Curaçao, personnel injured through use of a smoke grenade WP, 26 April 2006

The Hague, May 2007 (project number M2006DE0426-01)

THE DUTCH SAFETY BOARD

The Dutch Safety Board was set up to establish the causes or probable causes of individual incidents or categories of incidents in all sectors. The sole aim of the Board's investigations is to prevent accidents or incidents from occurring in the future and to make recommendations based on its findings wherever appropriate. The organization comprises a Board of five permanent members and, in addition, has a number of permanent committees. Special guidance committees are formed for specific investigations. The Dutch Safety Board is assisted by a professional bureau consisting of investigators, secretarial reporters and support staff.

CONTENTS

CONSIDERATION

THE INCIDENT

In the week of 24 to 28 April 2006 there was an exercise on Curaçao at the military drill ground square Wacao, approximately 45 kilometres northwest of Willemstad. This exercise was held under the responsibility of the Naval Command Caribbean (CZMCARIB), a regional command of the Royal Netherlands Navy Command (CZSK).

The exercise was part of the programme to train Antillean conscripts (so-called *miliciens*) to become rifle group commanders. The exercise involved the use of dummy ammunition, including smoke grenades. Smoke grenades were thrown to camouflage participants' movements from the eyes of their opponents, or "enemies", in the exercise. Participating in the exercise were 18 trainees, three officers and four assisting soldiers. The officers were in charge of the exercise, with one in overall charge and two sergeant instructors leading the exercise itself.

On Wednesday 26 April 2006, the third day of the exercise, the participants were scheduled to practise moving as a group (10-15 persons) through enemy terrain. In the morning, this was done without using ammunition; in the afternoon smoke grenades were used for the first time. During the course of the afternoon, the supply of standard smoke grenades was exhausted and the WP (White Phosphorus) smoke grenade no. 23 was issued as a replacement.

The sergeant head instructor assigned to the training unit had never before worked with the WP smoke grenade no. 23. He was unfamiliar with the type of grenade and the way it functions. He picked one up to examine it more closely and walked approximately 25 metres onto the drill ground square and removed the safety pin. The second sergeant instructor, who was equally unfamiliar with this type of hand grenade, saw that the pin had been removed from the hand grenade and advised throwing the hand grenade. The sergeant head instructor, who had removed the pin, followed this advice and threw the smoke hand grenade into the wind several metres away from them. To his surprise, nothing happened initially – he expected a hissing sound and an almost immediate production of smoke as is the case when the standard 7C2 smoke hand grenade is thrown – until there was an explosion several seconds later accompanied by a release of phosphorus. Both instructors were standing in the radius within which the burning phosphorus was dispersed and suffered first- and second-degree burns. One of the Antillean *miliciens* also suffered burns. The three wounded were driven to the sickbay at Parera naval base, from where they would be transferred to the Curaçao hospital. The instructor who had thrown the grenade required hospitalization and was transported to the Netherlands several days later to be treated at the burns centre in Beverwijk[1]. The two others were allowed to go home after treatment in the Curaçao hospital.

INVESTIGATION FRAMEWORK

The Ministry of Defence conducted its own investigation into the incident on account of its own responsibility. However, the Ministry of Defence has always indicated that it also greatly appreciates the independent and transparent investigations into incidents conducted by the Dutch Safety Board.

Although, on the face of it, the incident seemed fairly innocent, it did involve ammunition. The greatest care must be exercised when using explosive substances such as ammunition. Seemingly minor events, in this case a typographical error, can have disastrous consequences. The 1983 accident involving a mortar mine, for example, resulted in seven fatalities because the instructor thought the mortar mine was an instruction model. That incident also concerned a training situation and, as with the incident in Curaçao on 26 April 2006, involved a failure to understand the nature of the hazardous object. An additional consideration is an incident with a flash/2-bang (F/2B) hand grenade[2] examined by the Ministry of Defence Accident Investigation Temporary Committee (TCOD) in 2004.

Weapons and ammunition are part and parcel of the armed forces and, consequently, life-and-death situations quickly arise. It is therefore essential that the Ministry can have absolute trust that

[1] He returned to Curaçao after three weeks. He is expected to resume his duties fully after a recovery period.
[2] TCOD letters no. Tcod/2004/176 and 177, 2 September 2004.

procedures are followed and discipline is maintained whenever weapons and ammunition are used. Knowledge on the use of weapons and ammunition must therefore meet, and be guaranteed to meet, the appropriate requirements for each level and each functional area.

During the exploratory phase of the investigation, it soon became clear that the materials concerned were handled either incorrectly or without sufficient knowledge. Earlier studies by the TCOD and the Dutch Safety Board also highlighted the need to address this issue. For example, the investigation into the collision of an armoured vehicle with a train[3] revealed that the crew apparently failed to realize which (sight) limitations were associated with an armoured vehicle or lacked sufficient knowledge of the (sight) limitations inherent in driving an armoured vehicle. The TCOD investigation into an incident involving a torpedo[4] revealed that the level of knowledge was not maintained and that there were no measures in place to ensure the maintenance of the required level of knowledge. Finally, the investigation into the chlorine gas incident[5] revealed that knowledge of the systems being worked with was lacking.

Given these considerations and the Ministry's desire for an independent investigation, the Dutch Safety Board decided to start an investigation.

CONTEXT

The smoke grenades used

The Ministry of Defence has ten kinds of smoke grenades at its disposal, including the standard 7C2 smoke grenade and the WP smoke grenade. The standard 7C2 smoke grenade begins hissing and producing smoke virtually immediately on activation (1-3 second delay). The WP smoke grenade, no. 23, has a delay of three to four seconds, after which time an explosion disperses burning phosphorus in a radius of approximately 15 metres and smoke is released. Both types of grenade produce smoke, though in very different ways.

Interchangeability and temporary substitution

The Ministry of Defence has a large range of ammunition at its disposal. Rules are drawn up on paper for all types of ammunition covering, among other things, the purpose, the composition, the technical specifications, the effect and the safety aspects. Some types of ammunition are interchangeable because they can be fired with the same weapon or because they have the same effect. The Ministry of Defence has an administrative system for registering which types of ammunition are interchangeable. The groups of interchangeable ammunition are indicated by a four-digit code, the NOV (Interchangeability Number) code. Types of ammunition with the same NOV code are interchangeable. The standard smoke grenade and the WP smoke grenade have different NOV codes, namely NOV code 4811 and NOV code 4821 respectively.

The logistical process

In the summer of 2004, CZMCARIB submitted its ammunition requirements for 2005. This list of requirements also included a quantity of standard smoke grenades. As there was a temporary problem in supplying these standard 7C2 smoke grenades (NOV code 4811), a substitute was designated (the DM25 smoke grenade, NOV code 4831). While this smoke grenade has a different NOV code, and is therefore in principle not interchangeable with the standard 7C2 smoke grenade, under certain circumstances it is possible to designate ammunition with another NOV code as a substitute. Subsequently, Royal Netherlands Navy staff in Den Helder made a typographical error in the NOV code when designating this substitute ammunition, resulting in the WP smoke grenade, no. 23, (NOV code 4821) being wrongfully designated as a substitute for the standard 7C2 smoke grenade. This typing error went unnoticed throughout the entire logistical process, up to and including the issuing of the ammunition. Because the list of ammunition requirements for 2005 was only supplied in March 2006, there was still a shortage of standard smoke grenades in April 2006. Consequently, when the exercise began on Monday 24 April 2006, both the standard 7C2 smoke grenades and the WP smoke grenades, no. 23, were issued and taken.

Knowledge and skills

All marines follow a programme of training courses. The first training course covers the various smoke grenades, including the standard smoke grenade and the WP smoke grenade. The various training courses all include instruction of a "safety doctrine", which clearly prohibits working with

[3] TCOD report of 16 January 2004: "Collision of YPR with train near Assen on 17 June 2003".
[4] TCOD report of 10 December 2004: "Fall of torpedo in submarine torpedo room on 16 March 2004".
[5] OVV report OVV no. M2005DF0705 01 of 16 May 2006: "Den Helder, Chlorine gas intoxication in the training mock-up "Bever" on 4 July 2005".

unfamiliar ammunition or with ammunition whose effect is unknown. However, this safety doctrine has never been explicitly set out on paper. The Marines' Manual does include a general safety rule that ammunition or remains of ammunition discovered should be left alone. However, this is of a different order than the safety doctrine referred to above.

The Dutch Safety Board is surprised that something as essential as a safety doctrine has not been set down in writing. The Board also considers it alarming that the doctrine has not been institutionalized to the extent that personnel automatically act in accordance with it. As a result, we had a situation where in an organization renowned for its professionalism and operational effectiveness such as the Royal Netherlands Marine Corps, four experienced marines (three sergeants and one lieutenant), including a shooting instructor, were unfamiliar with the WP smoke grenade, did not act in accordance with this safety doctrine and did not know the safety rules that specifically apply to this type of smoke grenade. Moreover, interviews held with experienced marines at the executive level gave us the impression that their knowledge of the WP hand grenade (with one exception) was similarly lacking.

This is even more remarkable given that the WP smoke grenade is included in the category of weapons and ammunition that are considered part of the regular "kit" of an infantryman, as evidenced by the inclusion of the WP smoke grenade in the Marines' Manual (KM) and the Royal Netherlands Army Soldiers' Manual. If a number of marines at the level of experienced sergeant and lieutenant demonstrated such gaps in knowledge, the Safety Board wonders about the knowledge and conduct at the level of marine first class.

ANALYSIS

The analysis of the facts points up two important aspects that contributed to the cause of the incident:

a. the logistical process with respect to ammunition;
b. the knowledge and skill of the personnel.

The logistical process
In the current logistical process concerning the planning, budgeting, application and issuing of CZSK smoke grenades, there is no point at which the allocation and issuing of the correct grenades is actually verified. If the WP smoke grenade, no. 23, had been thrown toward the practice enemy during the exercise to create a smoke screen, it is very likely that more casualties would have resulted. This incident is an example of a situation where a small error can have grave consequences.

During the investigation, we discovered that this incident was not isolated. In 2005 another administrative error was made in allocating substitute ammunition. The Ministry of Defence had designated the flash-and-bang grenade[6] as a substitute for the offensive hand grenade[7]. The CZSK reversed this substitution and the flash-and-bang grenade was then allowed to be replaced by the offensive hand grenade. As with the substitution of the standard smoke grenade, nowhere along the logistical process was this administrative error detected and, consequently, it could never be corrected. In this case, however, because the two types of grenades differ physically so much from one another, the mistake was eventually discovered.

The present CZSK ammunition process has ammunition coordinators (MUNCOs) at four different levels. With MUNCOs at different levels, it would seem that the organization has been designed with built-in verification points to intercept errors in a timely fashion.

Within the organization of CZSK and CZMCARIB, the four MUNCOs are filled as described in section 2.3.3. The positions of MUNCO 2, 3 or 4 at CZMCARIB are performed as secondary jobs. In the period preceding the incident, the MUNCO 2 position was vacant and it was decided to allocate the MUNCO 2 responsibilities to MUNCO 3. At that time, the work of three different levels was being performed by a single person. This allocation of the different tasks to a single person negated the built-in organizational verification points and reduced the chance of errors being detected.

[6] The flash and bang is a grenade that disorientates people in an enclosed space by means of a loud bang and a flash of light, disabling them temporarily. This grenade is often used to imitate the effects of an offensive hand grenade during training exercises. This grenade may be used in an enclosed space.
[7] The offensive hand grenade is a grenade that can kill people within a specific radius by means of a pressure wave. This grenade may only be used in the open field.

These incidents, where the logistical process does not deviate from the logistical process that applies for all ammunition, show that the current logistical process regarding CZSK hand grenades lacks verification points to allow and guarantee the correct allocation and issuing of ammunition. It is remarkable that a single typing error could result in an incident such as that in Curaçao. This demonstrates that a minor error somewhere during the course of the process can have major implications.

The consequences of incidents involving explosive substances can be so disastrous that the greatest care possible must be exercised when handling the materials themselves and when following the administrative procedures governing the handling of the materials. The Safety Board considers it alarming that even small typographical errors can apparently result in the issuing of ammunition that should or may not by used and that this situation can only be prevented through human vigilance. Human error is inherent in human activity and relying solely on human vigilance to prevent incidents involving explosive substances will inevitably eventually lead to a (serious) incident. The Board wishes to emphasize that incorporating adequate safe methods of working should not be limited to the CZSK organization, given that ammunition provision occurs across all the arms forces.

One way of detecting the lack of verification points could have been via a properly functioning safety management system (VMS). The Dutch Safety Board focused extensively on the importance of the implementation and functioning of a VMS in its report on the incident with the "Bever"[8]. Therefore, we have not conducted any further investigation into VMS at the Ministry of Defence as part of this investigation.

Knowledge and skills
It is remarkable that four experienced marines (two instructors, an ammunition administrator and a lieutenant), despite their training, were unfamiliar with the WP smoke grenade, no. 23.

A lack of knowledge of the WP smoke grenade was also the reason for an earlier incident at the Ministry of Defence. In 1993 the WP smoke grenade was intentionally issued as a substitute for the standard smoke grenade. The standard smoke grenades were being used at the time to demarcate a helicopter landing area. There were no casualties during this incident because the WP smoke grenade was thrown from a greater distance.

An additional incident took place in 2004 that resulted from a lack of knowledge and experience. Unfamiliarity and a lack of practice with a F/2B hand grenade resulted in it detonating in the hand of a member of the *Korps Commandotroepen*.

The Safety Board finds it alarming that basic training and job training combined with operational training and experience do not apparently equip personnel with the required elementary knowledge and skills to handle certain kinds of ammunition. One of the conclusions of the investigation into the 2004 incident with the F/2B hand grenade was that training in general was not geared to the situation on the ground and that both basic and subsequent training focused insufficiently on using the F/2B grenade. This current investigation has shown that none of those involved (one officer and three non-commissioned officers) recognized the WP smoke grenade or had ever worked with one before. In the case of the incident involving the F/2B hand grenade, spending cuts meant the grenade concerned was unavailable during training. It is not within the scope of the current investigation to examine whether the observed gap in knowledge of and lack of experience with the WP smoke grenade, as well as infantry weapons and ammunition in general among infantrymen of both the Royal Netherlands Navy Command and Royal Netherlands Army Command, is widespread. The Board therefore feels it should make an general recommendation regarding this possible hiatus existing right across the armed forces.

[8] The Dutch Safety Board report "Den Helder, Chlorine gas intoxication in the training mock-up "Bever" on 4 July 2005" of 16 May 2006.

CONCLUSIONS

The Safety Board's investigation has led it to the following conclusions:

1. A typographical error made in the DMKM/WCS department resulted in the WP smoke grenade, no. 23, being wrongfully issued as a substitute for the standard smoke grenade.

2. The current ammunition process of the CZSK apparently contains insufficient verification points for detecting errors. This compromises safe working conditions and increases the risk of incidents.

3. The knowledge level of the personnel involved with respect to (handling) the WP smoke grenade contributed to the cause of the incident.

RECOMMENDATIONS

As a result of its investigation, the Safety Board makes the following recommendations to the Minister of Defence:

1. Evaluate the logistical process regarding ammunition right up to its use at the CZSK and the entire Defence organization and guarantee safety by establishing verification points along the process.

2. Given the seriousness of the incident, investigate whether the observed lack of knowledge of ammunition is an issue that affects the wider Defence organization. Take measures to address these observed gaps in knowledge and prevent them in the future.

P. van Vollenhoven
Chairman of the Dutch Safety Board

M. Visser
General Secretary

LIST OF ABBREVIATIONS

Burmarns	Bureau of Marine Affairs
CDS	Commander of the Armed Forces
CVM	Covenant on Ammunition
CZMCARIB	Naval Command Caribbean
CZSK	Royal Netherlands Navy Command
C-ZSK	Naval Command Caribbean
DMKM	Royal Netherlands Navy Directorate of Materiel
DMO	Defence Materiel Organization
DOST	Directorate of Operational Support
D-DMO	Director of Defence Materiel Organization
KL	Royal Netherlands Army
KM	Royal Netherlands Navy
KMar	Royal Netherlands Marechaussee Command
KWNA&A	Netherlands Antilles and Aruba Coastguard
KOVBA	Permanent Corps Order
LBB/KL	National Supply Agency of the Royal Netherlands Army
MARSTAF	Naval staff
MATLOG	Materiel Logistics
MP	Ministerial Publications
MUNBIS	Ammunition Administration and Information System
MUNCO	Ammunition Coordinator
MOC	Marine Training Centre
NOV	Interchangeability Number
OBL	Responsible Officer
OBACARIB	Permanent Orders CZMCARIB
OMU	War Ammunition
OPORD	Operation Order
SEWACO	Sensors, Weapon and Communication
SG	Secretary General
TCOD	Ministry of Defence Accident Investigation Temporary Committee
VS	Regulation
VVKM	Set of Regulations for the Royal Netherlands Navy
VVO	Continued Vocational Training
WCS	Weapon and communication system
WVGS	Carriage of Dangerous Goods Act
WP	White Phosphorus

1 INTRODUCTION

1.1 GENERAL

On 26 April 2006 a WP (White Phosphorus) grenade exploded during an exercise with Antillean militia on the military drill ground square in Wacao, Curacao. The explosion burned two instructors of the Marine Corps of the Royal Netherlands Navy Command (CZSK) and one member of the Antillean militia to such an extent that they had to be hospitalized.

