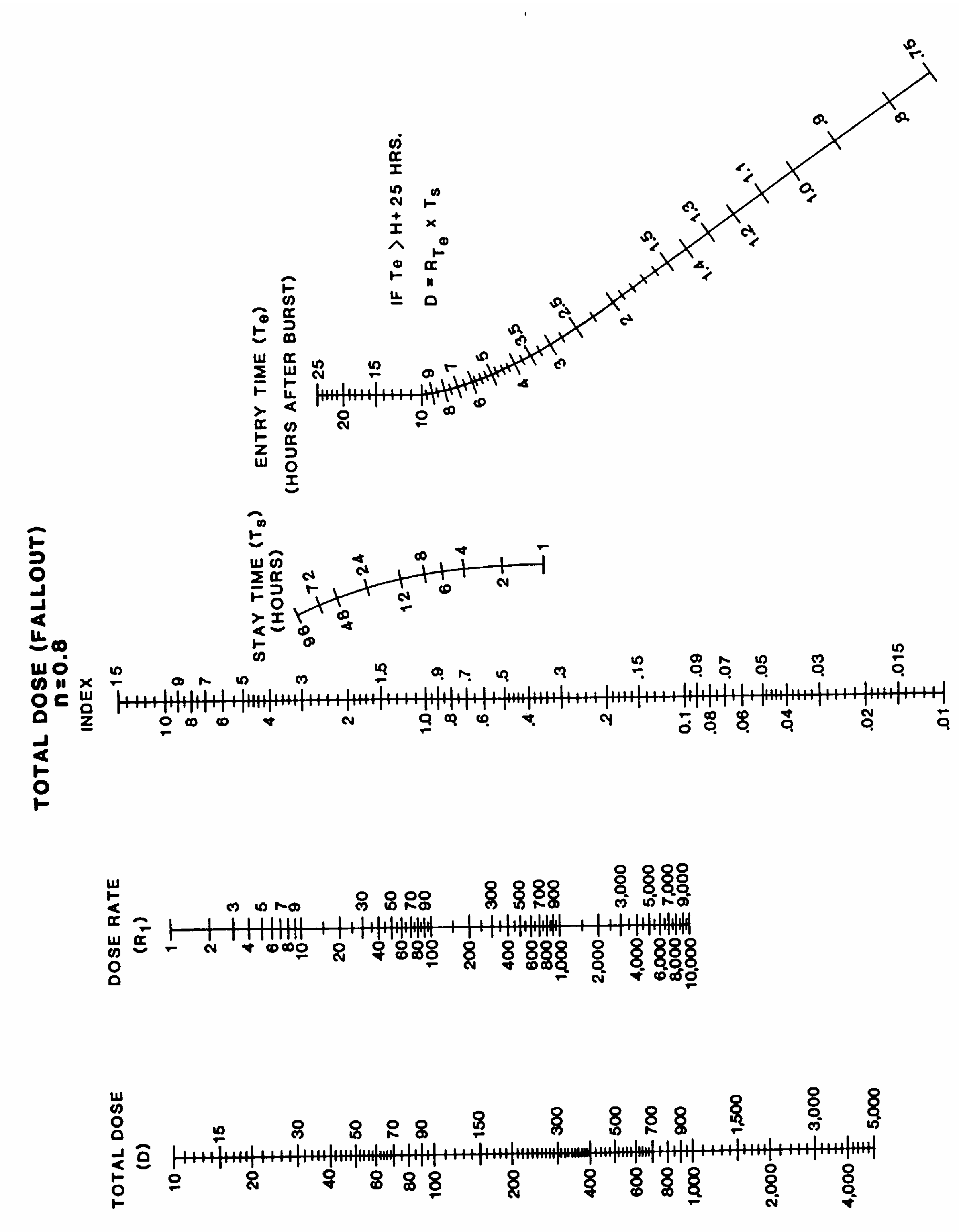


Figure J-34. Total Dose (Fallout)(n=0.8)

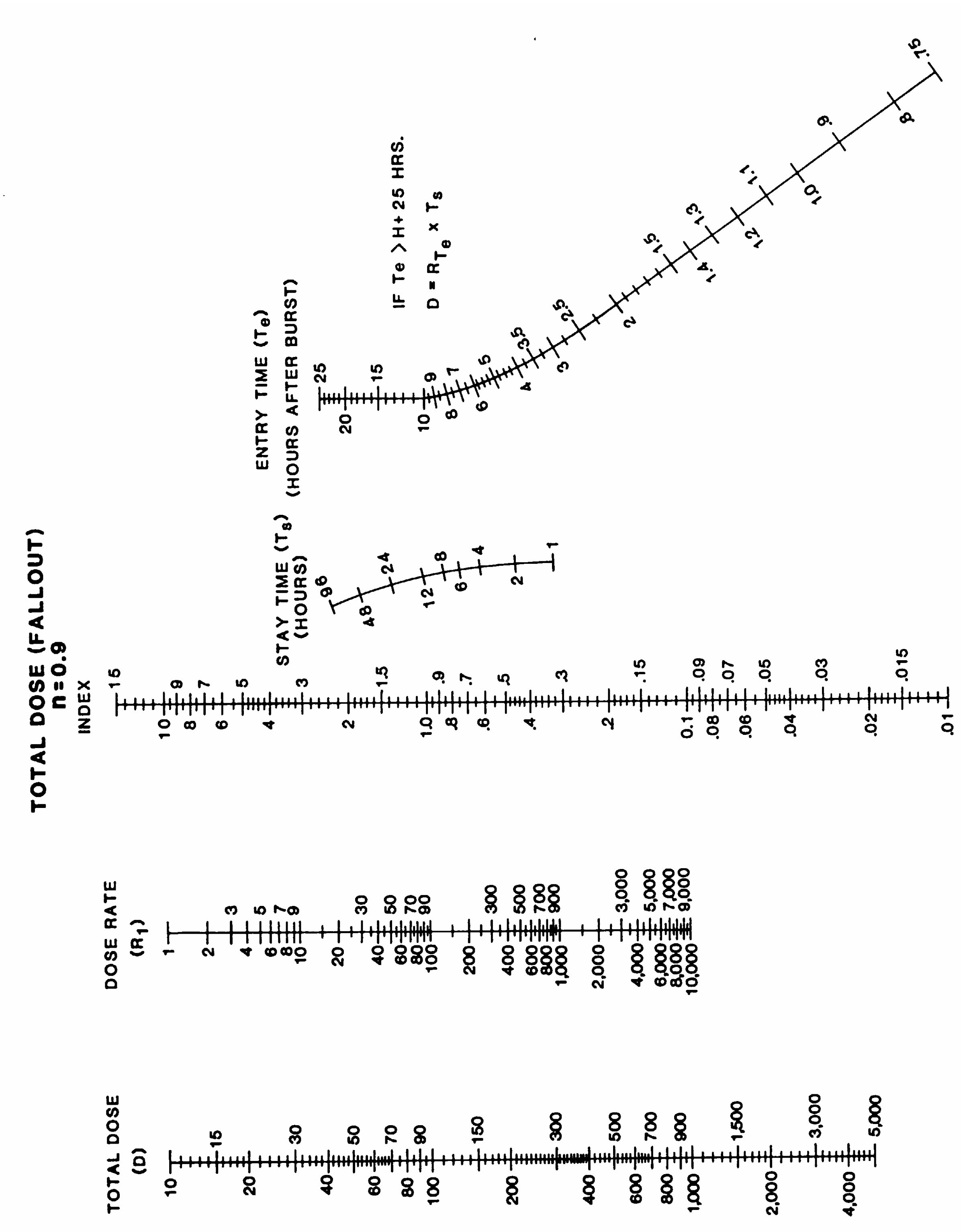


Figure J-35. Total Dose (Fallout)(n=0.9)

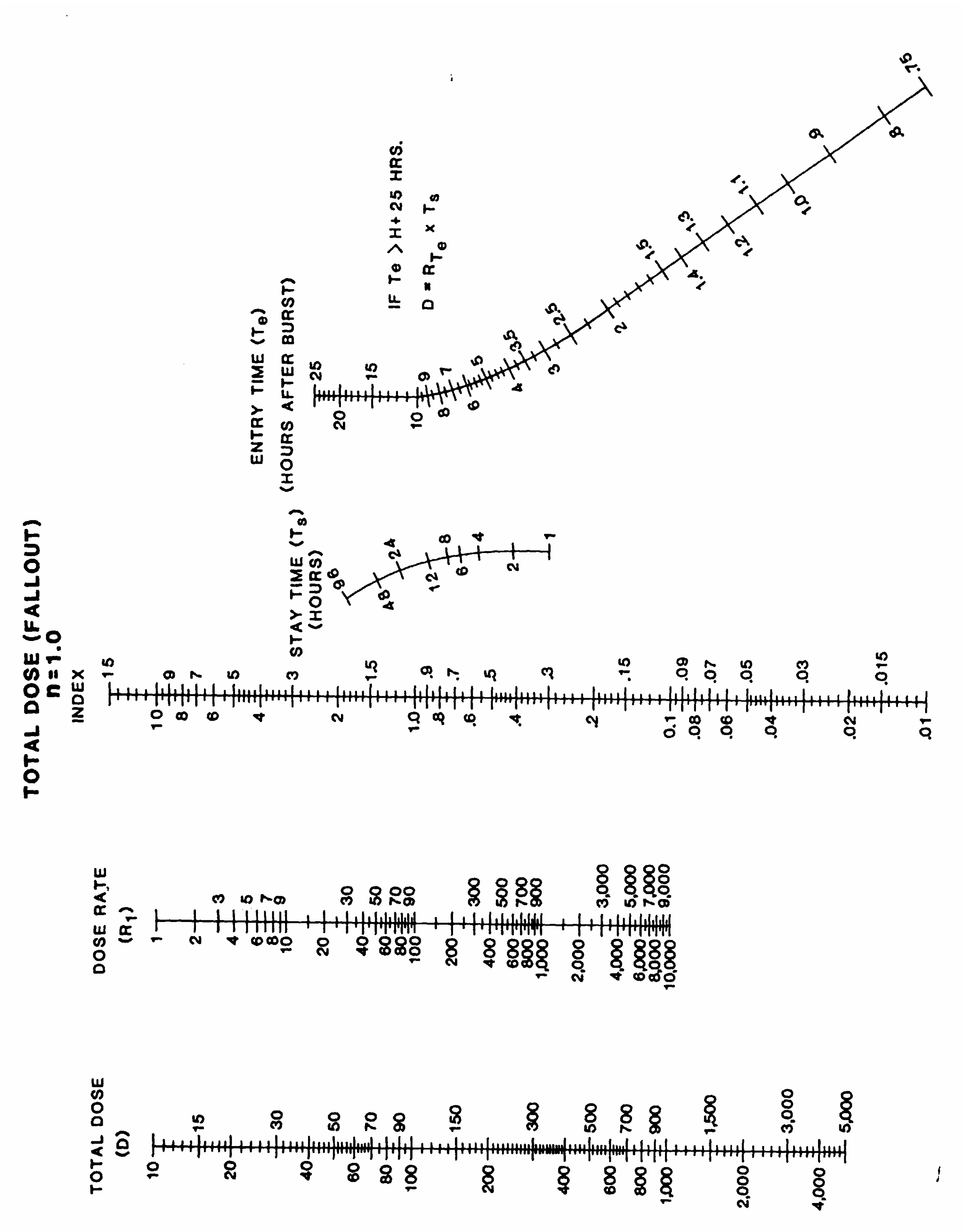


Figure J-36. Total Dose (Fallout)(n=1.0)

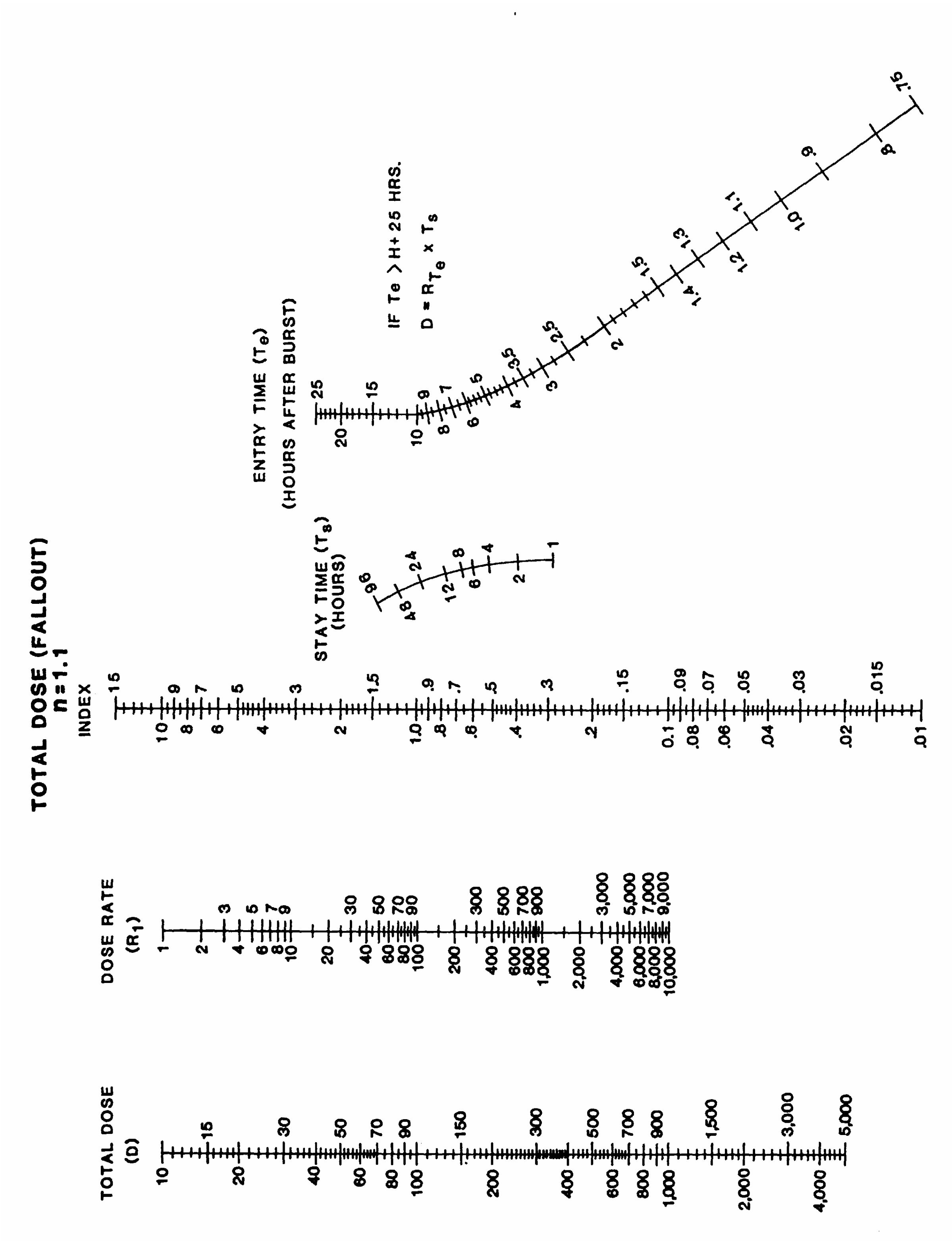


Figure J-37. Total Dose (Fallout)(n=1.1)

