AUSTRALIAN DEFENCE DOCTRINE PUBLICATION

OPERATIONS SERIES

ADDP 3.4
OPERATIONS IN A NUCLEAR, BIOLOGICAL AND CHEMICAL ENVIRONMENT

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Admiral, RAN
Chief of the Defence Force

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FOREWORD

1. Australian Defence Doctrine Publication (ADDP) 3.4 (ADFP 15) —*Operations in a Nuclear, Biological and Chemical Environment* describes the nature, doctrine and procedures to guide the planning and execution of nuclear, biological and chemical defence operations by the Australian Defence Force. The contents of this publication has been derived from general principles and doctrine contained in other relevant ADFPs, Defence Instructions (General), Allied Tactical Publications and Quadripartite Standardisation Agreements.

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GLOSSARY

aerosol

A suspension of minute solid or liquid particles in air or other gas.

biological agent (NATO)

A micro-organism which causes disease in humans, plants or animals, or causes the deterioration of material.

biological defence (NATO)

The methods, plans and procedures involved in establishing and executing defensive measures against attack utilising biological agents.

chemical agent (NATO)

A chemical substance which is intended for use in military operations to kill, seriously injure or incapacitate humans through its physiological effects. Excluded from consideration are riot control agents, herbicides, smoke and flame.

chemical attack

The employment of chemical agents, to produce casualties primarily to personnel or to make hazardous the occupation of certain areas.

Chemical, biological and radiological operations

Operations focussed on the lower level such as terrorism and asymmetric warfare.

chemical defence (NATO)

The methods, plans and procedures involved in establishing and executing defensive measures against attack utilising chemical agents.

chemical survey (NATO)

The directed effort to determine the nature and degree of chemical hazard in an area and to delineate the perimeter of the hazard area.

consequence management

The ADF/military support to the national response to mitigate and/or counter the threat or aftermath of a Chemical, Biological or Radiological incident and/or accident beyond the

capacities of the extant authorities. It includes measures to protect public health and safety, restore essential services and assist government and civil authorities in providing emergency relief.

contamination (NATO)
The deposit and/or absorption of radioactive material, biological, or chemical agents on and by structures, areas, personnel or objects.

contamination control (NATO)
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.

decontamination (NATO)
The process of making any person, object or area safe by absorbing, destroying, neutralising, making harmless, or removing, chemical or biological agents, or by removing radioactive material clinging to or around it.

dosimeter
An instrument for measuring and registering total accumulated exposure to ionising radiation.

hardening
The process of designing equipment to resist the effects of a nuclear detonation.

immediate decontamination (UKJS)
Decontamination carried out by the individual as part of chemical warfare immediate action drill.

monitoring
Assessing with instruments for known or suspected radiation, biological or chemical hazards.

nuclear, biological, and chemical collection centre (NATO)
The agency responsible for coordinating the activities of all nuclear, biological and chemical collection centres in a given area of observation. This agency may also assume the function of a collection centre for the area in which it is located.

nuclear, biological and chemical defence

The methods, plans, procedures and training required to establish defence measures against the effects of attack by nuclear weapons, chemical and biological agents. (**Note**: When aspects of nuclear, biological and chemical Defence are dealt with separately, they should be referred to accordingly, eg 'nuclear defence', 'biological defence', or 'chemical defence'.)

nuclear, biological, chemical operational environment

An operational environment in which:

a. one or more sides have the capability to use nuclear, biological, chemical weapons and the possibility exists for their employment, and/or

b. nuclear, biological, chemical weapons have been used and their effects persist in the area of operations to a level requiring forces to employ nuclear, biological, chemical defensive measures.

nuclear defence (NATO)

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.

nuclear radiation (NATO)

Particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important nuclear radiations, from the weapon standpoint, are alpha and beta particles, gamma rays, and neutrons. All nuclear radiations are ionising radiations, but the reverse is not true; X-rays for example are included among ionising radiations, but they are not nuclear radiations since they do not originate from atomic nuclei.

persistency

The duration of effectiveness of a chemical or biological agent in the target area after dissemination. Agents are classified as either persistent or non-persistent.

residual contamination (NATO)

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.

residual radiation (NATO)

Nuclear radiation caused by fallout, radioactive material dispersed artificially, or irradiation which results from a nuclear explosion and persists longer than one minute after burst.

ACRONYMS AND ABBREVIATIONS

ABCA	America, Britain, Canada and Australia
ADF	Australian Defence Force
ADFP	Australian Defence Force Publication
ADHQ	Australian Defence Headquarters
AIRSTDS	Air Standards
ALARA	as low as reasonably achievable
AO	area of operations
ASCC	Air Standardisation Coordinating Committee
BW	biological warfare
CBR	chemical, biological and radiological
CJTF	Commander Joint Task Force
colpro	collective protection
CW	chemical warfare
EMA	Emergency Management Australia
EMP	electromagnetic pulse
EOD	explosive ordnance disposal
HQAST	Headquarters Australian Theatre
IPE	individual protection equipment
JFAO	Joint Force area of operations
JFHQ	Joint Force Headquarters
JIPB	Joint Intelligence Preparation of the Battlespace
JMAP	Joint Military Appreciation Process
JTF	Joint Task Force
MOPP	mission oriented protective posture
MSR	main supply routes
NBC	nuclear, biological and chemical
NBCD	nuclear, biological and chemical defence
NBCCC	Nuclear, Biological and Chemical Control Centre
OEG	operational exposure guide

QSTAG	Quadripartite (US, UK, Canada and Australia) Standardisation Agreement
RAAF	Royal Australian Air Force
RAE	Royal Australian Engineers
RAN	Royal Australian Navy
ROTA	release other than attack
SIBCRA	Sampling and Identification of Biological, Chemical and Radiological Agents
SOP	standard operating procedures
TREE	transient radiation effects on electronics

CHAPTER 1

INTRODUCTION

It may not be the sheer killing power of these weapons that produces the greatest effect. It is the strategic, operational, psychological, and political impacts of their use that can affect strategic objectives and campaign decisions.

US JP 3-0, "Doctrine for Operations"

Executive Summary

- Nuclear, biological and chemical (NBC) weapons are designed to kill or incapacitate large numbers of personnel or neutralise area or specific targets.
- Chemical weapons, together with the possible terrorist use of biological weapons, remain the major NBC threat to the ADF.
- The aim of nuclear, biological and chemical defence (NBCD) in the ADF is to enable forces to successfully operate and complete their mission in a NBC environment.

General

1.1 Nuclear, biological and chemical (NBC) weapons are designed to kill or incapacitate large numbers of personnel or neutralise area or specific targets. NBC weapons are also designed to weaken the will and morale of both the forces involved and the civil population. The destructive capacity and more indiscriminate nature of NBC weapons in comparison to conventional weapons has resulted in international agreements aimed at countering their proliferation. Despite these agreements, NBC weapons exist in many countries throughout the world.

1.2 Australia's interests continue to be served by adherence to, and support of, wider acceptance of the 1968 Nuclear Non-Proliferation Treatry, the 1972 Biological Weapons Convention, the 1993 Chemical Weapons Convention and the 1925 Geneva Protocol on Gas and Bacteriological

Warfare. However, a NBC attack/incident, which includes riot control agents, civilian hazardous materials and electromagnetic pulse and transient radiation effects, remains a threat that the Australian Defence Force (ADF) must be able to deal with and continue operations in such an environment.

Threat to the Australian Defence Force

1.3 Chemical and biological weapons are technically the most easily produced of NBC weapons. Chemical weapons, together with the possible terrorist use of biological weapons, remain the major NBC threat to the ADF. The time required to develop an offensive capability using these weapons is significantly less than the time taken developing a defensive capability. In addition, police forces of many countries are experienced in the use of riot control agents and hold sizeable stocks of these agents.

1.4 A threat may also be posed to ADF personnel through the release of industrial chemicals or nuclear radiation. A release may follow either intentional or collateral damage to industrial chemical installations or facilities that house radioactive substances. These threats may be exacerbated in areas of operations where protracted fighting prevents routine maintenance or battle damage repair.

1.5 It is essential that ADF forces are staffed, equipped and trained for NBC operations and that joint policies, doctrine, procedures and techniques reflect the potential risks and the consequent requirement to be able to survive and operate in such conditions. Not only must ADF units be proficient in NBC defence measures, they must also be capable of integrating operationally with multinational partners.

1.6 The purpose of NBC defence is to protect the force from the strategic, operational, tactical, physiological and political impacts of use of NBC weapons, in order to be able to continue to operate in NBC environments by anticipating, training and equipping for such eventualities. Forces so prepared and able to survive and operate in NBC warfare conditions will reduce an enemy's incentive to employ such weapons.

Aim of Nuclear, Biological and Chemical Defence

1.7 The aim of nuclear, biological and chemical defence (NBCD) in the ADF is to enable forces to successfully operate and complete their mission in a NBC environment. A NBC environment may include one or a combination of NBC weapons, riot control agents and civilian toxic/hazardous materials.

In relation to NBC attacks or the hazards posed by the release of industrial chemicals, hazardous materials or radiological substances, NBCD must:

- minimise their effects;
- maintain the extant operational and logistic capability;
- provide for the rapid recovery of operational and logistic efficiency;
- deter attacks or industrial release by demonstrating a sound defensive capability; and
- actively target the enemy's offensive chemical and biological capability by executing conventional attacks on their command and control systems, operational stockpiles and delivery systems.

Purpose and scope

1.8 This publication provides guidance to commanders and staff officers for the planning and execution of NBC defensive operations. It focuses on the NBC threat and operational and logistic considerations for the conduct defence.

Standardisation agreements

1.9 Quadripartite Standardisation Agreements (QSTAG) and Air Standardisation Coordinating Committee Air Standards (AIRSTDS) outline the more technical details of ADF responsibilities and organisations for NBC. The American, British, Canadian and Australian (ABCA) Information Centre, located in Combined Arms Training and Development Centre, Puckapunyal is the current custodian of all the relevant up-to-date QSTAG. Director International Standardisation, Aerospace Development Branch, Australian Defence Headquarters, Canberra, is the current custodian of all relevant AIRSTDS. These Agreements are constantly updated and provide both general and technical information on all aspects of NBCD.

Historical Example: Sarin Gas Attack on Tokyo Subway

On 20 March 1995, terrorists from the Aum Shinryko Cult simultaneously released sarin, an organophosphate nerve gas at several points in the Tokyo subway system, killing 12 and injuring more than 5500 people.

Cult members concealed sarin in lunch boxes and soft drink containers and placed these onto train floors. The terrorists released the gas by puncturing the containers with umbrellas as they left the trains. The incident was timed to coincide with rush hour, when trains were packed with commuters.

Casualties demonstrated symptoms of miosis, headache, nausea, ocular pain, blurred vision, vomiting, coughing, muscle weakness and agitation. Physical signs and symptoms disappeared within a few weeks however psychological problems associated with post traumatic stress disorder persisted longer.

Source: http://www.sma.org/smj/97june3.htm

Figure 1-1: In 1995 terrorists conducted sarin attacks in Tokyo Subway

CHAPTER 2

THE NBC ENVIRONMENT

This is a complex problem that requires an experienced hand and a determined approach. First, we've got to deal with those nations that have used the gas. . . We must restore the prohibition against the use of those terrible weapons. The barriers against chemical warfare, breached during the Iran-Iraq War, must be repaired and raised even higher.

Second, we've got to prevent those nations approaching the threshold from proliferating. That calls for careful intelligence and controls on the technical capabilities that allow production of the weapons . . .

Third, we've got to prevent the most ominous proliferation of all. The eventual combination of chemical weapons and ballistic missiles could put new destructive power in the hands of governments with terrorist records.

At the end of the First World War, the so-called war to end all wars, mankind sought safety in collective security. Part of that security was to outlaw the use of certain weapons — chemical weapons — as a sign of our civilisation. Collective security failed eventually under Hitler's blows. One of the first signs of the breakdown of civilisation was the use of gas in Ethiopia.

From that time until our own, despite World War II, and countless conflicts, somehow the ban on the use of chemical weapons remained intact. Yet now, just as we look up, look forward to a new decade and perhaps a whole new era of peace — the alarm bell has sounded. I've heard that bell and I know what it means. And if I'm remembered for anything, it would be this: a complete and total ban on chemical weapons.

President George Bush, Address at the University of Toledo

Toledo, Ohio, October 21, 1988

Executive Summary

- Even in peacetime a NBC defence capability is needed against accidents or unlawful events. The Australian Federal Government has tasked all State Governments to ensure that their emergency organisations are capable of responding to and mitigation of incidents either deliberate or accidental involving war type NBC agents.

- An enemy may use strategic or tactical nuclear weapons, classic biological or chemical weapons, or newly developed weapons from the bio-chemical spectrum.

General

2.1 The end of the Cold War has reduced the threat of large-scale conflict, but significant nuclear, biological and chemical (NBC) weapon capabilities remain, and have proliferated to a degree among the minor powers. Many of the weapons possessed by the former Soviet Union are now dispersed across independent states without the benefit of the centralised control of the Warsaw Pact. Thus, the potential for the use of NBC weapons has become asymmetrically in nature; more difficult to predict, with the possibility that they could be used in a wide range of scenarios, and well short of global conflict.