The investigation dealt with the question as to how a WP smoke grenade could possibly have been among the supply of ammunition intended for the exercise. In attempting to answer this question, the investigation considered two important aspects: the logistical process with regard to ammunition and the knowledge and skills of the personnel involved.

The incident resulted in the Naval Command Caribbean setting up a Investigation Committee. The investigation was concluded on 30 June 2006 and a report was presented with a number of conclusions and recommendations. The conclusions and recommendations are contained in Annex 11.

1.2 READING GUIDE

This report contains six chapters. Chapter 2 presents the facts that are essential to understanding the cause of the incident. Chapter 3 focuses on the assessment framework. Chapter 4 describes the persons involved and their responsibilities. Chapter 5 analyses the facts with regard to the incident by making use of the TRIPOD method. Chapter 6 draws sub-conclusions based on the findings and analysis of the investigation, formulates final conclusions and makes recommendations.

2 FACTUAL INFORMATION

2.1 INTRODUCTION

This chapter presents the facts that are essential to understanding the cause of the incident. The chapter begins with a description of the circumstances surrounding the incident. It then focuses on general information concerning the ammunition, including several definitions and a description of types of ammunition involved in the incident. Additional information is also provided concerning the materiel logistics process within the CZSK. Finally, a number of details relevant to this investigation are presented, including the way in which the marines were trained and the exercise preparations.

2.2 CIRCUMSTANCES SURROUNDING THE INCIDENT

The CZSK's mission in the Caribbean area is formulated as follows: "To optimize the operational readiness of the navy in the Caribbean region in order to provide the fighting power desired by the Commander of the Netherlands Armed Forces". This mission includes one of the following tasks: "Provide the required measure of personnel and materiel readiness including calling up, examining, selecting and training the Antillean and Aruban militia". For the training of the Antillean militia, the CZSK has a training unit at the Suffisant Marine Barracks where the continued vocational training programmes (VVO), among others, are conducted.

As part of this VVO, an exercise took place at the military drill ground square Wacao, approximately 45 kilometres northwest of Willemstad, in the week of 24 to 28 April 2006. The purpose of this exercise was to train the personnel of a unit of the Antillean militia to command a small group by having them act as rifle group commanders. A rifle group commander is in charge of a small group moving through enemy territory. The exercise used practice ammunition consisting of blank cartridges and smoke grenades. The blank cartridges are used to imitate rifle shots while the smoke grenades are thrown to camouflage the soldiers' movements from the eye of the (practice) enemy.

The personnel involved in this exercise consisted of 18 course participants, three officers and four assisting soldiers. The three officers, of whom one was a commanding officer (OBL) and two were sergeant instructors, were in charge of the exercise. The exercise was organized in such a way that all participants would remain at the military ground square for the entire week. A tent camp was therefore set up on the military ground square and all supplies and provisions required for both their stay and the exercise self were taken from the Parera and Suffisant Marine Barracks on Monday morning.

On Wednesday 26 April 2006, the third day of the exercise, the participants were scheduled to practice moving with a group (10-15 persons) through enemy territory. This part of the exercise included the use of a practice enemy. After a number of runs, the group discovered that they had insufficient ammunition and a short break was inserted in the day's programme to allow for additional ammunition to be arranged. The ammunition was issued from one of the Landrovers present under the supervision of the OBL and a new supply of smoke grenades was used. Because the supply of standard smoke grenades had been depleted, the WP smoke grenade, no. 23, was issued as a substitute for the standard smoke grenade.

The sergeant head instructor assigned to the training unit had never before worked with the WP hand grenade, no. 23. He was unfamiliar with the type of grenade and the way it functions. He picked one up to examine it more closely and walked approximately 25 metres onto the drill ground square and removed the safety pin. The second sergeant instructor, who was equally unfamiliar with this type of hand grenade, saw that the pin had been removed from the hand grenade and advised throwing the hand grenade. The sergeant head instructor, who had removed the pin, followed this advice and threw the smoke hand grenade into the wind several metres away from them. To his surprise, nothing happened initially – he expected a hissing sound and an almost immediate production of smoke as is the case when the standard 7C2 smoke hand grenade is thrown – until there was an explosion several seconds later accompanied by a release of phosphorus. Both instructors were standing in the radius[9] within which the burning phosphorus was dispersed and suffered first- and second-degree burns. Also one of the Antillean *miliciens*, who was reading his notes within the radius within which the phosphorus dispersed, suffered burns. The three wounded were driven to the sickbay at Parera naval base, from where they would be

[9] Radius of approximately 15 metres without taking the wind direction into account.

transferred to the Curacao hospital. The instructor who had thrown the grenade required hospitalization and was transported to the Netherlands several days later to be treated at the burns centre in Beverwijk[10]. The two others were allowed to go home after treatment in the Curaçao hospital.

Figure 1: General view of the scene of the incident

2.3 GENERAL INFORMATION REGARDING AMMUNITION

The investigation asked the question how a WP no. 23 smoke grenade could possibly have been among the supply of ammunition intended for the exercise. To answer this question, we will first provide additional information on ammunition in general and smoke grenades in particular. We will then explain how the materiel logistical process is organized with respect to ammunition at CZSK by looking at the situation prior to the restructuring of the Defence organization in the autumn of 2005. The reorganization brought about a change of tasks, responsibilities and authorities in different parts of the ammunition process. This organizational change will be indicated where relevant.

2.3.1 More detailed description of ammunition and related ammunition types

General
The definition of ammunition according to the Set of Regulations for the Royal Netherlands Navy[11] (VVKM) is as follows: “all objects, including their constituent parts, whose function depends on the presence of an explosive substance”. There are two categories of ammunition: Covenant Ammunition (CVM) and War Ammunition (OMU). CVM is ammunition that is issued on a yearly basis for the purpose of exercises and training. OMU is ammunition that is reserved for so-called serious operations[12] (for actual operational deployment). This categorization of ammunition is not related to ammunition type, meaning that a given type of ammunition can be issued as either CVM or OMU; the receiving party is responsible for using the ammunition for the purpose issued. The administration of the ammunition process at the CZSK is supported by the Ammunition

[10] He returned to Curaçao after three weeks. He is expected to resume his duties fully after a recovery period.
[11] 3 VVKM 11: 1121
[12] 3 VVKM 11: 1121

Administration and Information System (MUNBIS). This uses the Number Interchangeability Codes (NOV-codes). Ammunition with the same NOV code is interchangeable[13].

Since April 2004, the KM has observed a policy of managing ammunition based on the principle of "zero tolerance". This primarily relates to the administrative aspects of ammunition management, which, according to this policy, must always be in proper order.

All ammunition, both covenant and war ammunition, for operations in Curaçao must be stored in the designated bunkers at the Parera Navy Base. A soldier assigned the role of ammunition administrator is responsible for the actual, administrative and technical management of the ammunition supplies. At the same time, he is responsible for preparing and handling ammunition transports. Those wishing to use the ammunition are first required to submit a written request to the ammunition administrator. The ammunition administrator checks whether the user has the (administrative) authority to access the requested ammunition and then coordinates the pick-up of the ammunition with the user as well as, if applicable, the return of unused ammunition at the end of the exercise.

In the case of the exercise during which the incident took place, a number of different types of ammunition were used. As the incident only concerned smoke grenades, we will restrict descriptions to the various types of smoke grenades.

Smoke hand grenades
Smoke grenades are cylindrical hand grenades that produce smoke for a specific period of time. The Ministry of Defence uses these grenades for a variety of purposes. They can be used as smoke signals, wind direction indicators, target markers or helicopter landing markers. Smoke hand grenades are also used to camouflage troop movements. Multiple grenades are thrown to produce a smoke screen to camouflage troop movements from the (practice) enemy. During the exercise in Curaçao, where the incident took place, the smoke hand grenades were used to create this type of camouflage. A number of exercise participants were equipped with a number of smoke hand grenades in order to detonate them in the direction of the practice enemy at the command of the group commander.

Figure 2. Smoke hand grenade 7C2 and no. 22 and the smoke hand grenade WP, no. 23.

The Ministry of Defence has ten types of smoke grenades at its disposal. Figure 2 shows three grenades that played a role in the incident. The standard smoke hand grenades for exercises of this type are no. 7C2 and no. 22, both with the NOV code 4811. Grenade no. 7C2 begins to produce smoke one to three seconds after activation (the delay time) and grenade no. 22 produces smoke after approximately five seconds. These grenades do not detonate. Grenade 7C2 continues to produce smoke for approximately 50 seconds; grenade no. 22 produces smoke for approximately

[13] MP bundle 40-40: 2350 or 3 VVKM 14: 151 h.

one and a half minutes. The advantage of smoke hand grenade no. 22 over no. 7C2 is that it produces smoke in multiple colours.

During the exercise in Curacao, the WP smoke hand grenade no. 23, with NOV code 4821, was offered as an alternative to both of the smoke grenades mentioned. The explosive change of the WP smoke hand grenade, no. 23, detonates after three to four seconds when the phosphorus is dispersed. The phosphorus ignites when it comes in contact with oxygen. This reaction produces smoke. For further details on the WP hand grenade, no. 23, see Annex 9.

The signs and the colours, the explosion, the moment of the explosion and the dispersion of phosphorus correspond with the description of the WP smoke hand grenade in the regulations.

2.3.2 The materiel-logistical process with respect to ammunition

The Ministry of Defence has designated the Ammunition Agency, which comes under the National Supply Agency (LBB), formerly the National Supply Agency of the Royal Netherlands Army (LBB/KL), as the coordinating body for procuring and distributing a large part of ammunition for all the armed forces. This organization, which became part of the Defence Materiel Organization (DMO)[14] following the reorganization, is one of the bodies responsible for correct regulatory procedures with respect to ammunition. The LBB/Ammunition Agency determines, in consultation with the various branches of the military, which ammunition (with possibly different NOV codes) may be designated as substitute ammunition. Each year, the different branches of the military draw up ammunition requirements lists.

A number of organization divisions within the Royal Netherlands Navy (KM) have various tasks, responsibilities and authorities in the ammunition process.

a. Prior to the reorganization of the Ministry of Defence[15], the Naval Staff National Plans Department (MARSTAF/PLAN) allocated the budget, drew up an ammunition plan for the KM each year and was responsible for updating the plan. Following the reorganization in 2005, these tasks were assigned to the CZSK Directorate of Planning and Control.
b. The Bureau of Marine Affairs (Burmarns) and the Weapon and Communication Systems Department of the Royal Netherlands Navy Directorate of Materiel (DMKM/WCS) were partly responsible for detailing the ammunition plan drawn up by the naval staff. Burmarns offered advice, assessed the quotes and coordinated the production of technical and logistical documentation as well as the maintenance schedules. This detailing of the ammunition plan included authorizing substitute items. Following the reorganization, these tasks were divided between the Weapons and Ammunition Section of the Materiel Logistics Department of the staff of the Commander of the Royal Netherlands Navy (C-ZSK) and DMO[16].
c. The Logistical Services Division was responsible for carrying out the ammunition distribution process. This meant, among other things, that they arranged storage and distribution and verified that this was in accordance with the allocations. They were also responsible for the maintenance and quality control of ammunition. After the Naval Maintenance Company became a part of DMO on 1 September 2005, these tasks became the responsibility of DMO.
d. The regional commanders[17] were and still are responsible for checking and authorizing requests for both CVM and OMU in the ammunition process. They are also responsible for ensuring that the total quantity of used CVM corresponds with the planned quantities and checking whether additional requests may be necessary. Their tasks, responsibilities and authorities with respect to the ammunition process have not changed significantly with the reorganization. Each year the ammunition requirement for the following year is drawn up and the regional commanders are asked to take stock of the ammunition requirements of the divisions under their responsibility.

The incident happened to a unit of the Flag Officer, Caribbean (CZMCARIB). Before the Ministry of Defence reorganization, the Head of the Maintenance Service was responsible for drawing up CZMCARIB's ammunition requirement. To do this, he took stock of the requirement in consultation with the users of the various units. The Curaçao and Aruba ammunition administrators played an

[14] See organogram Annex 8.
[15] See organogram Annex 7.
[16] The DMKM/WCS personnel involved in the incident were transferred to the CZSK Weapons and Ammunition section in the new organization where they perform the same tasks referred to in this investigation.
[17] The Commander-in-Chief of the Fleet, the Commander of the Royal Netherlands Marine Corps and the Flag Officer, Caribbean.

important role in this stock-taking exercise. Each year around 1 July, a complete list[18] of ammunition required for the following year was drawn up and sent to the Bureau of DMKM/WCS via the Head of Communications (H-SEWACO). DMKM/WCS[19] merged this list with the requirements lists of the other two regional units to form one application for required ammunition intended for the LBB/KL. Each year, close discussions between LBB/KL and DMKM/WCS resulted in lists of allocated ammunition that were sent to the divisions around the turn of the year. These lists were also sent to the Ammunition Agency (*Munitiebedrijf*) to verify that the allocated ammunition corresponded with the requested ammunition. If possible, the ammunition intended for CZMCARIB was sent with the supply ship that departs for the Caribbean area around the turn of the year. At other times of the year, too, ammunition was sent in ships heading to the Caribbean area for other purposes. Following the reorganization, some of the ammunition-related tasks of DMKM/WCS were taken over by the Head of the Materiel Logistics Department (H-MATLOG) of the CZSK. For the KM organizational structures before and after the reorganization, see Annexes 5, 6 and 7.

2.3.3 Ammunition administration at CZMCARIB

For the purposes of ammunition administration, CZMCARIB has issued a Permanent Order[20] which describes the organization of the ammunition administration. The organization contains the following four levels:

a. On the first level, at the head of the organization, is the CZSK Ammunition Coordinator (MUNCO 1). He is based in Den Helder;
b. On the second level is the CZMCARIB Ammunition Coordinator (MUNCO 2). He acts as the central contact point for MUNCO 1. This position is part of the MATLOG organization of CZMCARIB. MUNCO 2 is also the central contact point for the ammunition coordinators for Curaçao, Aruba and the Netherlands Antilles Coastguard (KWNA&A), who come under him. MUNCO 2 distributes the ammunition among the ammunition coordinators under him;
c. On the third level is the Ammunition Coordinators for Curaçao, Aruba and KWNA&A (MUNCO 3). MUNCO 3 distributes in turn the CVM among the units and coastal fortifications;
d. On the third level is the Ammunition Coordinators of the units and coastal fortifications (MUNCO 4).

At CZMCARIB the tasks of MUNCO 3 and MUNCO 4 have been merged because the ammunition of all units and coastal fortifications is stored in the ammunition bunkers of Parera Naval Base in Curaçao and the Savaneta Marine Barracks in Aruba. As a result, there are no administrators per unit and/or coastal fortification.

The various MUNCOs all have their own responsibilities and/or authorizations in the following three main processes: distributing CVM and allocating OMU within the jurisdiction of CZMCARIB, applying for and depositing ammunition and drawing up reports.

2.4 ADDITIONAL FACTS WITH RESPECT TO THE INCIDENT

2.4.1 Marine training

To analyse whether the level of knowledge was a factor in the cause of the incident, part of the investigation examined the level of knowledge of the personnel involved. This section takes a closer look at the training and refresher training of personnel with regard to ammunition.

All soldiers receive basic training on commencing service. In the case of marines, this training takes place at the Marine Training Centre (MOC) in Rotterdam[21]. It includes a lesson on hand grenades in which the various types of hand grenades used by the Marine Corps are discussed, including the WP smoke hand grenade, no. 23. In addition to providing information on the ammunition, the lesson focuses on how this ammunition should be handled. These safety instructions regularly form part of both the theoretical and practical elements of the lessons.