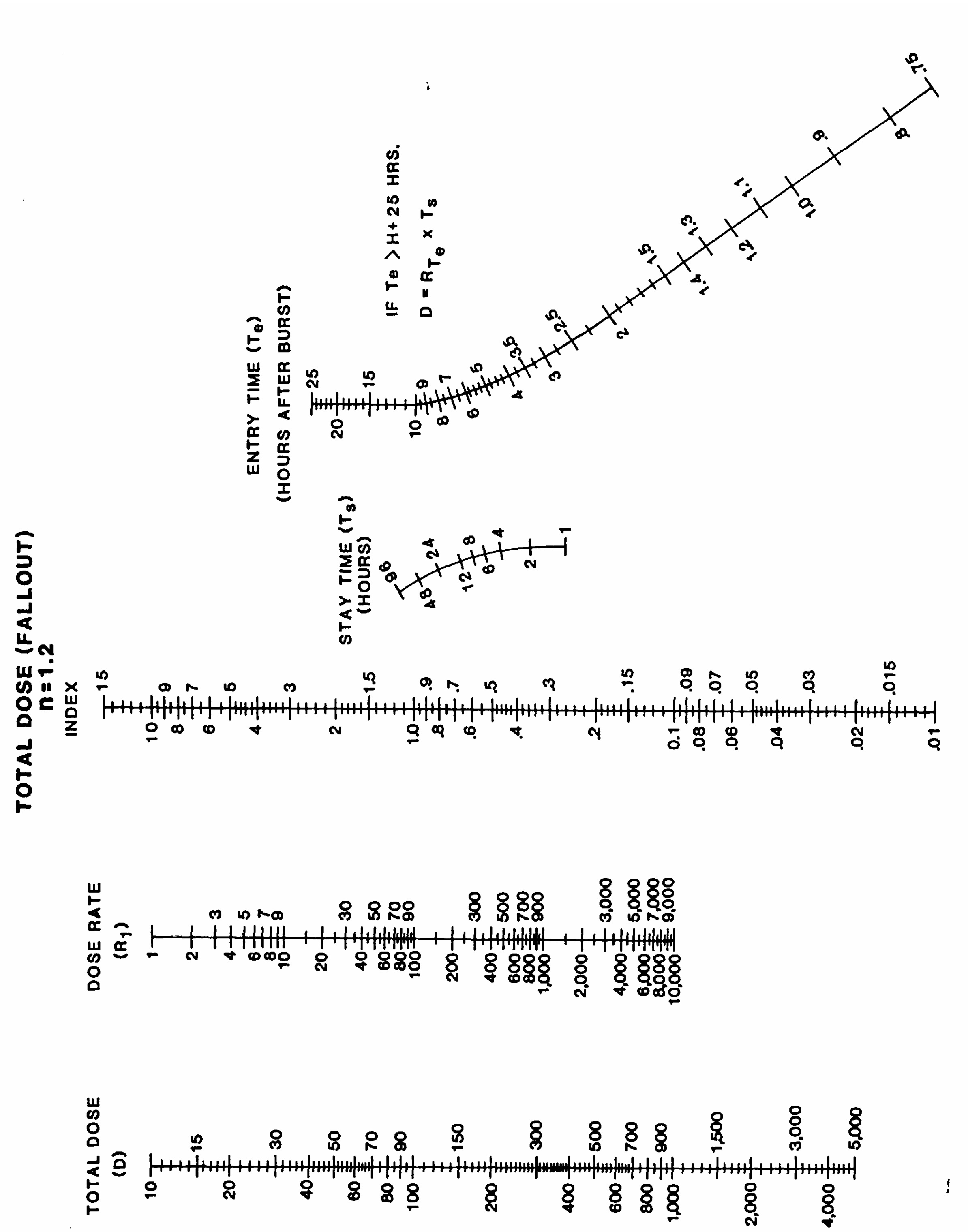


Figure J-38. Total Dose (Fallout)(n=1.2)

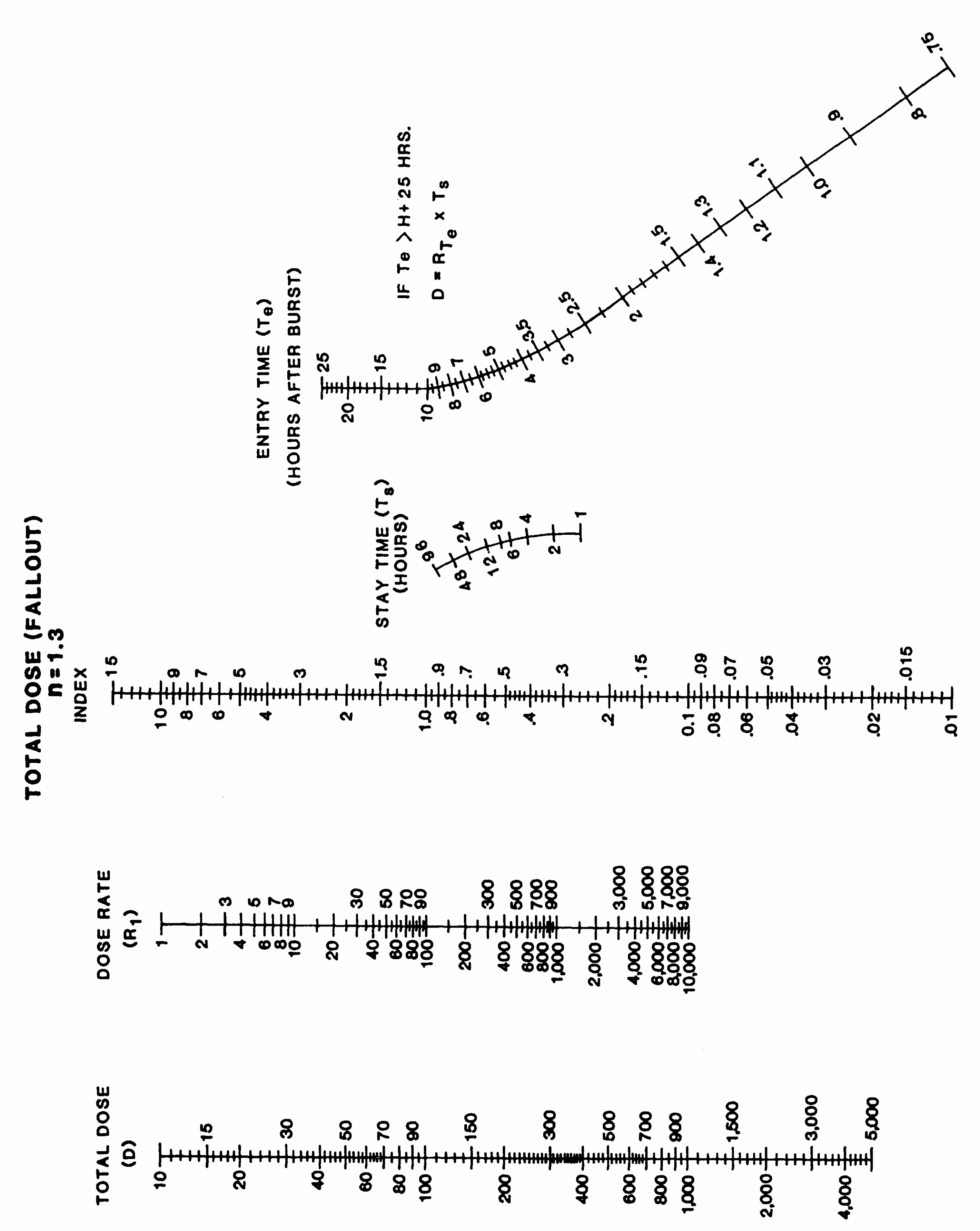


Figure J-39. Total Dose (Fallout)(n=1.3)

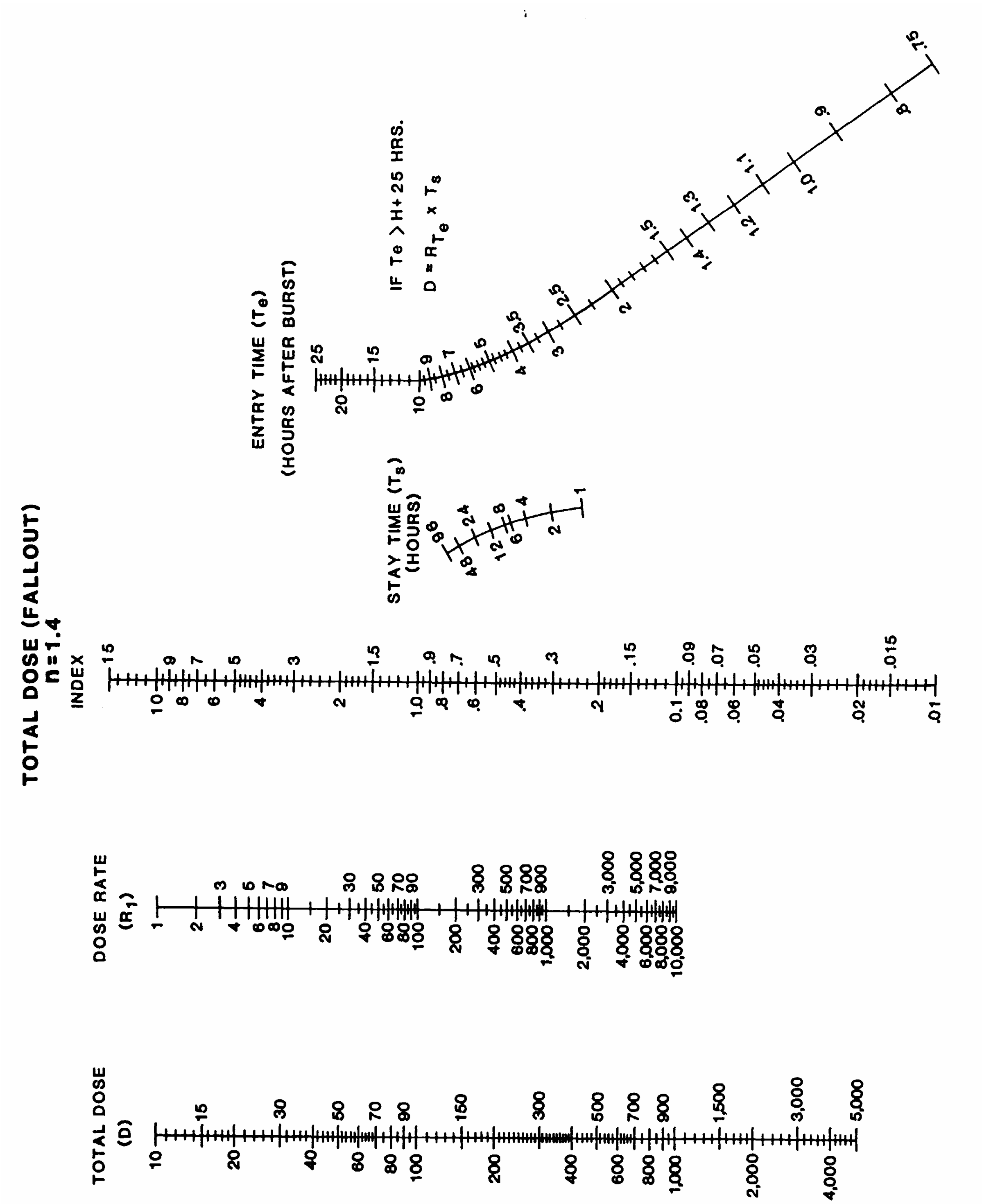


Figure J-40. Total Dose (Fallout)(n=1.4)

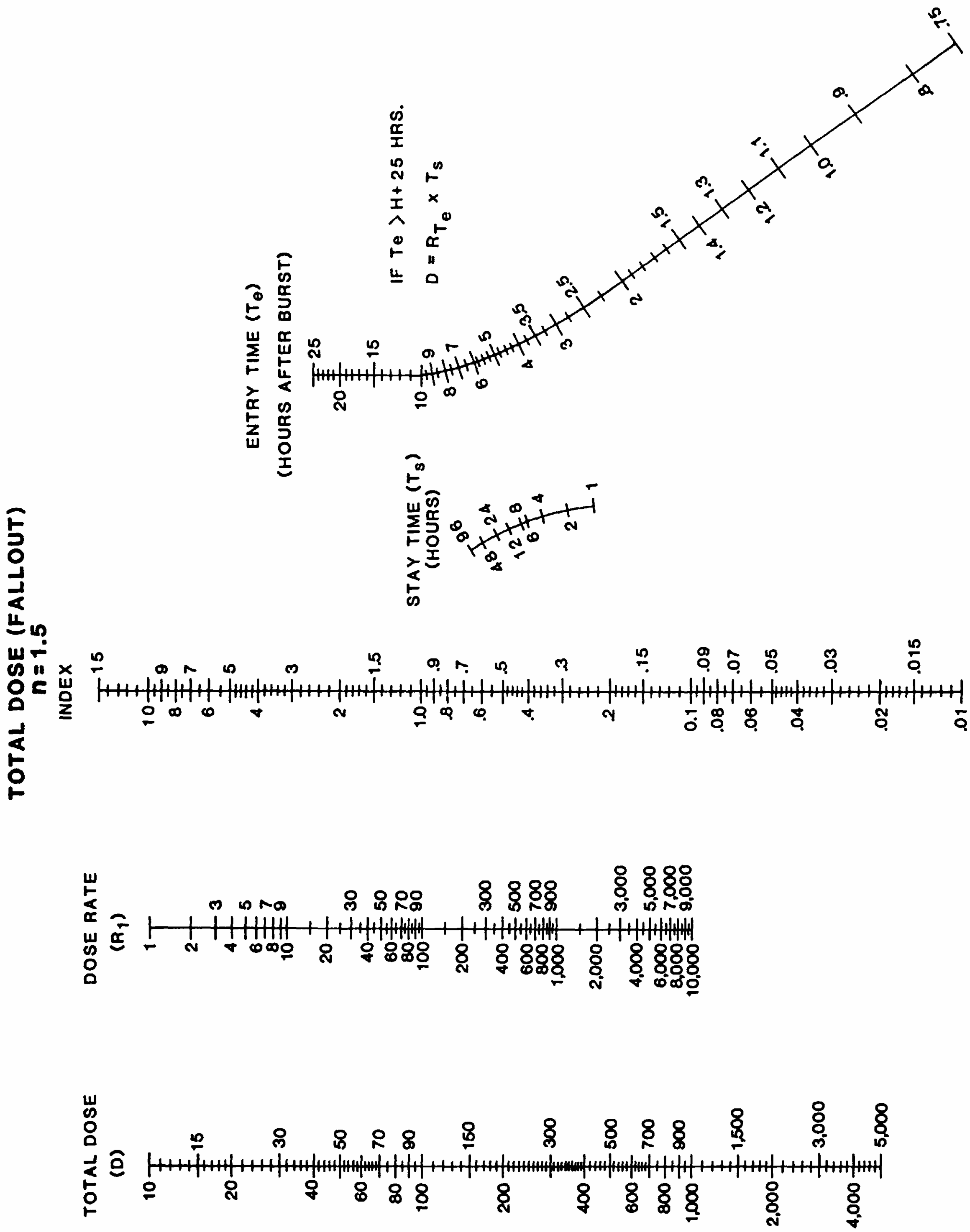


Figure J-41. Total Dose (Fallout)(n=1.5)