2.2 Even in peacetime a NBC defence capability is needed against accidents or unlawful events. The Australian Federal Government has tasked all State Governments to ensure that their emergency organisations are capable of responding to and mitigation of incidents either deliberate or accidental involving war type NBC agents. On peace support operations and during all types of conflict there may be a risk of riot control agents being released, release of harmful substances from damaged industrial plant or reactors as a result of an accident/unlawful action or contamination from the earlier use of NBC weapons between opponents.

2.3 A potential enemy with a NBC capability may use or threaten to use these types of weapons at any stage in a campaign. The form and scale will depend on the capability and intention of the nations concerned. Chemical and biological weapons in particular are capable of an impact totally disproportionate to their production costs, not just in the physical impact of using such weapons, but in the psychological effect on an opponent and the cost of defending against such weapons. However, in spite of the apparent advantages of possessing and utilising NBC weapons, it would be expected

that a nation state would be loath to use these weapons except as a last resort, but terrorist action presents as a different threat scenario.

2.4 An enemy may use strategic or tactical nuclear weapons, classic biological or chemical weapons, or newly developed weapons from the bio-chemical spectrum. Some weapons may have been developed from commercially available hazardous substances, and thus, hitherto not considered as biological or chemical agents. Increasingly, NBC is being associated with terrorist organisations. Methods of delivery may be by missile, rocket, aircraft, bombs or unconventional means. A commander must continuously re-evaluate the enemy's willingness and potential means to employ these types of weapons throughout the execution of a campaign.

Figure 2-1: NBC weapons may be delivered using strategic assets

2.5 The threat of use of NBC weapons by an enemy or terrorist organisation, can be almost as effective as actual use through the detrimental effect on own forces and the civilian population. The fact that an adversary could potentially use these types of weapons causes a reduction of operational capability through the need for heightened Mission Oriented Protective Posture levels, greater workload and psychological stress. The adverse effects of this tactic can be overcome through the provision of adequate training for Defence personnel, public information campaigns when

operating in built up areas, formalised and rehearsed post attack recovery plans and the collection of sound intelligence on enemy capabilities.

2.6 Nuclear. Despite an overall reduction in the number of warheads worldwide a significant stockpile remains. Of additional concern is the increasing number of nations who possess, or are actively pursuing a nuclear capability. Further risks evolve from the widespread and rapidly expanding use of radiation sources in industrial, commercial, medical, academic and domestic environments that could result in risks to Australian Defence Force (ADF) personnel.

2.7 Biological. Several nations possess offensive Biological Warfare (BW) capabilities or have advanced development programmes. The ability of BW agents to produce very large numbers of casualties and the relative ease of their production and delivery present a risk to ADF personnel.

2.8 Chemical. Of the nations who possess NBC capabilities, the largest group comprises those who have or are actively pursuing an offensive Chemical Warfare (CW) capability. Many nations stockpile and use riot control agents during civil unrest situations. Additionally the worldwide increase in the use, production, storage and transportation of (sometimes very toxic) chemicals poses a risk in almost all areas where ADF personnel might be deployed. CW has strategic, operational and tactical implications.

2.9 Civilian hazardous materials. There is a rapidly expanding occurrence of hazardous materials, which may include chemical, biological or radiological compounds, in a variety of industrial, commercial, academic, medical and domestic processes. These give rise to the possibility of ADF personnel being exposed to hazardous materials as a result of deliberate or accidental (maintenance error/accident, collateral damage, transportation accident, etc) release of these compounds. The threat from civilian hazardous materials, whether they be chemical, biological or radiological, are herein treated the same as a NBC threat.

NBC weapon effectiveness

2.10 Availability and ease of NBC weapon production. The production of nuclear weapons requires a large nuclear infrastructure, an advanced technological base and links to a nuclear program. The proliferation in the manufacture of nuclear devices would almost certainly be covert and it would not be possible to test them prior to first use. Conversely, biological and chemical weapons are relatively straightforward to produce and can be made in existing civilian facilities, assuming possession of a pharmaceutical or

biochemical industry. Therefore potential adversaries could possess the ability to begin manufacturing biological and chemical weapons relatively quickly unlike nuclear weapons. The priority of risk from this perspective is therefore biological and chemical, followed by nuclear.

NBC DEFENCE POLICY ISSUES

2.11 There are a number of complex, and potentially sensitive NBC defence policy issues to be addressed at the political, strategic and operational level in response to a deployment where a NBC threat exists. Defence Instruction (General) Operations 15–1—*Australian Defence Force Policy for Operations in a Nuclear, Biological and Chemical Environment* provides further guidance.

2.12 ADF response to NBC threat. A Commander Joint Task Force (CJTF) will need to be clear on the ADF's position regarding the likely military and diplomatic response to the use of, or threatened use of NBC weapons against ADF units. This issue will be more complicated if there is a requirement to harmonise national positions within a multinational coalition.

2.13 Wider responsibilities. Current ADF policy states that NBC defence protection will only be provided to 'essential civilians' who will be provided with the same levels of protection as military personnel. Clearly this definition will require careful consideration within the context of the operation and those involved, with implications for the scaling of equipment, training facilities and health countermeasures.

2.14 NBC defence equipment. The NBC threat and analysis will determine the type, quantity, and issue policies for NBC defence equipment and consumables required to support an operation. Early deployment of some assets, for example a biological detection system, can complement a deterrent posture and provide early warning. The CJTF and his staff should, however, be aware of the lead times required for the deployment of certain detection assets and consider other options.

2.15 Health countermeasures. Health Countermeasures include vaccinations and/or drugs (including antibiotics) designed to protect against/neutralise the effects of NBC attack. The decision to commence prophylactic and pre-treatments of personnel will only be made once a threat is determined to exist and in accordance with current Defence Medical Instructions and Policy. This is further complicated by medical, ethical, and legal factors. Long lead times for some vaccines to confer full immunity may, for example, generate pressure for early decisions to be made, but this

must be considered against the established risk. The issue of who to treat is also extremely complex; for example there may be a requirement or obligation to extend facilities beyond ADF personnel.

2.16 Chain of command briefings. The threat of NBC engenders a level of fear that is often out of proportion with reality. Knowledge and training will dispel fear, but the effects of rumour, the media and the paucity of accurate information will frustrate commanders, both before and after deployment. The chain of command needs to keep a tight grip on NBC issues if their damaging effects on morale and resolve are to be minimised.

2.17 Media. Media interest will be intense, and its handling of NBC matters will influence morale within the force and beyond, and may have wider implications for the success of the operation. Clear direction, at the strategic, operational and tactical levels, must be established at the outset of operational planning, and reviewed as the situation develops.

NBC EFFECTS

Nuclear hazards

2.18 Nuclear detonations or the release of radioactive material may cause nuclear hazards. The former are characterised by: thermal effects, including flash, a fireball and a heat pulse, blast, radiation and an electro-magnetic pulse (EMP)/transient radiation effect on electronics (TREE). The level of damage will depend on yield, height of burst, distance from ground zero and target vulnerabilities. The level of radiation and the radiological affects within the area will vary by event and could include nuclear weapon fallout and rainout, partial nuclear detonations, improvised radiological weapons (ie., the explosive scattering of radioactive material) or Release Other Than Attack (ROTA) from a nuclear facility.

2.19 Even small nuclear/radiological events are likely to have great political impact and may be used by a nation with a nuclear/radiological capability as a deterrant and counter-balance to superior forces. Therefore an attack of last resort or against key facilities, to achieve a significant operational impact cannot be discounted. In addition the availability of nuclear materials to terrorists has increased with the breakup of the former USSR, increased use of nuclear power facilities, research reactors and industrial applications. Radiological contamination is a hazard from inhalation, ingestion and exposure. Radiological contamination effects of nuclear weapons poses problems of long term contamination of equipment, land, facilities and personnel. This is because radiological contamination cannot be destroyed

or neutralised. It can only be removed to a safe place for natural decay, which may take many years. Countermeasures for nuclear/radiological events involve the control of time, distance and shielding from the radiological source. Radiological contamination generally will not present an immediate effect, requiring a period for the radiation sickness to take effect upon the body.

Biological hazards

2.20 Biological agents are living pathogenic micro-organisms that can infect humans, animals or plants. Whilst they may be used as a means of economic warfare or to deny certain areas to sections of a population the greatest concern is with agents that can infect humans. They are extremely potent and, in many cases, only a few micro-organisms are needed to infect exposed personnel. However exposure to a biological agent may not immediately be obvious because biological agents (apart from Toxins) require an incubation period of several hours to several days in the host before symptoms appear. Examples of potential BW agents are shown in annex A.

2.21 Toxins are non-living poisons normally derived from animals, plants or micro-organisms, although it may be possible to synthesise some toxins chemically. Toxins vary in their potency, but may be many times more toxic than chemical agents. However, they are slower acting than chemical agents, normally producing effects within hours. In many respects they are an intermediate between classical chemical agents and traditional biological agents. With advances in biotechnology and fermentation techniques they are likely to become more readily available to potential adversaries. Examples of toxins are shown in annex A.

2.22 Biological agents and toxins could be delivered either overtly or covertly. The major hazard for military forces lies in their potential for release as fine aerosols that can enter the respiratory tract. In the worst case, the hazard area can extend far downwind of the point of release. Accordingly, a good appreciation of delivery methods, meteorological conditions and the factors affecting the survival of micro-organisms in the aerosol state is necessary to determine weapon effectiveness. Even sub-optimal attacks can cause large numbers of casualties.

2.23 Biological agents are a hazard from inhalation, ingestion and injection. Living biological agents generally do not present an immediate effect requiring an incubation period for the micro-organism to establish in its host before symptoms show. Toxins are a poison having immediate effects similar to a spider or snake bite. Countermeasures for biological agents

include protective clothing, decontamination that involves destruction of the agent and medical preattack prophylactics.

2.24 Historically, BW has been perceived to be a strategic weapon to be targeted against population centres or concentration of forces. However, it is becoming increasingly apparent that BW can also be used tactically and that there are a wide variety of targets against which such weapons could be effective. Moreover, the relative ease of production and the difficulties in detecting and identifying BW agents, mean that BW is likely to become an increasingly attractive option for potential adversaries, including covert attack by irregular and terrorist forces.

Chemical hazards

2.25 Chemical agents can attack different physiological systems and can be classified as toxic and non-toxic. Toxic agents include blood, choking, nerve or blister agents. Non-toxic agents include riot control and incapacitating agents. It is important to acknowledge that there is not always a sharp dividing line between the two levels of effectiveness. From the military point of view the most useful classification is in terms of their persistency. Some agents have a high volatility at ambient temperatures and only create a transient hazard, whilst others have a lower volatility and create hazards which can last for days or weeks, depending upon the meteorological conditions. CW agents are likely to be employed with the primary aim of either producing casualties (non-persistent) or contaminating ground and/or equipment (persistent). They may be delivered in gaseous, liquid or aerosol form by a multitude of delivery systems.

2.26 Toxic chemicals can enter the body by ingestion, inhalation or absorption through the eyes and the skin. The normal means of personal protection are therefore respirators, suits, boots and gloves. However, wearing such equipment degrades performance, particularly if worn for long periods to counter a persistent chemical hazard. The threatened use of CW agents may therefore reduce the mission effectiveness of ADF personnel merely by forcing them into a protective posture. Chemical agents can be either destroyed or neutralised by decontamination procedures. Further details concerning CW agents are shown in annex B.

Toxic materials

2.27 Toxic materials is a generic term for a diverse category of compounds which may include chemical, biological or radioactive substances produced for legitimate reasons but which, if released accidentally or deliberately, or as

a result of collateral damage, may produce harmful effects in humans, animals, plants and materiel. Users may employ toxic materials to hamper military operations, either by deliberately releasing large quantities from storage depots, transportation facilities or by using improvised devices to deliver them. These hazards will be treated as either nuclear, biological or chemical hazards. The ADF, when requested, must be prepared and able to work in conjunction with and assist State Governments and their emergency services to counter either a deliberate or accident incident involving these materials. They are referred to by Australian emergency services organisatiions as Hazardous Materials Incidents or HAZMAT for short.

Sampling and Identification of Biological, Chemical and Radiological Agents (SIBCRA)

2.28 Should nuclear, biological or chemical warfare be used against ADF units, it will be necessary to show unambiguously and rapidly that such an attack has indeed taken place and to establish the exact nature of the agent. This information is required to provide confirmation to a CJTF, support medical requirements, support strategic decisions and prove treaty violations. Further details concerning the role of the SIBCRA team and the CJTF's responsibility is in annex C.

Figure 2-2: NBC sampling and identification[1]

THE IMPACT ON OPERATIONS

Impact of NBC attacks

2.29 Nuclear. Nuclear weapon attacks will cause many casualties, considerable materiel damage, obstacles to movement, and restrictions on the use of critical facilities, communications, and terrain. The effects of initial nuclear radiation can range from temporary, mild radiation sickness to immediate incapacitation and early death, depending on the dose received. Flash will cause eye damage ranging from permanent to temporary blindness. Thermal radiation can cause severe burns to exposed personnel and damage to equipment. Blast will damage or destroy buildings, vehicles and equipment, and kill or injure personnel. In addition, when channelled by hills, it will lead to a multiplication of the energy level in valleys. If enhanced radiation warheads are used, the radiation casualty radii will increase

[1] Photograph courtesy of DSTO CBRN Laboratories

dramatically without a corresponding increase in the materiel damage radii. Low levels of ionising radiation, deliberate or unintentional, may have no immediate effects on individuals or the conduct of operations. However continued exposure to low level ionising radiation could pose long-term health risks to individuals. The medical, legal and ethical implications of such exposure must be weighed against the immediate operational imperatives. The principle of radiation exposure control should be always to keep it to 'As Low as Reasonably Achievable'. EMP and TREE will inhibit or damage communications and electronic equipment at varying ranges. Fallout and neutron induced radiation will require the expenditure of time and resources for monitoring and survey, radiation exposure control, and decontamination operations. Ground shock may cause landslides, rupture of underground gas, fuel, and electrical lines, and collapse of building foundations. Shock waves will represent a threat to the hulls of submarines and surface vessels.