Many soldiers receive follow-up training that focuses on specialization, advancement or a specific function. These follow-up training courses do not however devote any attention to knowledge and

[18] This list distinguished between CVM and OMU.
[19] Following the reorganization, this task became the responsibility of the Weapons and Ammunition Section of the CZSK Materiel Logistics Department.
[20] The full set of regulations are included in OBACARIB 5.2.
[21] Officers trained at the Royal Naval Institute (KIM) are an exception.

skills acquired during the basic training. This means that the hand grenade lessons, as given at the MOC, are not repeated in follow-up training. It is, however, likely that this knowledge is expanded upon in follow-up training. CZSK keeps a personal file of each employee that records the training courses the employee has followed and whether they were completed successfully.

On the successful completion of basic training, the soldier is placed with one of the units of the CZSK. These units often provide refresher training courses that bone up professional knowledge and military skills acquired during the basic training. CZSK units are themselves responsible for keeping knowledge and skills of their personnel up to speed. These training courses focus primarily on the proficiency and operational deployment of the battalion, the company or platoon. Unit training courses and exercises are not recorded in the personal file.

CZSK has an overview of each employee that indicates whether that person has successfully completed a specific training course. The CZSK has no way of knowing the current status of an individual's acquired knowledge and skills.

2.4.2 Ammunition Administrator Training

The training of ammunition administrators focuses largely on the logistical process and there are no requirements with respect to technical knowledge of ammunition or its use.

This is notably apparent from the job requirements as stated in the Ministry of Defence job description of the CZMCARIB ammunition administrator. The focus of the job description is as follows: knowledge of ammunition management and ammunition storage, an understanding of logistical processes, and control and administration skills. The required qualification stated is a MUNBIS training course and an ammunition training course.

The MUNBIS training course (Ammunition Management and Information System) focuses on the administrative management of ammunition. The ammunition training course lasts one or two days and focuses on the recognition, storage and transport of ammunition.

Interviews with CZSK staff holding executive positions touched on the training of ammunition administrators. These interviews confirmed our impression, as described above, that the training focuses on the logistical process.

2.4.3 Marines Safety Doctrine

As indicated above, all marines receive Basic Training at the MOC in Rotterdam. In interviews, various members of CZSK staff holding executive positions pointed to the importance of the safety doctrine that is a part of all training involving handling ammunition. This doctrine states that marines are not to work with unfamiliar ammunition. The CZSK has not set out this doctrine in writing. However, the CZSK was able to show us safety rules with respect to handing over ammunition. These rules were essentially in line with the safety doctrine[22].

2.4.4 Preparation for the exercise

It is important to have all the facts and background information regarding the incident to arrive at a clear analysis. This section will present these facts.

An important element in preparations for an exercise is an Operation Order (OPORD). The officers in charge draw up this order to inform all participants and other interested parties about the planned exercise. One section of this OPORD concerns the logistical support, including the request for the required ammunition. The OPORD, written for the exercise during which the incident occurred and dated 9 March 2006, contains a request to the Parera Marine Base ammunition administrator to reserve 90 standard smoke hand grenades for the exercise. On receiving the request, the ammunition administrator discovered that the supply of standard smoke hand grenades was insufficient to meet the request and that the WP smoke hand grenade would have to be issued as an alternative. He phoned the exercise OBL to discuss this situation. The OBL, having consulted with one of the instructors, indicated that he had no objection to the alternative offered. Both officers declared that at the time they were unfamiliar with the "WP" prefix. The alternative hand grenade was accepted based on the fact that it produced smoke.

The ammunition administrator did not trust this substitute and sent questions in an e-mail to the staff of CZSK's Weapons and Ammunition Section regarding this substitute. The ammunition

[22] Marine's Manual: Chapter 16.

administrator says that this e-mail went unanswered[23] and that he was subsequently so busy that he forgot to pursue the matter.

A few days before the start of the exercise, the ammunition administrator again had contact with the officers in charge of the exercise. This concerned an exchange of e-mails regarding a reduction in the number of smoke hand grenades from 90 to 50 units and information about how the ammunition should be transported. The ammunition administrator pointed out to the officers the regulations[24] concerning the transport of dangerous substances which applied to the requested ammunition (the ammunition administrator indicated that the WP smoke hand grenade had to be transported separately from the other ammunition).

It is usual practice to pick up the ammunition from the ammunition bunkers before the exercise begins. The regulations state[25] that this must be done by a soldier with the rank of Sergeant Major or higher. Since the OBL was the only person senior enough, it was his task to pick up the ammunition and transport it to the exercise area on Monday 24 April. The OBL had a Landrover with a trailer available for the task. On receiving the WP smoke hand grenades, the OBL indicated that he was unfamiliar with how these smoke hand grenades worked. The ammunition administrator, who was equally unsure how the grenades worked, advised the OBL to test a grenade before using them in the exercise. Together with the WP smoke hand grenades, the OBL also took three copper sulphate pads and a burns instruction card[26] and placed them on the central control panel between the driver and passenger seats of the Landrover. He also took extra water. After the OBL arrived at the exercise ground and camp was set up, all ammunition was stored in the supplies tent. The OBL decided to leave the copper sulphate pads, instruction card and water in the Landrover because he thought these items were only needed during transport from the barracks to the Wacao exercise ground.

The other officers were not involved in the transport and storage of the ammunition. They were also not informed of the issued copper sulphate pads and the burns instruction card for using WP smoke hand grenades.

It is usual practice for a safety briefing to be held before an exercise begins. In the case of the exercise during which the incident occurred, this briefing was given by the OBL on Monday evening using the KOVBA 306.[27]

[23] There is no copy of this email message. Staff at CZSK's Weapons and Ammunition Section declare that they do not recall receiving any e-mail to this effect.
[24] MP 40-20: 1000 and 1100.
[25] Permanent Order Caribbean area (OBACARIB) chapter 5.2, section 6
[26] An instruction card on dealing with phosphorus-related incidents and treating phosphorus burns. 3 VVKM 6 Annex 6.
[27] Permanent Corps Order regarding risk analysis, risk reduction and providing assistance at exercises and training sessions

3 ASSESSMENT FRAMEWORK

3.1 General

This chapter presents the assessment framework – the framework the Dutch Safety Board uses to test its findings – for the investigation into the incident at the Wacao military drill ground square in Curaçao on 26 April 2006.

An assessment framework is an essential part of the investigation as it is extremely important that the criteria used in arriving at an assessment are understood. The Dutch Safety Board uses the assessment framework in its analysis of the incident and applies it to the circumstances, establishing the (probable) causes, the scale of the consequences, establishing structural lapses in safety and in compiling its recommendations.

3.2 Legislation and regulations

The assessment framework is based on national legislation and, specifically, Ministry of Defence and CZSK regulations. A number of laws and their associated decrees are not Kingdom laws or Kingdom decrees and therefore do not apply to the Netherlands Antilles and Aruba. Some laws and decrees relating to Defence, however, have been declared to apply by analogy abroad. The Ministry of Defence rules that do apply refer, if need be, to these laws and decrees. The Ministry of Defence regulations given below are only those that have a direct bearing on the incident under investigation. See Annex 2 for an overview of the other relevant laws and regulations.

- Armed Forces Carriage of Explosive Substances Decree (BVOSK, MP 40-20, 1200).
  This decree constitutes a fleshing out of Article 8 of the Carriage of Dangerous Goods Act (WVGS). The WVGS assumes that the military transportation of dangerous goods is subject to the same regulations as non-military transportation. As set out in the explanation of the Act, regulations may only be deviated from for certain aspects of the military transport of dangerous goods and objects in connection with the operational activities of the armed forces by virtue of an administrative order on the recommendation of the Minister of Defence. This decree specifies the requirements regarding the construction, configuration and outfitting of vehicles used for transporting explosive substances and objects, the inspection of these vehicles, including the relevant configuration and outfitting, their testing or inspection, and explanations or instructions on the packaging. Otherwise the regulations under the Carriage of Dangerous Substances Decree (BVGS) apply. With respect to handling explosive substances and objects, the requirements pursuant to the BVSOK or the regulations set out in the (civil) Carriage of Dangerous Substances Decree apply.

- Carriage of Dangerous Substances in Military Vehicles Exemption Rule 2002 (MP 40-20, 2000).
  Supplies are very frequently moved within barracks and on other Ministry of Defence facilities. These movements come under the operational scope of application of the WVGS. Since application of the WVGS rules would seriously impede normal operations at these facilities, exemption to these rules is granted. Furthermore, normal operations of the armed forces at these facilities should occur without compromising public safety. Therefore, the exemption is subject to the rule that all transports meet the military criteria for the internal transport of dangerous substances. This rule has been in force at the Ministry of Defence for many years and has shown to provide adequate guarantees for the safe internal transport and storage of dangerous substances.

- Rule concerning the technical administration of ammunition and explosive substances (3 VVKM 6).
  This rule contains provisions concerning the technical administration of ammunition and explosive substances used by the CZSK. It also mentions the responsibilities of operational units and coastal fortifications in respect of this matter. Annex 6 of this rule contains the instructions for dealing with phosphorus-related incidents and phosphorus burns.

- Rule concerning the supply of ammunition by the Royal Netherlands Navy (3 VVKM 11).
  This rule contains provisions concerning the supply of ammunition at the CZSK. The rule provides for the supply of ammunition at the CZSK in general terms. Detailed rules can be found in the relevant regulations regarding ammunition observed by the regional commanders.

- Corps Permanent Order (KOVBA) 306
  This rule provides a general risk analysis of possible dangers and a guideline for providing assistance in Curaçao. The KOVBA states that the OBL must give a safety briefing at each exercise.

- Manual for ammunition used by the Royal Netherlands Navy (Technical Instructions 250-B-02 (VS 9-850))
  This rule describes the use and purpose, composition, technical data, working, effect and safety aspects of ammunition articles. It also explains how to deal with dud ammunition and ammunition that fails to detonate. Also, it contains specifications and references to other rules.

- CZMCARIB Permanent Orders (OBACARIB) nr. 5.2
  This section of the OBACARIB deals more specifically with the organization of the CZMCARIB ammunition administration in accordance with 3VVKM11.

- Marines' Manual
  A manual that is issued to each individual mariner. This manual includes short descriptions of weapons and ammunition items such as the various smoke hand grenades used. The manual is based on the Royal Netherlands Army Soldiers' Manual.

3.3 Assessment framework for safety management

In principle, how an organization deals with its own responsibility for safety can be tested and evaluated in a number of ways. There is no universal manual that can be referred to for all possible situations, despite the fact that since the 1990s more emphasis has been placed on organizations taking more responsibility for safety. The Dutch Safety Board has therefore selected five safety points that give an idea of the aspects that can play a role (to a lesser or greater extent). The Safety Board feels that its choice of these five is justified since these safety points are included in numerous national and international laws and regulations and in a large number of widely accepted and implemented norms.

The selected safety points are as follows:

a. Understanding risks as a basis for a safety policy
b. A demonstrable and realistic safety policy
c. Implementing and sustaining the safety policy
d. Tightening the safety policy
e. Management, involvement and communication

Past experience has shown that the structure and content of the safety management system play a crucial role in clearly managing and continually improving safety. All organizations should aim for optimum safety. The Dutch Safety Board recognizes that any assessment of how an organization handles its own responsibility with regard to safety depends on the organization itself. Aspects such as, for example, the nature of the organization or its size can be important and should therefore be taken into account in any assessment. Even though the way an assessment is reached will differ depending on the incident, the underlying philosophy remains the same.

Organizations which, by the very nature of their activities, can be confronted with extremely dangerous situations should be expected to have a strongly developed sense of safety. One such organization, one which works with ammunition on a regular basis, is the armed forces. A high priority for safety and the application of the latest technology to guarantee safety should be standard right across the Defence organization. The Dutch Board of Safety expects the Defence organization to exercise prudence and good judgement in managing its risks so that these risks can be lowered as much as is reasonably possible given the circumstances.

4 PARTIES INVOLVED AND THEIR RESPONSIBILITIES

A number of different parties with different responsibilities were involved in the incident. The overview below only includes those parties that played a direct role in the incident and it views the organization as it was at the time of the incident. At the time the ammunition was supplied, the organizational structure of the Commander-in-Chief of the Netherlands Navy was still in force. Because the responsibilities in that organizational structure were transferred to the new organizational structure, the old structure will only be referred to if this is necessary for purposes of clarity or if a certain responsibility no longer exists. See Annexes 4, 5, 6 and 7 for an overview of the other parties that play a role.

The parties involved come under the following four directorates or commands:
- Central Staff (see annex 4);
- Royal Netherlands Naval Command;
- Naval Command Caribbean;
- The Defence Materiel Organization.

The organisation charts of these four directorates or commands are included in annexes 5, 6 and 7.

4.1 Royal Netherlands Naval Command

The relevant sections of the CZSK are the following:
- the Directorate of Operational Support;
- the Naval Command Caribbean.

See Annex 5 for the relationship between the various parties.

4.2 The Directorate of Operational Support

The Materiel Logistics Department
The Materiel Logistics Department is part of the Directorate of Operational Support and is responsible for managing, implementing, continuing and optimizing the materiel readiness of maritime single units. The Weapons and Ammunition Section is part of this department.

Weapons and Ammunition Section
The task of the Weapons and Ammunition Section is as follows:
- drawing up the weapons and ammunition requirements;
- preparing and managing the introduction of new weapons and ammunition;
- initiating and managing tests of weapons and ammunition;
- participating in inter-service projects and working groups;
- drawing up multi-year requirements for ammunition and small-calibre weapons;
- assigning covenant ammunition (CVM) to units.

4.3 The Naval Command Caribbean

See Annex 6 for an organisation chart of the Naval Command Caribbean.

The Flag Officer, Caribbean
The navy in the Caribbean region is under the command of the Flag Officer, Caribbean (CZMCARIB) whose responsibilities include:
- leading the organizational division of the Naval Command Caribbean while observing the commission, planning frameworks and guidelines of the CZSK;
- maintaining the desired operational deployability of the units in the sphere of operations of the Naval Command Caribbean through training and practice;
- the operational command of all branches of the armed forces operating in areas designated by the CZSK;
- organizing Antillean and Aruban conscription[28], including guiding, educating and training new miliciens and officers and assigning them to patrols and other duties on completing training.

[28] Conscription in the Caribbean region still subject to obligatory attendance.

Head of Materiel Logistics Department
The Materiel Logistics Department emerged from the former Curaçao Maintenance Service (*Instandhoudingsdienst*) following the reorganization and consists of approximately 77 persons. The department supports the units of CZMCARIB in terms of materiel and logistics where necessary. The Sensors, Weapons and Communication Bureau is part of the department.

Head of Sensors, Weapons and Communication (SEWACO)
The head of the Sensors, Weapons and Communication Bureau is responsible for the activities of the ammunition administrator. Each year, under his responsibility, a full list[29] is compiled of ammunition required for the following year.

Chief Ammunition Administrator
The Chief Ammunition Administrator is tasked with the actual, technical and administrative management of the (transport preparations of) ammunition supplies and the storage spaces for the various units. In this capacity, he acts as the contact point/advisor for the units and HSEWACO with respect to matters dealing with ammunition, ammunition logistics and ammunition administration.

Head of Training at Suffisant Marine Barracks
The Head of Training at Suffisant Marine Barracks is responsible for three training courses at the CZMCARIB organization, namely the Basic Training, Continued Vocation Training (VVO) and civilian training.

Mentor of Continued Vocation Training (Mentor VVO)
The Mentor of VVO is tasked with planning, preparing and implementing VVO. If there is target practice or the units are called out, as OBL, his tasks include giving instructions and briefings, in particular with respect to safety.

4.4 The Defence Materiel Organization

The Defence Materiel Organization (DMO) provides the different branches of the armed forces with resources and services and is responsible for their maintenance. The DMO therefore draws up a materiel policy with the Central Staff Defence Internal. With respect to materiel, the DMO is responsible for procuring, maintaining and discarding materiel. The DMO is responsible for an efficient and effective running of the logistical operation.

See Annex 8 for the relationship between the various parties.

The Directorate Weapon Systems and Agencies
The Directorate Weapon Systems and Agencies[30] is part of the DMO. This directorate combines the DMO tasks that relate to the materiel-logistical maintenance of materiel. The directorate is divided into the following divisions:

- Sea Systems and Agencies
- Land Systems and Agencies
- Air Systems and Agencies

Land Systems and Agencies
This division focuses on providing new materiel, including ammunition, fuels and raw materials. This materiel is maintained by the various organizational departments of the division for modifications, for example. One of the agencies that is part of Land Systems and Agencies is the National Supply Agency (LBB).

The National Supply Agency
The National Supply Agency (LBB) is the logistics agency that supplies all operational commands of the armed forces with durable and non-durable goods and services. In addition, the agency performs this task for Support Command. It supports the operational commanders in supplying their units, supplies the operational units in peacetime and manages and maintains the strategic supplies. One of the agencies that is part of the LBB is the Ammunition Agency.