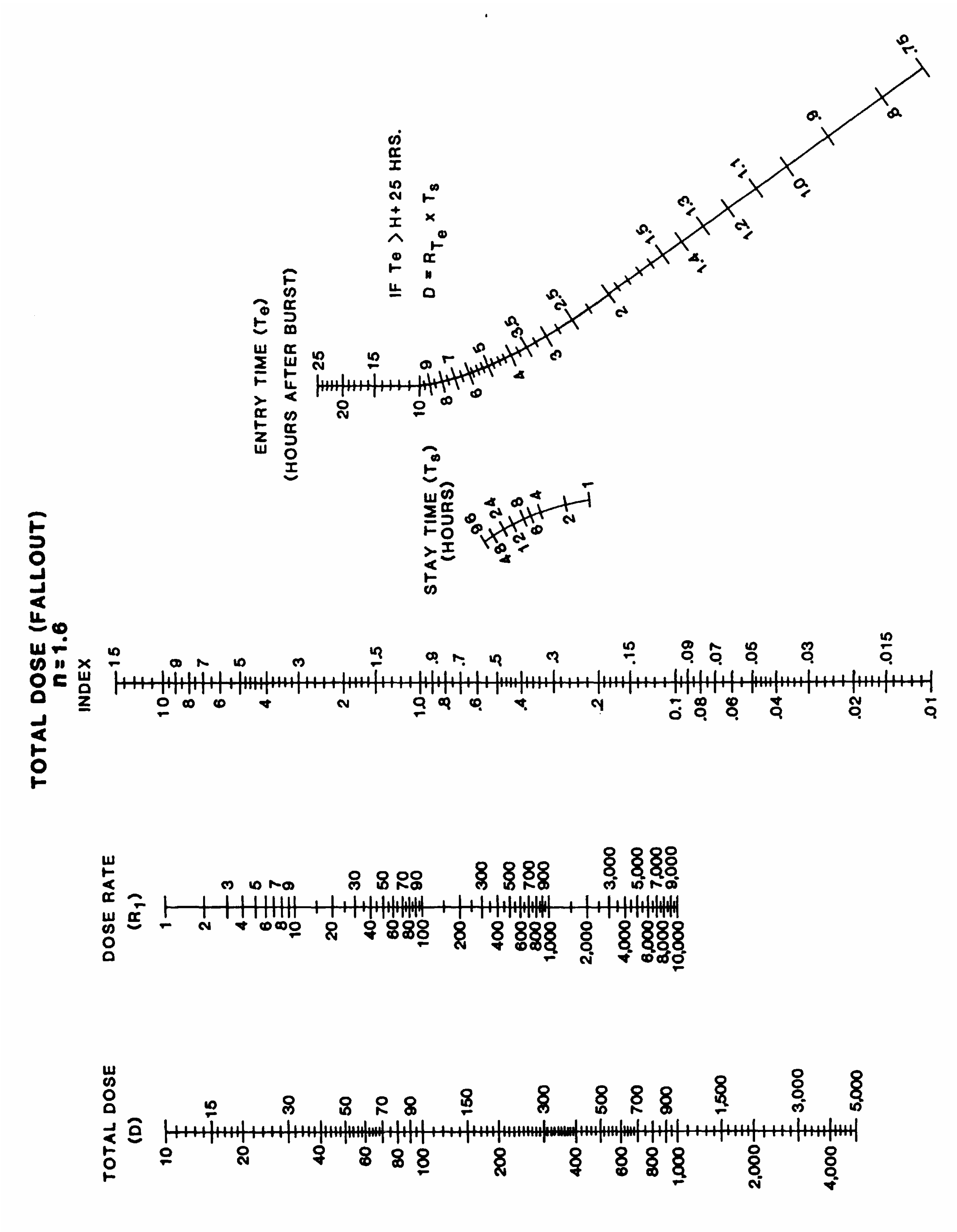


Figure J-42. Total Dose (Fallout)(n=1.6)

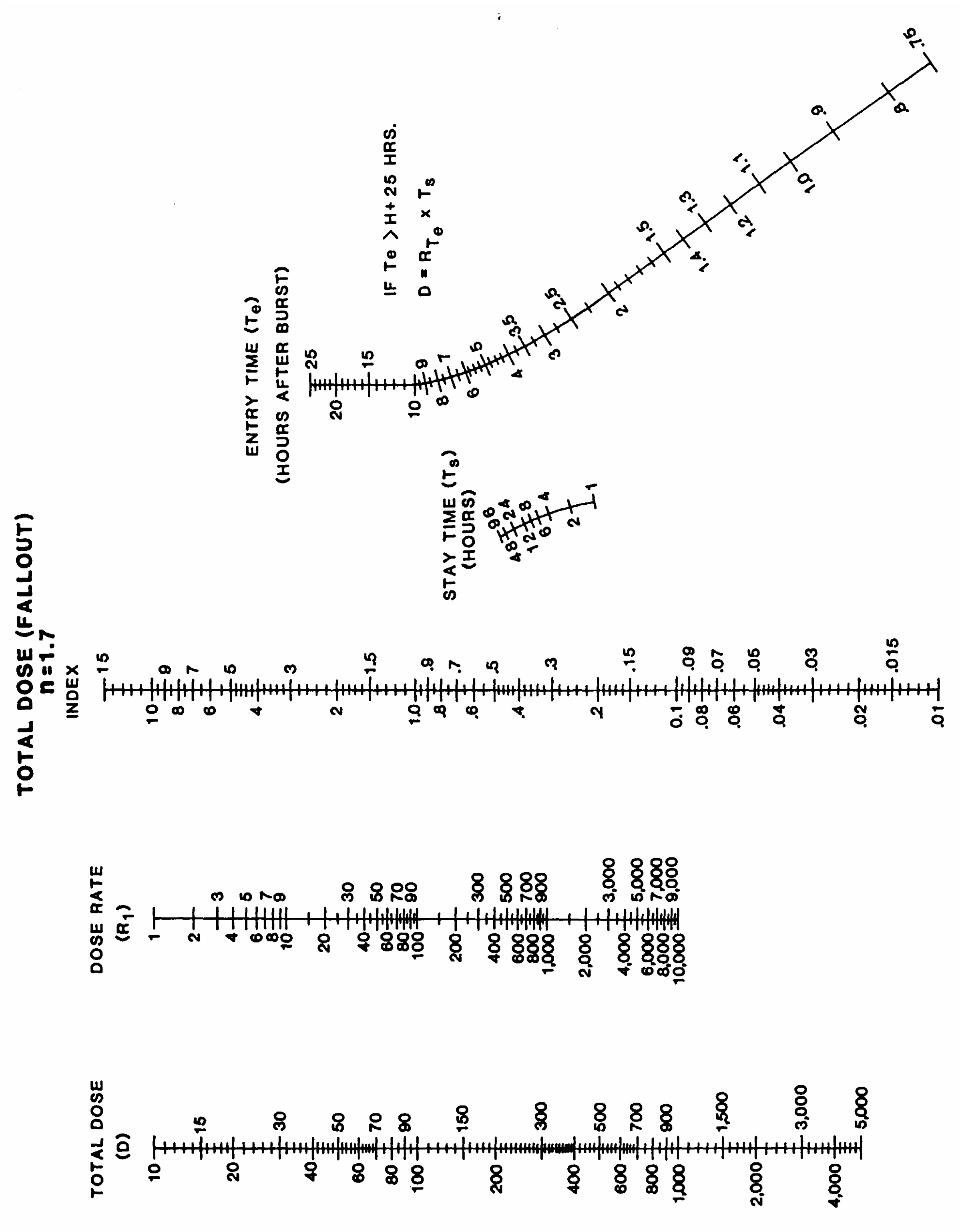


Figure J-43. Total Dose (Fallout)(n=1.7)

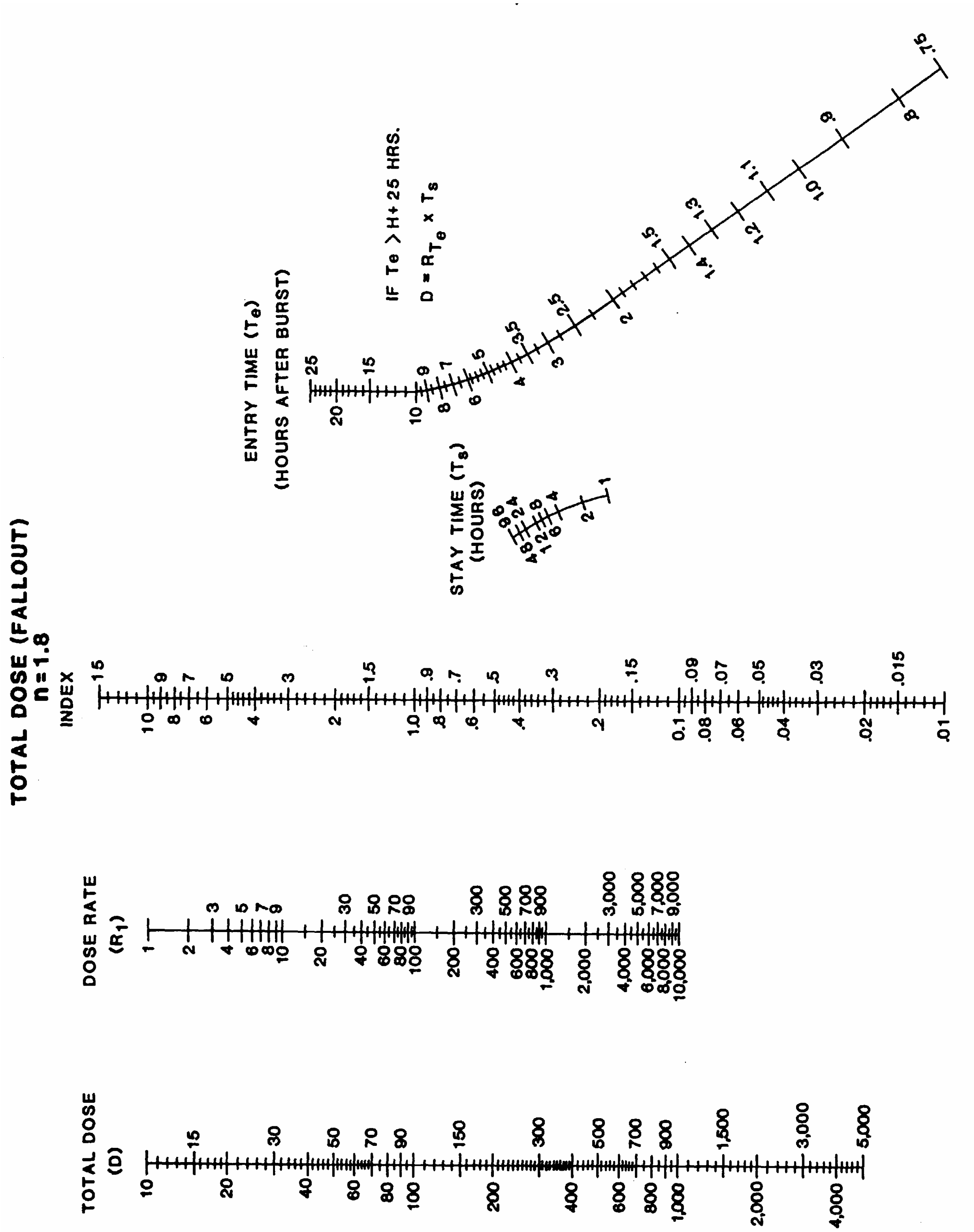


Figure J-44. Total Dose (Fallout)(n=1.8)

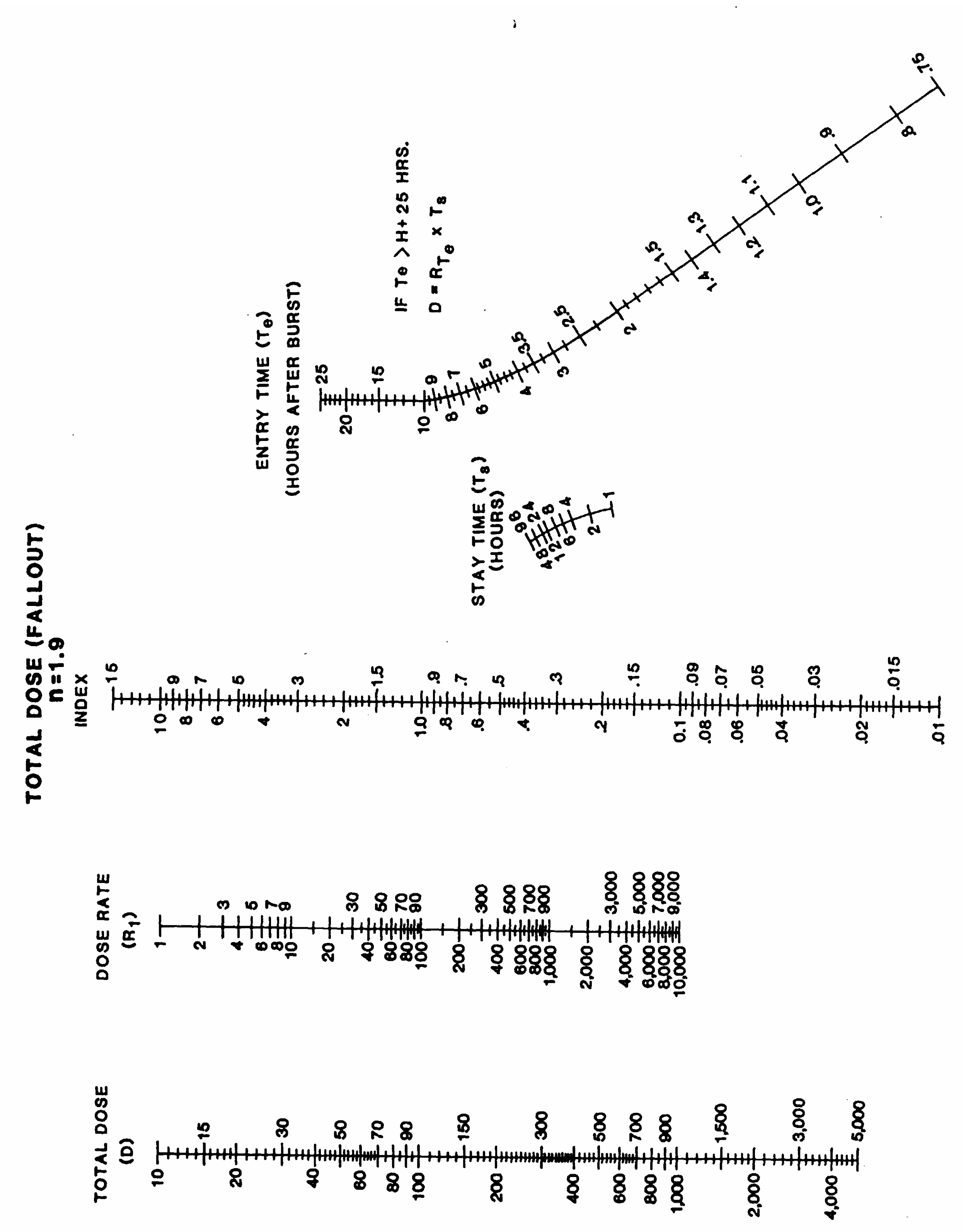


Figure J-45. Total Dose (Fallout)(n=1.9)