2.30 Biological and chemical. The effects of biological and chemical agents may vary from temporary incapacitation to death, either immediately or after a delay, among partially protected and exposed personnel. The immediate threat or the occurrence of these attacks or the requirement to operate in a contaminated environment will require individual protection. This will inevitably result in heat build up, psychological stress, reduced mobility, and degradation of vision, touch, hearing and speech. Individual and ultimately, unit operational effectiveness will be degraded.

2.31 NBC contamination. NBC contamination may require extensive NBC reconnaissance and monitoring measures and decontamination of personnel, materiel, equipment and parts of terrain occupied by vulnerable facilities (e.g. hospitals and air bases). The introduction of NBC casualties and contaminated conventional casualties in addition to other conventional casualties will place a serious strain on the health support system at all echelons. The sum of these effects will have a significant psychological impact upon the combat effectiveness of personnel and their units, although this can be minimised through a combination of good training and equipment. The impact on poorly trained or ill-equipped personnel will be serious, and may well threaten their ability to continue their mission, even in areas which are not directly affected.

British nuclear tests at Maralinga

Between 1952 and 1963 the British government, with the agreement and support of Australia, carried out nuclear tests at three sites in Australia – the Monte Bello Islands off the coast of Western Australian and at Emu Field and Maralinga in South Australia. An official history of the tests (JL Symonds, *A History of British Atomic Tests in Australia*, AGPS, Canberra) was published by the Department of Resources and Energy in 1985.

Maralinga was developed as the permanent proving ground site, following a request of the British in 1954 and, after its completion in 1956, was the location of all trials conducted in Australia. It was developed as a joint facility with a shared funding arrangement. Following the two major trials (Operation Buffalo in 1956 and Operation Antler in 1957), a number of minor trials, assessment tests and experimental programs (dating from 1959) were held at the range until 1963. Maralinga was officially closed following a clean-up operation (Operation Brumby) in 1967.

Fact Sheet 129, National Archive of Australia

Annex:

A. Biological agents and toxins
B. Chemical warfare agents
C. Sampling and Identification of Biological, Chemical and Radiological Agents (SIBCRA)

BIOLOGICAL AGENTS AND TOXINS

BW Live Agents	Diseases
BACTERIAL	Anthrax Brucellosis Cholera Melioidosis Plague Tularaemia Typhoid Fever
RICKETTSIAL	Q-Fever Rocky Mountain Spotted Fever Epidemic Typhus
FUNGAL	Coccidioidomycosis Histoplasmosis Nocardiosis
VIRAL	Influenza Ebola Fever Marburg Fever Lassa Fever Smallpox Venezuelan Equine Encephalitis Various Arboviruses (now known as toga or flaviviruses)
CHLAMYDIAL	Psittacosis
Note: The list above is used only to show the wide variety of live BW agents that could be used in a biological attack. Many are not naturally found and some are rare. It is unnecessary to have a detailed knowledge of these diseases as such information is obtainable from specialist medical staff.	

Table 2A–1: Examples of potential BW live agent diseases by type

BW Agents	Approx lethality % (untreated)	Incubation Period, days
Lethal Transmissible		
Plague (pneumonic)	100	3-4
Plague (bubonic)	50-60	2-6

BW Agents	Approx lethality % (untreated)	Incubation Period, days
Cholera	5-75	1-7
Ebola Fever	70	7
Lassa Fever	35	14
Marburg Fever	30	14
Smallpox	5-60	7-16
Lethal Non-Transmissible		
Anthrax (pulmonary)	100	1-7
Meliodosis	80-100	1-5
Epidemic Typhus	10-40	6-15
Tularaemia (typhoidal form) (most likely BW form)	35	1-10
Non-Lethal Transmissible		
Influenza	1	1-3
Dysentery	2	1-7
Typhoid Fever	10	7-21
Non-Lethal Non-Transmissible		
Brucellosis	2	5-21
Q-Fever	0-4	14-21
Rocky Mountain Spotted Fever	2	3-10
Venezuelan Equine Encephalitis	1	2-5
Coccidioidomycosis	1	10-21
Nocardiosis	1	Weeks
Histoplasmosis	1	5-18
Various potential Arboviruses		

Notes

1. The figures given for lethality relate to civilian experience. They do not allow for higher doses by inhalation or delay in identification.

2. The figures for incubation periods refer to the natural occurrence of the disease and not for spread by aerosol.

Table 2A–2: Examples of potential BW agents by operations classification

Some examples of natural toxins that could be used in warfare are as follows:

Toxin	Produced by	Symptoms	Usual Effect for Specific Route of Entry
Staphylococcal Enterotoxin	Bacteria	Headache, nausea and vomiting, diarrhoea (sever prostration).	Incapacitating by oral route from 6-48 hours.
Botulinum Toxin	Bacteria	General weakness, double vision, dizziness, weakness of the muscles.	80% lethal without medical care, 25% lethal with good medical care. Infection taken orally.
Trichothecene Mycotoxin	Fusaria species of Fungi	Nausea, vomiting, blood filled blisters on skin, internal bleeding.	Lethal in 5% of cases, an incapacitating agent on skin and orally.
Cobra Neurotoxin	Cobra snake	Numbness, tiredness, clouding of consciousness, dimming of vision, weakness of muscles, paralysis of breathing.	Usually lethal when injected.
Palytoxin	Marine Corals	Cardiac arrest due to constriction of blood supply.	Lethal. Fast acting when absorbed into skin cut.
Ricin	Castor oil plant and seeds	Abdominal pain, fever, burning in the throat muscle, weakness, convulsions, collapse.	Lethal in high doses taken orally or when injected. Very lethal if inhaled.
Tetrodotoxin	Puffer Fish	Collapse, muscular weakness.	Lethal following ingestion.

Table 2A–3: Examples of Toxins

CHEMICAL WARFARE AGENTS

Agent	Method & Effect	Physical Symptoms
Nerve Agents		
Tabun (GA) Sarin (GB) Soman (GD) VX	Absorption Inhalation or Ingestion Rapid action	Running nose, salivation, tightness of chest, pinpoint pupils, dim vision. Dizziness, sweating. Vomiting, involuntary bodily functions, twitching and convulsions, breathing ceases (includes thickened GD-TGD).
Blood Agents		
Hydrogen Cyanide (AC)	Inhalation Very rapid action	High Concentration. Rapid increase in the depth of breathing (hyperventilation), violent convulsions within 20 seconds, death within one minute. Low Concentration. Dizziness, nausea and headache for several hours. The cyanide is detoxified in the body.
Cyanogen Chloride (CK)	As above.	As above, in addition there will be severe irritation of the eyes and respiratory tract.
Choking Agents		
Phosgene (CG)	Inhalation Final symptoms brought on by heavy exertion	**Initial Symptoms**. Irritation of eyes and throat, coughing, choking, nausea and vomiting. **Latent Period**. Little apparent discomfort. **Final Symptoms**. Painful cough, frothing at the mouth, lung collapse. **Note**. Phosgene casualties will always become stretcher cases.
Chlorine (CL)	Non-persistent Inhalation	Coughing, choking and possible death

Table 2B–1: Agents

Agent	Method of Effect	Physical Symptoms
Mustard (H)	Absorption Ingestion Inhalation Quick acting yet delayed symptoms	Vapour attacks moist sweating areas of skin and mucous membranes of the eyes and throat. Liquid attacks any exposed body surface. The effects may be slow to appear (hours to days depending on exposure) although liquid will act more quickly. Agent causes irritation, reddening and blistering. If agent is inhaled or ingested slow death may result.
Lewisite (L)	As above but rapid action and symptoms	Effects as above except irritation immediate. Recovery complicated by the possibility of arsenical poisoning so that damage may be permanent.
Mustard/Lewisite (HL)	As above	A combination of above serials.
Phosgene Oxime (CX)	Absorption Ingestion Inhalation Very rapid action	Causes rapid and intense paid on contact with skin especially moist areas. Kills skin at point of contact and forms weals. The pain may cause a breakdown of gas discipline.

Table 2B–2: Blister/Damaging Agents

Agent	Method of Effect	Physical Symptoms
Quinuclidinyl Benzilate (BZ) Riot Control Agent (CS)	Inhalation Ingestion and absorption possible	Mental and physical delayed action agent, causes sleepiness, decreased alertness and co-ordination with progressive intoxication. Can have reverse effects on some personnel.

Table 2B–3: Incapacitating Agents

SAMPLING AND IDENTIFICATION OF BIOLOGICAL, CHEMICAL AND RADIOLOGICAL AGENTS (SIBCRA)

Overview

1. Should nuclear, biological or chemical warfare agents be used against Australian Defence Force (ADF) units, it will be necessary to show unambiguously and rapidly that such an attack has indeed taken place and to establish the exact nature of the agent. This information is required to:

a. **Provide confirmation to the Commander Joint Task Force.** The commander whose forces may have been exposed to a nuclear, biological or chemical attack needs verification that his analysis of battlefield events is correct. Presumptive identification will aid the commander with the information needed to readjust forces and to take appropriate medical action to preserve the force for future operations. If quick medical action is taken before the onset of symptoms, a significant number of casualties can be prevented.

b. **Support medical requirements.** A good sample of the agent can help the medical community to determine the best way to medically counter the attack. However, the sample must be of good quality and properly collected and preserved to be useful for this type of analysis. The SIBCRA Identification Teams need to be specifically trained in the critical areas of proper sampling techniques and the handling and evacuation of samples.

c. **Support strategic decisions.** The initiation of a nuclear, biological or chemical attack against ADF units is a significant escalation of the level of warfare. As such, the national command authority may consider initiating retaliatory measures. However, the public at large will want clear, indisputable proof of the use of these agents to support such actions. A good, well-documented sample which verifies that an agent was employed is needed to support the accusation of use.

d. **Prove treaty violations.** The Chemical Weapons Convention (CWC) and the Biological and Toxic Weapons Convention

(BWC), which ban the production and use of these weapons, also require requests for investigation to be accompanied by substantial supporting evidence. While there is no international agreement on the use of nuclear weapons, positive proof to the use of nuclear weapons will equally be required. Violation of treaties such as the CWC and BWC can bring political recriminations from the international community and possibly sanctions against the violator. Detection of the attack provides the attacked country with grounds for taking reprisals or retaliatory measures against the perpetrator. However, the international community demands a 'legal' quality of proof that the attack did take place. A sample with clear chain of custody is a major step in establishing the proof required. Information about the samples must be as detailed and comprehensive as possible.

SIBCRA decision making process.

2. The accompanying figure shows the SIBCRA decision making process:

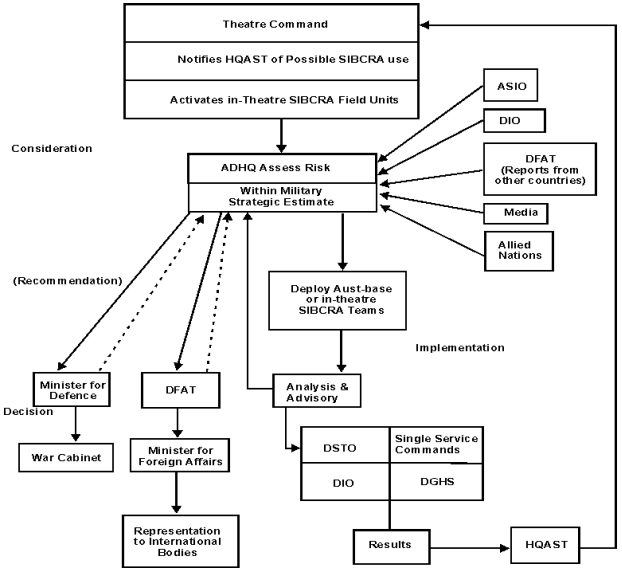

Figure 2C–1: SIBCRA decision making process

Planning considerations.

3. The following planning considerations need to be taken into account:

a. Topography and climate.

(1) Location and access to the sample site.

(2) Route to the sample transfer point.

(3) Down wind hazard.

(4) Work rate and the resulting heat stress on the sampling team.

b. Time of Day. Currently effective sampling at the attack site can not be performed at night or periods of reduced visibility.

c. Type of Agent. The hazard presented by the agent, its persistency and hazard area will dictate the sampling method.

d. Protocols.

(1) Samples must be removed from hazard area before packaging for shipment.

(2) Shipment will require special approved containers that will require prior co-ordination.

(3) Biological sampling will require at least 75 individual samples for each attack area.

(4) Chain of custody and security must be maintained throughout the sampling and movement of samples.