[29] This list distinguishes between CVM and OMU.
[30] Sub-task decree of the Defence Materiel Organization 2006, MP 10-155

The Ammunition Agency

The task of the Ammunition Agency is to procure, store, maintain and issue ammunition and ammunition-related items for operational use by the Royal Netherlands Army in its entirety and the other branches of the armed forces with respect to the agreed Single Service Management/ Single Service Procurement ammunition and ammunition-related items. The Ammunition Agency consists of the staff (Utrecht), the Weapon Systems and Ammunition Testing Department (’t Harde) and the Physical Distribution and Maintenance Department (Veenhuizen).

5 ANALYSIS

5.1 INTRODUCTION

Chapter 2 presented the facts that contributed to the cause of the incident.

This chapter analyses these facts more thoroughly to establish the exact causes, formulate conclusions and make recommendations using the TRIPOD method. This analysis method works on the principle that taking measures (barriers) allows the danger to be controlled, so that the event does not occur or, if the measure fails, people and materiel are protected from the consequences of the event (incident). See Annex 10 for a detailed description of the analysis method used and the barrier numbering.

The analysis of the facts distinguishes between failing and missing barriers. A failing barrier is one that has always been present and has always functioned, but where something has failed, resulting in the failure of the barrier as a whole. A missing barrier is one that could have been put in place to provide sufficient protection but wasn't.

Following a short description of the events that resulted in the incident in section 5.2, the failing barriers will be described in section 5.3 and the missing barriers in section 5.4. The investigation revealed a number of relevant facts that fall within this scope but that are not visible in the TRIPOD scheme. The final section will deal with these facts.

5.2 SHORT DESCRIPTION OF THE EVENTS RESULTING IN THE INCIDENT

The various events, hazards and objects can be described in the following manner.

An incorrect code was used when the ammunition was being assigned to CZMCARIB. Because of the lack of verification points along the entire assignment process, this error went undetected. This error resulted in the WP smoke hand grenade being designated as a substitute for the standard smoke grenade, and consequently, turning up in the CZMCARIB ammunition supply.

Subsequently, the WP smoke hand grenade was taken to be used on an exercise. The error could have been detected – and the detonation of the grenade prevented – at the time of issue and when in the possession of the user if a check had been made to verify that this grenade was right for the objective for which it was taken.

Finally, the WP smoke hand grenade was used during the exercise. There was still the possibility during the exercise that the grenade would not be used because this type of ammunition was unfamiliar to those present. The personnel present were not protected when the grenade was thrown and there were no copper phosphorus pads available to treat any phosphorus burns.

5.3 FAILING BARRIERS

The following failing barriers were established. Each section dealing with a barrier begins with the principle behind the barrier concerned and ends with a sub-conclusion.

Assigning ammunition using NOV codes (barrier 1)
If the correct NOV codes had been used when assigning the ammunition to CZMCARIB, no WP smoke hand grenades, no. 23, would have ended up in the CZMCARIB ammunition supply as substitutes for standard smoke grenades.

In the summer of 2004, DMKM/WCS submitted an ammunition requirements list for 2005 to the Bureau of Marines Affairs (Burmarns). This happens every year and falls under the responsibility of the Head of the CZMCARIB Maintenance Service. This requirements list contained a quantity of standard smoke grenades with the NOV code 4811. In October 2004, the representatives of Burmarns responded with a provisional allocation of the requested standard smoke hand grenades. In November 2004, this request was corrected and, in reference to the standard smoke hand grenades, it was stated that the National Supply Agency of the Royal Netherlands Army (LBB/KL) was temporarily unable to supply these grenades and that the WP smoke hand grenades, no. 23, with NOV code 4821, had been designated as a substitute. In April 2005, the definitive allocation of

ammunition for CZMCARIB for 2005 had been made, again containing the same information[31]. Correspondence between the LBB/KL and Burmarns reveals that LBB/KL did not designate ammunition with NOV code 48**2**1 as a substitute, but ammunition with NOV code 48**3**1[32]. It can be concluded that the LBB/KL data was incorrectly processed when the substitute ammunition was allocated and that the WP smoke hand grenades were erroneously designated as substitute ammunition. Burmarns has indicated that this mix-up was the result of a typographical error. The conclusion that a typing error was made by Burmarns is supported by the fact that the allocation of substitute ammunition for the standard smoke grenades intended for the other two regional commanders proceeded correctly.

Sub-conclusion 1
DMKM/WCS made a typing error in allocating ammunition to CZMCARIB, resulting in WP smoke hand grenades being wrongfully designated as a substitute for the standard smoke hand grenades.

Check of interchangeability on issuing (barrier 5)
If the ammunition had been checked on receipt to ensure that this grenade was right for the intended objective, the error could have been detected. The WP smoke grenades, no. 23, would then never have turned up in the ammunition supply of the exercise.

In the months leading up to the exercise, there was contact between the ammunition administrator and those leading the exercise. The ammunition administrator indicated that the WP smoke hand grenade would be issued as a substitute for the standard smoke grenade. At that time, those involved could have checked, by consulting the regulations and instruction manuals, whether the WP smoke hand grenade was suitable for the objective of the exercise.

When the OBL picked up the ammunition from the ammunition administrator, he was confronted with the additional precautions required when using and transporting WP smoke hand grenades. This was a moment at which the user could have checked if the WP smoke hand grenade was suitable for the objective of the exercise. The safety information of the WP smoke hand grenade[33] states that it may only be used on hand grenade ranges. If those involved had been aware of this, it is likely that the WP smoke hand grenade would never have been taken.

Sub-conclusion 2
The users of the WP smoke hand grenade failed at a number of different times to check if the WP smoke hand grenade was suitable for the objective of the exercise.

Basic principles for handling ammunition should have meant that the ammunition was checked to ensure it was suitable for the intended objective. No such check was performed because those involved blindly assumed that an identical substitute for the standard smoke hand grenade had been issued. Given the level of training and experience (see section 2.4.1) of those involved, it is not unfair to assume that the WP smoke hand grenades should have been recognized for what they were.

CZSK units are themselves responsible for keeping their ammunition knowledge and skills up to date. It is part of the job of those in executive positions to keep their units and personnel ready for deployment. The training courses focus primarily on the proficiency and operational deployment of the battalion, the company or platoon. Unit training courses and exercises are not logged in the employees' personal files. The personnel involved were deployed to many different units and, during the course of the investigation; it was not possible to find out whether the actions leading up to the incident bear any relationship to this lack of record keeping.

We had a situation where in an organization renowned for its professionalism and operational effectiveness such as the Royal Netherlands Marine Corps, four experienced marines (three sergeants and one lieutenant, including a shooting instructor) were unfamiliar with the WP smoke grenade, did not act in accordance with this safety doctrine and did not know the safety rules that specifically apply to this type of smoke grenade.

[31] Because the 2005 requirements were only provided in March 2006, this shortage of standard smoke grenades in April 2006 still applied.
[32] Ammunition with NOV code 4831 is a smoke hand grenade that has virtually the same effect as the smoke hand grenade with the NOV code 4811.
[33] See Annex 9, point 6.

This is even more remarkable given that the WP smoke grenade is included in the category of weapons and ammunition that are considered part of the regular "kit" of an infantryman, as evidenced by the inclusion of the WP smoke grenade in the Marines' Manual (KM) and the Royal Netherlands Army Soldiers' Manual. If a number of marines at the level of experienced sergeant and lieutenant demonstrated such gaps in knowledge, the Safety Board wonders about the knowledge and conduct at the level of marine first class. The Board finds it alarming that basic training and job training combined with operational training and experience do not apparently equip personnel with the required elementary knowledge and skills to handle hand grenades[34].

A lack of knowledge of the WP smoke grenade was also the reason for an earlier incident at the Ministry of Defence. In 1993 the WP smoke grenade was intentionally issued as a substitute for the standard smoke grenade. The standard smoke grenades were being used at the time to demarcate a helicopter landing area. There were no casualties during this incident because the WP smoke grenade was thrown from a greater distance. Statements made indicate that this incident was reported. However, because that incident occurred more than 13 years ago, details are no longer available.

Sub-conclusion 3
Basic training and job training combined with operational training and experience do not apparently equip personnel with the required elementary knowledge and skills to handle hand grenades.

Setting aside the WP smoke hand grenade by the user (barrier 6)
If the instructors, in accordance with the safety rules and doctrine (working with unfamiliar ammunition), had set aside the unfamiliar WP smoke hand grenade, the incident would never have happened.

The instructors assumed during the exercise that they were not working with unfamiliar ammunition. They declared that they took the WP smoke hand grenade to be a smoke grenade (used often in the past) that had the same effect as the standard smoke hand grenade they had worked with that same day. They decided to test the grenade out of curiosity to see if the effect of this grenade would be different from that of the standard smoke hand grenade. One of the instructors knew that an alternative for the standard smoke hand grenade would be available. He and the OBL had been informed of this fact in an e-mail exchange about a month before the exercise. This e-mail exchange did not, however, make any mention of the WP smoke grenade. The instructor who threw the grenade declared that its name did not strike him as odd or cause him to become suspicious. The OBL was aware that they would be working with WP smoke hand grenades. When the ammunition for the exercise was picked up, the fact that WP smoke hand grenades had been designated as substitutes for the standard smoke hand grenades was discussed at length. However, the OBL saw no reason to inform his instructors of this. Also during the safety briefing, which was held on Monday evening for all exercise participants, no mention was made of the WP smoke hand grenade. Those involved in the incident failed to properly assume their responsibility with respect to the safe handling of ammunition.

Sub-conclusion 4
Those directly involved in the incident failed to properly assume their responsibility with respect to the safe handling of ammunition.

Shielding of personnel (barrier 7)
If the personnel present had been adequately shielded when the WP smoke hand grenade exploded, there would have been no injuries.

The rules state that the WP smoke hand grenade may only be used on a hand grenade range[35]. The rules also give the safe distance as 100 metres[36] and state that the dispersion pattern of the phosphorus is approximately 15 metres. Because the WP smoke hand grenade was issued to the user as a substitute for the standard smoke hand grenade, the effect it had when thrown came as a complete surprise. This is why the grenade was thrown without observing a safe distance or using the appropriate shielding. The wind direction had not been taken into account either. Because

[34] The CvO of CZMCARIB, in as far as they are able to judge, considers the curriculum of the Basic Training incomplete, ambiguous and erroneous (see Annex G). In its investigation, the Dutch Board of Safety was unable to confirm this specific assessment.
[35] VS 9-850: phosphorus smoke grenades
[36] VS 9-850: phosphorus smoke grenades

the grenade was thrown into the wind, the phosphorus dispersion pattern shifted to the direction of the thrower.

Because of the high temperature, both instructors had removed their jackets and wore just T-shirts, exacerbating the effect of the phosphorus coming into contact with their bodies.

Sub-conclusion 5
No safe distance was observed or correct shielding used when the grenade was thrown.

Application of copper sulphate pads (barrier 8)
If a burns instruction card, copper sulphate pads and sufficient water had been present, the consequences for the victims could have been less serious.

Figure 3. A copper sulphate pad (in its packaging)

The OBL was given three copper sulphate pads, a burns instruction card and water when he picked up the WP smoke hand grenades. He declared that his impression was that he was given these items in order to comply with regulations regarding the transport of the WP smoke hand grenades. There was no discussion about the articles with the ammunition administrator. Also, the OBL apparently accepted the copper sulphate pads without knowing how, when and why they should be used.

In the morning of the day of the incident, one of the participants stumbled during an exercise. His injury was so serious that it was decided to take him to the Parera Marine Base sick bay in the Landrover. This was the same Landrover in which the copper sulphate pads and the burns instruction card were stored. This meant that the pads and burns instruction card were no longer present on the drill ground at the time of the incident. The fact that these items were absent did not influence the occurrence of the incident one way or another. The correct use of the copper sulphate pads might have reduced the seriousness of the consequences of the burning phosphorus for the three persons affected.

Sub-conclusion 6
The absence of copper sulphate pads and burns instruction card during the incident removed an opportunity to reduce the seriousness of the consequences of the burning phosphorus.

5.4 MISSING BARRIERS

The following missing barriers can be distinguished. Each section dealing with a barrier begins with the principle behind the barrier concerned and ends with one or more sub-conclusions.

Using verification points in the ammunition process (barrier 2)
If a sufficient number of verification points[37] had been incorporated into the entire logistical process of planning, budgeting, requesting and issuing ammunition (the ammunition process), the typing error would have been noticed and no WP smoke hand grenades would have ended up in the CZMCARIB ammunition supply as substitutes for standard smoke grenades.

The organizational divisions responsible for the ammunition process are described in section 2.3.2. The typing error was made by DMKM/WCS when allocating substitute ammunition for the standard smoke grenades. This allocation was sent to the Storage and Distribution Department of the

[37] Verification can be performed by personnel or programmed in the software

Logistical Services Division of the Naval Maintenance Company and to the ammunition administrator of CZMCARIB[38]. In addition to the logistic processing of the allocation, the personnel of the Materials Planning Department of the Naval Maintenance Company were responsible for verifying that the allocated ammunition corresponded with the ammunition that was originally requested[39]. The allocation of the smoke hand grenades corresponded with the request, so that both standard smoke hand grenades and WP smoke hand grenades were shipped to the Caribbean. Given the information they had from DMKM/WCS concerning the substitution, there was no reason for the Materials Planning Department of the Naval Maintenance Company not to approve the allocation of WP smoke hand grenades for CZMCARIB.

A study of the regulations and rules as well as interviews with the responsible officers of the various organizational divisions reveal there is no verification of the ammunition allocation, as drawn up by DMKM/WCS. This means that the typing error went undetected because of the absence of verification points in the ammunition process. The absence of verification points is a structural failing in the ammunition process that could result in similar incidents occurring in the future. The current process is unable to ensure the correct allocation and issuing of ammunition.

This view is supported by the fact that a similar error was discovered during the investigation, which, while it did not result in any serious incident, increased the chance of one happening. Because of failings with the offensive hand grenade[40], the LBB/KL designated the flash-and-bang grenade[41] as a substitute in 2005. As with the smoke hand grenade, DMKM/WCS received written information stating that, owing to a shortage of offensive hand grenades, the flash-and-bang may be used as a substitute. However, CZMCARIB documentation reveals that DMKM/WCS indicated that the offensive hand grenade may be used as a substitute for the flash-and-bang. As the substitution of the standard smoke hand grenade demonstrates, at no point was this procedural error detected and, consequently, it could not be corrected.

The current ammunition process has ammunition coordinators (MUNCOs) at four different levels. The presence of MUNCOs at different levels would seem to indicate an organization with built-in verification points for detecting errors in good time.

The CZSK organization and CZMCARIB have four MUNCOs as described in section 2.3.3. The functions of MUNCO 2, 3 or 4 at CZMCARIB are performed as secondary jobs. In the period preceding the incident, the MUNCO 2 position was vacant and it was decided to allocate the MUNCO 2 responsibilities to MUNCO 3. At that time, the work of three different levels was being performed by a single person. This allocation of the different tasks to a single person eliminated the built-in verification points and reduced the chance of errors being detected.

Sub-conclusion 7
The current CZSK ammunition process lacks verification points that make it impossible to ensure the correct ammunition is allocated and issued.

In the past working with ammunition at the CZSK was regularly subjected to audits and inspections. Important aspects of the ammunition process were examined at both the organizational level, by the Internal Control Investigations Department, and the Ministry of Defence level, by the Defence Audit Service and the Netherlands Court of Audit[42]. These revealed that improvements could be made to increase safety and working practices with respect to ammunition. Analysis of the audit and inspection reports show, however, that they mainly focus on the administrative control of the ammunition process. Most suggestions for improvement focus on getting the quantities of ammunition at the various organizational divisions to tally demonstrably (including streamlining the information systems). This is also reflected in the fact that the Ministry of Defence in general and the CZSK in particular have implemented measures that focus almost exclusively on the administrative controllability of the ammunition process. A good example of such a measure introduced by the CZSK is the implementation of the so-called zero tolerance policy. The

[38] The reaction of CZMCARIB personnel to this substitution is described in section 2.4.4 and 5.3.
[39] See 3VVKM 11: 2350.
[40] The offensive hand grenade is a grenade that can kill people within a specific radius by means of a pressure wave. This grenade may only be used in the open field.
[41] The flash-and-bang is a grenade that disorientates people in an enclosed space by means of a loud bang and a flash of light, disabling them temporarily. This grenade is often used to imitate the effects of an offensive hand grenade during training exercises.
[42] In compiling their reports, the three services mentioned, in addition to their own audits and inspections, exchanged information to arrive at their conclusions and recommendations.

failings of the ammunition process, such as those revealed by the analysis of the Curaçao incident, should receive more attention in audits and inspections, so that not just the control procedures but the ammunition process itself is examined.