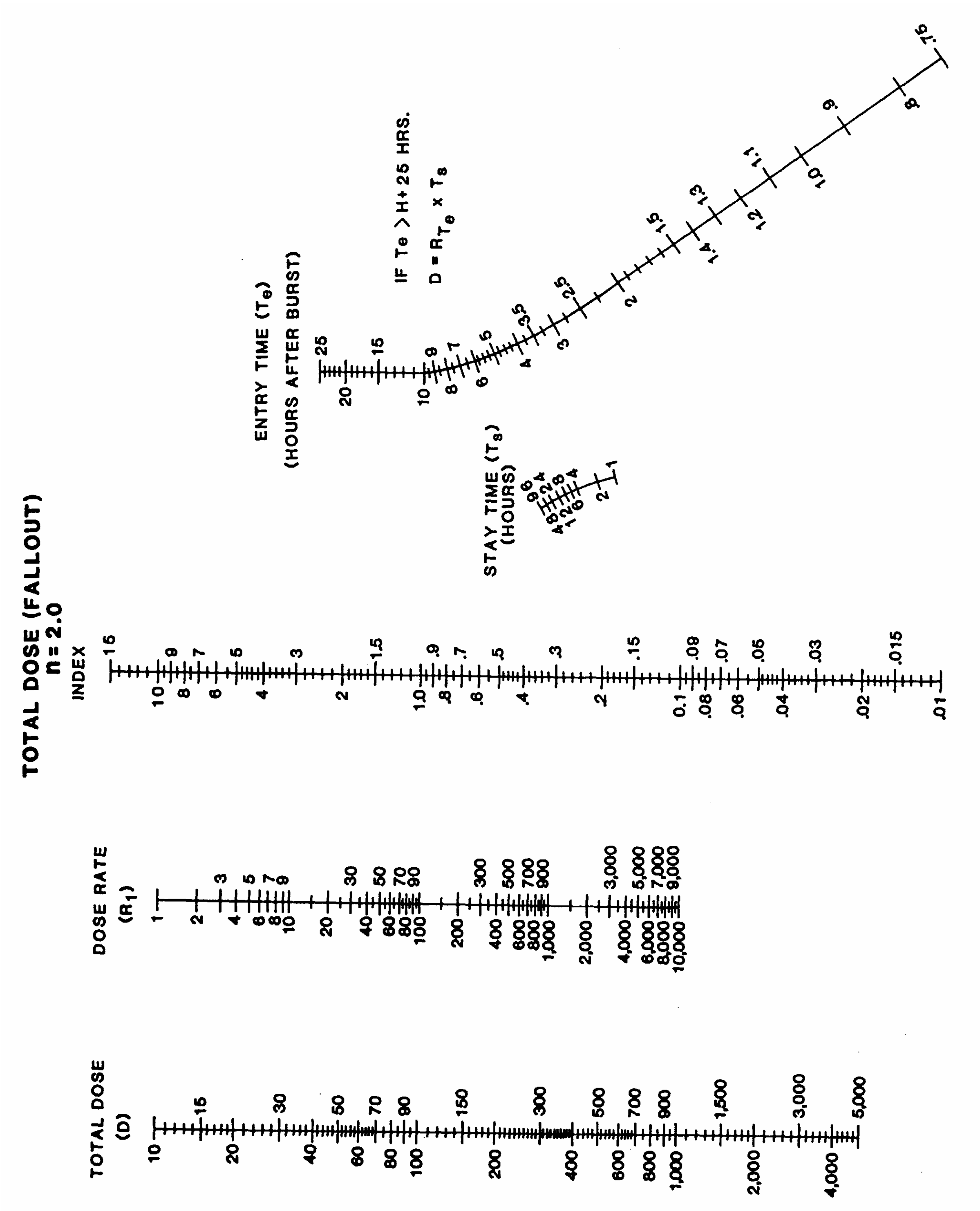


Figure J-46. Total Dose (Fallout) (n=2.0)

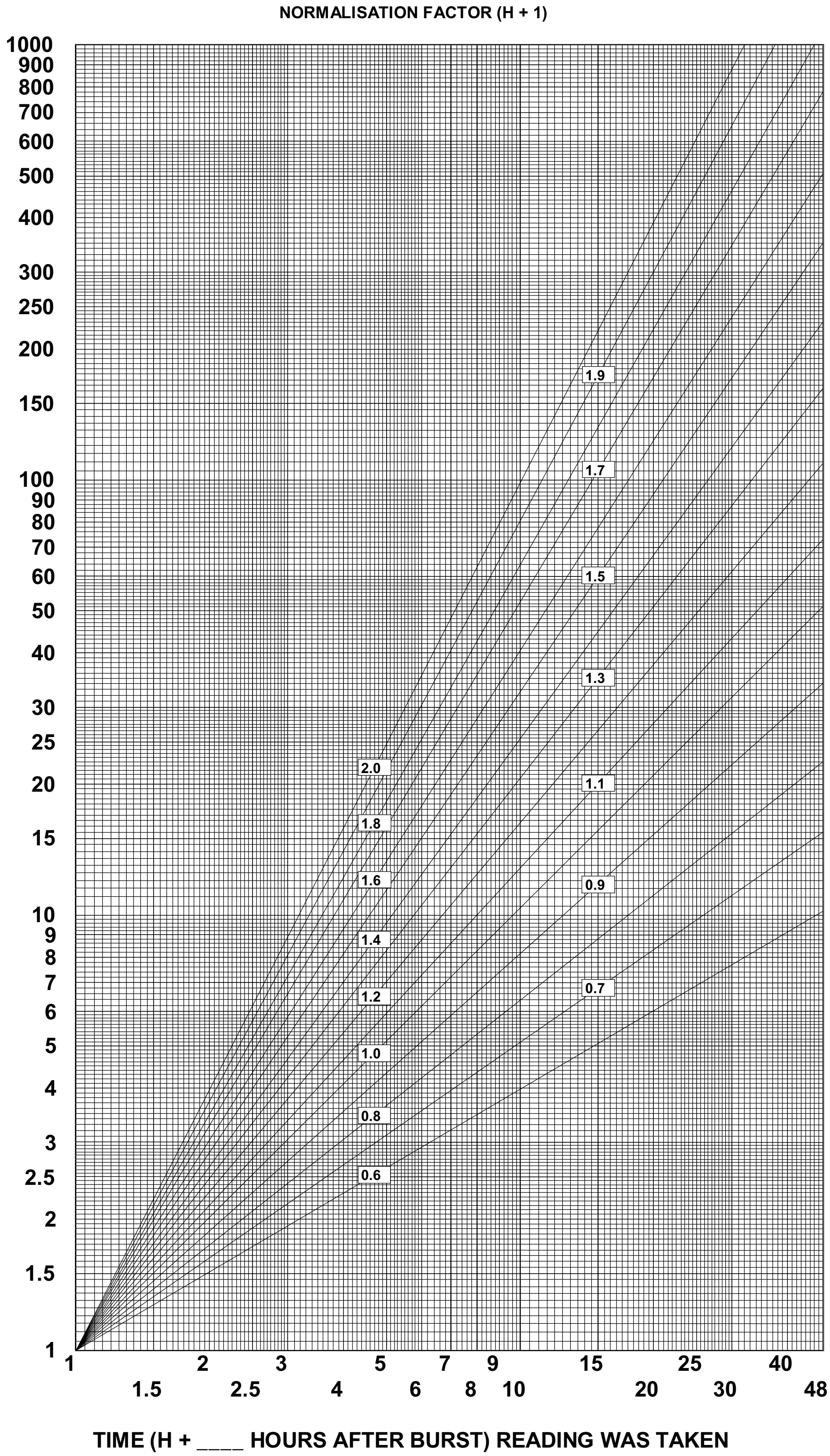


Figure J-47. Graphical Method for Determining Normalization Factor (H+1)

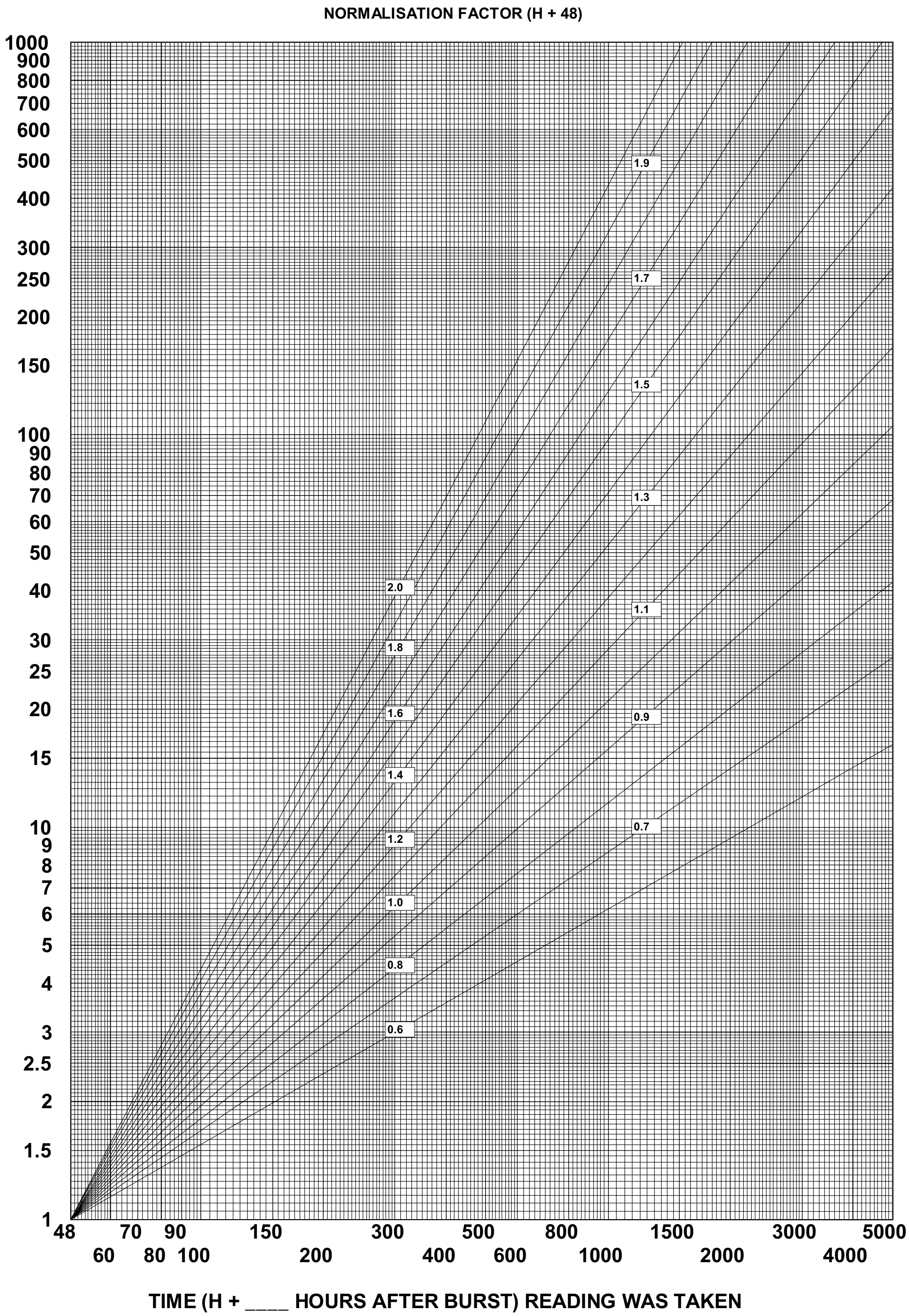


Figure J-48. Graphical Method for Determining Normalization Factor (H+1)

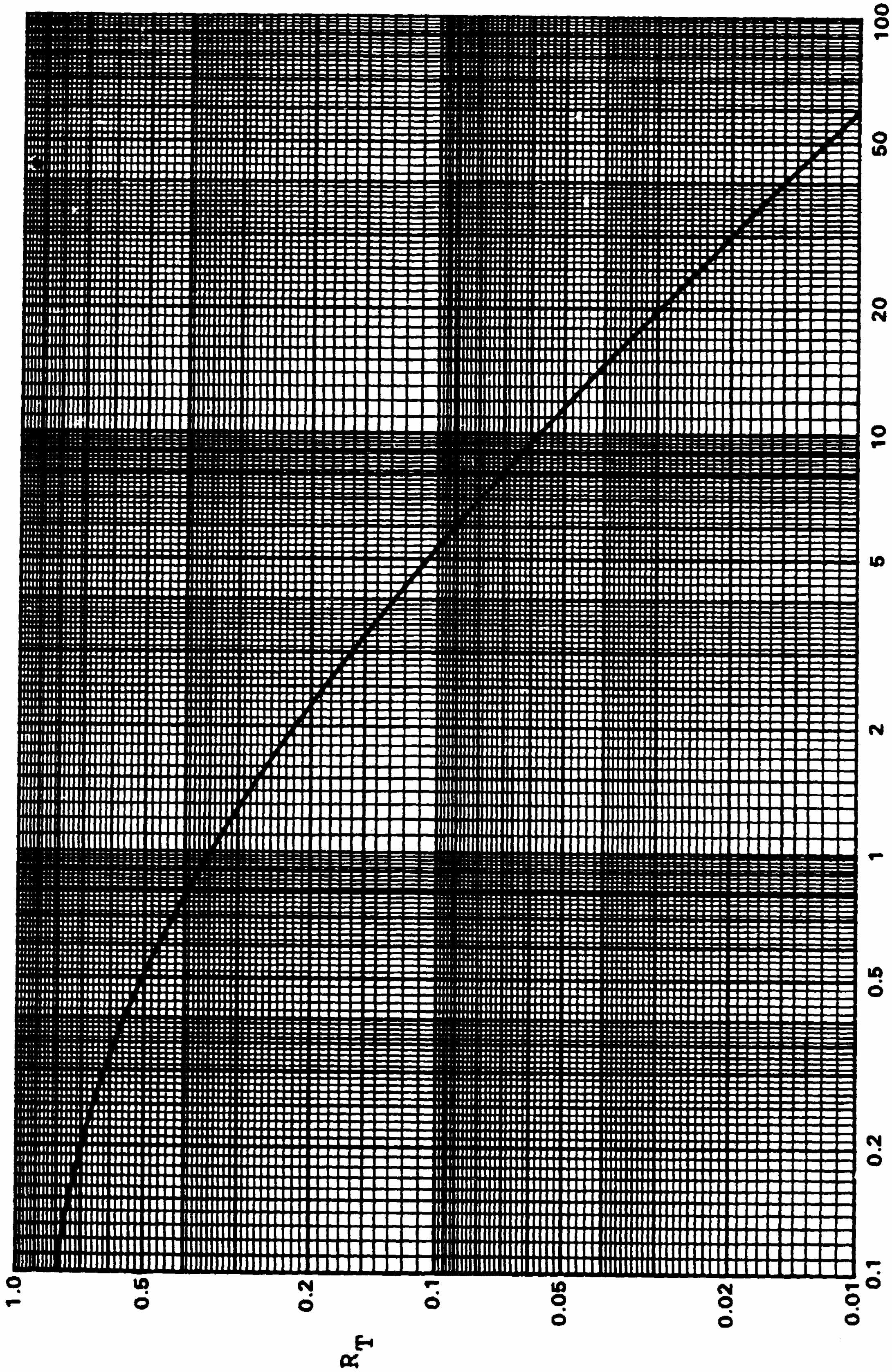


Figure J-49. Multiplication Factor

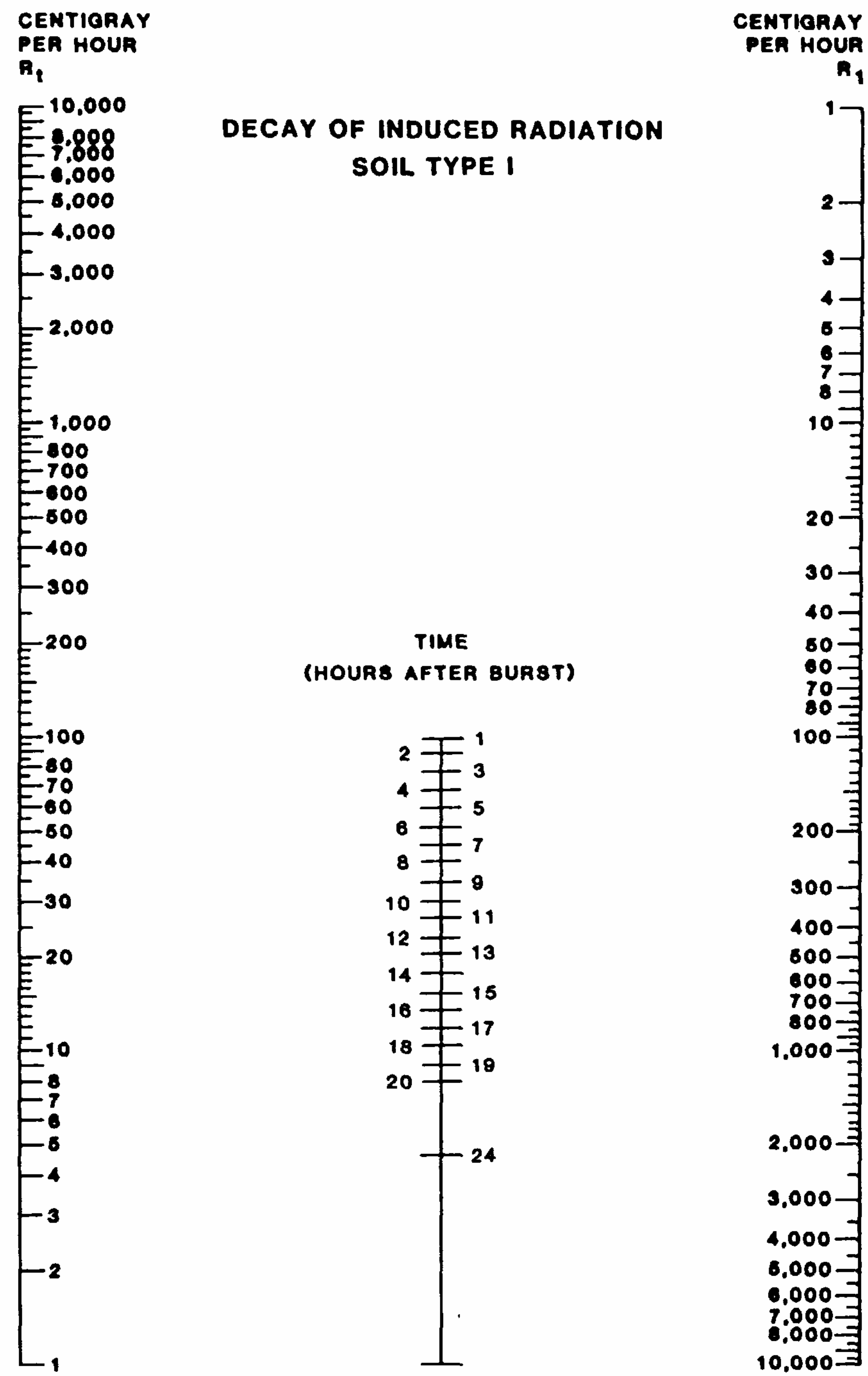


Figure J-50. Decay of Induced Radiation (Soil Type I)