CHAPTER 3

COMMAND AND CONTROL

Executive Summary

- Single services have distinct responsibilities for NBC Defence.
- Planning for NBC operations is conducted as part of JMAP.
- The intelligence requirement of NBC operations is to identify the enemy's NBC capability and motivation, determining the nature, availability, locations, and deliverability of its NBC weapons, and its ability to operate in a NBC environment.

Introduction

3.1 The Nuclear, Biological and Chemical Defence (NBCD) command and control system must allow for the control and coordination of NBCD operations at all levels. NBCD staffs are organised into Nuclear, Biological and Chemical control centres (NBCCC) at all levels of command. The level of staffing and function of the cells will be dependent on the nuclear, biological and chemical (NBC) threat and type of operations conducted. Dependent on the level of the NBC threat, the NBCCC functions are to direct, collect, process and disseminate NBC intelligence, manage the warning and reporting system, produce hazard predictions and advise commanders and their staffs on all aspects of NBCD. Many of these functions are carried out in conjunction with the relevant intelligence staffs.

COMMON AND SINGLE SERVICE RESPONSIBILITIES

Common responsibilities

3.2 Each Service is responsible for:

- individual training of personnel in the principles of NBC operations;
- maintaining personnel preparedness and equipment at the designated level for the specific ship/base/facility/area;

- NBCD measures for own Service bases, dockyards and establishments;

- NBC explosive ordnance disposal in accordance with Australian Defence Force Publication (ADFP) 56—*Explosive Ordnance Disposal*; and

- training and provision of personnel for NBCCC.

Royal Australian Navy (RAN) responsibilities

3.3 The RAN is responsible for all aspects of NBCD procedures for ships, dockyards and naval establishments, except for special-to-purpose aspects undertaken by the Army and Royal Australian Air Force (RAAF). The RAN is also responsible for the purely maritime aspects of NBCD.

Figure 3-1: Navy is responsible for NBCD procedures for ships, dockyards and naval establishments

Army responsibilities

3.4 The Army is responsible for:

- all aspects of NBCD particular to the land environment, except for special-to-purpose aspects undertaken by the RAN and RAAF;

- development of materiel requirements and for Single Service Logistic Management of common-user equipment, including provision of common-user items of:
  - protective clothing; and
  - decontaminants, filters and other consumables;
- training NBCD instructors, under the Service Memorandum of Agreement for NBCD Training;
- conduct of NBC reconnaissance and survey (except on RAN or RAAF bases/establishments) including provision of aircraft and equipment for tactical airborne radiological survey in the land area of a joint force area of operations (JFAO);
- provision of decontamination personnel, equipment and facilities for a deployable joint force headquarters (JFHQ) in land operations; and
- assistance in provision of meteorological data for NBC hazard prediction in a JFAO.

Figure 3-2: Army elements are responsible for land NBC functions

RAAF responsibilities

3.5 The RAAF is responsible for:

- all aspects of NBCD particular to the Air environment, including airfield defence, aircraft operations and support activities, except for special-to-purpose aspects undertaken by the RAN and Army;
- dissemination of meteorological data for NBC hazard predictions;
- conduct of NBC aerial reconnaissance and survey (except where provided by Army aviation);
- development of materiel requirements and single Service management of aircrew clothing and equipment, and aircraft monitoring, detection and survey equipment; and
- provision of decontamination personnel, equipment and facilities for RAAF bases/units.

Figure 3-3: RAAF has NBCD responsibilities for the air environment

Civil responsibilities

3.6 The Commonwealth organisation, Emergency Management Australia, is responsible for developing plans covering the civil defence aspects of NBCD and for the planning and coordination of civil/defence responses to NBC emergencies. State and territory governments are normally responsible for chemical, biological or radiological (CBR) incidents/accidents. ADFP 44—*Civil-Military Cooperation* discusses the ways the Australian Defence Force (ADF) provides support to civil authorities.

3.7 Consequence management is the term used to describe ADF support to the national response to mitigate and/or counter the threat or aftermath of a CBR incident or accident which is beyond the capacity of the relevant state/territory authorities. It includes measures to protect public health and safety, restore essential government services and provide emergency relief to government and civil authorities.

3.8 Additional responsibilities are listed in Defence Instruction (General) Operations 15–1—Australian Defence Force Policy for Operations in a Nuclear, Biological and Chemical Environment.

JOINT OPERATIONS

3.9 The joint military appreciation process (JMAP), which incorporates the joint intelligence preparation of the battlespace (JIPB) as an integral and continuous part, is described in ADDP 5.0 (ADFP 9)—*Joint Planning* chapter 8. This process should be used by commanders at each level of the operational continuum in the development of their plan.

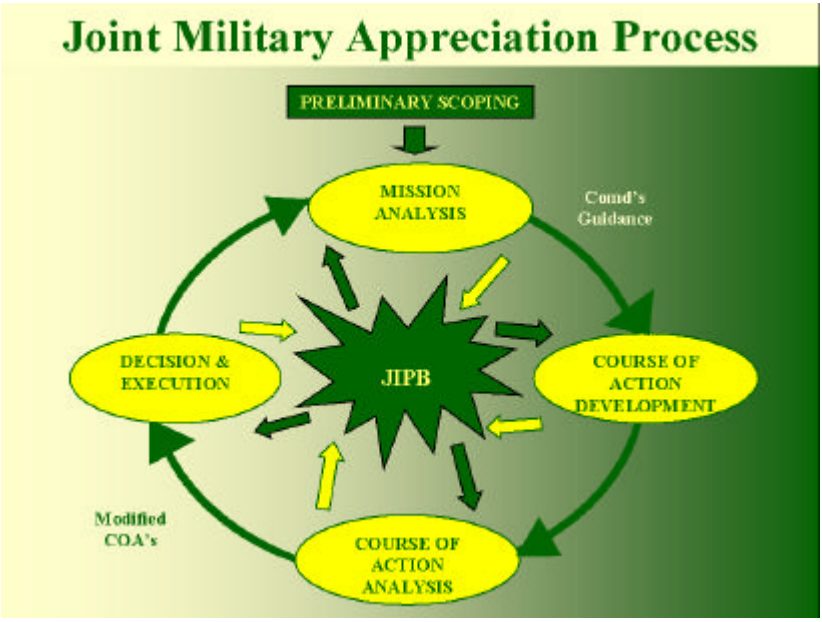

Figure 3-4: Joint Military Appreciation Process

3.10 Where the threat of NBC warfare is low, the intelligence staff at Headquarters Australian Theatre (HQAST) is responsible for the provision of advice on enemy NBC capabilities. As the threat increases, a staff officer NBC may be appointed within HQAST to provide specialist advice on operations in an NBC environment and preparation of NBC annexes to plans and orders. Additional staff may be appointed to assist where necessary. Where the threat of NBC warfare is high, a NBCCC should be raised within HQAST and staffed by appropriately qualified personnel. Responsibilities for the NBCCC are detailed in chapter 5.

The NBC estimate

3.11 The fundamentals of NBC defence, listed in chapter 4, form the basis of the responsibilities that a Commander Joint Task Force (CJTF) will be expected to undertake in any operation with a NBC threat. These will be reflected in the NBC annex of the Theatre Commander's Directive to the CJTF, and will provide a starting point from which the headquarters staff can conduct a detailed NBC Estimate as a contribution to the CJTF's plan. The

issues which should be covered in the Theatre Commander's Directive are as follows:

- NBC threat assessment, including capabilities and Releases Other Than Attack.
- Equipment and training requirements, including the requirement for training in the joint environment, for the assigned force.
- Health counter measures policy (eg. vaccination programmes).
- Protection and NBC defence training requirements for civilians (eg. civilian staff or workers, host nation personnel, and possibly others within the JFAO).
- Health support and evacuation.
- Command, control and communications requirements both in theatre and to Australia.
- Any additional information (eg. sustainability, and specialist NBC assets).

Further information on the Formal NBC Estimate, which may be utilised where appropriate to supplement JMAP planning, is in annex A.

Essential tasks

3.12 The CJTF's ability to establish an effective NBC defence in the JFAO will, in addition to completion of the NBC Estimate, depend upon the following tasks, undertaken primarily by the JTF NBC staff, and in close consultation with other divisions of the HQ:

- Establishment of a NBC Cell capable of 24-hour operation. Implicit in this will be the implementation of Warning and Reporting procedure based upon Allied Tactical Publication 45—*Reporting Nuclear Detonations, Biological and Chemical Attacks, and Predicting and Warning of Associated Hazards and Hazard Areas*, relevant Quadripartite Standardisation Agreements and Electronic Warning and Reporting Systems.
- Coordination of ADF specialist resources.

- Effective liaison and coordination of NBCD issues with multinational partners, and any non-military or non-governmental organisation involved with the operation.

- Development of sustainment plans for NBCD equipment, spares and consumables.

- Coordination of the health countermeasures policy and casualty handling, evacuation and isolation procedures for ADF personnel and others for who the CJTF is responsible.

Post-conflict activities

3.13 The post-conflict phase of any operation can be lengthy with the results of enemy use of NBC agents having a significant impact on the physical recovery of forces from the area of operations. It is incumbent on the CJTF to identify post-conflict NBC decontamination and disposal requirements as early as possible and factor them in to the plan.

3.14 The CJTF's responsibilities resulting from the enemy's use of NBC weapons will include:

- Burial or removal of human remains.

- Safe levels of equipment decontamination.

- Removal or destruction of NBC munitions.

- Removal of contaminated terrain/decontamination of facilities.

- Disposal policy.

- Returning of contaminated infrastructure to Host Nation authorities.

INTELLIGENCE

3.15 The intelligence requirement of NBC operations is to identify the enemy's NBC capability and motivation, determining the nature, availability, locations, and deliverability of its NBC weapons, and its ability to operate in a NBC environment. Intelligence must strive to eliminate the element of surprise, even from the first attacks. This, together with information on weather and terrain factors influencing nuclear effects, radioactive fallout,

biological and chemical agents, and hazardous materials, will help with assessing the probability, nature and effect of NBC attacks or industrial chemicals and hazardous materials risk. Accurate, timely, and continuous intelligence of the enemy's capabilities, together with vigilant monitoring of the battlefield through specialised NBC systems, will ensure forces are maintained at the appropriate posture to avoid or defend against the effects of NBC agents.

3.16 Health intelligence can assist in identifying the NBC risk or threat. Information regarding the development and use of an enemy's preventive medicine capability, health treatment facilities, and any unusual medical activities may indicate the imminence of a NBC attack. Once NBC weapons have been used, analysis of the attacks may provide advance warning of further attacks. Health intelligence will help to identify which biological and chemical agents have been used.

3.17 Any risk assessment must consider own capabilities and limitations in light of the intelligence available on likely enemy capabilities and potential courses of action. A continuing technical estimate on the possibility of the enemy developing weapons capable of defeating individual and collective protection is essential.

3.18 The JMAP, JIPB, NBC Estimate and Directives/Orders process, suitably modified to accommodate NBCD requirements, will assist.

Historical Example – Chemical warfare in the Iran-Iraq war

Both Iran and Iraq are parties to the Geneva Protocol, which prohibits the use of asphyxiating, poisonous or other gases, and all analogous liquids materials or devices as well as the use of bacteriological methods of warfare

During the early period of the invasion of Iran by Iraq, Iran has reported the use of chemical warfare by Iraqi forces. An international team of specialists sent in by the United Nations Secretary General conclusively verified these reports at Hoor-ul-Huzwaizah on 13 March 1984.

The specialists identified a number of poison gases including mustard gas taken from an unexploded bomb found at an Iraqi attack site, and the nerve agent, tabun also taken from defective Iraqi munitions. Other agents found included tear gas, choking gas (chlorine), Arsenicals, nitrogen mustard, germ warfare agents and mycotoxins.

Iraqi weapons used to deliver the chemical agents included bulk-filled free-fall aircraft bombs, artillery munitions and air-to-ground rockets

These chemical weapons reportedly caused several thousand Iranian casualties over the course of the war.

Excerpts from Stockholm International Peace Research Institute Fact Sheet
J.P. Robinson and J Goldblat 1984

Annex:

A. Command and control planning

COMMAND AND CONTROL PLANNING

FORMAL ESTIMATE

It is essential for a commander to consider:

- Enemy capabilities, doctrine and equipment.
- Weather and terrain.
- State of own nuclear, biological and chemical (NBC) defence training and equipment.
- Competence in NBC procedures.

COMBAT ESTIMATE

- Surprise and Security
- Protection of Own Forces (NBC)
  - Individual protection equipment (IPE), dress category.
  - Detection equipment.
  - Warning and reporting.
  - Contamination control.
  - Nuclear and chemical recce and survey (all arms and specialist) Biological detection (specialist).
- Impact of NBC measures on:
  - War Fighting capability.
  - Units/formations battle procedure and ability to maintain tempo.

- – Morale.

- Is Mission achievable if under:
  - – NBC direct attack?
  - – NBC indirect attack?

Step 1 - Mission Analysis.

- – Limitations
  - * Constraints.
  - * Freedoms.

Step 2 - Evaluation of Factors.

- – Enemy Intentions (Doctrine).
  - * Chemical warfare (CW) agents on primary avenues of approach.
  - * CW agents elsewhere (flanks, rear) - Surprise.
- – Own Forces Capability.
  - * All arms NBC recce.
  - * Medical Recce/Specialist Recce.
  - * Specialist assets eg RAE.
- – Time and Space.
  - * Degradation (50% more time).
  - * Orders process (1/3-2/3) (increase time to account for degradation).
- – Movement.