Sub-conclusion 8
Audits and inspections of the ammunition process in the past did not focus sufficiently on the process and the necessary checks and balances.

Checking incoming ammunition (barrier 3)
If there had been a check whether the ammunition supplied was consistent with the objectives for use by CZMCARIB, the WP smoke hand grenades would never have ended up in the CZMCARIB ammunition supply as substitutes for standard smoke grenades.

The fact that the WP smoke hand grenade was issued as a substitute for the standard smoke hand grenade is in accordance with the Ammunition Administration and Information System (MUNBIS). The typing error (see sub-conclusion 1) resulted in the WP smoke hand grenade being registered in the system as CVM to compensate for the temporary shortage of standard smoke hand grenades. However, this is simply an administrative check that was correct in this situation.

There was no officer present at CZMCARIB with the appropriate training to verify whether the ammunition supplied was consistent with use by CZMCARIB. This means that this check could not be carried out.

Sub-conclusion 9
There was no check when the ammunition was supplied to ensure that the ammunition was consistent with the objectives for use by CZMCARIB.

Check of interchangeability on issuing the WP smoke hand grenade (barrier 4)
If a check had been made when the WP smoke hand grenade was issued to ensure that it was suitable for the intended objective, it would have been discovered that the wrong ammunition had been issued and the WP smoke hand grenade would never have ended up in the ammunition supply for the exercise.

The CZMCARIB ammunition administrator was responsible for issuing ammunition for the exercise. His declaration reveals that he was unaware of the effect of the WP smoke hand grenades. Given that the training of ammunition administrators largely focuses on the logistical process (see barrier 3) we can conclude that, when issued, there was no check to confirm that the WP smoke hand grenade was suitable for the intended objective.

Despite the fact that the ammunition administrator had had no technical training with respect to ammunition, he e-mailed questions to the Weapons and Ammunition Section of the CZSK regarding this substitution (also see section 2.5). The ammunition administrator did not receive an answer to this e-mail and he forgot to pursue the matter owing to work pressure[43]. Staff at the Weapons and Ammunition Section of CZSK declare that they never saw this e-mail message. And because the e-mail was not saved, it is impossible to investigate why this breakdown of communication occurred.

On being issued the ammunition by the ammunition administrator, the OBL indicated that he was unfamiliar with how the WP smoke hand grenade worked. By not responding, the ammunition administrator forfeited an opportunity to retain the ammunition or consult the relevant documentation.

Sub-conclusion 10
There was no check when the ammunition was issued to ensure that the ammunition was suitable for the intended objective.

5.5 ADDITIONAL FACTS

The scope in Annex 1 states that the focus of the investigation is the way ammunition is managed in the CZSK organization. The investigation brought to light a number of relevant facts that fall

[43] During the investigation in Curaçao, several officers declared that the ammunition administrator was under considerable work pressure owing to a staff shortage and the 2005 reorganization.

within this scope but that are not visible as barriers in the TRIPOD scheme. This section examines those facts.

5.5.1 The 2005 reorganization of the Ministry of Defence

As a division of the Ministry of Defence, the Royal Netherlands Navy was reorganized in the autumn of 2005. Because the request for and issuing of the standard and WP smoke hand grenades took place after the reorganisation, the investigation considered whether the reorganization may have been a factor in the occurrence of the incident.

The following aspects were revealed:

a. Although their names have changed, the organizational divisions involved in the ammunition process have not undergone any significant changes with respect to their tasks, responsibilities and authorities.
b. The rules concerning ammunition became obsolete with the reorganisation. The CZSK responded to this by explicitly indicating that the original tasks, responsibilities and authorities, as described in the rules, would have to be taken over by the new organizational divisions until the rules had been adapted to the new organisation.
c. All CZSK staff were to have a job introduction interview following the formal establishment of the new organization for which they would be given Job Information Forms. These interviews never took place at the Weapons and Ammunition Section of the CZSK. As far as we can ascertain, however, this fact had no bearing on the occurrence of the accident.

Sub-conclusion 11
There is no demonstrable relationship between the reorganization and the occurrence of the incident.

5.5.2 Transport and storage of ammunition

On Monday 24 April 2006, the first day of the exercise, the OBL reported to the ammunition bunker to pick up the requested ammunition and transport it to the exercise ground. He had a Landrover with a trailer for transporting the ammunition. According to the regulations[44], however, the requested ammunition should not have been transported with a Landrover and trailer as was the case. The requested Thunderflashes and WP smoke hand grenades should not have been placed in the same space and, given the fact that the trailer also contained a gas bottle, it can be concluded that the ammunition could not be transported in accordance with the regulations. This, however, did not stop the OBL and, ignoring the advice of the ammunition administrator, he took all the ammunition in a single trip.

The base camp was set up on the Wacao exercise ground on Monday evening. The camp comprised a number of tents, including the supply tent. Contrary to the regulations[45], all the ammunition was placed in this tent next to each other.

Sub-conclusion 12
During the exercise, the ammunition was transported and stored in a manner that contravened regulations.

[44] Carriage of explosive substances (BVOSK) (MP 40-20, 1200) in conjunction with ADR
[45] MP 40-21 chapter 2.7.4 and 2.7.6 (In the then valid MP, these provisions were contained in sections 5260 and 5270)

[Burns instructions card, Ammunition boxes, Copper sulphate pads, Water]

Figure 4. The WP smoke hand grenades with required safety items, ready for transport.

5.5.3 Documentation and rules

Knowledge of ammunition can be acquired by reading the appropriate documentation and rules as well as by attending lessons. Information on the WP smoke hand grenade can be found in the Marines' Manual and in VS 9-850. The Marines' Manual was issued in 2002 as a general manual for Marine Corps personnel. The book was published once and has not been updated. The description and instructions relating to the WP smoke hand grenade do not differ significantly from those contained in the Royal Netherlands Army Soldiers' Manual[46]. The Marines' Manual is a good source of information for working safely with the WP smoke hand grenade. However, because no one is actually responsible for this book, the information is not updated.

VS 9-850 contains highly detailed descriptions of the hand grenades, including their purpose, composition, technical data, functioning, effect and safety aspects. The information relating to the WP smoke hand grenade is included in Annex 9. It is remarkable that the use and purpose of the WP smoke hand grenade are presented in terms of the dispersal of smoke while the burning properties of the grenade are considerable. More detailed safety guidelines are only given in the section on the safety aspects, such as the grenade's mandatory use in hand grenade ranges[47], the risk of burns and the dangers connected with the explosion. Despite the fact that the rules contain all the necessary information, the manner in which the grenade is described and the fact that this grenade is described as simply a smoke hand grenade are confusing. It is impossible to imagine an exercise situation (other than on a hand grenade range) in which the WP smoke hand grenade would be used to camouflage troop movements from the practice enemy. This is, however, described as the purpose of the smoke hand grenade.

Sub-conclusion 13
The way in which the WP smoke hand grenade is described and the fact that this grenade is described as simply a smoke hand grenade are confusing.

[46] The Royal Netherlands Army Soldiers' Manual, published by the Royal Netherlands Army (VS 2-1352).
[47] See VS 9-850

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 SUB-CONCLUSIONS

The analysis produced the following sub-conclusions:

1. DMKM/WCS made a typographical error when allocating ammunition to CZMCARIB, resulting in WP smoke hand grenades being wrongly designated as substitutes for the standard smoke hand grenades.

2. The users of the WP smoke hand grenade failed at a number of different times to check if the WP smoke hand grenade was suitable for the objective of the exercise.

3. Basic training and job training combined with operational training and experience do not apparently equip personnel with the required elementary knowledge and skills to handle hand grenades.

4. Those directly involved in the incident failed to properly assume their responsibility with respect to the safe handling of ammunition.

5. No safe distance was observed or correct shielding used when the grenade was thrown.

6. The absence of copper sulphate pads and a burns instruction card during the incident eliminated any chance of reducing the seriousness of the consequences of the burning phosphorus.

7. The current CZSK ammunition process lacks verification points that make it impossible to ensure the correct ammunition is allocated and issued.

8. Audits and inspections of the ammunition process in the past did not focus sufficiently on the process and the necessary checks and balances.

9. There was no check when the ammunition was supplied to ensure that the ammunition was consistent with the objectives for use by CZMCARIB.

10. There was no check when the ammunition was issued to ensure that the ammunition was suitable for the intended objective.

11. There is no demonstrable relationship between the reorganization and the occurrence of the incident.

12. During the exercise, the ammunition was transported and stored in a manner that contravened regulations.

13. The way in which the WP smoke hand grenade is described and the fact that this grenade is described as simply a smoke hand grenade are confusing.

6.2 FINAL CONCLUSIONS

Following its investigation, the Dutch Safety Board has drawn the following conclusions:

1. Because of a typographical error, the DMKM/WCS department wrongly designated the WP smoke hand grenade, no. 23, as a substitute for the standard smoke hand grenade.

2. The current ammunition process of the CZSK apparently contains insufficient verification points for detecting errors. This compromises safe working conditions and increases the risk of incidents.

3. The knowledge level of the personnel involved with respect to (handling) the WP smoke grenade contributed to the occurrence of the incident.

6.3 RECOMMENDATIONS

As a result of its investigation, the Safety Board makes the following recommendations to the Minister of Defence:

1. Evaluate the logistical process regarding ammunition right up to its use at the CZSK and the entire Defence organization and guarantee safety by establishing verification points along the process.

2. Given the seriousness of the incident, investigate whether the observed lack of knowledge of ammunition is an issue that affects the wider Defence organization. Take measures to address these observed gaps in knowledge and prevent them in the future.

Administrative bodies to which a recommendation is directed are required to inform the responsible minister of their position relating to compliance with the recommendation within six months of publication of this report. Non-administrative bodies or people to whom a recommendation is directed are required to inform the responsible minister of their position relating to compliance with this recommendation within a year. A copy of responses must also be sent to the chairman of the Dutch Safety Board and the Minister of the Interior and Kingdom relations.

ANNEX 1 JUSTIFICATION OF THE INVESTIGATION

Start of the investigation
On Friday 28 April 2006, the Ministry of Defence reported the incident following questions from the Dutch Board of Safety which were prompted by reports in the media. On Thursday 27 April 2006, the CZSK established an internal investigative committee.

On Tuesday 9 May 2006, the Board accepted a proposal to begin an investigation. Two Dutch Safety Board investigators were in Curaçao from 16 May to 23 May 2006 to conduct the investigation at the site of the incident.

Scope
The focus of the Dutch Safety Board's investigation is on the underlying factors that resulted in the incident. The incident involved a unit of the CZSK. The scope of the investigation therefore focuses on how ammunition is handled within the CZSK. The ammunition process within the broader Defence organization is only addressed in relation to the CZSK.

This project will not examine the usefulness of military exercises nor will it address the issue of whether smoke hand grenades provide any added value to the exercises with the Antillean militia.

Other investigations
The CZSK investigated the incident (internal investigation).

The Caribbean Brigade of the Royal Netherlands Marechaussee (KMar) began a criminal investigation of the incident. On Thursday 18 May 2006, it announced that the facts known to it at the time did not warrant any legal proceedings. It handed the results of its investigation to the Dutch Safety Board.

Interviews
As part of the investigation, interviews were held with those directly involved and those holding executive positions in the CZSK. Interviews were also held with representatives of LBB and the CZSK staff in Den Helder. The Dutch Safety Board also had access to statements made to the KMar by a number of persons involved in the incident.

Analysis
The analysis focuses on the reconstruction of the incident and its immediate and underlying causes.

Drafts
The draft final report (without consideration and recommendations) was presented for assessment of inaccuracies to the Defence organizations involved (the Ministry of Defence and the CZSK) and to involved parties at CZMCARIB. The Dutch Safety Board has incorporated any relevant feedback into the definitive version of the final report.

REACTIONS TO THE DRAFT FINAL REPORT FROM PARTIES INVOLVED THAT WERE NOT INCORPORATED INTO THE DEFINITIVE REPORT

- CZMCARIB stated the following: "*It is stated that the ammunition administrator 'is tasked with the actual, administrative and technical management of the ammunition supplies'. The conclusions of the CVHHO report (pg. 18, point 6) point out that the technical management of ammunition is not part of the job description of the ammunition administrator. Technical management is part of the (logistical) ammunition chain*".

  Response of the Dutch Safety Board: The Personnel Department of the CZSK Directorate has provided us with a job description that contains the job information details for the position of head ammunition administrator (Business unit: KM001; Job 04019156). Chapter 3 of this document states that the officer is responsible for the actual, administrative and technical management of the ammunition supplies.

- C-ZSK stated the following: "*I do not agree with your sub-conclusion 3. It states that documentation and knowledge with respect to smoke hand grenades fall short; the report incorrectly concludes that all marines lack adequate knowledge of and experience with hand grenades owing to substandard training".*

Response of the Dutch Safety Board: The supporting arguments of sub-conclusion 3 do not state that all marines lack sufficient knowledge of and experience with hand grenades. In an organization renowned for its professionalism and operational effectiveness such as the Royal Netherlands Marine Corps, four experienced marines (three sergeants and one lieutenant, including a shooting instructor) were unfamiliar with the WP smoke grenade, did not act in accordance with this safety doctrine and did not know the safety rules that specifically apply to this type of smoke grenade. This is even more remarkable given that the WP smoke grenade is included in the category of weapons and ammunition that are considered part of the regular "kit" of an infantryman, as evidenced by the inclusion of the WP smoke grenade in the Marines' Manual (KM) and the Royal Netherlands Army Soldiers' Manual. If a number of marines at the level of experienced sergeant and lieutenant demonstrated such gaps in knowledge, the Board wonders about the knowledge and conduct at the level of marine first class. Sub-conclusion 3 addresses the possibility that the lack of knowledge may be a broader problem within the organization. The second recommendation explicitly calls for this possibility to be examined.

- C-ZSK states the following with respect to sub-conclusion 8: "*Sub-conclusion 8 asserts that insufficient attention is paid to checks and balances in the ammunition process. This is worded in very general terms; the passage preceding the sub-conclusion states clearly that this does not refer to the management of ammunition. It is not a subject of debate that errors were made in handling ammunition in this case. This does not, however, prove that little or no attention is paid to checks and balances in the entire CZSK organization. The report ignores the checks performed by KMAR/Dangerous Substances Inspectorate, the role of the safety advisors, the storage checks in the GVC and the checks made during the refurbishment of ships (SARC)".*

  Response of the Dutch Safety Board: In this sub-conclusion, the Dutch Safety Board concluded that too little attention is paid to the ammunition ***process.*** This sub-conclusion does not diminish the fact that several agencies conduct audits and inspections. However, an analysis of the audits and inspection reports reveals that the checks carried out are quantitative and that the ammunition process as such remains underexamined.

ANNEX 2 LEGISLATION AND REGULATIONS WITH RESPECT TO THE ASSESSMENT FRAMEWORK

- *The Working Conditions Act*
  The Working Conditions Act is not a Kingdom Act, and does not apply to the Netherlands Antilles and Aruba. The internal Defence rules that are in force are based on this law and, where necessary, refer to it.

- *The Weapons and Ammunition Act*
  The Weapons and Ammunition Act is not a Kingdom Act, and does not apply to the Netherlands Antilles and Aruba. The relevant internal Defence rules that are in force are based on this law and, where necessary, refer to it.

- *The Carriage of Dangerous Substances Act* (MP 40-20, 1000)
  The Carriage of Dangerous Substance Act (WVGS) is not a Kingdom Act and does not apply to the Netherlands Antilles and Aruba. The WVGS and the regulations based on it prescribe the regulations that apply to the transport of dangerous substances in the Netherlands. The regulations concern, among other things, the requirements regarding the construction, configuration and outfitting of vehicles and the requirements regarding the packaging of dangerous substances. In principle, these regulations also concern the transport of dangerous substances by military vehicles in the Netherlands. Certain aspects of the military transport of explosive substances with military vehicles are governed by separate regulations in connection with the operational activities of the armed forces by virtue of the Armed Forces Carriage of Explosive substances Decree. The relevant internal Defence rules that are in force are based on this law and, where necessary, refer to it.

- *The Armed Forces Carriage of Explosive substances Decree* (MP 40-20, 1100)
  This administrative order is based on the Carriage of Dangerous Substances Act (WVGS) and replaces, where necessary, the Regulation concerning Dangerous Substances, which was a fleshing out of the Dangerous Substances Act. This decree has a number of objectives: simplifying and streamlining the administration of the dangerous substances system, implementing treaties, creating a framework for determining WVGS transport routes and setting out provisions for implementing the dangerous substances system.