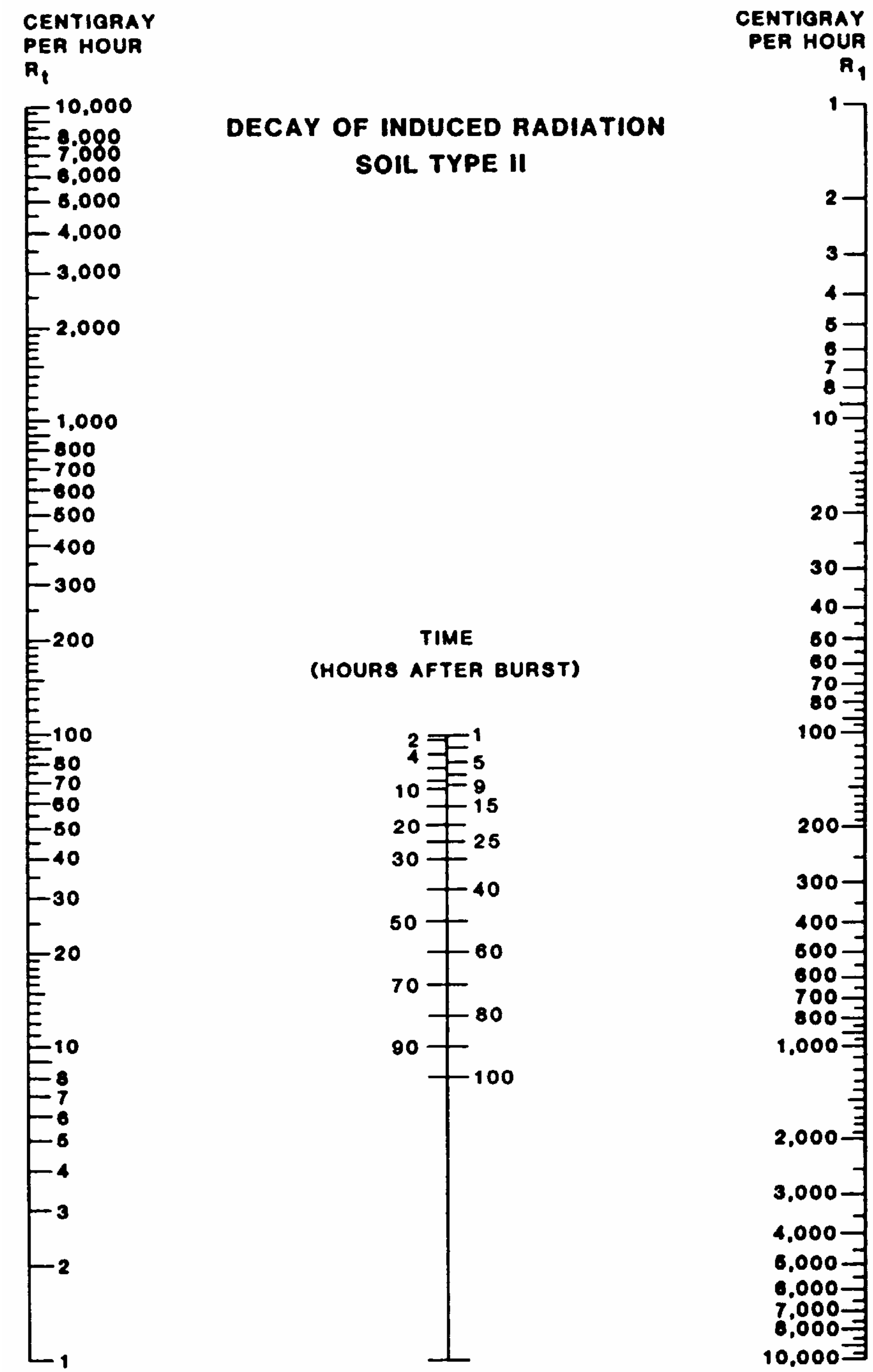


Figure J-51. Decay of Induced Radiation (Soil Type II)

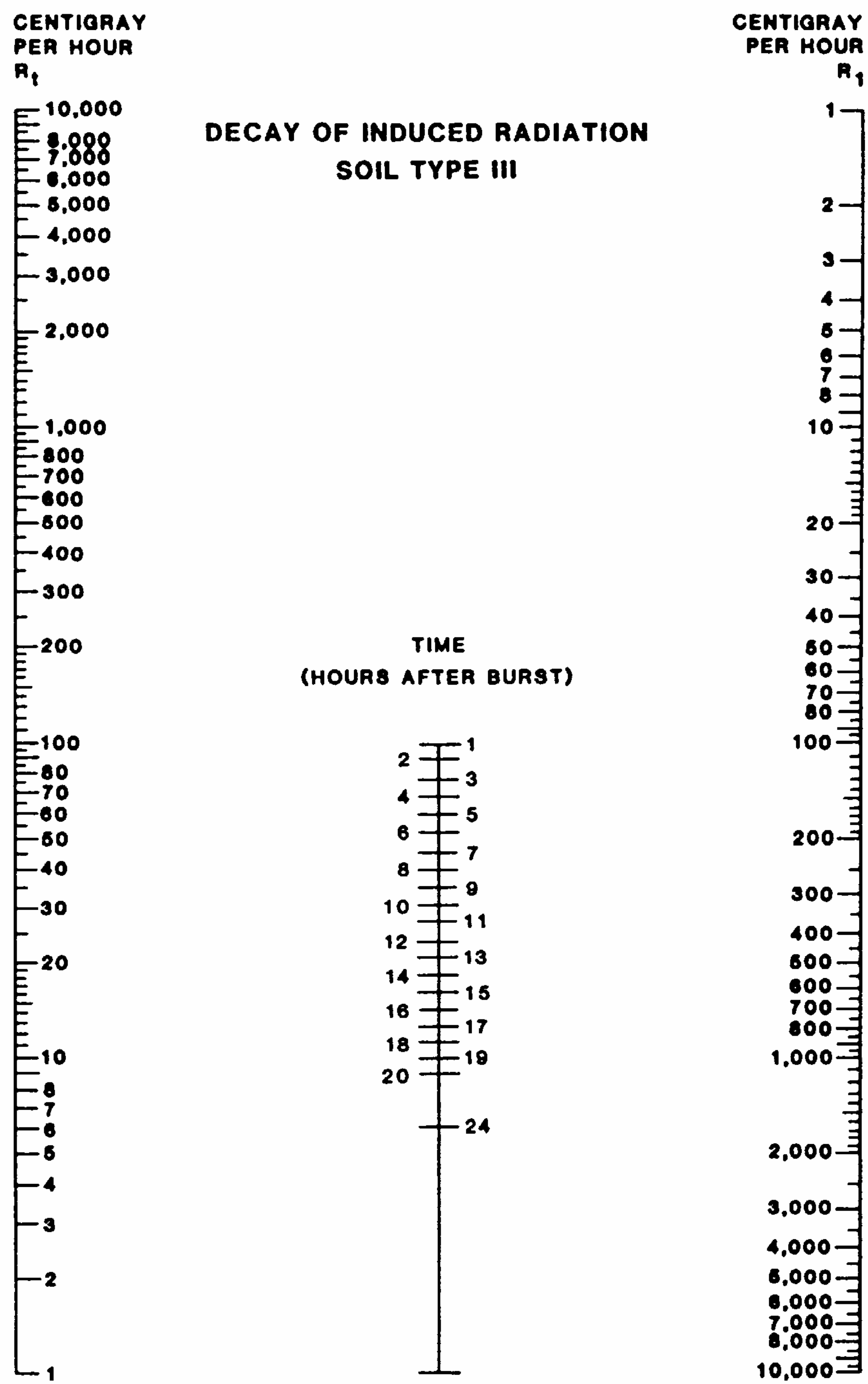


Figure J-52. Decay of Induced Radiation (Soil Type III)

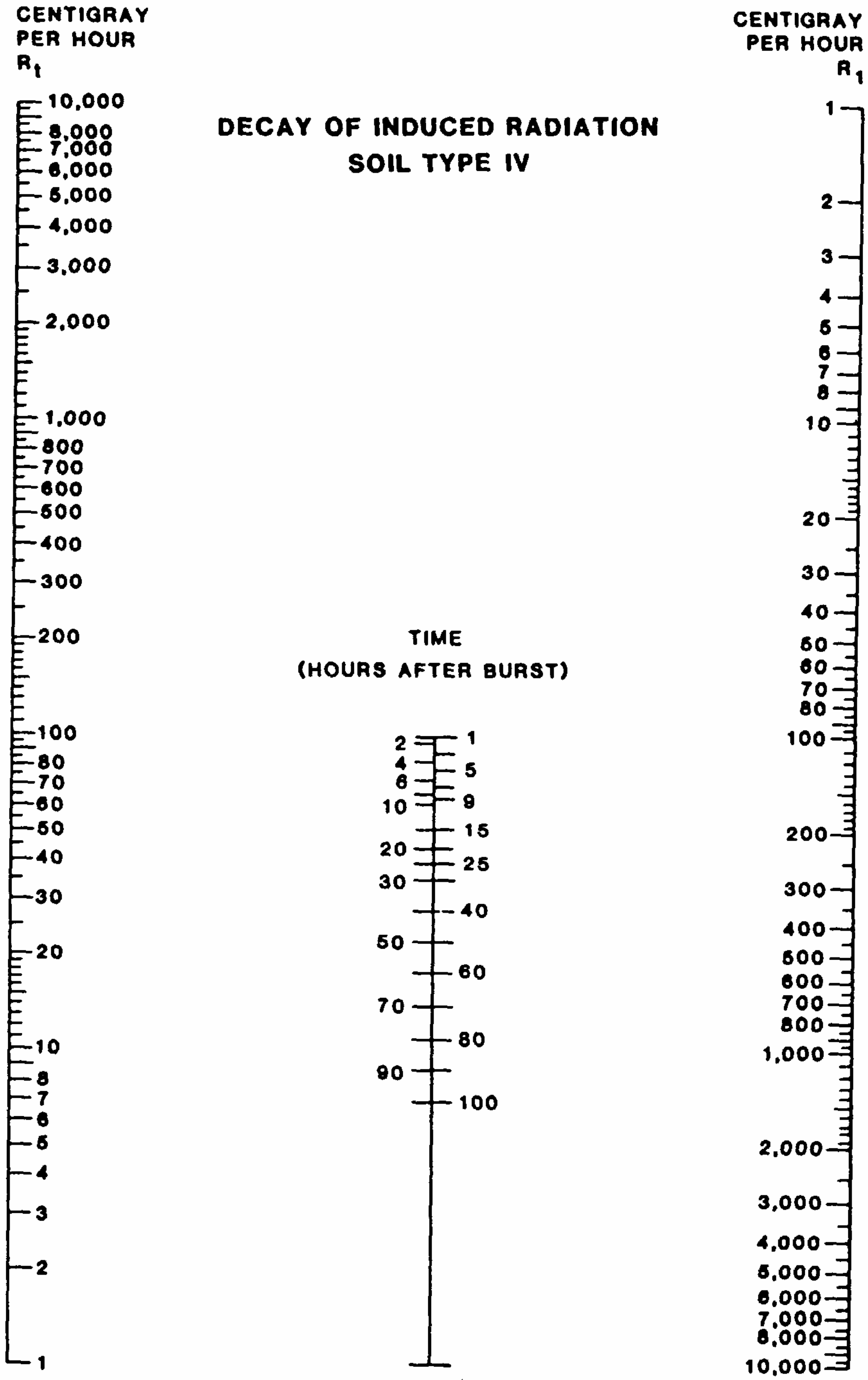


Figure J-53. Decay of Induced Radiation (Soil Type IV)

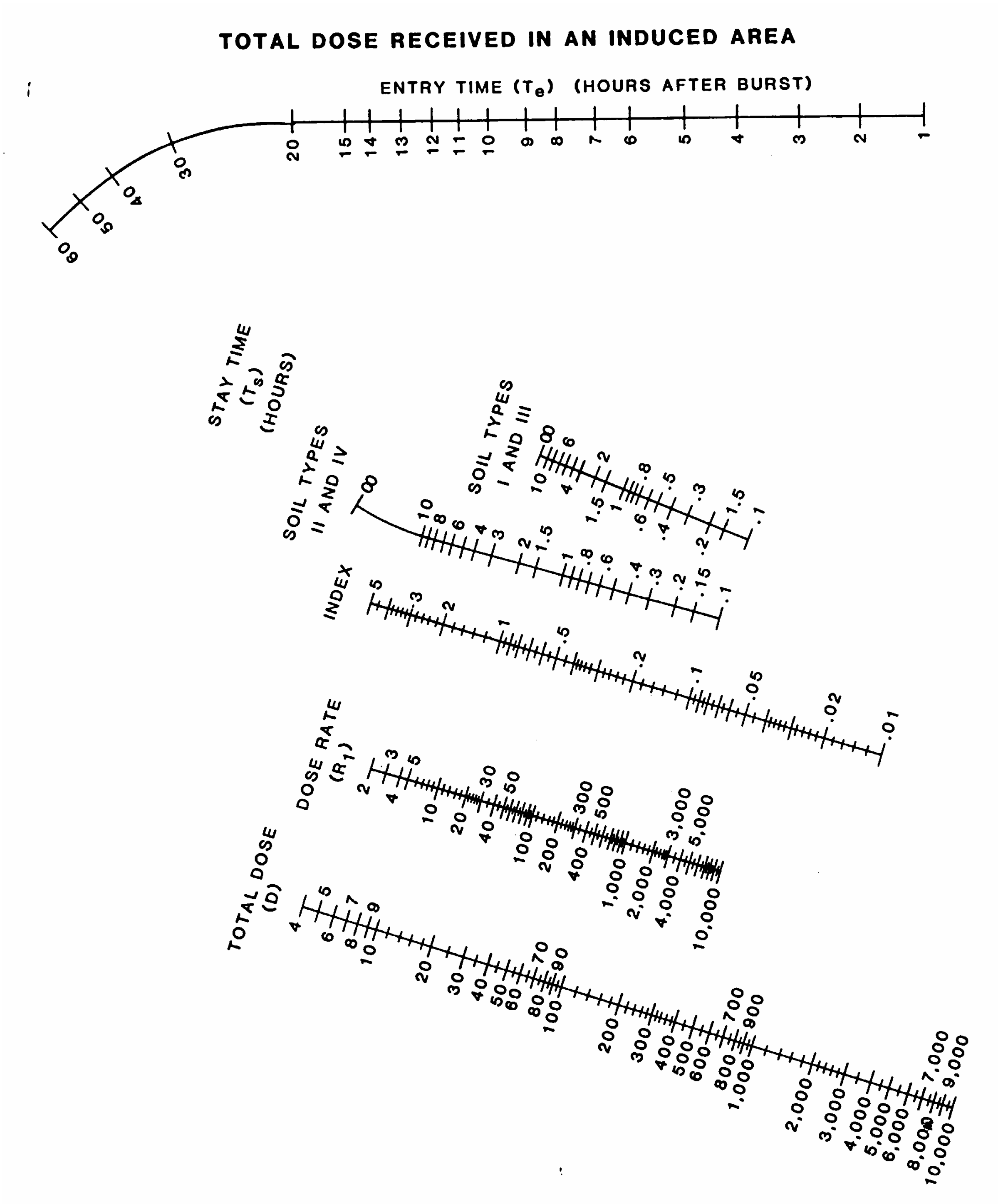


Figure J-54. Total Dose (Induced Radiation)

Appendix K

CALCULATIONS

This appendix provides a single reference location for CBRN hazard prediction related calculations. The calculations are explained earlier in the manual.