* Simple plan.
* Reduced freedom of movement (to avoid contamination/cross contamination).
* Use of vehicle collective protection (if fitted).
* Increased errors in IPE.

– Summary of possible tasks.

* Nuclear and Chemical survey.
* Decontamination.

Step 3 - Consideration of Course of Action.

– Assessment of impact on:

* Command.
* Information.
* Firepower.
* Manoeuvre.
* Protection.
* Combat Service Support.

Step 4 - Commander's Decision.

– Inform NBC Advisor of risk assessment decision.

Step 5 - Development of Plan

– Integrated NBC.

– Correct NBC defence posture.

– Rehearse plan and adjust measures accordingly.

CHAPTER 4

OPERATIONS IN A NUCLEAR, BIOLOGICAL AND CHEMICAL ENVIRONMENT

Even in theory the gas mask is a dreadful thing. It stands for one's first flash of insight into man's measureless malignity against man.

Reginald Farrer, "The Void of War"

Executive Summary

- The principles of NBC Defence include hazard avoidance, protection and contamination control.
- NBCD hazard assessment and risk analysis is required to enable the commander to risk manage the appropriate measures of avoidance, protection and contamination control for the conduct of operations in an NBC environment. NBC risk management must be a dynamic process integral to operations.

General

4.1 At the operational level, nuclear, biological and chemical (NBC) defence involves the protection of the forces and the means to remove or cope with operationally significant hazards, conceal intentions in the area of operations and provide adequate health service support to preserve the fighting capability of the forces.

4.2 No single solution can be automatically applied to every situation anticipated in a NBC environment therefore, it could be expected that naval, ground, and air forces might respond differently to the same hazard. Amphibious forces are especially vulnerable to NBC weapon effects during the assault phase, in particular, the ship-to-shore movement period. Obviously the best method of conducting operations would be to avoid a NBC hazard however, that is not always practical. When subjected to a NBC hazard, each commander should assess the following factors in determining the proper course of action:

- nature of the mission;
- identification of the type, degree and persistency of the hazard;
- influence of weather and terrain on the hazard;
- impact of casualties and equipment damage on the unit's ability to accomplish its mission;
- effects of full NBC protection on combat capability (morale, physical debilitation etc);
- the time required and available to react to a NBC attack;
- estimate of effort necessary to eliminate or reduce the contamination hazard;
- capabilities of the unit, or availability of specialised NBC unit assistance, for hazard reduction;
- vulnerability to, and probability of, follow-on NBC attacks; and
- exploitation by enemy conventional forces immediately following NBC attacks.

PRINCIPLES OF NUCLEAR, BIOLOGICAL AND CHEMICAL DEFENCE (NBCD)

4.3 The principles that form the basis for NBCD are discussed below. These principles are inter-related, and must be considered together to minimise the effects from NBC weapons.

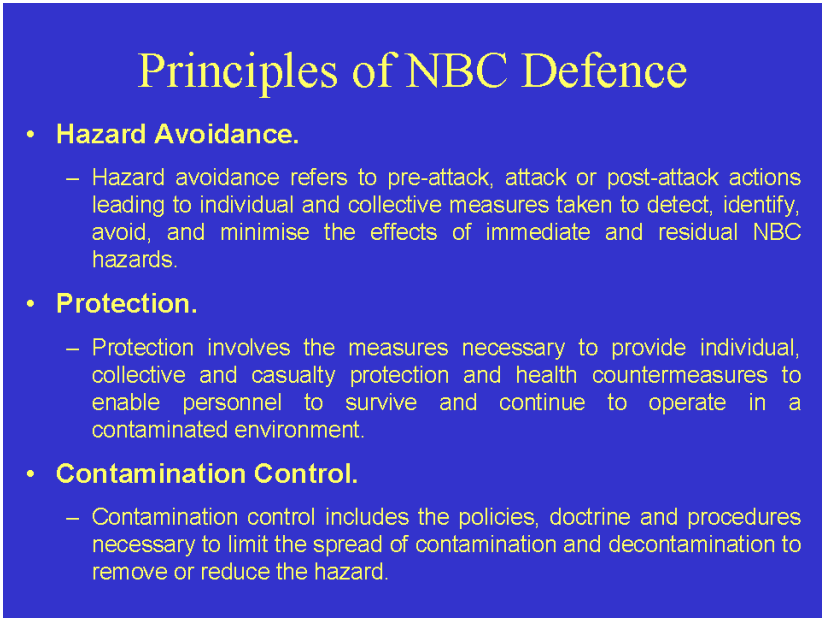

Figure 4-1: Principles of NBC Defence

HAZARD AVOIDANCE

4.4 Hazard avoidance refers to those actions taken to detect, identify, avoid, and minimise the effects of immediate and residual NBC hazards. Hazard avoidance will reduce, and sometimes eliminate, the need for protection and decontamination, however it must be acknowledged that total hazard avoidance will be impossible to achieve. Exposure may be caused by immediate and residual NBC hazards as a result of direct attack, by passing through NBC contaminated areas or by being in the downwind hazard zone of vapour, aerosol, liquid, or fallout particle cloud travel

4.5 Hazard avoidance is achieved by the following:

- hazard prediction,
- detection and identification,
- warning and reporting, and

- monitoring and survey.

Hazard prediction

4.6 Procedures for the prediction of hazards resulting from nuclear or chemical attack are included in Quadripartite Standardisation Agreement (QSTAG) 187—*Reporting Nuclear Detonations, Radioactive Fallout and Biological and Chemical Attacks and Predicting Associated Hazards*. No procedure currently exists for the plotting of biological agents.

Detection and identification

4.7 **Detection**. Detection gives warning of NBC weapon effects against which individual and collective protection measures must be taken. The equipment and procedures necessary for attack protection must be made ready and deployed in the pre-attack phase. NBC attacks need to be detected at the earliest possible opportunity so that a timely alarm can be given. Detection is conducted by:

- intelligence indications of enemy intent,
- use of normal surveillance of enemy activity, and/or
- the reaction of detection equipment to the presence of NBC weapon effects.

4.8 **Identification**. Identification provides accurate determination of a NBC attack and the extent of its effect upon courses of action. Identification is conducted by use of various equipments for the purpose provided by units.

Warning and reporting

4.9 The joint NBC warning and reporting system is discussed in chapter 5 and detailed in QSTAG 187—Reporting Nuclear Detonations, Radioactive Fallout and Biological and Chemical Attacks and Predicting Associated Hazards.

Monitoring and survey

4.10 **Monitoring and Survey**. Monitoring is a periodic or continuous check of contamination levels in a known NBC hazard area. A survey is an organised effort to delineate the extent and level of contamination. NBC

attacks are significantly affected by weather and their own decay. NBC attacks are monitored to identify reductions in their concentration and extent or a shift in their downwind effects.

4.11 Radiological Monitoring and Survey. Radiological monitoring and survey involves the use of instruments to detect the presence of radiation and measure its intensity. The use of instruments to check personnel and equipment for radiological contamination is also known as monitoring.

4.12 Biological Monitoring and Survey. Biological monitoring and survey includes collection of field samples and subsequent laboratory testing. It also includes statistical monitoring using data supplied from unit medical records.

4.13 Chemical Monitoring and Survey. Chemical monitoring may be conducted by periodically testing the air for vapour contamination or by the continuous operation of automatic chemical detector and alarm systems. When surveying for liquid contamination, in order to determine the extent of the spread, physical checking with detection paper is required.

4.14 Marking of Contaminated Areas. Areas of NBC contamination, and chemical minefields are to be marked in accordance with QSTAG 501—*Warning Signs for the Marking of Contaminated or Dangerous Land Areas, Complete Equipments, Supplies and Stores*.

Hazard avoidance plan

4.15 The following should be considered in developing a hazard avoidance plan:

- **Intelligence** will assist with identifying risks and threats, including political and military intentions and capabilities.

- **Passive defensive measures** can be adopted, for example: deception, camouflage, the selection of positions related to risk, the imposition of exclusion zones in hazard areas and communications security. Dispersion, use of shelters and protective covers, and concealment will be continuously exercised. Personnel and equipment not imperative to the mission, or the protection of fixed installations or units, should be in dispersal areas outside the base or area of immediate operations. Personnel movement on weather decks should be closely controlled as the threat escallates.

- **Protective measures** for a given threat level are given later in this chapter. These may be modified on the judgement of the local commander following a risk assessment.

- **Detection, identification, marking** and, wherever possible, **avoidance** of contaminated areas should be adopted where ever possible.

- **Warning and reporting** of attacks will enable pre and post event NBCD to be more effective.

- **Relocation or re-routing** may be ordered to move personnel and material to an uncontaminated area.

PROTECTION

4.16 Prior to the hostile use of NBC weapons, commanders should evaluate the vulnerability of their units to NBC hazards they are likely to face in projected areas of operations. Based on this analysis, mitigation techniques and appropriate levels of individual and collective protection should be established. Individual and collective protection enhances survivability, and thus individuals must be trained and equipped to function effectively under these conditions. Health countermeasures must also be put into effect before an attack is made.

4.17 Protection not only applies to personnel, but also to vehicles, equipment and supplies. Total protection is not always achievable but measures can still be taken to provide protection. Factors to be considered may include the following:

- type of threat (ie nuclear, biological or chemical);

- persistency/non-persistency of a substance;

- overhead cover available;

- coverings available;

- hardening/collective protection available;

- availability of fixed shelters; and

- pre-wetting.

Individual protection

4.18 Requirements exist for prophylactic or preventive compounds (immunisations and medications) as well as other pre-treatment measures administered under the commander's directions to individuals to enhance their prospects of survival if exposed to small concentrations of ionising radiation or biological or chemical contamination. These prophylactic and pre-treatment measures could reduce or simplify subsequent requirements for further medical therapy. Individual protection equipment (IPE), identified below, is the minimum that should be issued to all personnel who may be at risk from NBC attack.

4.19 Nuclear. All personnel who may be exposed to the effects of nuclear weapons must be provided with total fire-retardant body protection, respiratory protection system (mask), prophylactics/pre-treatment medications, antidotes, personal dosimeter, a decontamination kit and eye protection to protect against flash blindness. Personnel exposed to the release of radioactive substances must be provided with respiratory protection, personal dosimeter and complete body covering.

4.20 The best individual defence against nuclear attack on land is to construct field defence. A properly constructed shelter offers excellent protection against both initial and residual radiation because earth is a good shielding material. An overhead covering of earth or other material will reduce the amount of immediate or residual radiation to which an individual is subjected and will also provide protection against liquid chemical agents.

4.21 Biological. All personnel who may be exposed to a biological aerosol attack should be provided with respiratory, ocular and complete skin protection.

4.22 Chemical. All personnel who may be exposed to chemical agents or the release of industrial chemicals must be provided with respiratory, ocular and complete skin protection.

Collective protection

4.23 NBC contamination may persist for a prolonged period and some means of collective protection (colpro) will be necessary. Protective shelters are required to enable rest and relief of personnel required to work outside in individual protective clothing. Colpro is defined as protection that is

provided to a group of individuals in a NBC environment, that permits relaxation of individual protection. Any reduction in individual protection will depend on the type of colpro provided, the work activity, and the enclosure (eg. building, tank, van, hospital or a ship's gas tight citadel etc).

4.24 Colpro should also be provided for all major headquarters, bases and major joint combat assets to provide optimum working conditions. Protective shelters should be pressurised with filtered air and, in a nuclear environment, should be located underground. A safe means of entry/exit must be provided. The shelters may either be fixed (permanent), mobile (eg armoured vehicles with NBCD capability) or portable (inflatable shelters) in construction.

Equipment survivability

4.25 Equipment may be damaged by heat, blast, initial nuclear radiation and electromagnetic pulse effects of a nuclear burst or by contact with a liquid chemical. They may also be damaged by decontamination procedures. Equipment that cannot be effectively decontaminated may become unusable due to the hazard it presents to personnel.

4.26 Electromagnetic Pulse and Transient Radiation Effects on Equipment. Electronic equipment should be disconnected from all antennae and power supply cables, etc when not in use, to protect components from the destructive effects of electromagnetic pulse and transient radiation effects on equipment.

Health countermeasures

4.27 Health treatment in a NBC environment will be on two levels: measures to counter NBC weapon effects, and measures for treatment of casualties under NBC conditions. Operational planners should take account of these requirements, through the co-ordination of health services, to include adequate shelter, food, medical prophylactics, and fluids.

4.28 The health support system should provide for the management and evacuation of casualties in a NBC environment and is discussed in greater detail in chapter 6.

CONTAMINATION CONTROL AND DECONTAMINATION

Contamination control

4.29 Contamination control includes all the factors that cover the monitoring, surveying, plotting, recording and management of the hazard in contaminated areas. The effects of NBC weapons produce immediate and delayed casualties. Delayed casualties may be caused by radiation sickness, infection from micro-organisms and the effects of a variety of lethal and non-lethal chemical substances. Casualties can be minimised by the rapid application of decontamination measures. Decontamination is a progressive operation that removes residual contamination from personnel and materiel with the aim of restoring combat power by allowing a reduction in protection levels.