- *Service regulation concerning the carriage of dangerous substances in military vehicles abroad* (MP 40-20, 3000)
  This service regulation states, among other things, that the WVGS regulations that apply to the transport of dangerous substances in military vehicles apply equally to similar transport abroad, regardless of the laws and regulations in effect in the country concerned or any relevant provisions under international law.

- *Rule concerning the commission and organization of the Royal Netherlands Navy* (1 VVKM 1)
  This rule contains regulations concerning the organization and command structure of the Royal Netherlands Navy and instructions pertaining to commands. The Commander of the Royal Netherlands Navy, a regional commander and the operational group commanders may issue supplementary regulations to this rule. This rule is outdated in a number of respects and the organization will be modified in due time.

- *Royal Netherlands Army Soldiers' Manual*
  An official manual that is issued to each individual Royal Netherlands Army soldier. This manual includes short descriptions of weapons and ammunition items such as the various smoke hand grenades used.

ANNEX 3 OTHER PARTIES INVOLVED AND THEIR RESPONSIBILITIES

Below follows a list of the other parties involved and their responsibilities to the extent they are not mentioned in Chapter 4.

THE CENTRAL STAFF

See Annex 4 for the relationships between the various parties.

The Ministry of Defence
The Ministry includes the following service divisions[48]:

- the service division of the Secretary-General;
- the Defence Staff;
- the Defence Materiel Organization.

The Ministry of Defence functions according to an official hierarchical model. This means that the secretary-general, directors-general, directors and commanders bear line responsibility for all results of the ministry, their directors-general, directorates, service divisions and commands.

The Minister of Defence
The Minister of Defence bears final (political) responsibility for the ministry. All tasks that civil servants perform fall under the political responsibility of the minister. The authorities of the minister have mostly been mandated. In principle, all authorities with respect to the primary process and operations are delegated to a senior manager (general mandate), possibly subject to restrictions (special mandate).

The secretary-general
The secretary-general (SG) is officially responsible for running all service divisions. The SG has been granted the authority to take decisions on behalf of the Minister of Defence (mandate) and to perform juristic acts under private law (power of attorney). The SG has mandated some of that authority. The service division of the Secretary-General falls under the secretary-general.

The Commander-in-Chief of the Netherlands Armed Forces
The Defence Staff comes under the Commander-in-Chief of the Netherlands Armed Forces (CDS). The CDS is the minister's highest military advisor, corporate planner, requirements drafter and corporate operator. The CDS commands the Operational Commands of the armed forces, including the CZSK. In his role as corporate operator, he has overall responsibility for managing the deployment and readiness process of the Operational Commands. The CDS manages the (commanders of the) Operational Commands directly and bears primary responsibility for the execution of military operations. He performs this task within the defence policy framework of the Central Staff. The Operational Commands are partly managed by developing, transferring, verifying and evaluating frameworks and norms.

THE ROYAL NETHERLANDS NAVY COMMAND

The Commander of the Royal Netherlands Navy
The CZSK comes under the Commander of the Netherlands Royal Navy (C-ZSK) whose tasks include[49]:

- leading the CZSK with due regard for the instructions and guidelines of the CDS;
- the effective organization, operations and internal management of the CZSK;
- execution of the tasks of the Royal Netherlands Navy Command, namely the readiness, maintenance and recuperation of the Command's operational capacity;
- advising on defence policy from the perspective of the head of the CZSK;
- drawing up the requirements and quality criteria for products and services supplied by Support Command and the Defence Materiel Organization, within the set frameworks.

The Director of Operational Support
The Directorate of Operational Support (DOST) is headed by the Director of Operational Support whose tasks include[50]:

- providing the CZSK planning frameworks and guidelines to the DOST management;

[48] General Defence Organization Decree 2005, MP 10-100
[49] General Defence Organization Decree 2005, MP 10-100
[50] General Defence Organization Decree 2005, MP 10-100

- organizing personnel and materiel, establishing operations and getting basic skills up to an operational level;
- continuing personnel and materiel readiness of the units under the command of the director of Operations (see Annex 5) with due observance of the commission and the CZSK planning frameworks;
- training or organizing the training of personnel;
- providing or organizing medical care for personnel;
- facilities support for all processes in the Royal Netherlands Navy Command;
- formulating the criteria for the products and services to be supplied by the Defence Materiel Organization and the Services Centres Command to the Royal Netherlands Navy Command, within the set frameworks.

NAVAL COMMAND CARIBBEAN

The Parera Marine Barracks Commander (also Head of Facilities Support)
As the barracks commander, the Parera Marine Barracks Commander is responsible for all facilities at the barracks used by the units stationed there.

The Suffisant Marine Barracks Commander (also Head of Facilities Support)
As the barracks commander, the Suffisant Marine Barracks Commander is responsible for all facilities at the barracks used by the units stationed there. As Head of Facilities Support, he is accountable to the Parera Marine Barracks Commander.

THE DEFENCE MATERIEL ORGANIZATION

The Director of the Defence Materiel Organization (D-DMO)
The DMO is headed by the D-DMO. Since 1 January 2005, he has been officially in charge of the Defence Materiel Organization (DMO) and bears responsibility for the defence materiel policy. The various materiel organizations have been placed under the DMO as part of this policy. The responsibilities of the HDM include[51]:

- lead the DMO in an official capacity, with due regard for the instructions and guidelines of the SG;
- develop materiel-logistical frameworks for the Operational Commands, the Royal Netherlands Marechaussee Command, the Services Centres Command and the central staff;
- managing and monitoring the process of providing, maintaining and discarding defence materiel (management of the materiel-logistical chain), including handling the defence-materiel process and advising ministers;
- executing materiel-logistical tasks, namely supplying products and services for the materiel-logistical support of Defence's primary process;
- the effective organization, operations and internal management of the DMO and its subordinate materiel organizations.

The Director of Weapon Systems and Agencies
The Directorate of Weapon Systems and Agencies is headed by the Director of Weapon Systems and Agencies whose responsibilities include[52]:

- lead the Directorate of Weapon Systems and Agencies in an official capacity, with due regard for the instructions and guidelines of the HDM;
- support (operational) commanders in optimizing, making ready and operating the (weapon) systems and managing the operation costs;
- advising on the formulation of materiel policy with regard to managing and maintaining materiel;
- the effective organization, operations and internal management of the Directorate of Weapon Systems and Agencies.

Sea Systems and Agencies
Technologies that are unique to military maritime systems are the specialist area of Sea Systems and Agencies. In addition, Sea Systems and Agencies acts as a technological databank for the entire Defence organization in areas such as radar, health and safety, the environment and chemical technology. Sea Systems and Agencies comes under the Naval Maintenance Company.

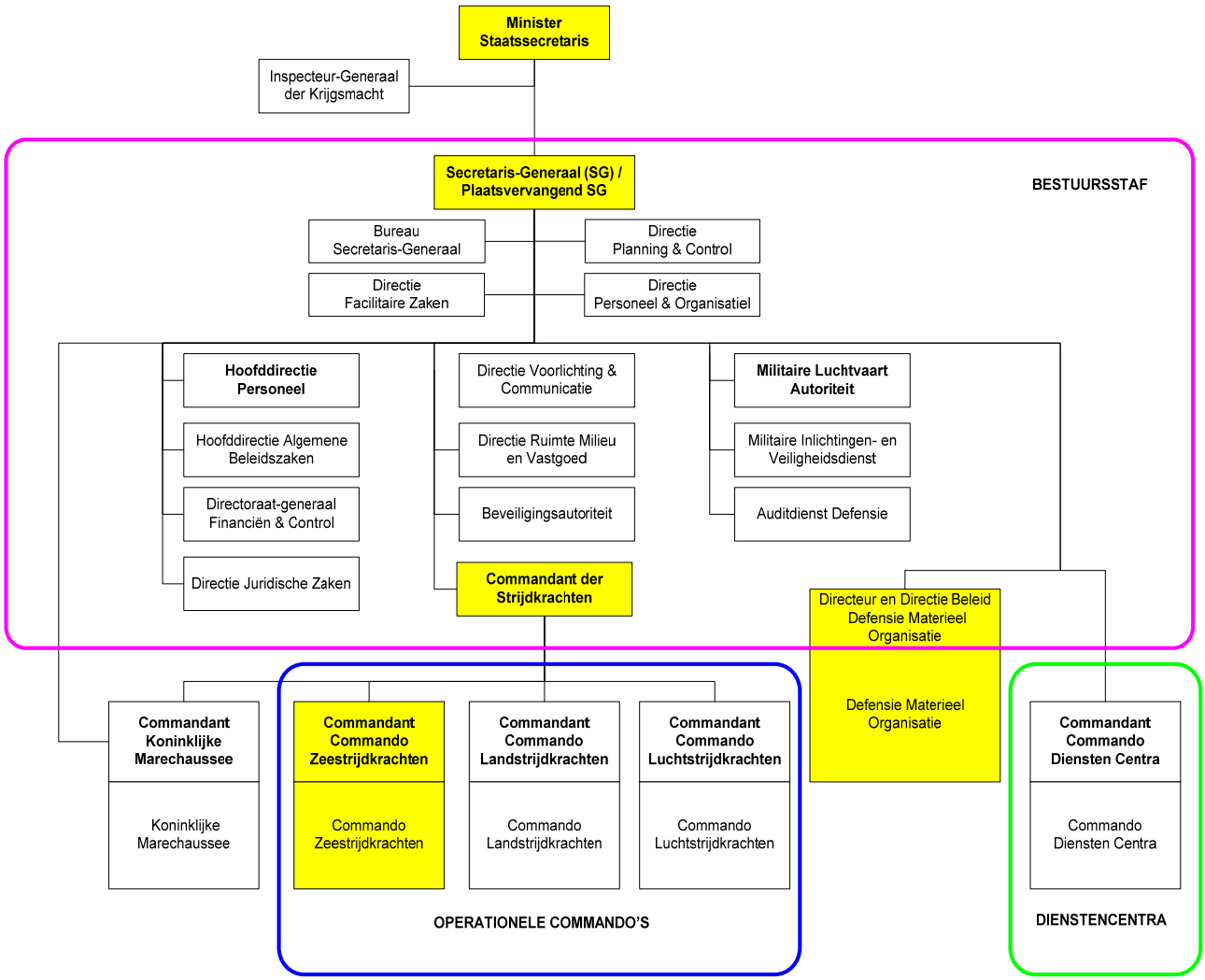
[51] General Defence Organization Decree 2005, MP 10-100
[52] Defence Materiel Organization Sub-task Decree 2006, MP 10-155

The Naval Maintenance Company
Maintenance work, repairs and modifications are the responsibility of the Naval Maintenance Company. It is also responsible for all logistical and maintenance work to on-board electronic and weapons systems, keeping ships and submarines in good working order. The Naval Maintenance Company also provides technical advice and support to ships wherever in the world they may be and supports major materiel projects. The Naval Maintenance Company is composed of the divisions Platform, Sensors Weapon and Command Systems (SEWACO), Special Products and Logistical Services. The Logistical Services division runs the Ammunition Store for storing ammunition for the CZSK.

Land Systems and Agencies
In addition to the LBB, this organization includes:

The Weapon Systems and Ammunition Department
This Department is responsible for, inter alia, managing and maintaining the weapon systems and ammunition and, where necessary, discarding them. The Department also develops materiel-logistical expertise with regard to weapons systems and ammunition that it can then offer to those requiring it.

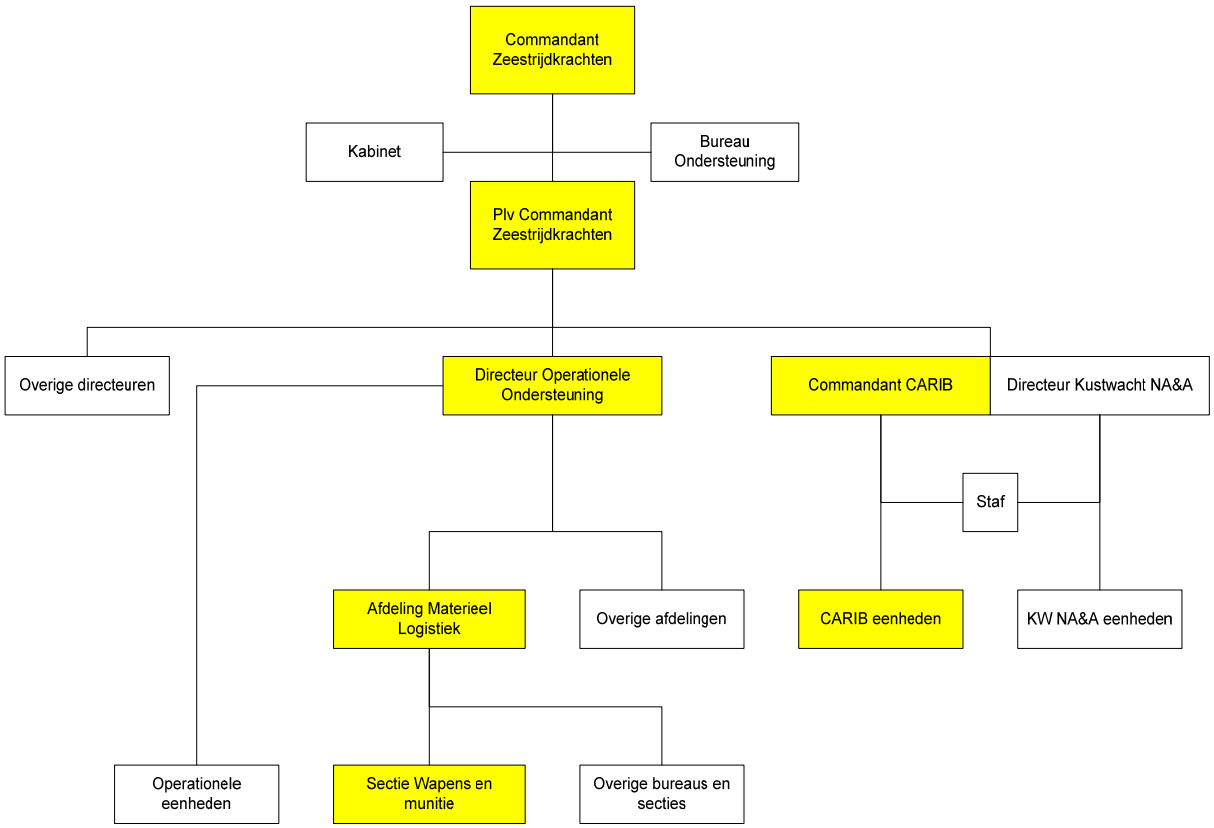
ANNEX 4 CENTRAL STAFF ORGANISATION CHART



Minister Staatssecretaris	Minister State Secretary
Inspecteur-General der Krijgsmacht	Inspector-General of the Armed Forces
Secretaris-General (SG) / Plaatsvervangend SG	Secretary-General (SG) / Deputy SG
Bureau Secretaris-General	Office of the Secretary-General
Directie Planning & Control	Directorate of Planning & Control
Directie Facilitaire Zaken	Directorate of Facilities Services
Directie Personeel & Organisatie	Directorate of Personnel & Organization
Hoofddirectie Personeel	Principal Directorate of Personnel
Hoofddirectie Algemene Beleidszaken	Principal Directorate of General Policy Affairs
Directoraat-generaal Financiën & Control	Directorate-General of Finance and Control
Directie Juridische Zaken	Directorate of Legal Affairs
Directie Voorlichting & Communicatie	Directorate of Information and Communication
Directie Ruimte Milieu en Vastgoed	Directorate of Spatial Planning, Environment and Infrastructure
Beveiligingsautoriteit	Security Authority
Commandant der Strijdkrachten	Commander-in-Chief Armed Forces
Militaire Luchtvaart Autoriteit	Military Aviation Authority
Militaire Inlichtingen- en Veiligheidsdienst	Defence Intelligence and Security Service
Auditdienst Defensie	Defence Audit Board
Directeur en Directie Beleid Defensie Materieel Organisatie	Directorate and Director of Materiel Policy