Calculations contained in Appendix E and F, for Chemical and Biological Contamination Avoidance TTP:

Downwind travel distance:

$\mathbf{d_1 = u_1 \times t_1}$
$\mathbf{d_2 = 2u_2}$
$\mathbf{d_3 = 2u_3}$

Total Downwind Distance:

$\mathbf{DA = d_1 + d_2 + d_3}$

Leading and Trailing Edge:

DL = 1.5 x DA (Leading Edge in KM)
DT = 0.5 x DA (Training Edge in KM)

Initial Hazard Area (BIO ONLY):

$\mathbf{H_1 = A + d_1 \text{ or } A + (u_1 \times t_1)}$

Calculations Contained in Appendix G, Nuclear Contamination Avoidance TTP:

Polar Plot Method for Determining Ground Zero:

0.35kmps x time (s) = Distance to ground zero (GZ) in km

M4A1 Calculator:

Covert degrees to mils by 17.8 x degrees = mils

Yield Estimation:

Yield 1 + yield 2 = sum yield / 2 = average yield

Time of Arrival of Fallout:

$$\frac{\text{distance from GZ (km)}}{\text{effective wind speed in (Kmph).}} = \text{TIME OF ARRIVAL}$$

Detailed Fallout Prediction:

Effective Wind Speed = <u>RADIAL LINE DISTANCE FROM GZ to CB Height (KM)</u>

Time of Fall from CB (HR)

Time of Completion of Fallout:

$$T_{comp} = 1.25 \times T_{arrival} + \frac{2 \times Cloud\ radius}{Effective\ wind\ speed}$$

Measuring Nuclear Data:

$$Transmission\ Factor\ (TF) = \frac{Inside\ dose\ rate}{Outside\ dose\ rate}$$

Outside Dose Rate $OD = ID/TF$

Correlation Factor $(CF) = \frac{1}{TF} = \frac{OD}{ID}$

Air-Ground Correlation Factor $(AGCF) = \frac{\text{Ground dose rate}}{\text{Aerial dose rate}}$

Ground dose rate = Air dose rate x AGCF

Calculation of "H" Hour or "Time of Burst":

$$T_1 = \frac{Tb - Ta}{(Ra/Rb)^{1/n-1}}$$

Determining Decay of Fallout:

$$R_1 \times t_1^{\,n} = R_2 \times t_2^{\,n}$$

Determination of Decay Rate

$$n = \frac{\log(Ra/Rb)}{\log(Tb/Ta)}$$

Determining the Period of Validity for the Decay Rate (n):

$$Tp = 3(Tb - Ta) + Tb$$

Determining the Normalizing Factor (NF)

$$R_1 = NF \times R_2$$

$$NF = (T_2)^n$$

Determining the Overall Correction Factor (OCF):

NF x AGCF = OCF or NF x VCF = OCF.

Plotting Data and Producing a NBC-5 (NUC) Report

INTERVAL DISTANCE = $\frac{\text{ROUTE OR COURSE LEG DISTANCE (KM)}}{\text{NUMBER OF READINGS-1}}$

Determination of the Dose Rate for an Arbitrary Time. The Kaufmann equation can be used as follows:

$R_1 \times t_1{}^n = R_2 \times t_2{}^n$ can be mathematically changed to represent the missing (or objective) variable to read: $R_2 = R_1 / (t_2)^n$ **or** $R_2 = R_1 / NF$

Determination of the Time at which a given Dose Rate is to be Expected: The Kaufmann equation can also be used as follows:

$R_1 \times t_1{}^n = R_2 \times t_2{}^n$ can be mathematically changed to represent the missing (or objective) variable to read: $t_2 = R_1 \times t_1 / R_2$

Note: If R_1 is the normalized dose rate reading at H+1, then t_1 will always be 1. Therefore the equation can be set-up as: $t_2 = R_1 / R_2$

Total Dose Procedures.

$D = R_{Te} \times T_s$ can be mathematically changed to represent the missing (or objective) variable to read: $R_{Te} = \frac{R_1}{(T_e)^n}$

$$D = \frac{R_1}{(T_e)^n} \times T_s$$

Crossing a Fallout Area.

$$R_{avg} = \frac{R_{\max}}{2}$$

Optimum Time of Exit from Fallout Areas.

$$T_{opt} = MF \times T_{ev}$$

$$TF_{Ratio} = T_{FS}/T_{FM}.$$

Neutron Induced Radiation Areas

Crossing an Induced Radiation Area

$$R_{avg} = \frac{R_{\max}}{2}$$

$$T_S = \frac{distance}{speed}$$

ID = OD x TF

Determination of Decay Rate for Induced Radiation:

$$\frac{1}{t} \, x \, 1n\left(\frac{R_a}{R_a + t}\right)$$

Determination of the Dose Rate for an Arbitrary Time :

$$R_1 + t = Ra * EXP (-n * t)$$

Determination of Dose Accumulated in a Neutron Induced Area:

$$D=R_1/n*(EXP(-n*t_{in})-EXP(-n*t_{out}))$$

Determination of Time of Exit from a Neutron Induced Area Given a Maximum Dosage:

$$T_{out} = -l/n*ln(EXP(-n*T_e)-(n*DL)/R_l$$

Determination of the Earliest Time of Entry:

$$T_e = -1/n*(DL/(R*n*(l-exp(-n*T_s))))$$

Appendix L
REPRODUCIBLE EXAMPLE FORMS

This appendix contains the following reproducible forms:

- Nuclear Data Sheet – Monitoring or Point Technique
- Nuclear Data Sheet – Route or Course Leg Technique
- Chemical / Biological or ROTA Data Sheet – Monitoring or Survey
- Effective Downwind Message Worksheet
- Nuclear Fallout Prediction Worksheet – Surface Burst
- Unit Radiation Dose Record
- CBRN / TIM / ROTA Sample Documentation
- NBC1 Observer's Initial or Follow-Up Report
- NBC2 Evaluated Data Report
- NBC3 Immediate Warning of Predicted Contamination and Hazard Areas
- NBC4 Reconnaissance/Sampling/Monitor/Survey Results
- NBC5 Actual Contamination Area Report
- NBC6 Detailed Information of CBRN / TIM / ROTA Attack/Incident
- Biological Integrated Detection System (BIDS) Incident Report (BIR)

NUCLEAR DATA SHEET- **MONITORING OR POINT TECHNIQUE** For use of this Example Form, see FM 3-11.3	DATE	PAGE NO.	NO. OF PAGES
SURVEY PARTY OR MONITORING UNIT DESIGNATION	MONITOR (Print Name)		
MAP USED	TYPE OF VEHICLE OR OTHER SHIELDING	INSTRUMENT TYPE	

READING NO.	LOCATION	TIME	DOSE RATE (cGyph)	DO NOT USE*	READING NO.	LOCATION	TIME	DOSE RATE (cGyph)	DO NOT USE*
1					16				
2					17				
3					18				
4					19				
5					20				
6					21				
7					22				
8					23				
9					24				
10					25				
11					26				
12					27				
13					28				
14					29				
15					30				

REMARKS

*DO NOT USE. CBRNCC only

CORRELATION FACTOR DATA

LOCATION	READING NO.	DOSE RATE (cGyph)		CF*	LOCATION	READING NO.	DOSE RATE (cGyph)		CF*
		INSIDE	OUTSIDE				INSIDE	OUTSIDE	

NUCLEAR DATA SHEET- ROUTE OR COURSE LEG TECHNIQUE (Ground and Aerial Survey) For use of this Example Form, see FM 3-11.3	DATE	PAGE NO.	NO. OF PAGES

SURVEY PARTY DESIGNATION	MONITOR (Print Name)

MAP USED	AIRCRAFT OR VEHICLE TYPE	INSTRUMENT TYPE

ROUTE OR COURSE LEG DESIGNATION			
TIME AT START OF LEG OR ROUTE			
TIME ROUTE COMPLETED (Ground) OR SURVEY HEIGHT (Air)*			
DISTANCE OR TIME INTERVAL USED			

REMARKS

READING No.	Dose Rate cGyph	DO NOT USE **	READING No.	Dose Rate cGyph	DO NOT USE **	READING No.	Dose Rate cGyph	DO NOT USE **
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
10			10			10		
11			11			11		
12			12			12		
13			13			13		
14			14			14		
15			15			15		
16			16			16		
17			17			17		
18			18			18		
19			19			19		
20			20			20		

*Times of start and stop are reported for each route or portion of route completed at one time by ground survey. If a route is done in parts, use a separate column for each part.
**DO NOT USE. For CBRNCC only

LOCATION	HEIGHT (feet) AIR ONLY	DOSE RATE (cGyph)		CF**
		INSIDE AIR	OUTSIDE GROUND	

<table>
<tr><td colspan="3">CHEMICAL / BIOLOGICAL or ROTA *
DATA SHEET- MONITORING OR SURVEY
* ROTA in this case encompasses TIC/TIB.
For use of this Example Form, see FM 3-11.3</td><td>DATE</td><td colspan="2">PAGE NO.</td><td>NO. OF PAGES</td></tr>
<tr><td colspan="2">UNIT DESIGNATION</td><td colspan="5">MONITOR OR SURVEY TEAM MEMBER
(Print Name)</td></tr>
<tr><td colspan="2">MAP USED</td><td colspan="5">MONITOR OR SURVEY TEAM NUMBER</td></tr>
<tr><td colspan="2" rowspan="2">LOCATION / TIME OF TEST OR INDICATION</td><td colspan="4">TYPE OF DETECTOR USED
(SPECIFY WHICH TYPE)</td><td rowspan="2">AGENT DETECTED</td></tr>
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</table>

EFFECTIVE DOWNWIND MESSAGE WORKSHEET

For use of this form, see FM 3-3-1; the proponent agency is TRADOC

TIME OF WIND MEASUREMENT (DATE-TIME GROUP) D D t t t t ____________

DATA AND CALCULATIONS

MESSAGE LINE	YIELD (KT)	CLOUD-TOP HEIGHT (METERS)	CLOUD-BOTTOM HEIGHT (METERS)	2/3 STEM HEIGHT (METERS)	(1) DISTANCE OF GZ/CB RADIAL LINE (KM)	EFFECTIVE WIND SPEED-sss (KMPH) (1) x 1/TIME OF FALL = sss ROUND OFF TO NEAREST KILOMETER PER HOUR	(2) AZIMUTH OF GZ/CT RADIAL LINE (DEGREES)	(3) AZIMUTH OF GZ/2/3 STEM RADIAL LINE (DEGREES)	EFFECTIVE DOWNWIND DIRECTION-ddd (DEGREES) SUM OF (2)+(3) = (2) AND (3) / 2 = ddd[1]	WARNING AREA ANGLE
A	2	4,900	2,600	1,700	____	____ X 1.136 = ____	____	____	____ = ____/2 = ____	____
B	5	7,100	4,400	2,800	____	____ X 0.758 = ____	____	____	____ = ____/2 = ____	____
C	30	11,600	7,700	5,100	____	____ X 0.455 = ____	____	____	____ = ____/2 = ____	____
D	100	14,400	9,300	6,200	____	____ X 0.385 = ____	____	____	____ = ____/2 = ____	____
E	300	16,700	11,000	7,400	____	____ X 0.333 = ____	____	____	____ = ____/2 = ____	____
F	1,000	21,600	13,500	9,000	____	____ X 0.286 = ____	____	____	____ = ____/2 = ____	____
G	3,000	26,250	15,800	10,500	____	____ X 0.250 = ____	____	____	____ = ____/2 = ____	____

EFFECTIVE DOWNWIND MESSAGE

ZULU DDtttt ___ ___ ___ ___ ___ ___
ALFA dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
BRAVO dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
CHARLIE dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
DELTA dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
ECHO dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
FOXTROT dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___
GOLF dddsss ___ ___ ___ ___ ___ ___ ___ ___ ___

[1] When the azimuth of the ground zero/cloud-top radial line (2) or the azimuth of the ground zero/2/3 stem radial line (3) falls in the first quadrant (0° to 90°) and the other falls in the fourth quadrant (270° to 360°), result of $\frac{(2)+(3)}{(2)}$ will be the back azimuth of the effective downwind direction. In this case, determine ddd by the following method: If result is greater than 180°, subtract 180°; If result is less than 180°, add 180°. Enter in the effective downwind message.

DA FORM 1971-3-R, SEP 94 EDITION OF SEP 86 IS OBSOLETE USAPPC V1.00

NUCLEAR FALLOUT PREDICTION WORKSHEET – SURFACE BURST

For use of this Form, see FM 3-11.3

NOTE: Complete Worksheet to determine NBC-3 (NUC) Report. (Line out unused unit of measure in far right hand column).

A.	Time of burst (date-time group) (From NBC-2 (NUC) Report)	___________________________	DELTA (DD TTTTZ MMM YYYY) (local or Zulu time)
B.	Ground Zero Coordinates (GZ) (From NBC-2 (NUC) Report)	___________________________	FOXTROT (yy zzzzzz) (Actual or Estimated)
C.	FY/TY Ratio (from target analysis for friendly weapons only) (If known, enter #, If unknown or For enemy attack, enter "1").	___________________________	
D.	HOB (from target analysis for friendly weapons only) (If known, enter #, If unknown or For enemy attack, enter "0").	___________________________	Meters
E.	Yield (From NBC-2 (NUC) Report)	___________________________	KT or MT
F.	Cloud Top Height (Use Fig. J-3 on p. J-11.)	___________________________	10^3 meters or feet
G.	Cloud Bottom Height (Use Fig. J-3 on p. J-11.)	___________________________	10^3 meters or feet
H.	2/3 Stem (Use Fig. J-3 on p. J-11.)	___________________________	10^3 meters or feet
I.	Stabilized Cloud Radius (Use Fig. J-3 on p. J-11.)	___________________________	PAPA BRAVO – rr (KM)
J.	Time of Fall from Cloud Bottom (Use Fig. J-3 on p. J-11.)	___________________________	Hours

NOTE: Plot F., G. and H. on current Wind Vector Plot. Measure distance from GZ to Cloud Bottom Height.