4.30 Contamination control will only be achieved by sound discipline, training and by the rigid enforcement of decontamination procedures. Nuclear, biological and chemical control centres (NBCCC) at each level of command will be required to provide advice on contamination control methods.

4.31 Contamination control can be achieved by:

- establishment of clean/dirty lines between contaminated and uncontaminated areas based on advice from the NBCCC,
- clear marking and reporting of contaminated areas by radiological and chemical survey teams,
- controlled entry and exit points at the 'clean/dirty' line,
- positioning of personnel and equipment decontamination facilities at the controlled entry and exit points,
- timely supply of adequate decontaminants and protective equipment by the logistic system,
- continuous monitoring of 'clean' areas,
- effective disposal of effluent from decontamination stations, and
- sound training and standard operating procedure at all levels.

Decontamination

4.32 The need for decontamination will significantly affect any operational plan. A commander must decide on the degree of decontamination necessary and the control measures to be adopted. Decontamination will impose delay to operations and may render the force less capable of defeating a follow-up attack. Conversely, failure to decontaminate may increase the risk of sustaining NBC casualties and reduce the operational effectiveness of the force in the longer term. Priorities for decontamination must be clearly directed by the commander and initial measures should be limited to those necessary to allow operations to continue. The following principles of decontamination should be considered in order of priority:

- **As soon as possible.** The sooner the contamination is removed, the sooner the protective clothing levels can be reduced and combat power restored.

- **Only where necessary.** To survive and win in a contaminated environment, precious resources and time cannot be wasted. Thus, decontamination should only be carried out where it is necessary to continue the mission.

- **As far forward as possible.** Contaminated personnel and equipment should not be moved rearwards if decontamination assets can be moved forward safely. This allows assets to be where they are needed, decontamination to begin earlier and limits the spread of contamination to other areas.

- **By priority.** Items of equipment should be cleaned in their order of importance to the mission.

4.33 Decontamination is conducted at three levels. They are defined as follows:

- **Immediate Decontamination.** Immediate decontamination is the decontamination by individuals of themselves and their personal equipment when contamination is either detected or suspected.

- **Operational Decontamination.** Operational decontamination is aimed at permitting the extant operational task to be completed. Decontamination is to be conducted on those parts of operational equipment, materiel and/or terrain that are essential to the operation and to which personnel are likely to be in close proximity.

- **Final or Thorough Decontamination.** Final or thorough decontamination is conducted to reduce the hazard to the lowest possible level with the aim of permitting some relaxation in the wearing of individual protection equipment depending on the NBC threat. Total decontamination is not achievable without major reconstruction of the equipment and this is generally considered impractical during operations.

Figure 4-2: Decontamination facilities can be established close to the contamination area

Decontamination planning

4.34 Decontamination planning is usually conducted once intelligence concerning the likelihood of further enemy NBC activity is determined. Decontamination of any organisation must be planned in detail because significant resources such as manpower, time, equipment and stores need to be closely coordinated. Factors for consideration in the conduct of decontamination operations include the following:

- site requirements for personnel and equipment decontamination,
- time required,
- personnel required to operate the decontamination stations,
- decontamination equipment required (eg pumps and showers), and
- stores required.

4.35 The planning for decontamination should also include a waste management plan which outlines how the wastes generated during the decontamination process are managed. This plan should include:

- Identification of any chemicals or hazardous substances that are to be used for the decontamination;
- Method of containment of chemicals and contaminated residues;
- Transportation requirements for contaminated residues if required;
- Identification of appropriate disposal path for all contaminated materials, chemicals and residues; and
- Compilation of complete and accurate documentation to ensure objective evidence of disposal action is available to prove Defence's duty of care has been met.

4.36 Consideration should also be given to the use of natural weathering. Considering the majority of weather conditions Australian Defence Force (ADF) personnel are likely to operate under where a large scale NBC threat could exist, isolating larger, non essential equipment to allow for effect of the weather conditions (temperature, wind, sunlight, rain and evaporation) could reduce the active decontamination requirement. If natural weathering is to be used then the possible environmental harm of this option must be considered. Natural weathering does not mean disposing of NBC contamination into the ground and claiming that natural weathering will degrade the substance. This should be assessed on a case by case basis depending on the situation and operational requirements.

RISK MANAGEMENT

4.37 NBCD hazard assessment and risk analysis is required to enable the commander to risk manage the appropriate measures of avoidance, protection and contamination control for the conduct of operations in an NBC environment. NBC risk management must be a dynamic process integral to operations.

4.38 Hazard Assessment. Assessment of a NBC hazard seeks to determine the extent of the hazard in terms of substance type, likely effects, area of contamination (or potential area) and disposition of forces.

4.39 Risk Analysis. The risk analysis determines the risk to operations from exposure of forces and their equipment to the assessed NBC hazard. This analysis is based on the likelihood of exposure to the hazard (in terms of probability of occurance) and the consequences of such exposure.

4.40 Risk Management. The subsequent risk management options will be examined by the commander with the aim of selecting those that can best achieve the operational mission, within the NBC environment, with minimal force degradation. Hazard assessment, risk analysis and the consequent risk management are ongoing and part of the operational appreciation process.

Mission oriented protective posture levels

4.41 Prolonged wearing of full protective dress will adversely affect individual performance. Protective dress inhibits the body's normal cooling system and breathing resistance and psychological stress will further induce excessive fatigue. In warm to hot climates the incidence of heat exhaustion may become very high and personnel may be unable to perform their tasks adequately. While some measures, such as reduced work rates and rest programs, may assist in the management of individual performance levels, the effects on group dynamics and group cohesion are more complex. The use of IPE will degrade the combat effectiveness of the group. The degradation of combat effectiveness is dependent on many complex and interrelated factors, but groups may become combat ineffective within minutes.

4.42 The actual performance degradation experienced will depend on the particular task. Tasks that are physically demanding or require great manual dexterity or intense concentration will be most affected. In some cases it may be necessary to provide colpro for personnel required to

perform very demanding tasks. Additional personnel may be required to allow additional rest periods to be taken.

4.43 Despite exposure to NBC agents the wearing of full protective dress for continuous periods is not always necessary. The level of protection adopted must be consistent with both the threat and the task performed. Procedures adopted for each mission oriented protective posture (MOPP) level are designed to afford maximum protection whilst allowing the operation to be completed. The three levels of MOPP are detailed in table 4 –1. These levels need not be rigidly adhered to, and commanders may authorise variations dependent on the type of agent or operation. Commanders as part of their risk management strategy will determine those variations.

4.44 MOPP levels are as follows:

Serial	Level of MOPP	Items Worn	Items Carried
(a)	**(b)**	**(c)**	**(d)**
1.	Minimum	Combat clothing	Protective clothing, respirator, gloves, overboots
2.	Medium	Protective clothing and overboots, or treated boots	Respirator and gloves
3.	Maximum	Protective clothing, respirator, gloves, overboots	

Table 4–1 —Mission Oriented Protective Posture Levels

Figure 4-3: MOPP 3 [1]

Performance/capability degradation

4.45 Operations within a NBC environment will have a significant effect on the physiological and psychological performance of personnel. Commanders at all levels must take into account the degraded performance levels when operations are conducted in NBC IPE.

RECONSTITUTION

4.46 The return of forces to their home locality is a highly complex matter, politically, militarily and environmentally. This section highlights factors

[1] Photograph courtesy of DSTO CBRN Laboratories

concerning NBC contaminated equipment and remains which will have an impact on the recovery to Australia.

Tasks and responsibilities

4.47 Australian Defence Headquarters (ADHQ). ADHQ will provide military strategic advice to HQAST specific to the recovery, including:

- burial or removal of human remains,
- safe levels of equipment decontamination,
- removal or destruction of NBC munitions,
- removal of contaminated terrain/decontamination of facilities,
- disposal policy, and
- returning of contaminated infrastructure to Host Nation authorities.

4.48 HQAST. HQAST will be responsible for the planning and allocation of assets to meet the recovery plan. Joint Movement Group, on behalf of HQAST, conducts the strategic movement planning. HQAST is also responsible for issuing:

- a Directive to the Commander Joint Task Force (CJTF) and the supporting commands which includes instructions concerning NBC decontamination,
- disposal Instruction for contaminated equipment,
- instructions for the removal or burial of human remains, and
- instructions for the removal or destruction of NBC munitions.

4.49 Joint Task Force Headquarters. The headquarters staff is responsible for the production of the CJTF's in-area recovery plan with guidance from the strategic estimate on recovery prepared by HQAST

4.50 Supporting Commands. The Supporting Commands are responsible for:

- providing input on the extent of contamination,
- the production of plans and directives to meet decontamination or disposal requirements,
- issuing instructions for decontamination of equipment,
- burial or movement of human remains,
- removal or destruction of NBC munitions,
- removal of contaminated terrain/decontamination of facilities, and
- disposal of equipment which can not be decontaminated.

Considerations

4.51 End State. Although a 100% contamination clear end state is difficult to achieve, this must be the aim at every stage of the recovery process.

4.52 Responsibilities of Host Nation. If the ADF has relied upon host nation support, then a duty of care to the host exists. Every effort must be taken to ensure that environmental difficulties do not degrade the relationship between the host nation and Australia.

4.53 Requirement for Surge Manning. Additional NBC force elements and specialists may be required to deploy to theatre to facilitate the recovery.

4.54 Planning Factors. Every operation will have its own unique planning factors: however, the following factors apply to all operations and will need to be considered at the recovery planning stage:

- the detailed operational and logistical end states incorporating residual contamination as a result of equipment decontamination sites and contaminated equipment disposal areas;
- residual ADF commitments, for example specialists to assist the host nation in decontamination, may remain in theatre in an advisory capacity; and

- the establishment of specialist teams to staff the hand-over of host nation assets, and designate areas of residual contamination.

4.55 Disposal of equipment. The disposal of NBC contaminated equipment is a potentially lengthy and complicated issue. Disposal is taken to mean transfer of or destruction of NBC contaminated equipment. The responsibilities are:

- **ADHQ:** to provide the policy.

- **HQAST:** to issue the instruction.

- **CJTF:** to advise on items for disposal. The link between CJTF and HQAST should be exercised extensively at this stage. Particular attention should be paid to hazardous waste resulting from decontamination operations and items that can not be effectively decontaminated.

Use of Chemical Weapons in WWI

The Hague Convention of 1899, discussed the use of chemical weapons on a large scale and as a result, signatories agreed not to use projectiles whose sole purpose was the diffusion of asphyxiating or deleterious gases. During Hague II conducted early in the 20th Century, this was extended to prohibit the use of poison or poisoned weapons, including a clause for the avoidance of projectiles, weapons and materials that could cause unnecessary suffering.

Battles in the western Front of Europe during WWI saw the introduction of the use of chemical weapons on a large scale. In August 1914, French troops used gas grenades during a battle. As a result of the French bombardment, German soldiers were killed by asphyxiation. German forces alleged that the French had deliberately broken the Hague Conventions by using lethal fumes from a liquid explosive called turpinite

On 22 April 1915, German forces launched a chlorine gas attack at Ypres catching Allied forces by surprise. The Germans justified their actions on the basis that France broke the conventions first and that the Hague Convention only prohibited the use of projectiles, whereas the Germans had released the gas from cylinders.

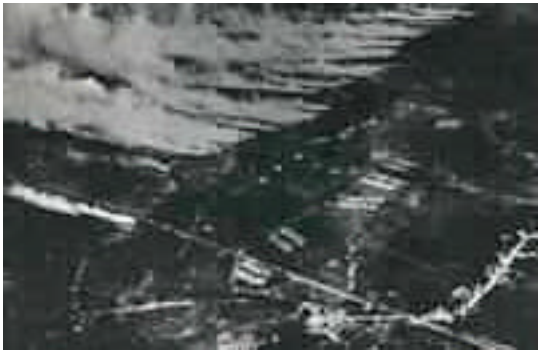

Figure 4.4: German forces release chlorine gas at Ypres

Throughout the remainder of the war, both Germany and the Allies used chemical warfare agents. The primary gases used during WWI were chlorine, phosgene, a mixture of chlorine and phosgene, and mustard delivered using cylinders or artillery although the former was eventually abandoned, as artillery projectiles became more reliable.

The use of chemical weapons had both physical and psychological debilitating effects on soldiers of both sides. Estimation of casualties from gas attacks during WWI have been estimated between 300000 and 900000 however this can not be confirmed because of the poor record keeping of casualties.

Excerpts from:
Germany's Use of Chemical Warfare in World War 1 (The Great War)
Brian Blodgett

CHAPTER 5

WARNING AND REPORTING

Executive Summary

- Early warning of NBC hazards can enable units to take appropriate defensive measures and thereby minimise casualties.

- NBC attacks and resultant contamination will have a serious influence on any battle situation. In order to enable commanders to assess the impact of NBC attacks on plans and decisions, they must be provided with timely, accurate and evaluated information on these NBC attacks.

Aim

5.1 The aim of the warning and reporting system is to ensure that all friendly forces likely to be affected are informed of:

- nuclear detonations and biological or chemical attacks;

- location of potential industrial, chemical and radiological hazards;

- areas of radioactive, biological or chemical contamination;

- predicted fallout areas and downwind chemical and biological hazard areas;

- impending friendly nuclear and chemical strikes; and

- intelligence assessment of likely enemy intentions to use nuclear, biological and chemical (NBC) weapons.