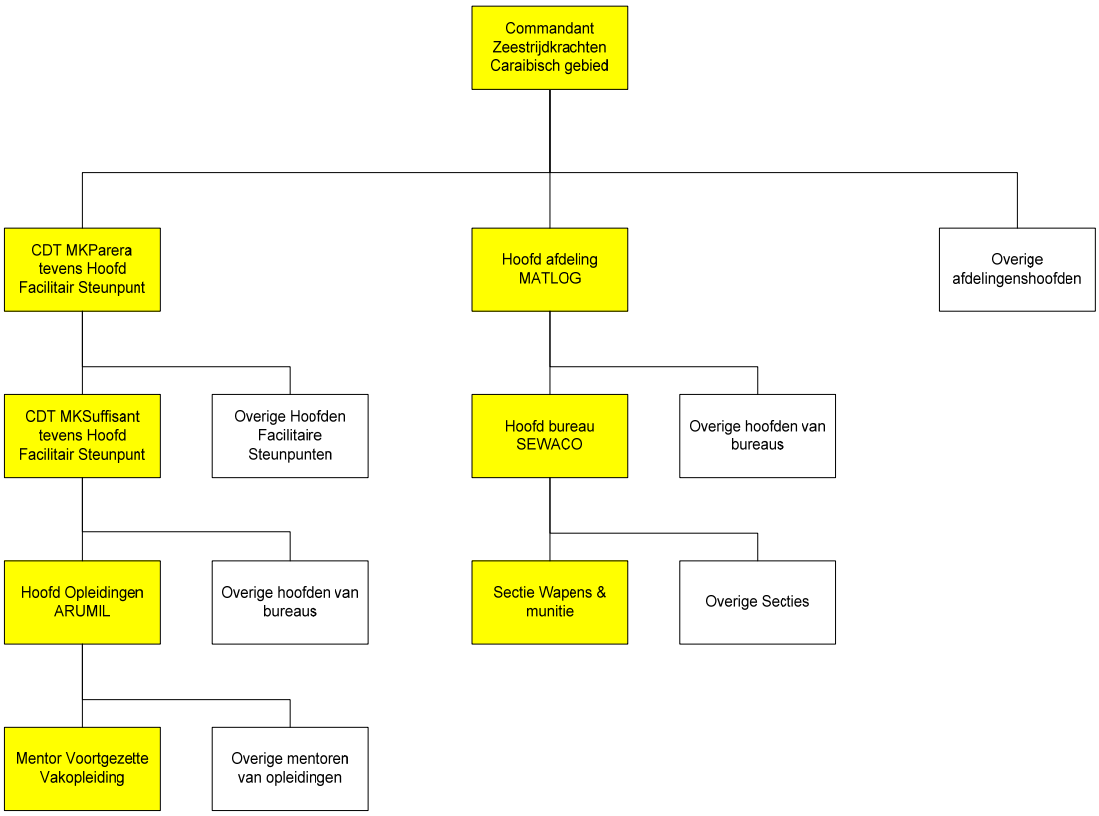
BESTUURSSTAF	CENTRAL STAFF
Defensie Materieel Organisatie	Defence Materiel Organization
Commandant Koninklijke Marechaussee	Commander of the Royal Netherlands Marechaussee
Koninklijke Marechausee	Royal Netherlands Marechaussee
Commandant Commando Zeestrijdkrachten	Commander of the Royal Netherlands Navy
Commando Zeestrijdkrachten	Royal Netherlands Navy Command
Commandant Commando Landstrijdkrachten	Commander of Royal Netherlands Army
Commando Landstrijdkrachten	Royal Netherlands Army Command
Commandant Commando Luchtstrijdkrachten	Commander of Royal Netherlands Air Force
Commando Luchtstrijdkrachten	Royal Netherlands Air Force Command
OPERATIONELE COMMANDO'S	OPERATIONAL COMMANDS
Commandant Commando Diensten Centra	Commander of the Support Command
Commando Diensten Centra	Support Command
DIENSTENCENTRA	SUPPORT

ANNEX 5 ORGANISATION CHART OF THE ROYAL NETHERLANDS NAVY COMMAND



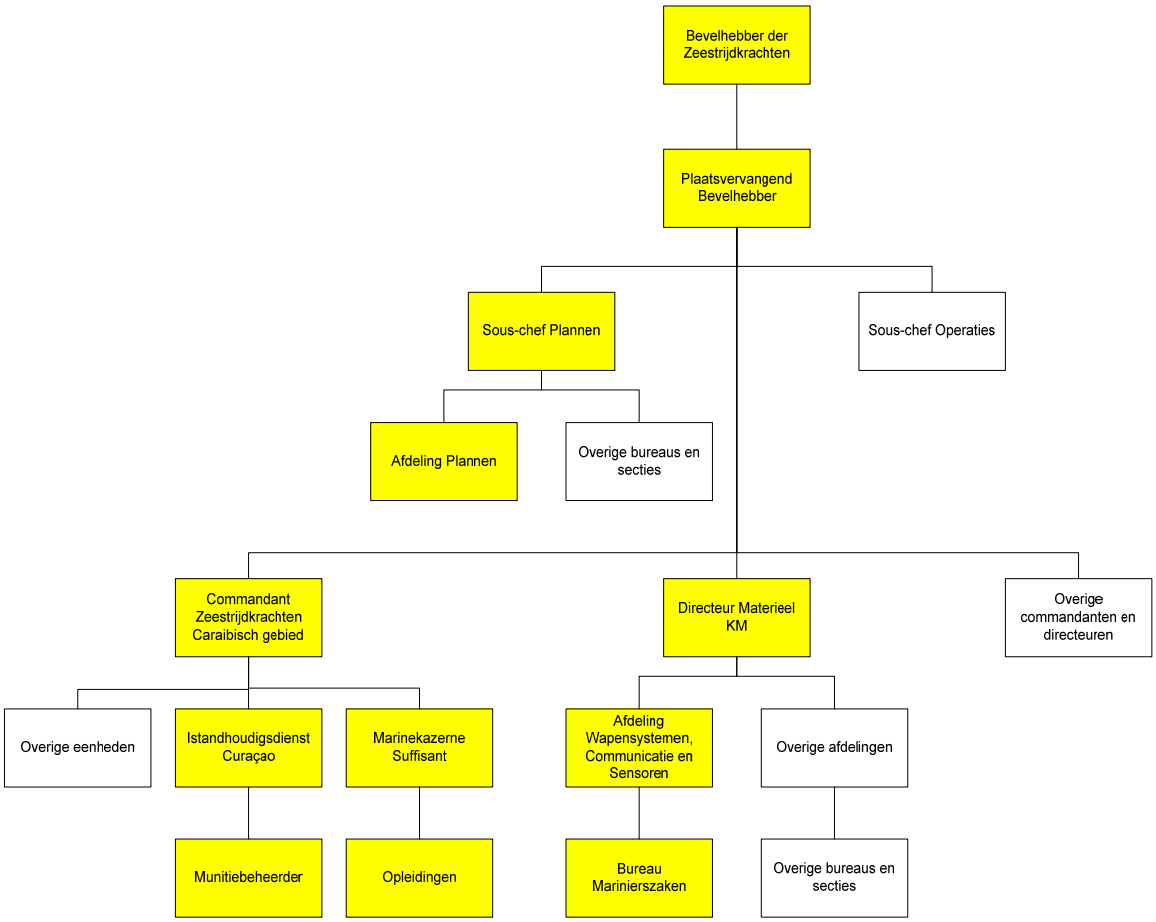
Commandant Zeestrijdkrachten	Commander of the Royal Netherlands Navy
Kabinet	Personal Office of the Commander
Bureau Ondersteuning	Policy Support Division
Plv Commandant Zeestrijdkrachten	Deputy Commander of the Royal Netherlands Navy
Overige directeuren	Other directors
Directeur Operationele Ondersteuning	Director of Operational Support
Commandant CARIB	Flag Officer, Caribbean/CARIB
Directeur Kustwacht NA&A	Director Coastguard Netherlands Antilles & Aruba
Staf	Staff
Afdeling Materieel Logistiek	Materiel-Logistical Department
Overige afdelingen	Other departments
CARIB eenheden	Caribbean units
KW NA&A eenheden	Coastguard Netherlands Antilles & Aruba units
Operationele eenheden	Operational units
Sectie Wapens en munitie	Weapons and Ammunition Section
Overige bureaus en secties	Other agencies and sections

ANNEX 6 NAVAL COMMAND CARIBBEAN ORGANISATION CHART



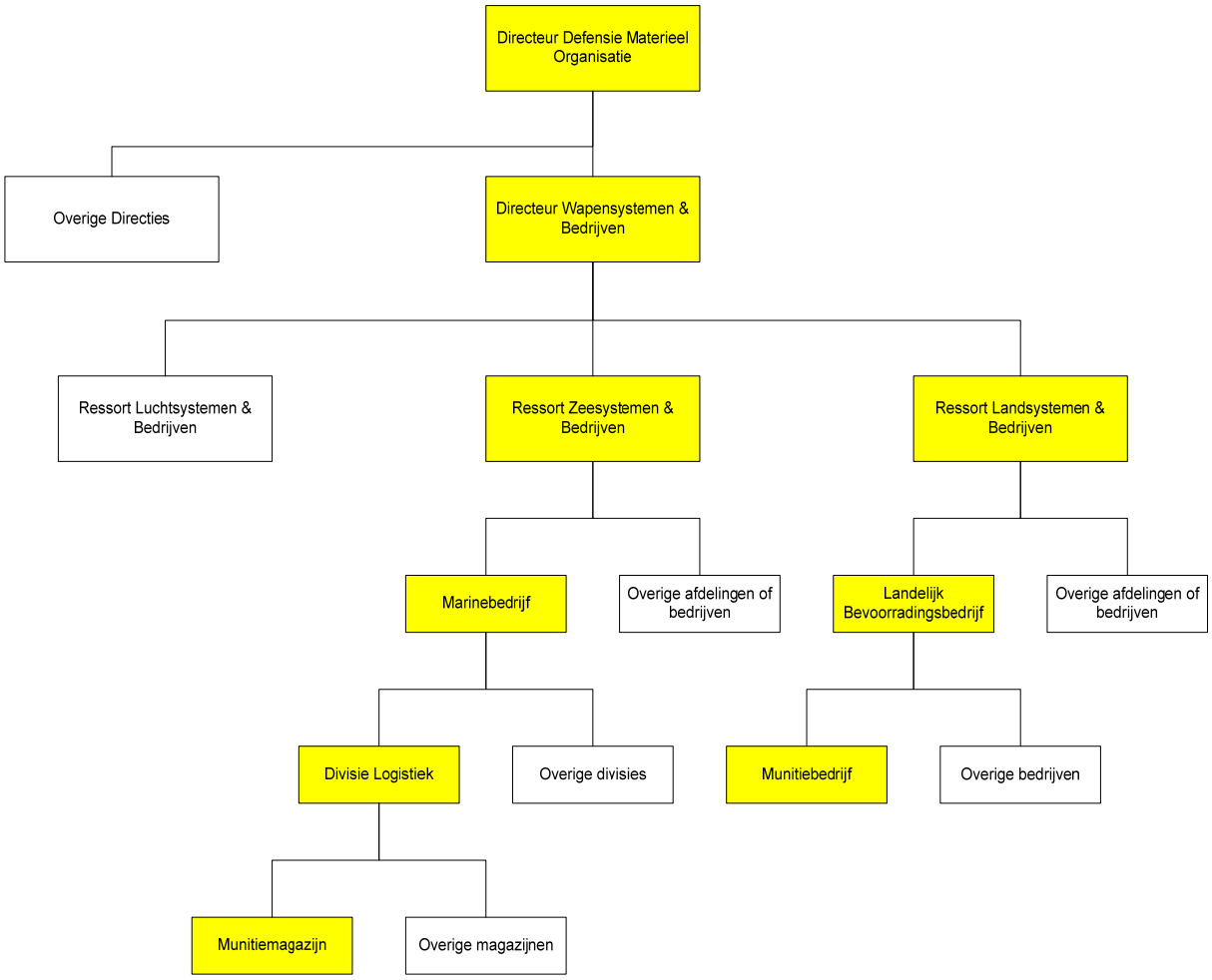
Commandant Zeestrijdkrachten Caraïbisch gebied	Flag Officer, Caribbean
CDT MKParera tevens Hoofd Facilitair Steunpunt	Commander of Parera Marine Barracks and Head of Facility Support
Hoofd afdeling MATLOG	Head of MATLOG department
Overige afdelingshoofden	Other heads of department
CDT MKSuffisant tevens Hoofd Facilitair Steunpunt	Commander of Suffisant Marine Barracks and Head of Facility Support
Overige Hoofden Facilitaire Steunpunt	Other Heads of Facility Support
Hoofd bureau SEWACO	Head of SEWACO bureau
Overige hoofden van bureaus	Other heads of bureaus
Hoofd Opleidingen ARUMIL	Head of ARUMIL Training
Sectie Wapens & munitie	Weapons and Ammunition Section
Overige Secties	Other sections
Mentor Voortgezette Vakopleiding	Continued Vocational Training Mentor
Overige mentoren van opleidingen	Other training mentors

ANNEX 7 ROYAL NETHERLANDS NAVY 2004 ORGANISATION CHART



Bevelhebber der Zeestrijdkrachten	Commander-in-Chief of Royal Netherlands Navy
Plaatsvervangend Bevelhebber	Deputy Commander-in-Chief
Sous-chef Plannen	Deputy Head for Planning
Sous-chef Operaties	Deputy Head of Operations
Afdeling Plannen	Planning Department
Overige bureaus en secties	Other agencies and sections
Commandant Zeestrijdkrachten Caraïbisch gebied	Commander of the Netherlands Naval Force, Caribbean area
Directeur Materiel KM	Director of Materiel, Royal Netherlands Navy
Overige commandanten en directeuren	Other commanders and directors
Overige eenheden	Other units
Instandhoudingsdienst Curaçao	Maintenance Service Curacao
Marinekazerne Suffisant	Suffisant Marine Barracks
Afdeling Wapensystemen, Communicatie en Sensoren	Weapon Systems, Communications and Sensors Department
Overige afdelingen	Other departments
Munitiebeheerder	Ammunition Administrator
Opleidingen	Training Courses
Bureau Marinierszaken	Bureau of Marine Affairs
Overige bureaus en secties	Other bureaus and sections

ANNEX 8 ORGANISATION CHART OF DEFENCE MATERIEL ORGANISATION



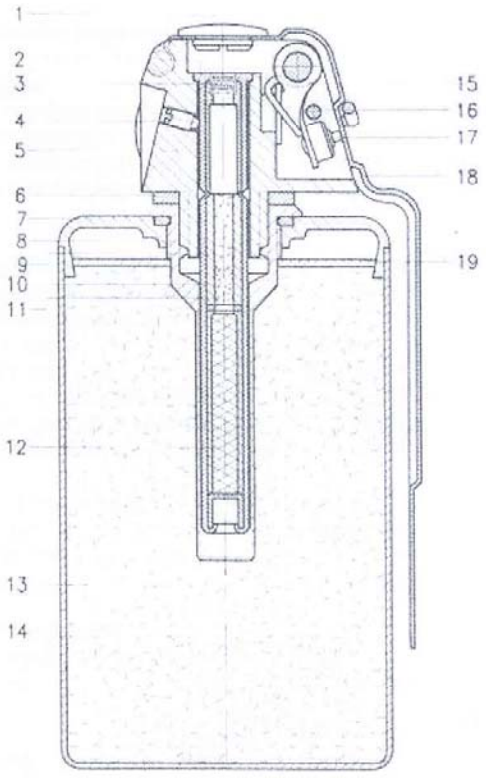
Directeur Defensie Materieel Organisatie	Director of the Defence Materiel Organization
Overige Directies	Other Directorates
Directeur Wapensystemen & Bedrijven	Director of Weapon Systems and Agencies
Ressort Luchtsystemen & Bedrijven	Air Systems and Agencies Branch
Ressort Zeesystemen & Bedrijven	Sea Systems and Agencies Branch
Ressort Landsystemen & Bedrijven	Land Systems and Agencies Branch
Marinebedrijf	Navy Agency
Overige afdelingen of bedrijven	Other departments or agencies
Landelijk Bevoorradingsbedrijf	National Supply Agency
Overige afdelingen of bedrijven	Other departments or agencies
Divisie Logistiek	Logistics Divisions
Overige divisies	Other divisions
Munitiebedrijf	Ammunition Agency
Overige bedrijven	Other agencies
Munitiemagazijn	Ammunition Store
Overige magazijnen	Other stores

ANNEX 9 INFORMATION ON WP SMOKE HAND GRENADE, NO. 23

foto 1 rookhandgranaat phospher nr 23 met ontsteker nr 19C3/20

VS 9-850
C 50.41
Blad 2

afb 1 aanzicht



afb 2 doorsnede

1 *afdekstop*
2 *vertragingsslagpijpje*
3 *slaghoedje*
4 *borgschroef*
5 *ontstekerlichaam*
6 *rubberen ring*
7 *afdichtingsring (neopreen)*
8 *houder*
9 *vertraagsas*
10 *loodazide*
11 *pentriet*
12 *secundaire lading*
13 *fosforlading*
14 *granaatlichaam*
15 *veer*
16 *veiligheidspen*
17 *slagpin*
18 *veiligheidshefboom*
19 *bitumen afdeklaag*

1 guard
2 delay element
3 percussion cap
4 locking screw
5 detonator
6 rubber ring
7 sealing ring
8 casing
9 delay axle
10 lead azide
11 penthrite
12 secondary well
13 phosphorus well
14 filler
15 spring
16 safety pin
17 striker
18 safety lever
19 bitumen coating

1 Use / Purpose

The phosphorus smoke hand grenade no. 23 with detonater no. 19C3/20 is a grenade used for dispersing smoke. The purpose of the phosphorus is to obscure the view.