K.	Radial Line Distance from GZ to Cloud Bottom Height	___________________________	KM
L.	Effective Wind Speed $\frac{K}{J}$ = __________ =	___________________________	PAPA BRAVO – sss (KMPH)
M.	Downwind Distance of ZONE I (Use Fig. J-8 or p. J-15) with E. and L.)	___________________________	PAPA BRAVO – xxx (KM)
N.	Adjustment Calculation of Downwind Distance of ZONE I FY/TY Factor (C.) _________ x HOB (D.) __________ = Use Fig. J- on p. J-. Use Fig. J- / on p. J- / . (If unknown or For enemy attack, enter "1" and "1".)	___________________________	
O.	Adjustment of Downwind Distance of ZONE I	___________________________	PAPA BRAVO – xxx (KM)

NOTE: Ensure that lateral limit angle (angle between Left and Right Radial Lines) is $\geq 40^0$. If not, then, add azimuths; divide sum by 2; add 20^0 to each azimuth. These are your NEW Radial Lines. Ensure you enter the NEW azimuths below.

P.	Azimuth of Left Radial Line	___________________________	PAPA BRAVO – dddd (mils or degrees)
Q.	Azimuth of Right Radial Line	___________________________	PAPA BRAVO – cccc (mils or degrees)

R. NBC-3 (NUC) Report

ALPHA	(AAA)	___________________________	(Strike Serial Number)
DELTA	(DD TTTTZ MMM YYYY)	___________________________	(Local or Zulu time)
FOXTROT	(yy zzzzzz)	___________________________	(Actual or Estimated)
PAPA BRAVO	(sss xxx rr) * (dddd cccc)**	___________________________	(Azimuths of Radial Lines – Mils or Degrees)

* sss – Effective Wind Speed (KMPH) * xxx – Downwind Distance of ZONE I (KM)
* rr – Cloud Radius (KM)
**dddd – Left Radial Line **cccc – Right Radial Line

UNIT RADIATION DOSE RECORD

For use of the Example Form, use FM 3-11.3

UNIT:	DATE:

ELEMENT	Previous Exposure	New Exposure	Total Exposure	RES Category

Radiation status category of Unit	Number of Elements						Category Total [1]	Overall RES [2]
	2	3	4	5	6	7		
	Sum of RES Numbers						Radiation Status Categories	
RES-0	0	0-1	0-1	0-2	0-2	0-3	RES – 0	0 = (no exposure)
RES-1	1-2	2-4	2-5	3-7	3-8	4-10	RES – 1	1 = Greater than 0cGy, but less than or equal to 70cGy
RES-2	3-4	5-7	6-9	8-12	9-14	11-17	RES – 2	2 = Greater than 70cGy, but less than or equal 125cGy
RES-3	5-6	8-9	10-12	13-15	15-18	18-21	RES – 3	3 = Greater than 125cGy

NOTE: For Category Total, see 1 below. For Overall Unit Radiation Exposure Status, see 2 below.
[1] To determine Category Total, add total number of RES's (0,1,2, 3 for each element) "RES Category" column.
[2] To determine Overall RES, Determine total number of elements. Enter the number of elements and continue down that column to locate the category total (Note 1) range, then read the RES category to the left or right.

Example: A Unit had five (5) elements with a total RES Category of 11. Enter "5" as the number of elements. Using this column, locate "11". "11" is between the range of "8-12"; read left or right: Overall RES would be RES-2.

CBRN / TIM SAMPLE DOCUMENTATION DATA SHEET				DATE					PAGE NO.		NO. OF PAGES
UNIT DESIGNATION	TEAM NUMBER				TEAM MEMBER (Print Name)				MAP USED		
LOCATION	*TIME OF DETECTOR ALERT (SPECIFY WHICH TYPE)								** AGENT DETECTED (or Dose Rate)	***AGENT IDENTIFICATION	**** SAMPLE DESCRIPTION
	AN/VDR-2	M8 Paper	M256A1	M88 ACADA	ICAM	JBPDS	OTHER				
1											
									**** **Sample ID #:**		
2											
									**** **Sample ID #:**		
3											
									**** **Sample ID #:**		
4											
									**** **Sample ID #:**		
5											
									**** **Sample ID #:**		
6											
									**** **Sample ID #:**		
7											
									**** **Sample ID #:**		
8											
									**** **Sample ID #:**		
									**** **Sample ID #:**		

NOTES:	Route / Destination:	MET Data (If applicable)	Correlation Factor Data
*** Enter time of test or indication under appropriate piece of detection equipment.** **** If BIO, determine detection by:** **-Type of Agent Detected:** **(T / C / S / B / N)** **-Confidence Level:** **(0 / 1 / 2 / 3 / 4 / 5 / 6 / 7 / 8 / 9 / 10)** **For radiation detection enter Dose Rate (cGy/hr).** ***** If BIO, determine Identification by:** **-Agent Code or Negative (N).** ****** If sample collected:** **-Enter Sample ID #** **-Enter Sample Description (Liquid, Solid, Vapor)** **(e.g. Solid-vegetation)**	Distance (Km): Speed (Km/hr) or Time interval used (Sec/Min):	Wind Speed (MPH): Wind Direction (DEG): Temp (C): Humidity (%):	Inside Dose Rate: / Outside Dose Rate: Means of Delivery of Agent: Terrain Description:
REMARKS:			

CBRN WARNING AND REPORTING SYSTEM (CBRNWRS)

LINE ITEMS

Line:	MEANING:
ALPHA	Strike Serial Number
BRAVO	Location of observer and direction of attack or event
CHARLIE	Date-time group of report or observation and end of event
DELTA	Date-time group of attack or detonation and attack end
FOXTROT	Location of attack or event
GENTEXT	General text
GOLF	Delivery and quantity information
HOTEL	Type of nuclear burst
INDIA	Release information on biological/chemical agent attacks or ROTA events
JULIET	Flash-To-Bang Time in Seconds
KILO	Crater description
LIMA	Nuclear burst angular cloud width at H+5 minutes
MIKE	Stabilised cloud measurement at H+10 minutes
MIKER	Description and status of a ROTA event
NOVEMBER	Estimated nuclear yield in kilotons
OSCAR	Reference date-time group for estimated contour lines
PAPAA	Predicted attack/release and hazard area
PAPAB	Detailed fallout hazard prediction parameters
PAPAC	Radar determined external contour of radioactive cloud
PAPAD	Radar determined downwind direction of radioactive cloud
PAPAX	Hazard area location for weather period
QUEBEC	Location of reading/sample/detection and type of sample/detection
ROMEO	Level of contamination, dose rate trend & decay rate trend
SIERRA	Date-time group of reading or initial detection of contamination
TANGO	Terrain/topography and vegetation description
WHISKEY	Sensor information
XRAYA	Actual contour information
XRAYB	Predicted contour information
YANKEE	Downwind direction and downwind speed
ZULU	Actual weather conditions

NBC1 REPORT TEMPLATES

NBC1 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
BRAVO	Location of Observer and Direction of Attack or Event	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	O	
GOLF	Delivery and Quantity Information	M	
HOTEL	Type of Nuclear Burst	M	
JULIET	Flash-to-Bang Time in seconds	O	
LIMA	Nuclear Burst Angular Cloud Width at H+5 Minutes	O	
MIKE	Stabilized Cloud Measurement at H+10 Minutes	O	
PAPAC	Radar Determined External Contour of Radioactive Cloud	O	
PAPAD	Radar Determined Downwind Direction of Radioactive Cloud	O	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC1 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	C	
BRAVO	Location of Observer and Direction of Attack or Event	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	O	
GOLF	Delivery and Quantity Information	M	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
TANGO	Terrain/Topography and Vegetation Description	M	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC1 (ROTA) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
BRAVO	Location of Observer and Direction of Attack or Event	M	
CHARLIE	Date-Time-Group of Report or Observation and End of Event	M	
FOXTROT	Location of Attack or Event	O	
GOLF	Delivery and Quantity Information	M	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
MIKER	Description and Status	O	
TANGO	Terrain/Topography and Vegetation Description	M	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC2 REPORT TEMPLATES

NBC2 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	M	
HOTEL	Type of Nuclear Burst	M	
NOVEMBER	Estimated Nuclear Yield in KT	M	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC2 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	M	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
TANGO	Terrain/Topography and Vegetation Description	M	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC2 (ROTA) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	M	
CHARLIE	Date-Time-Group of Report /Observation and Event End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	M	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
MIKER	Description and Status	M	
TANGO	Terrain/Topography and Vegetation Description	M	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M)

NBC3 REPORT TEMPLATES

NBC3 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	O	
HOTEL	Type of Nuclear Burst	O	
NOVEMBER	Estimated Nuclear Yield in KT	O	
PAPAB	Detailed Fallout Hazard Prediction Parameters	M	
PAPAC	Radar Determined External Contour of Radioactive Cloud	O	
PAPAD	Radar Determined Downwind Direction of Radioactive Cloud	O	
XRAYB**	Predicted Contour Information	C	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

** Line Item is repeatable up to 50 times to represent multiple contours
The "Cond" column in the examples shows that each set is either operationally determined (O), conditional (C) or mandatory (M)

NBC3 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHYA	Strike Serial Number	M	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
PAPAA	Predicted Attack/Release and Hazard Area	M	
PAPAX*	Hazard Area Location for Weather Period	M	
XRAYB**	Predicted Contour Information	C	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* Line Item is repeatable up to 3 times in order to describe three possible hazard areas corresponding to the time periods from the CDM. A hazard area for a following time period will always include the previous hazard area.

** Line Item is repeatable up to 50 times to represent multiple contours. The "Cond" column in the examples shows that each set is either operationally determined (O), conditional (C) or mandatory (M)

NBC3 (ROTA) Report	
From:	To:
Precedence:	Security Classification:

DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	M	
CHARLIE	Date-Time-Group of Report /Observation and Event End	M	
FOXTROT	Location of Attack or Event	M	
GOLF	Delivery and Quantity Information	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
PAPAA	Predicted Attack/Release and Hazard Area	M	
PAPAX*	Hazard Area Location for Weather Period	M	
XRAYB**	Predicted Contour Information	C	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* Line Item is repeatable up to 3 times in order to describe three possible hazard areas corresponding to the time periods from the CDM. A hazard area for a following time period will always include the previous hazard area.

** Line Item is repeatable up to 50 times to represent multiple contours

The “Cond” column in the examples shows that each set is either operationally determined (O), conditional (C) or mandatory (M)

NBC4 REPORT TEMPLATES

NBC4 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond	Template
ALPHA	Strike Serial Number	O	
KILO	Crater Description	O	
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	M	
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	
WHISKEY	Sensor Information	O	
YANKEE*	Downwind Direction and Downwind Speed	M	
ZULU*	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Items QUEBEC, ROMEO, SIERRA and TANGO are a segment. With exclusion of Line Item ROMEO, this segment is mandatory. Line Items/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

NBC4 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond	Template
ALPHA	Strike Serial Number	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	
TANGO*	Terrain/Topography and Vegetation Description	M	
WHISKEY	Sensor Information	O	
YANKEE*	Downwind Direction and Downwind Speed	M	
ZULU*	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Items QUEBEC, ROMEO, SIERRA and TANGO are a segment. With exclusion of Line Item ROMEO, this segment is mandatory. Line Items/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

NBC4 (ROTA) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond	Template
ALPHA	Strike Serial Number	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	
TANGO*	Terrain/Topography and Vegetation Description	M	
WHISKEY	Sensor Information	O	
YANKEE*	Downwind Direction and Downwind Speed	M	
ZULU*	Actual Weather Conditions	O	
GENTEXT	General Text	O	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Items QUEBEC, ROMEO, SIERRA and TANGO are a segment. With exclusion of Line Item ROMEO, this segment is mandatory. Line Items/segments are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

NBC5 REPORT TEMPLATES

NBC5 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	
OSCAR	Reference Date-Time-Group for Estimated Contour Lines	M	
XRAYA*	Actual Contour Information	M	
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Sets are repeatable up to 50 times to represent multiple contours

NBC5 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
OSCAR	Reference Date-Time-Group for Estimated Contour Lines	M	
XRAYA*	Actual Contour Information	M	
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Sets are repeatable up to 50 times to represent multiple contours

NBC5 (ROTA) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
CHARLIE	Date-Time-Group of Report /Observation and Event end	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	
OSCAR	Reference Date-Time-Group for Estimated Contour Lines	M	
XRAYA*	Actual Contour Information	M	
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Downwind Speed	O	
ZULU	Actual Weather Conditions	O	
GENTEXT	General Text	O	

The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Sets are repeatable up to 50 times to represent multiple contours

NBC6 REPORT TEMPLATES

NBC6 (NUC) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	
FOXTROT	Location of Attack and Qualifier	O	
QUEBEC*	Location & Type Reading /Sample /Detection	O	
SIERRA	Date-Time-Group of Reading	O	
GENTEXT	General Text	M	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Item QUEBEC, is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

NBC6 (CHEM/BIO) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	
FOXTROT	Location of Attack and Qualifier	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	
QUEBEC *	Location & Type Reading /Sample /Detection	O	
SIERRA	Date-Time-Group of Reading	O	
GENTEXT	General Text	M	

* The “Cond.” column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Item QUEBEC, is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

NBC6 (ROTA) Report			
From:		To:	
Precedence:		Security Classification:	
DTG Sent:		Category of Report: Initial Follow-up	
Line Item	Description	Cond.	Template
ALPHA	Strike Serial Number	O	
CHARLIE	Date-Time-Group of Report /Observation and Event End	O	
FOXTROT	Location of Attack or Event	O	
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	
QUEBEC*	Location & Type Reading /Sample /Detection	O	
SIERRA	Date-Time-Group of Reading	O	
GENTEXT	General Text	M	

* The "Cond." column in the examples shows that each line item is either Operationally determined (O) or Mandatory (M).