5.2 Reliable warning and reporting is essential not only to the immediate operations, but also to sustaining effective logistic support. Over estimation of the threat, or false alarms may result in the logistic system being required to supply NBC defence equipment possibly at the expense of ammunition or rations. Conversely, should the warning and reporting system not be

sufficiently sensitive friendly forces may incur unnecessary losses of personnel and equipment.

5.3 Early warning of NBC hazards can enable units to take appropriate defensive measures and thereby minimise casualties. The effectiveness of the warning and reporting system depends on:

- prompt detection, with minimal false alarms;
- prompt, accurate reporting of all NBC incidents to the area Nuclear, Biological Chemical Control Centre (NBCCC);
- timely warning to all friendly forces in the vicinity;
- accurate hazard assessment and risk analysis to provide subsequent advice as to whether protective measures should be taken or normal activities continued;
- maintenance of a record of NBC contamination, and monitoring of meteorological conditions to ensure that hazard areas are continually updated and appropriate warnings given; and
- a thorough knowledge of the enemy's doctrine, equipment and intentions in the use of NBC attacks.

NUCLEAR, BIOLOGICAL AND CHEMICAL WARNING AND REPORTING ORGANISATION

General

5.4 NBC attacks and resultant contamination will have a serious influence on any battle situation. In order to enable commanders to assess the impact of NBC attacks on plans and decisions, they must be provided with timely, accurate and evaluated information on these NBC attacks. A joint force NBC reporting and warning organisation is established to ensure timely provision of the most accurate data on enemy NBC attacks and hazard areas.

Structure of the organisation

5.5 The NBC reporting and warning organisation can be divided into two levels:

- source level, and
- NBCCC.

Source level

5.6 NBC information may be sourced from personnel at any level. All source level elements should have an appropriate number of personnel trained to collect NBC information and generate the NBC report forms listed in paragraph 5.8.

Nuclear, Biological and Chemical Control Centre

5.7 NBCCC are to be established at formation headquarters and other organisations that have a requirement to gather and process information on NBC matters to conduct operations. NBCCC are tasked and manned to perform the following tasks:

- report the initial enemy use in-theatre of nuclear, biological or chemical weapons
- clarify, consolidate and evaluate NBC attack data reported from the source level or other NBC centres or agencies;
- compute fallout predictions and chemical downwind hazard areas based upon processed NBC attack data and disseminate warnings to units likely to be affected;
- analyse, survey and monitor results and disseminate the location of known contaminated areas to units likely to be affected;
- direct survey efforts within its zone of observation;
- disseminate NBC meteorological data;
- request and provide detailed information on chemical or biological attacks as directed ;
- provide hazard assessment and disseminate risk analysis summaries;

- exchange NBC information with appropriate national military and civilian authorities as arranged by directives and standing operating procedure; and

- maintain and manage a permanent record of chemical analyses, evidence essential for post combat reconstruction of potential NBC incidents.

Standard nuclear, biological and chemical message formats

5.8 NBC attacks and resultant contamination are reported from source level to the NBCCC at higher headquarters, which assesses the implications and warns other units likely to be affected. The six standard NBC Warning Reporting messages (detailed in Quadripartite Standardisation Agreement (QSTAG) 187—*Reporting Nuclear Detonations, Radioactive Fallout and Biological and Chemical Attacks, and Predicting Associated Hazards*), are designed to be used for the exchange of NBC information:

- **NBC 1.** Observer's initial report, giving basic data.

- **NBC 2.** Report used for passing evaluated data.

- **NBC 3.** Report used for immediate warning of predicted contamination and hazard areas.

- **NBC 4.** Report used for passing monitoring and survey results.

- **NBC 5.** Report used for passing information on areas of actual contamination.

- **NBC 6.** Report used for passing detailed information on chemical or biological attacks.

Hazard prediction

5.9 QSTAG 187 provides models and details procedures for the prediction of hazards resulting from radioactive fallout or chemical attack. There is no hazard prediction procedure for biological agents due to the nature of their transmission.

Friendly strike warning

5.10 Procedures for warning of friendly nuclear strikes are also included in QSTAG 187.

Historical Example : Bombing of Hiroshima

Hiroshima was the primary target of the first atomic bomb mission. The bomb exploded over Hiroshima at 8:15 on the morning of August 6, 1945. About an hour previously, the Japanese early warning radar net had detected the approach of some American aircraft headed for the southern part of Japan. The alert had been given and radio broadcasting stopped in many cities, among them Hiroshima. The planes approached the coast at a very high altitude.

At nearly 8:00 AM the radar operator in Hiroshima determined that the number of planes coming in was very small - probably not more than three - and the air raid alert was lifted. The normal radio broadcast warning was given to the people that it might be advisable to go to shelter if B-29's were actually sighted, but no raid was expected beyond some sort of reconnaissance. At 8:15 AM, the bomb exploded with a blinding flash in the sky and a great rush of air and a loud rumble of noise extended for many miles around the city; the first blast was soon followed by the sounds of falling buildings and of growing fires and a great cloud of dust and smoke began to cast a pall of darkness over the city.

At 8:16 AM the Tokyo control operator of the Japanese Broadcasting Corporation noticed that the Hiroshima station had gone off the air. He tried to use another telephone line to reestablish his program, but it too had failed. About twenty minutes later the Tokyo railroad telegraph centre realised that the main line telegraph had stopped working just north of Hiroshima. From some small railway stops within ten miles of the city came unofficial and confused reports of a terrible explosion in Hiroshima. All these reports were transmitted to the Headquarters of the Japanese General Staff.

Military headquarters repeatedly tried to call the Army Control Station in Hiroshima. The complete silence from the city puzzled the men at Headquarters; they knew that no large enemy raid could have occurred, and they knew that no sizeable store of explosives was in Hiroshima at that time. A young officer of the Japanese General Staff was instructed to fly immediately to Hiroshima, to land, survey the damage, and return to Tokyo with reliable information for the staff. It was generally felt at Headquarters that nothing serious had taken place, that it was all a terrible rumour starting from a few sparks of truth.

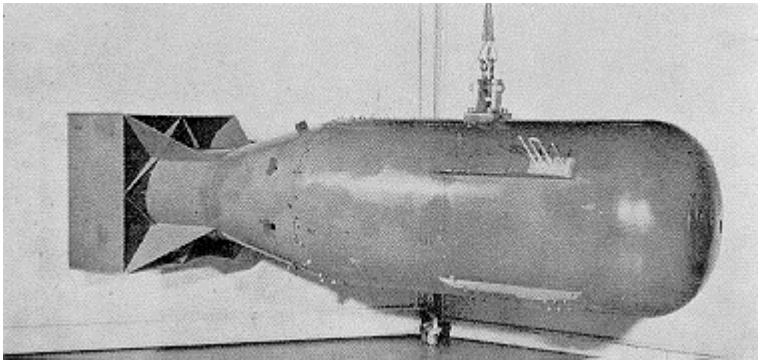

Figure 5-1 – "Littleboy" was dropped at Hiroshima on 6 August 1945[1]

The staff officer went to the airport and took off for the southwest. After flying for about three hours, while still nearly 100 miles from Hiroshima, he and his pilot saw a great cloud of smoke from the bomb. In the bright afternoon, the remains of Hiroshima were burning.

Their plane soon reached the city, around which they circled in disbelief. A great scar on the land, still burning, and covered by a heavy cloud of smoke, was all that was left of a great city. They landed south of the city, and the staff officer immediately began to organize relief measures, after reporting to Tokyo.

Tokyo's first knowledge of what had really caused the disaster came from the White House public announcement in Washington sixteen hours after Hiroshima had been hit by the atomic bomb.

The Avalon Project : The Atomic Bombings of Hiroshima and Nagasaki
© 1996-2002 The Avalon Project at Yale Law School.

[1] Photograph Source: Hiroshima Peace Site (www.pcf.city.hiroshima.jp)

CHAPTER 6

SUPPORT TO NUCLEAR, BIOLOGICAL AND CHEMICAL OPERATIONS PLANNING CONSIDERATIONS

6.1 Nuclear, biological and chemical (NBC) operations place greater demands on the logistic system because of the requirement to supply protective equipment and decontamination materials, often in response to a high rate of consumption, and within contaminated conditions. This is complicated further by the need to sustain NBC defence (NBCD) efforts while also supporting the wider operation. Logistics in a NBC environment is vital to survival, but equally so to the overall mission. Furthermore, operations are likely to be joint, and possibly combined and multi-agency. Although national forces are expected to deploy with their own integral logistic support, some mutual support may be necessary, particularly where there are disparities in NBCD capability.

6.2 Contamination from NBC hazards in many cases poses as great a problem to logistic units as to combat units. Most logistic functions become more difficult under NBC conditions. The demand for NBC protective equipment and training may extend beyond Australian Defence Force (ADF) units to multinational forces, non-military organisations, and non-combatants. Health treatment and evacuation of casualties may need to be conducted under NBC conditions. Some key logistic planning considerations are as follows:

- Requirements, priorities and procedures for decontamination and evacuation of materiel at supply, maintenance and administrative sites.

- Resupply of expended NBC equipment, protective clothing, decontaminants, and medical supplies.

- Evacuation priorities, decontamination, and treatment of NBC casualties or conventional patients who have been contaminated with NBC agents or radioactivity.

- Decontamination of food and water sources for human consumption and use.

- Graves registration procedures including the movement, decontamination, and marking of contaminated remains.

- Movement of both personnel and organisational replacements through contaminated areas.

- Measures to reduce the impact of the NBC environment on civilian-military co-operation efforts.

- Procedures for handling NBC incident casualties and NBC mass casualty incidents both in military operations or in support of State Government emergency services.

NBC LOGISTIC PRINCIPLES

6.3 Foresight. High consumption rates of decontaminants, water, protective clothing, vaccines and/or toxoids are a feature of NBCD operations. Striking the right balance between providing adequate stocks of NBCD equipment without compromising the logistic requirements of the overall mission will need careful consideration.

6.4 Economy. The future demand for NBCD equipment and logistic support may be difficult to assess, particularly if there is a requirement to provide this beyond the ADF chain of command. Thus, resources must be used effectively, efficiently, and economically, making best use of any additional or local (eg. host nation) support that is available. Demand will be greatly impacted by the warning and reporting system. The early or unnecessary breaking of seals on lifed items will exacerbate any problems in acquisition and transportation. Accordingly, to reduce the NBCD logistic support requirements, which will impact on the theatre wide logistic support, the consumption of NBCD equipment should be delayed until as late as practicable, contingent upon accurate warning and reporting. This will also minimise the harmful effect on personnel of working in an NBC environment.

6.5 Cooperation. Reconciling the overall logistic needs of the force with its NBCD needs will require close cooperation at all levels. Operational plans must integrate logistic considerations and include requirements for NBCD. The protection of NBCD supplies will be important, particularly if there is an NBC threat. The effects of contamination on main supply routes (MSR), supply points and fixed sites should be incorporated into overall planning.

6.6 Flexibility. The logistic system must be versatile and able to react rapidly to meet unforeseen emergencies and operate in NBC degraded conditions. The hazards and potential damage caused by NBC attacks may require relocation of support bases and health service support, major

redirection of supply flow, reallocation of transport and construction means, or short-notice transfer of personnel or units. Plans must be made for a surge capability for NBC related equipment to a theatre in which the use of NBC weapons is anticipated.

NBC LOGISTIC CONSIDERATIONS

6.7 On the NBC battlefield, organisations may be subject to catastrophic losses. When such losses occur, each affected unit must be brought back to operational effectiveness or replaced. First, there must be an assessment of the criticality of the function. If the function is determined to be critical, it must be resumed. Second, the unit's remaining combat capability must be assessed. Using the surviving assets as a base, commanders must determine what personnel and equipment each unit will need to return to an acceptable level of effectiveness. Personnel may come from the replacement system, health channels, or other organisations that perform less critical functions. The required equipment may come from the supply system, maintenance facilities, or other organisations.

Equipment

6.8 Decontamination. Decontamination of equipment is performed to prevent casualties, increase unit and individual effectiveness, and limit the spread of contamination. All personnel perform immediate decontamination of their skin and equipment. Specialist assets for example in Army, Royal Australian Engineers (RAE) provide units with decontamination support required beyond their own capabilities. The RAE accomplishes this through the use of medium-scale decontamination equipment. Decontamination is provided for equipment; stockpiles of materiel; and facilities, terrain, and MSR on a priority basis, with the RAE decontaminating high priority items. Lower priority items will be decontaminated by user unit's organic decontamination resources or left to weather. Plans for decontamination of large areas must include maximum use of all available equipment and material. Items of equipment that cannot be decontaminated should identified during advance planning.

6.9 Clothing Exchange and Showers. Although the standard is to provide at least a weekly shower for personal hygiene and an exchange of clothing for each Service member, this will be performed more regularly in a NBC environment.

6.10 Equipment Recovery and Evacuation. The recovery and evacuation of equipment is essential to sustaining military operations. Even

in an NBC environment, units cannot consider equipment expendable, especially NBC protective equipment, once it becomes inoperative and contaminated. Items should, wherever practical, be decontaminated and recovered. If the situation will not allow the equipment to be decontaminated, and the contamination is severe enough to prevent recovery and evacuation, the location will be noted and reported for later recovery. Each Service component should develop procedures for the recovery and evacuation of contaminated equipment.