2 Composition / description

General
The phosphorus smoke hand grenade no. 23 has a body with phosphorus on which a detonator no. 19C3/20 has been mounted with a screw. The detonator consists of the detonation mechanism no. 19C3 and delay element no. 20.

Body
The body of smoke hand grenade no. 23 is made up of three parts: a pressed sheet steel cylinder, a lid (welded onto the cylinder) and the detonator casing that is threaded both on the interior and exterior. This casing is screwed onto the lid after the grenade is filled with phosphorus and the bitumen coating layer has been applied. Air-tightness is maintained by a neoprene ring between the lid and casing.

Detonation mechanism
The detonation mechanism no. 19C3 has a different safety pin than the 19C2, which has a split pin. The safety pin of detonation mechanism no. 19C3 has been so designed that it can be removed with a twist-and-pull action. The body of the striker is under constant spring tension. The striker is kept in the safety position by the safety pin and the safety lever. The locking screw has been placed under a corner to prevent damage to the delay element. The locking screw keeps the delay element in the correct position. A rubber ring has been placed between the detonation mechanism and the body of the grenade to keep it airtight and moisture proof.

Safety element
The safety element no. 20 has an aluminium body containing a percussion cap, a delaying axle, a primary filler (lead azide and pentaerythritol tetranitrate) and a secondary filler (tetryl with 2% graphite). The secondary filler acts as a dispersing agent.

3 Technical data

Dimensions		
Height of hand grenade (full)	121	mm
Diametre of hand grenade (full)	53	mm
Length of delay element	75	mm
Diametre of delay element	7.5	mm
Mass		
- hand grenade (full)	500g	
- detonation element	70g	
- primary phosphorus filler with bitumen layer	265g	
- delay axle	0.5g	
- lead azide (primary filler)	0.1g	
- pentaerythritol tetranitrate (primary filler)	0.05g	
tetryl (secondary filler)	1.2g	
External characteristics		
Base colour	light green	
Colour of lettering	light red	
Colour of band	yellow	
Other details		
Delay time of delay element	3 to 4 seconds	

4 Functioning

The safety pin can easily be removed by turning it a quarter of a turn. This releases the bent arm from the safety lever, after which the safety pin can be removed. The hand grenade can now be thrown. The safety lever is then thrown off by the pressured striker. The striker turns on its axle

and impacts the percussion cap with some force, causing the detonation. No sound or smoke is produced while the delay axle burns. After the delay time has elapsed, the primary and secondary fillers of the delay element ignite one after the other, causing the body of the grenade to rip open and the phosphorus to be dispersed.

5 Effect
White smoke is produced immediately after the phosphorus has been dispersed. The burning phosphorus causes a combusting effect.

6 Safety aspects
Use in peacetime

- **Only** permitted on hand grenade ranges with the use of shielding and where the wind speed is < 3m/s and where, especially, the wind direction is away from the thrower.
- The phosphorus hand grenade no. 23 may be thrown from armoured vehicles for tests on the ISK range B in consultation with the ISK safety officer.

Important!

- **For all other exercises in the open involving the creation of a smoke screen, the smoke hand grenade no. 7C2 (NOV code 4811) must be used.**

Other aspects
The reaction products of white phosphorus are poisonous.

NOTE!

- Personnel in a smoke screen must wear field masks for protection.
- The smoke hand grenade must not be used in enclosed or partially enclosed spaces.
- Metal fragments may be propelled up to 100 metres from the point of detonation of the grenade.

7 Duds, unexploded grenades

Duds
N/A

Unexploded grenades
Wait 30 minutes
Warn the safety officer of the shooting range.
UNEXPLODED GRENADES MAY <u>ONLY</u> BE REMOVED BY TRAINED AND AUTHORIZED PERSONNEL.

8 Specifications

TVA 1330-2-4-025	Phosphorus smoke hand grenade no. 23

9 References

IWK-MUN-4821	GREN HAND SMOKE WP.
MP 40-20	Rules concerning the transport and storage of explosive substances and ammunition.
NC 9-65	Name and Code List of ammunition and other Class V goods.
VS 2-1012	Shooting ranges and grounds.
VS 2-1350	Soldiers' Manual
VS 2-1351	Officers' Manual
VS 7-827	Hand grenades

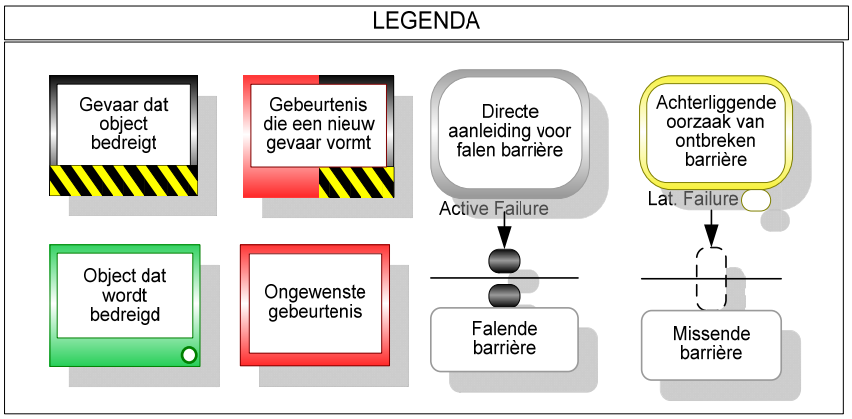
ANNEX 10 TRIPOD SCHEME

The TRIPOD method was used in the analysis of the incident. This method was developed to trace the direct causes of incidents to failings in organizations responsible for the safe operation of the (sub) system. The TRIPOD theory at the heart of the method assumes that people act and behave as they do in specific situations because the system allows them to (consciously or unconsciously) and that circumstances are easier to influence than people. The circumstances that allow the actual error to take place subsequently point to latent or underlying factors that can be viewed as (indirect) causes of the incident.

According to the TRIPOD theory, undesirable events/accidents occur because of a loss of control of (business) processes. In other words, when barriers, whose job it is to regulate a process, are either missing or failing, an accident/undesirable event results. Missing barriers are the result of latent errors while failing barriers are the result of actual errors. These actual errors can be explained in the context in which they occur. The context is found in the errors at system level (underlying factors or latent errors). We can ask the right questions by identifying the hazards, the event and targets and, subsequently, the barriers, actual errors, context and underlying factors.

As indicated, the basis of the TRIPOD is an HET diagram (**H**azard **E**vent **T**arget). In an HET diagram, hazards are represented by yellow/black shading, events/accidents by red shading and targets by green shading (see key). TRIPOD works on the principle that, by taking measures (barriers), the hazard can be controlled and the event prevented or – in case the measure fails - people and material can be protected from the consequences of the accident.

TRIPOD distinguishes between failing barriers, inadequate and missing barriers. A failing barrier is a barrier that has always been present and that has always functioned. Something occurs at the time of the event or accident that causes the barrier to fail as a whole. An inadequate barrier is a measure that the owner or user of an installation believes will provide sufficient protection. A missing barrier is a barrier that could have been put in place to provide sufficient protection but was not.



LEGENDA	KEY
Gevaar dat object bedreigt	Hazard that threatens target
Gebeurtenis die een nieuw gevaar vormt	Event that constitutes a new hazard
Directie aanleiding voor vallen barrière	Direct cause for barrier failure
Achterliggende oorzaak van ontbreken barrière	Underlying cause for missing barrier
Object dat wordt bedreigd	Target being threatened
Ongewenste gebeurtenis	Undesired event
Falende barrière	Failing barrier
Missende barrière	Missing barrier

ANNEX 11 CONCLUSIONS AND RECOMMENDATIONS OF THE CZMCARIB INTERNAL INVESTIGATIVE COMMITTEE

Conclusions

a. *Regarding the requesting, supplying, storing and issuing of the phosphorus grenade with NOV code 4821:*

1. The way ammunition is stored at CZMCARIB/MATLOG in Curacao did not influence the occurrence of the accident. The phosphorus hand grenades are stored in accordance with the danger category.
2. The lettering and packaging of the ammunition, particularly that of the smoke grenades involved in the accident, was according to regulations. The smoke grenades were packed in the appropriate ammunition box. The exterior of the ammunition box was marked with the correct description and danger category.
3. The smoke hand grenade (type 7C2), with NOV code 4811, that was initially requested should not have been substituted with the phosphorus smoke hand grenade, with NOV code 4821, that was eventually supplied because the two types are not interchangeable in terms of functioning, effect and application. According to 3 VVKM 11, the definition of NOV code is as follows: *Interchangeability Code Number, grouping of NATO stock numbers (NSNs) per type and application of ammunition.* The interchangeability of the different NOV codes was not checked carefully enough when the actual substitution was made. According to point 2420 of 3 WKM 11, the DMKM/WCS department was responsible for entering the NOV codes and dealing with the associated logistics documentation before the reorganization of CZSK. The department was also responsible for authorizing substitute articles. These responsibilities were probably assigned to the DOST/MATLOG department in the new CZSK organization.
4. The phosphorus smoke hand grenade, with NOV code 4821, which was supplied as a substitute, had already been part of the CZMCARIB ammunition supply as OMU for some time. The allocation of the substitute was, as far as the committee can determine, the first time this type of smoke grenade was supplied as covenant ammunition (CVM, practice ammunition) to CZMCARIB.
5. Crucial (technical and user) information concerning the functioning and effects of the phosphorus smoke hand grenade was not known to the officials at the CZMCARIB branch who were involved in requesting, storing and issuing ammunition. The user of the smoke hand grenade was also unaware of this crucial information. The reason this user information could not be obtained or looked up subsequently, that is after the phosphorus hand grenades had been supplied and before they were issued, was because of a lack of technical knowledge regarding ammunition and time and work pressure at both the MATLOG Weapons and Ammunition Section and the WO ANTMIL at the Suffisant Military Barracks (partly as a result of a staff shortage).
6. The CZMCARIB/MATLOG department is responsible for the physical and administrative management of ammunition (including storage) in the ammunition supply chain. Ammunition administrators are not trained in the technical aspects of ammunition and the job description for the position does not list technical knowledge as a requirement. Ammunition administrators are only trained in ammunition storage and ADR. The officials at CZMCARIB/MATLOG also have no direct access to all the relevant technical documentation pertaining to ammunition.
7. The internal checking procedures for ammunition, as performed by line officials, the OIB department, the Naval Maintenance Company and the DMO (Military Committee on Dangerous Substances Section), focuses primarily on the administration and storage methods of ammunition. The use of ammunition items, i.e. the actual deployment of ammunition items in exercises on appropriate exercise grounds, does not feature at all prominently during these checks.

b. Regarding the preparation for and the conduct of the WO exercise at Wacao:

1. The OBL and the other officers involved in the WO exercise at Wacao did not know the exact working and effects of the phosphorus hand grenade supplied as a substitute. Operating on the basis of knowledge acquired during training and their previous extensive experience with various types of smoke hand grenades – all non-explosive – they were convinced they were dealing with another non-explosive substitute hand grenade. Indications (particularly from the ammunition administrator, in telephone conversations, e-mail correspondence and verbally at the time of issue) that the phosphorus hand grenade worked differently did not prompt the OBL or head instructor to examine the matter further. The OBL and head instructor also jumped too quickly to the conclusion that a substitute hand grenade would not be provided if it was not of the same type and intended for the same purpose as the requested smoke hand grenades. Although, given their training and experience, this may seem a reasonable conclusion to draw; the committee feels both the OBL and the head instructor should have acted differently. They should have examined the exact working of the phosphorus grenade more closely.
2. The safety plan used for the exercise was too generic and did not focus sufficiently on the specifics of the exercise in question and the ammunition used. There was no mention at all of the smoke grenades. The safety plan was drawn up in accordance with the provisions in KOVBA 306, but dealt with the circumstances of the exercise and the special conditions in Curacao in only general terms.
3. The safety briefing, which was based on the safety plan and given by the OBL, was too general in nature and did not discuss the use of smoke grenades. The safety briefing was held before the ammunition was picked up. No follow-up safety briefing was given subsequently or during the exercise although there was good reason to do so given that the ammunition administrator had provided supplementary specific transport instructions for the ammunition and dressing materials (copper sulphate pads).
4. OBL and the other officers involved in the incident failed to communicate adequately from the time the ammunition was picked up. The OBL did not discuss with his instructors the advice he had received from the ammunition administrator to test a phosphorus hand grenade before actually deploying the grenades. Moreover, this advice was forgotten in the commotion of the exercise. He also failed to inform the others of the transport and burns instructions and the specific dressing materials (copper sulphate pads). Had they been aware of all of this, officers would probably have decided to first test the functioning of the phosphorus smoke hand grenade.
5. The storage of the smoke hand grenades at Wacao was not in accordance with the guidelines under point 1750 of 3WKM6. The storage of the smoke hand grenades took no account of the different danger categories/storage groups. All smoke hand grenades were set down next to each other in the BEVO tent.
6. The safety measures pertaining to the “standard” smoke hand grenades used were not observed when the phosphorus hand grenade was thrown. Had the phosphorus hand grenade been thrown in accordance with those guidelines, the committee feels the chance of personal injury would have been substantially less.
7. The occurrence of the accident can be attributed to human error, and not to any mechanical or other technical failing.

c. Regarding training and (safety) regulations:

1. Working safely with non-standard types of ammunition, such as the phosphorus hand grenade provided as a substitute, is insufficiently guaranteed. The main contributing factors to this conclusion are the lack of user instructions and the fact that the relevant user instructions that are available are fragmented across a range of regulations and documentation that, moreover, are not easily or fully accessible to users and officials in the ammunition supply chain. Furthermore, in general, the responsibility of users to be familiar with the functioning and effects of ammunition has not been adequately set out and made clear.
2. The frequent use during exercises of the “standard” and most common types of smoke hand grenades, combined with the relatively innocuous character of this type of ammunition in the eyes of the users (as these smoke grenades do not explode), means that the safety measures are not stringently observed. This increases the chance of accidents.
3. The lesson curriculum used in the Marine Corps EVO with respect to the usage and safety guidelines and effects of smoke hand grenades is, as far as the committee is able to ascertain within the scope of the investigation, incomplete, unclear and incorrect.

4. The same applies to the Marine's Manual, of which there are a number of different versions in circulation. It is unclear who is responsible for the version management of this reference book that is issued to every marine.

Recommendations

1. Ensure that the safety guidelines pertaining to the transport and use of ammunition are always observed.
2. Investigate the background to the substitution of the requested smoke hand grenade, with NOV code 4811, by a phosphorus smoke hand grenade, with NOV code 4821.
3. Ensure that there are personnel at CZMCARIB who possess adequate technical knowledge of ammunition.
4. Include in the relevant rules a provision that ammunition is to be picked up by a minimum of two persons, of whom 1 is preferably the unit's PC and the other is of SMJR rank or higher. This combination of an experienced official supporting a normally relatively inexperienced PC will reduce the risk of unfamiliarity with or uncertainty about the ammunition to be picked up.
5. Include in the relevant rules a provision that details which officials are authorized to pick up and return ammunition.
6. Ensure a clear division of responsibilities among the users of ammunition with regard to the type, functioning, safety measures and other aspects that are important when using ammunition.
7. Include in the relevant rules a provision that states OPORDs must contain all relevant information on the exercise described in the OPORD, including a detailed safety plan.
8. Ensure compliance with the provisions in KOVBA 306/0BACARIB 2.2 regarding the drafting of a safety plan and holding a safety briefing.
9. Ensure compliance with the provisions in 3 WKM 6 regarding the storage of ammunition in the field.
10. Ensure compliance with the provisions in MP 40-20 regarding the transport of ammunition.
11. Examine the rules and documentation pertaining to the descriptions of ammunition types, functioning, effects, safety measures and provisions to ensure they are clear. As part of this exercise, investigate the situation regarding the version management of the Marine's Manual and make sure there are not multiple copies of this Manual in circulation. Also examine the comprehensiveness of the ammunition Manual in use at the KM (TH 250-B-02).
12. Include all relevant safety guidelines and user instructions in lesson curricula and reference works that discuss ammunition. Have the lesson curricula and reference works checked for completeness. Use the lessons learned from this accident, particularly in the training of officers, to prevent a repeat of this accident.
13. Have the applicability of ammunition items play a greater role in internal checking protocols.