* Line Item QUEBEC, is repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

BIDS/JSLBNCRS/NBCRV Number: _________________________

19 Digit Sample Identification Number: __________________

1. Detection Time
    a. DTG
    b. Background Sample
    c. Command Directed Sample
2. MET Data
    a. Elevation
    b. Direction
    c. Wind Speed
    d. Temperature
    e. Relative Humidity
3. Identification
    a. DTG
    b. Agent Code
    c. Negative
4. Mode of Operation
    a. Standard
    b. Single Sample
    c. Periodic
    d. Degraded
    e. Extreme Cold

Biological Incident Report

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GLOSSARY

PART I—ABBREVIATIONS AND ACRONYMS

A

AAR	after action report
AB	airbase
ABM	antiballistic missile
AC	hydrogen cyanide, (blood agent)
ACAA	automatic chemical agent alarm
ACADA	automatic chemical agent detection and alarm
ACAMS	Automatic Continuous Air Monitoring System
AEP	Allied Engineering Publication
AERP	aircraft eye/respiratory protection
AF	Air Force
AFB	Air Force base
AFDD	Air Force doctrine document
AFH	Air Force handbook
AFI	Air Force instruction
AFJMAN	Air Force joint manual
AFM	Air Force manual
AFMAN	Air Force manual
AFPAM	Air Force pamphlet
AFPD	Air Force policy directive
AFR	Air Force regulation
AFRRI	Armed Forces Radiobiology Research Institute
AFTTP	Air Force tactics, techniques, and procedures
AO	area of operations
AOI	area of interest
AOR	area of responsibility
APC	armored personnel carrier
AT	antiterrorism
ATTN	attention

B

BIDS	Biological Integrated Detection System
BW	biological warfare

C

C	Celsius
C2	command and control

C4I	command, control, communications, computers, and intelligence
CA	civil affairs
CADK	chemical agent detection kit
CAIRA	chemical accident/incident response and assistance
CAM	chemical-agent monitor
CAPDS	Chemical Agent Point Detection System
CAPE	contamination avoidance protective entrance
CB	chemical-biological
CBIAC	Chemical and Biological Defense Information Analysis Center
CBR	chemical, biological, and radiological
CBRN	chemical, biological, radiological, or nuclear
CBRNE	chemical, biological, radiological, nuclear, and high yield explosives
CBPS	chemical biological protective shelter
CBR	chemical, biological, and radiological
CCA	contamination control area
CCD	camouflage, concealment, and deception
CCP	casualty collection point
CDC	Centers for Disease Control and Prevention
CDE	chemical defense equipment
CDM	chemical downwind message
CE	civil engineer
CFM	cubic feet per minute
CFR	Code of Federal Regulations
CG	commanding general, phosgene (choking agent)
cGy	centigray
cGyph	centigray per hour
CHEMTREC	Chemical Transportation Emergency Center
CJCS	Commander of the Joint Chiefs of Staff
CK	cyanogen chloride (blood agent)
CLS	contracted logistic support
CM	consequence management
COA	course of action
COCOM	combatant command (command authority)
COG	center of gravity
COLPRO	collective protection
COMM	communications
COMSEC	communications security
CONUS	continental United States
CPE	collective protection equipment
CSS	combat service support
CST	civil support team
CW	chemical warfare

D

DA	Department of the Army
DA PAM	Department of the Army pamphlet
DFU	dry filter unit
DKIE	decontaminating kit, individual equipment
DOD	Department of Defense
DODD	Department of Defense directive
DODI	Department of Defense instruction
DOT	Department of Transportation
DSN	Defense Switched Network
DST	decision support tools
DU	depleted uranium

E

ECP	entry control point
EDM	effective downwind message
EMP	electromagnetic pulse
EMS	emergency medical services
EOC	emergency operations center
EOD	explosive ordnance disposal
EPW	enemy prisoner of war
ERG	Emergency Response Guidebook

F

F	Fahrenheit
FBI	Federal Bureau of Investigation
FFR	for future reference
FL	Florida
FM	field manual (Army)
FMFM	Fleet Marine Force Manual
FP	force protection
FPCON	force protection condition
FROG	free rocket over ground

G

g	gram(s)
GA	tabun (nerve agent)
GB	sarin (nerve agent)
GCCS	Global Command and Control System
GD	soman (nerve agent)
GF	cyclosarin (nerve agent)
GZ	ground zero

H

H	Levinstein mustard (blister agent)
ha	hectares
HAZMAT	hazardous materials
HD	distilled mustard (blister agent)
HHA	handheld assay
HN	host nation, nitrogen mustard (blister agent) (HN-1, HN-2, HN-3)
HOB	height of burst
HQ	headquarters
HSS	health service support
HT	mustard-T mixture
HVAC	heating, ventilation, and air conditioning
HVT	high-value target

I

IBADS	Interim Biological Agent Detection System
ICAM	improved chemical-agent monitor
ICS	incident command system
IED	improvised explosive device
IPB	intelligence preparation of the battlespace
IPDS	improved point detection system
IPE	individual protective equipment
IR	intelligence requirement
IRT	initial response team
ISR	intelligence, surveillance, and reconnaissance

J

JBPDS	Joint Biological Point Detection System
JF	joint force
JFC	joint force commander
JIPB	joint intelligence preparation of the battlespace
JMETL	joint mission-essential task list
JP	joint publication
JSLIST	Joint Service Lightweight Integrated Suit Technology
JTF	joint task force
JWARN	Joint Warning and Reporting Network

K

kg	kilogram(s)
km	kilometer(s)
kph	kilometers per hour
kt	kiloton(s)

L

L	lewisite (blister agent)
LLR	low-level radiation
LOAC	law of armed conflict
LOC	line of communications

M

m	meter(s)
m^2	square meters
MADCP	mortuary affairs decontamination collection point
MANSCEN	Maneuver Support Center
MCCDC	Marine Corps Combat Development Command
mcg	microgram(s)
MCRP	Marine Corps reference publication
MCWP	Marine Corps Warfighting Publication
MD	Maryland
MEDSURV	medical surveillance
METT-TC	mission, enemy, terrain and weather, troops available and civilian
mg	milligram(s)
mg/L	milligrams per liter
mg/m^2	milligrams per square meter
mg/m^3	milligrams per cubic meter
$mg\text{-}min/m^3$	milligrams per minute, cubed
mL	milliliter(s)
MIJI	meaconing, intrusion, jamming, or interference
MILSTRIP	Military Standard Requisitioning and Issue Procedures
MLR	multiple launch rocket
MLRS	Multiple Launch Rocket System
mm	millimeter
MO	Missouri
MOA	memorandum of agreement
MOB	main operations base
MOPP	mission-oriented protective posture
MOU	memorandum of understanding
mph	miles per hour
mrad	millirads
mSv	millisieverts
MTF	medical treatment facility
MTTP	multiservice tactics, techniques, and procedures

N

NAAK	Nerve-agent antidote kit
NAI	named area of interest
NATO	North Atlantic Treaty Organization
NAVFAC	Naval Facility
NAVMED	Naval Medical Command
NAVMEDCOMINST	Navy medical command instruction
NBC	nuclear, biological, and chemical
NBC-IST	nuclear, biological, and chemical installation support team
NBCRS	Nuclear, Biological, and Chemical Reconnaissance System
NBCWRS	Nuclear, Biological, and Chemical Warning and Reporting System
NCO	noncommissioned officer
NEO	noncombatant evacuation operation
NOFORN	not releasable to foreign nationals
NSC	National Security Council
NSTM	Naval Ships Technical Manual
NTTP	Navy tactics, techniques, and procedures
NVD	night vision device
NWDC	Navy Warfare Development Command
NWP	Naval warfare publication

O

OEG	operational exposure guide
OPCEN	operations center
OPCON	operational control
OCONUS	outside the continental United States
OPLAN	operation plan
OPNAV	Office of the Chief of Naval Operations
OPORD	operation order
OPR	office of primary responsibility
OPREP	operational report
OPSEC	operations security
OPTEMPO	operating tempo
OSC	operations support center

P

PA	public address
PDD	Presidential decision directive
PIR	priority intelligence requirement
PMCS	Preventive-maintenance checks and services
POC	point of contact
POL	petroleum, oil, and lubricants
PPE	personal protective equipment

PSYOP	psychological operations
PVNTMED	preventive medicine

R

R&S	reconnaissance and surveillance
RADIAC	radiation detection, identification, and computation
RCA	riot control agent
RDECOM	Research Development and Engineering Command
RES	radiation exposure status
RI	Rhode Island
RM	risk management
ROC	regional operations center
ROE	rules of engagement
ROTA	release other than attack
RSCAAL	Remote-Sensing, Chemical-Agent Alarm
RV	radius of vulnerability

S

SA	situational awareness
SALUTE	size, activity, location, unit, time, and equipment
SBCCOM	US Army Soldier and Biological Chemical Command
SCBA	self-contained breathing apparatus
SIP	shelter in place
SIR	special information requirement
SMART	special medical augmentation response team
SME	subject matter expert
SOF	special operations forces
SOP	standard operating procedure
SRD	secret restricted data
SSM	surface-to-surface missile
STANAG	standardization agreement
STB	super tropical bleach

T

TA	target acquisition
TAP	threat assessment and planning
TB	technical bulletin
TEL	transporter-erector-launcher
TEU	technical escort unit
TFA	toxic free area
TGD	thickened soman
TIB	toxic industrial biological
TIC	toxic industrial chemicals
TIM	toxic industrial material
TIR	toxic industrial radiological

TM	technical manual
TPFDL	time-phased force and deployment list
TRADOC	United States Army Training and Doctrine Command
TSP	training support package
TTP	tactics, techniques, and procedures
TX	Texas

U

UJTL	Universal Joint Task List
US	United States
USA	United States Army
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USACMLS	United States Army Chemical School
USAF	United States Air Force
USAMEDCOM	United States Army Medical Command
USAMRICD	US Army Medical Research Institute for Chemical Defense
USAMRIID	United States Army Medical Research Institute of Infectious Diseases
USMC	United States Marine Corps
USN	United States Navy
UXO	unexploded ordnance

V

VA	Virginia, vulnerability assessment
VB	vapor barrier
VHA	vapor hazard area
VX	a nerve agent

W

WMD	weapons of mass destruction
WMD-CST	weapons of mass destruction—civil support team

PART II – TERMS AND DEFINITIONS

Aerosol. A liquid or solid composed of finely divided particles suspended in a gaseous medium. Examples of common aerosols are mist, fog, and smoke. (JP 1-02)

Avoidance. Individual and/or unit measures taken to avoid or minimize nuclear, biological, and chemical (NBC) attacks and reduce the effects of NBC hazards. (JP 1-02)

Biological agent. A microorganism that causes disease in personnel, plants, or animals or causes the deterioration of materiel. (JP 1-02)

Biological defense. The methods, plans, and procedures involved in establishing and executing defensive measures against attacks using biological agents. (JP 1-02)

Biological threat. A threat that consists of biological material planned to be deployed to produce casualties in personnel or animals or damage plants. (JP 1-02)

Biological weapon. An item of materiel which projects, disperses, or disseminates a biological agent including arthropod vectors. (JP 1-02)

Blister agent. A chemical agent which injures the eyes and lungs and burns or blisters the skin. Also called vesicant agent. (JP 1-02)

Blood agent. A chemical compound, including the cyanide group, that affects bodily function by preventing the normal utilization of oxygen by body tissues. (JP 1-02)

Chemical agent. Any toxic chemical intended for use in military operations. (JP 1-02)

Chemical ammunition. A type of ammunition, the filler of which is primarily a chemical agent. (JP 1-02)

Chemical defense. The methods, plans, and procedures involved in establishing and executing defensive measures against attack utilizing chemical agents. (JP 1-02)

Chemical dose. The amount of chemical agent, expressed in milligrams, that is taken or absorbed by the body. (JP 1-02)

Chemical environment. Conditions found in an area resulting from direct or persisting effects of chemical weapons. (JP 1-02)

Collective nuclear, biological, and chemical protection. Protection provided to a group of individuals in a nuclear, biological, and chemical environment which permits relaxation of individual nuclear, biological, and chemical protection. (JP 1-02)

Combatant command. A unified or specified command with a broad continuing mission under a single commander established and so designated by the President, through the Secretary of Defense and with the advice and assistance of the Chairman of the Joint Chiefs of Staff. Combatant commands typically have geographic or functional responsibilities. (JP 1-02)

Contamination. (1) The deposit, absorption, or adsorption of radioactive material, or of biological or chemical agents on or by structures, areas, personnel, or objects. (2) Food and/or water made unfit for consumption by humans or animals because of the presence of environmental chemicals, radioactive elements, bacteria or organisms, the byproduct of the growth of bacteria or organisms, the decomposing material (to include the food substance itself), or waste in the food or water. (JP 1-02)

Contamination control. Procedures to avoid, reduce, remove, or render harmless (temporarily or permanently) nuclear, biological, and chemical contamination for the purpose of maintaining or enhancing the efficient conduct of military operations. (JP 1-02)

Decontamination. The process of making any person, object, or area safe by absorbing, destroying, neutralizing, making harmless, or removing chemical or biological agents, or by removing radioactive material clinging to or around it. (JP 1-02)

Detection. In nuclear, biological, and chemical (NBC) environments, the act of locating NBC hazards by use of NBC detectors or monitoring and/or survey teams. (JP 1-02)

Host nation support. Civil and/or military assistance rendered by a nation to foreign forces within its territory during peacetime, crises, or emergencies, or war based on agreements mutually concluded between nations. Also called HNS. (JP 1-02)

Identification. 1. The process of determining the friendly or hostile character of an unknown detected contact. 2. In arms control, the process of determining which nation is responsible for the detected violations of any arms control measure. 3. In ground combat operations, discrimination between recognizable objects as being friendly or enemy, or the name that belongs to the object as a member of a class. Also called ID. (JP 1-02)

Individual protection. Actions taken by individuals to survive and continue the mission under nuclear, biological, and chemical conditions. (JP 1-02)

Individual protective equipment. In nuclear, biological, and chemical warfare, the personal clothing and equipment required to protect an individual from biological and chemical hazards and some nuclear effects. (JP 1-02)

Mission-oriented protective posture. A flexible system of protection against nuclear, biological, and chemical contamination. This posture requires personnel to wear only that protective clothing and equipment (mission-oriented protective posture gear) appropriate to the threat level, work rate imposed by the mission, temperature, and humidity. Also called MOPP. (JP 1-02)

Mission-oriented protective posture gear. Military term for individual protective equipment including suit, boots, gloves, mask with hood, first aid treatments, and decontamination kits issued to soldiers. Also called MOPP gear. (JP 1-02)

Nerve agent. A potentially lethal chemical agent which interferes with the transmission of nerve impulses. (JP 1-02)

Nonpersistent agent. A chemical agent that when released dissipates and/or loses its ability to cause casualties after 10 to 15 minutes. (JP 1-02)

Nuclear, biological, and chemical-capable nation. A nation that has the capability to produce and employ one or more types of nuclear, biological, and chemical weapons across the full range of military operations and at any level of war in order to achieve political and military objectives. (JP 1-02)

Nuclear, biological, and chemical defense. Defensive measures that enable friendly forces to survive, fight, and win against enemy use of nuclear, biological, or chemical (NBC) weapons and agents. US forces apply NBC defensive measures before and during integrated warfare. In integrated warfare, opposing forces employ nonconventional weapons along with conventional weapons (NBC weapons are nonconventional). (JP 1-02)

Nuclear, biological, and chemical environment. Environments in which there is deliberate or accidental employment, or threat of employment, of nuclear, biological, or chemical weapons; deliberate or accidental attacks or contamination with toxic industrial materials, including toxic industrial chemicals; or deliberate or accidental attacks or contamination with radiological (radioactive) materials. (JP 1-02)

Nuclear defense. The methods, plans, and procedures involved in establishing and exercising defensive measures against the effects of an attack by nuclear weapons or radiological warfare agents. It encompasses both the training for, and the implementation of, these methods, plans, and procedures. (JP 1-02)

Persistency. In biological or chemical warfare, the characteristic of an agent which pertains to the duration of its effectiveness under determined conditions after its dispersal. (JP 1-02)

Persistent agent. A chemical agent that, when released, remains able to cause casualties for more than 24 hours to several days or weeks. (JP 1-02)

Protection. Measures that are taken to keep nuclear, biological, and chemical hazards from having an adverse effect on personnel, equipment, or critical assets and facilities. Protection consists of five groups of activities: hardening of positions, protecting personnel, assuming mission-oriented protective posture, using physical defense measures, and reacting to attack. (JP 1-02)

Protective mask. A protective ensemble designed protect the wearer's face and eyes and prevent the breathing of air contaminated with chemical and/or biological agents. (JP 1-02)

Residual Contamination. Contamination which remains after steps have been taken to remove it. These steps may consist of nothing more than allowing the contamination to decay normally. (JP 1-02)

Survey. The directed effort to determine the location and the nature of a chemical, biological, and radiological hazard in an area. (JP 1-02)

Toxic chemical. Any chemical which, through its chemical action on life processes, can cause death, temporary incapacitation, or permanent harm to humans or animals. This includes all such chemicals, regardless of their origin or of their method of production, and regardless of whether they are produced in facilities, in munitions or elsewhere. (JP 1-02)

Toxic industrial biological—Biological materials (bacteria, viruses, and toxins) found in medical research or pharmaceutical and other manufacturing processes that are toxic to humans and animals or cause damage to plants. (FM 4-02.7)

Toxic Industrial Chemical. Chemical compounds used or produced in industrial processes that are toxic to humans and animals, or cause damage to plants. (FM 4-02.7)

Toxic Industrial Materials. Toxic industrial materials may be toxic industrial chemical (TIC), toxic industrial biological (TIB), and toxic industrial radiological (TIR) materials. (FM 4-02.7)

Toxic Industrial Radiological. Radiation emitting materials used in research, power generation, medical treatment, and other non-weapon developmental activities that are harmful to humans and animals if released outside their controlled environments. (FM 4-02.7)

Weapons of mass destruction. Weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. Weapons of mass destruction can be high explosives or nuclear, chemical, biological, and radiological weapons, but exclude the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon. Also called WMD. (JP 1-02)

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