Emergency destruction and evacuation of captured NBC munitions

6.11 Plans for destruction or disablement of NBC munitions must minimise the risk of release of agents. Options for emergency disposition of these munitions, in order of preference are:

- evacuation to a safer location;
- rendering safe in accordance with explosive ordnance disposal (EOD) procedures; and
- marking and abandoning, having recorded the location.

6.12 The evacuation of NBC munitions requires the establishment of transportation procedures. Technical assistance from specialist assets (eg RAE/Clearance Diving teams) should be sought.

6.13 Enemy NBC munitions in danger of being recaptured, or those that pose a unique challenge to safety, may require destruction in line with EOD procedures. Technical intelligence reports on all captured NBC munitions and fusing systems should be raised before the evidence is destroyed.

Supply

6.14 Water Provision for Decontamination. Decontamination places excessive demands on the water supply system, particularly as contingency stocks of water may not be available. Water supply units are capable of providing water to acceptable levels for decontamination of personnel and unit equipment. Potable water is not required for decontamination, but may be required if non-potable water is not available. Units must use their organic assets to transport water.

6.15 Transport. A NBC environment will increase the importance of alternative modes of transport and routes, thus making centralised

movement control imperative. NBC intelligence reports will help to monitor contaminated routes and the regulation of traffic on MSR.

6.16 Nuclear Survivability and NBC Contamination Survivability Standard. Mission-critical equipment should meet all nuclear survivability and NBC contamination survivability standards. These standards are designed to ensure that ADF equipment is hardened to exposure to specific NBC weapon effects, capable enough to be used within a contaminated environment, and capable of being decontaminated so that it can be purged of absorbed agent and returned safely to service.

HEALTH SUPPORT

6.17 Because of potentially large numbers of casualties that may result from the use of NBC weapons, and the special handling required that can drain health resources, careful coordination of health resources, including the provision of adequate shelter, food, isolation, medical prophylactics, and fluids will be required.

Defensive measures

6.18 There is a number of interrelated defensive measures that should be included in the planning aspects associated with health support in a NBC environment. These include intelligence gathering; surveillance of key sectors to deter an attacker; health defensive measures to protect personnel at risk against exposure, infection, or intoxication; physical defensive measures to reduce the risk of personnel inhaling any chemical agent or biological aerosol that may be present; and early detection. Although the detection of a biological aerosol is not itself a countermeasure, effective detection plays a key role in enabling other countermeasures to be used efficiently.

Health management

6.19 Health management of NBC casualties may involve large numbers of individuals with infectious diseases, exposure to chemical agents and/or toxins, and injuries resulting from nuclear weapons. Health units will require augmentation to decontaminate incoming casualties. The fact that the source of exposure may have been artificially created by deliberate hostile means will not change the basic principles of treatment. For instance, in the event of a biological attack, the most important factor in providing operationally relevant information and adequate health management, will be the rapid establishment of an accurate, specific identification of the agent.

6.20 In contrast to naturally occurring epidemics in which the disease incidence increases over a period of weeks or months, an artificially induced epidemic will peak in a few hours or days. Since a biological attack may be silent or nearly so, the first indication of a problem may be an increase of casualties without any indication of origin; symptoms of natural disease may be indistinguishable from those caused by an enemy attack. Onset of illness following exposure to toxic agents may range from minutes to as long as three weeks. Some potential biological agents are infectious; thus, attack may have important planning considerations.

6.21 Some aspects of health management after biological attack are unique, and require special alertness and training. Timely identification and communication of the threat is essential for survival. Casualties may not occur at the same time as they would in the case of saturation bombing or a massive surprise attack with nerve agents. The degree of exposure to the agent and host resistance causes the onset of illness to be spread over a number of hours or days. An increasing casualty load is anticipated with relatively few initial casualties, but a greater number over successive hours or days until a peak is reached. An exception is an attack with biological toxin(s) that might create an immediate and dramatic mass casualty situation.

6.22 Decontamination and collective protection against NBC attacks are particularly important if the situation necessitates a prolonged stay in a presumed infected area. Health management must provide reasonably adequate shelter, establish uncontaminated food and water intake, and ensure specific treatment is available. Demands for military health support to neighbouring civilian populations following such an attack will probably be intense, especially if the attack contaminated neighbouring civilian populations with concentrations of very young, very old, and those already suffering from underlying disease or other forms of weakening stress. Medical facilities security must also be planned.

Health intelligence

6.23 Intelligence staff can assist in the theatre threat assessment by evaluating the state of potential adversary's biological warfare (BW) effort. Local efforts to conduct tactical health intelligence investigations of disease resulting from suspected enemy biological agent employment can provide limited analysis of enemy drugs, serums, and antibiotics. It is instrumental in gathering data from the various health units and non-medical units. The importance of medical alertness cannot be over-emphasised.

Preventive medicine principles

6.24 In a NBC environment, preventive medicine services will be in great demand. There is a possibility that many deaths would occur following an effective NBC attack. Demands for military health support to both military and civilian populations will probably be intense. Health personnel must assist the commander in determining the health hazards associated with nuclear fallout and chemical/biological contamination, such as safe food and water sources, and in determining when to use prophylactics, immunisation, and other preventive measures associated with NBC warfare. Health personnel must be aware of the NBC threat in the theatre and be continually updated on diseases, potential disease vectors[1] and the susceptibility of troops to these diseases. In NBC conditions, diseases known to exist in the area may be manifested but not transmitted to our forces. The appearance of a disease or vector not known to exist naturally in the theatre is an indication that biological warfare agents are being introduced into the area. Following an effective NBC attack, the application of general preventive medicine principles will be important.

6.25 The tendency of individuals in an emergency situation to become careless regarding food and water sanitation, general hygiene, and other common disease control measures, could be a significant cause of secondary spread of disease. The problems of maintaining safe water and food conditions will differ for military personnel deployed throughout the operational area and for the civilian population.

6.26 Following a NBC attack all food, except tinned or otherwise well-protected food, should be thoroughly inspected to ensure adequate protection had been provided. Foods determined to be safe must be protected against secondary contamination. Protective measures must be practised by those who transport, store, prepare, and serve food, as well as by those who consume the food. In addition, consideration must be given to applying control measures necessary to prevent contamination of foodstuffs by insects, rodents and other vectors.

6.27 It is difficult to maintain satisfactory personal and area field sanitation, particularly in unfamiliar climates. Strict measures are required for waste treatment and sewage. Water surveillance and area water sanitation control measures must be instituted. The best assurance of water sanitation is

[1]Vectors are living carriers - for example insects and rodents.

water purification or boiling. However, water purification tablets and military systems for boiling or purifying large amounts of water for consumption and hygiene purposes, may not be effective against chemical agents, toxins or certain biological agents.

6.28 Washing with soap and water is the most effective and simple personal hygiene measure for the control of communicable diseases. It is the responsibility of each person to apply standard individual protective and sanitary measures as appropriate.

Patient evacuation

6.29 A NBC environment forces the commander to consider to what extent evacuation assets (eg ground vehicles, aircraft, and personnel) will be committed to the contaminated area. If a task force is operating in a contaminated area, most of the health evacuation assets will be operating there. Cumbersome protective gear, climate, increased workloads, and fatigue, will greatly reduce the effectiveness of those involved with evacuation. If evacuation personnel are sent into a radiologically contaminated area, the operational exposure guide (OEG) must be established. Based on the OEG, commanders decide which evacuation assets will be sent into the contaminated area. Every effort will be made to limit the number of contaminated evacuation assets that are employed. To keep the contamination of evacuation assets to a minimum, patients should be decontaminated before transport.

Figure 6-1: Evacuation of patients is carried out by personnel in protective equipment

Patient decontamination and triage

6.30 The management and treatment of contaminated casualties will vary with the tactical situation and the nature of the contaminant. Each health unit must have a plan that can be put into effect immediately. Decentralisation is necessary: casualties must not be kept waiting for decontamination. All health units should have appropriately scaled sets of medical items and decontamination equipment for treatment of contaminated patients originating in their area. Patient decontamination serves three purposes:

- to, prevent the patient's system from absorbing additional contaminants;
- to protect health personnel treating the patient and other patients from contamination; and
- to limit the spread of contamination.

6.31 Health treatment facilities will establish decontamination areas. When casualties arrive, they must be seen at a triage point and directed to the proper area. The triage officer must determine if the patients have a surgical or medical condition that requires priority over decontamination.

6.32 90-95% of all decontamination can be accomplished by removing the outer clothing and footwear, usually before admission, and without interfering with medical treatment. Actions should be taken immediately to ensure all personnel suspected of being contaminated by a biological agent are cleaned and kept free of disease-producing organisms.

Figure 6-2: Decontamination of casualties should be effected immediately

Health facilities

6.33 Because of the health unit location, threat capabilities, and the unique aspects of NBC operations, the following factors must be considered:

- NBC weapons are capable of producing mass casualties. Even though few chemical casualties become fatalities, they require intensive medical support. In the first few hours after a NBC attack, health facilities can be swamped with casualties who require lengthy hospitalisation.

- At the same time the patient load is increasing, other factors combine to complicate medical support operations. Operations in protective gear reduce individual and collective efficiency at a time when manpower requirements increase. Patient decontamination requires manpower and will reduce the number of personnel available to treat casualties. Heat stress in individual protection equipment will require more frequent rest breaks, further reducing care capability.

- Establishing and maintaining a facility with collective protection, and continuously monitoring the air inside the shelter for contaminants

requires additional personnel. These procedures decrease the ability to treat patients ~~as~~ efficiently and effectively.

Impact on health services support

6.34 The contaminated battlefield will be a difficult environment in which to operate. Stress from protective gear, reduced visual and tactile senses, reduced communication capability and a sense of isolation are all detrimental to military operations. The health support system has several unique aspects that must be considered.

6.35 Contamination may be transferred to the health treatment facility if patients are evacuated without being decontaminated. Patients must be decontaminated before they are admitted into the collective protective system. This is required to prevent the medical staff from becoming casualties; ordinarily, the medical staff works without protective equipment.

6.36 Many health support assets are fixed or possess limited mobility. They are often located near command, control and communication activities and main supply routes; hence, they must continue to operate within the contaminated environment. Treatment cannot cease while the unit relocates.

Oxygen production and resupply

6.37 Production of liquid and gaseous oxygen will not normally occur in a NBC contaminated environment. Product transfer operations (gaseous and liquid) will also be curtailed unless medical and flight line requirements demand it. Supply and health units should develop plans to resupply critical gases and cryogenic liquids in the contaminated area from primary and alternate sources. These sources include production and storage organic to the unit, from other Services, from a host nation, or by commercial contract.

Special medical augmentation for operations in a NBC contaminated environment

6.38 Decontamination operations are resource intensive. It is unrealistic to expect medical personnel to manage both medical treatment and decontamination of patients. Decontamination operations must, therefore, be planned. Augmentation to provide decontamination support must also be addressed in planning.

Burial procedures

6.39 Burial procedures in a NBC environment will be complicated by the possibility of mass fatalities, and the consequences of contamination. Decisions about burial sites and repatriation of the dead will be emotive, and are likely to be made at the political/strategic level. Notwithstanding this, there will be a requirement for in-theatre emergency burial procedures. Where the capabilities exist, human remains will be decontaminated and handled in a convention manner. However, if they cannot be decontaminated, they will be buried at the site of recovery, and the site clearly marked accordingly. Defence Force Regulations Part VI—*Disposal of Dead Bodies of Members of the Defence Force* and Defence Instruction (General) (DI (G)) Personnel 20–4—*Missing-in-Action Presumed Killed: Recovery of Human Remains of Australian Defence Force Members* provides additional information on disposal of bodies.

Health support

6.40 Further details on health support for NBC operations are referred to in Australian Defence Force Publication (ADFP) 1.2 (Formerly ADFP 53)—*Military Health Manual* , chapter 9, ADFP 1.21.4 (Formerly ADFP 713) —*Health Aspects of Nuclear, Biological and Chemical Defence,* DI (G) Operations 15-2—*Biological Warfare Vaccination Policy* and in current ADF Health Policy and Doctrine.

Historical Example – Chemical attack on Halabja

The city of Halabja is located about 260 kilometers north-east of Baghdad in Iraq. It is close to the Iranian border and has a population of approximately 70000 people with most of the people being farmers or cattle breeders.

The battle for Halabja began on March 15, 1988, when Kurdish rebels and Iranian Revolutionary Guards, equipped with chemical warfare suits, moved into the town, driving out Iraqi units in heavy fighting.

On Friday, 17th March 1988, Iraqi military forces conducted an attack on Halabja using a combination of conventional and chemical weapons. The chemical attack began at 6:20 p.m. preceded by artillery barrages dropping paper streamers used by Iraqi forces to gauge wind speed and direction. The attack continued sporadically over three days with bombers attacking Halabja and all roads leading to the surrounding mountains, dropping a conventional cluster bombs and a cocktail of poison gases: mustard gas, cyanide gas, the nerve agents sarin, tabun, and VX, which Iraq had just begun to manufacture.

It was the largest chemical attack ever launched against a civilian population resulting in excess of 5000 dead and 7500.casualties.

Excerpts from "Bloody Friday"

A.Atroushi 1989

Figure 6-3: Civilian casualties at Halabja